



# Literature and Registry Review

2005 - 2016

170 Peer Review Articles and Book Chapters from 22 Countries

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*“HEMICAP RESURFACING PROVIDES A  
UNIQUE AND FAVORABLE ALTERNATIVE TO PRIOR IMPLANT DESIGNS  
BY PROVIDING ANATOMIC RE-APPROXIMATION”*

Patellofemoral Kinematics After Limited Resurfacing of the Trochlea.  
Provencher M, Ghodadra N, Verma N, Cole BJ, Zaire S, Shewman E, Bach B.  
J Knee Surg. 2009;22:310-316

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Matthias R. Schurhoff

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# Foreword

This report is a review of the past decade outlining the introduction of inlay arthroplasty for arthrosis, early arthritis and traumatic lesions. Arthrosurface, Inc. (Franklin, MA) was launched in 2002 bringing innovation and a sports medicine approach to primary arthroplasty. In the past decade, Arthrosurface has invested and re-invested more than \$100 Million dollars in the development and commercialization of patient specific joint solutions that place the individual patient at the forefront of clinical decision making. The intraoperative choice of implant diameters and contour shapes allow the surgeon to not only cover the defect effectively, but also fit the implant to the patient while preserving healthy bone and cartilage. This is a departure from traditional arthroplasty, where the patient is typically fitted to the implant combining large bone cuts, cement and onlay joint replacements. In contrast, the Arthrosurface inlay arthroplasty is anatomically grouped with many curvatures within each diameter ensuring an off-the-shelf custom implant fit. The anatomic match is achieved using intraoperative visualization and 3D mapping of the joint surface. The range of implants can accommodate surface pathologies from focal to total arthroplasty thereby extending joint preservation therapy into the future. Over time, the HemiCAP portfolio expanded to currently over 170 implant sizes and curves for treatment of shoulder, wrist, hip, knee, ankle, and forefoot defects.

Patient demands continue towards “active solutions” with quick pain relief and fast re-integration into work and sports. New biological therapies and novel implant designs have been introduced to meet this ongoing trend and relegate traditional arthroplasty into later stage treatment to better accommodate today’s life expectancy. Joint restoration and preservation have become critical considerations for the long term management of joint arthrosis and arthritis. The transition into arthroplasty with inlay technology as a primary solution provides inherent advantages for high functional demands and future treatment options.

In 2013, Arthrosurface entered into biological cartilage therapies with an innovation of the 20 year old microfracture technique: The introduction of Nanofracture<sup>®</sup> was designed to address the shortfalls inherent to microfracture: Lack of a standardized technique, shallow perforation depth, subchondral bone disruption and tunnel compaction. New frontiers in cartilage repair and tissue augmentation are now being explored with “nanofracture plus” where the standardized and improved marrow stimulation design is combined with biological therapies including scaffolds, growth factors and stem cells.

The human element of science, technology, and innovation is frequently lost among standardized testing and averaged reporting methods. Therefore it is noteworthy to highlight individual success stories from patients who returned to remarkable performance levels winning championships in a variety of sporting disciplines following their Arthrosurface procedure. A few of these patients are featured in this review with their permission.

Many authors have reported, discussed, assessed, or mentioned Arthrosurface solutions in the primary and secondary literature. The selection of quotes from these articles inherently includes bias; however the collective opinion from experienced surgeons and thought leaders in the field of joint restoration lends itself as an educational tool for future research and scientific dialogue. Publications that only take reference to Arthrosurface related procedures are not included for the purpose of evidence, but are intended to provide insight into the related treatment spectrum. The goal of this compilation is to provide a comprehensive overview on the current knowledgebase, describe the technology from various angles, outline the growing range of indications, and profile key advantages that are unique to Arthrosurface procedures.

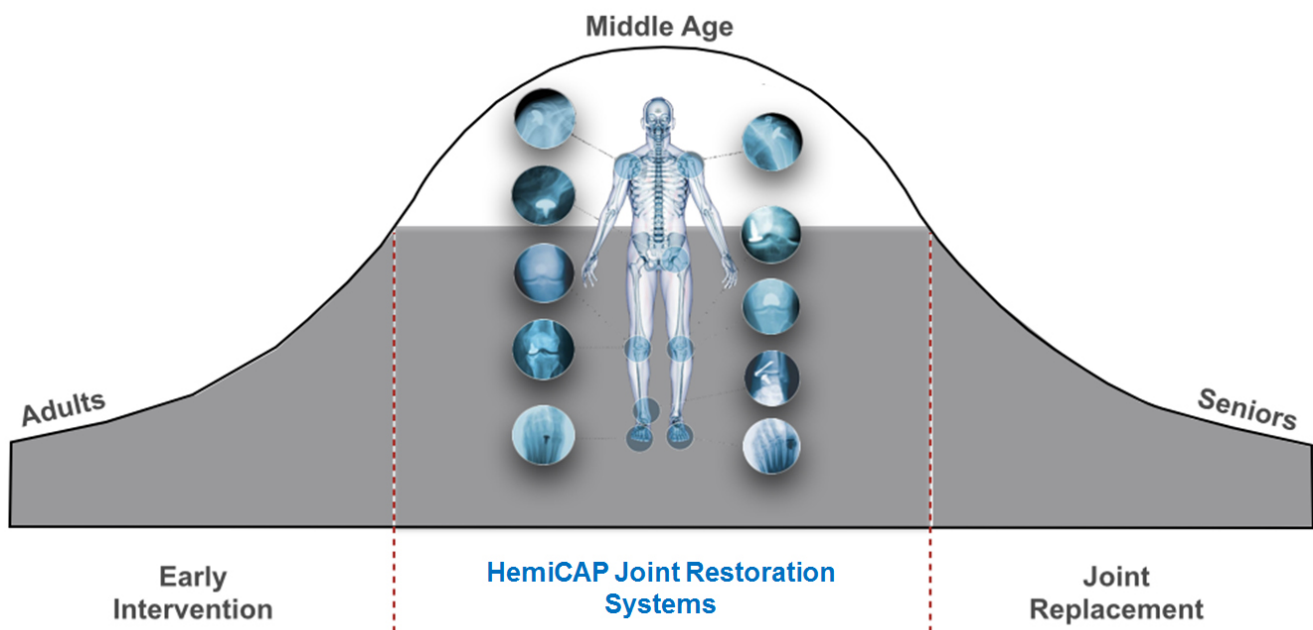
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February 2016

# Arthrosurface Joint Restoration

## From Biology to Arthroplasty





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# I. Overview

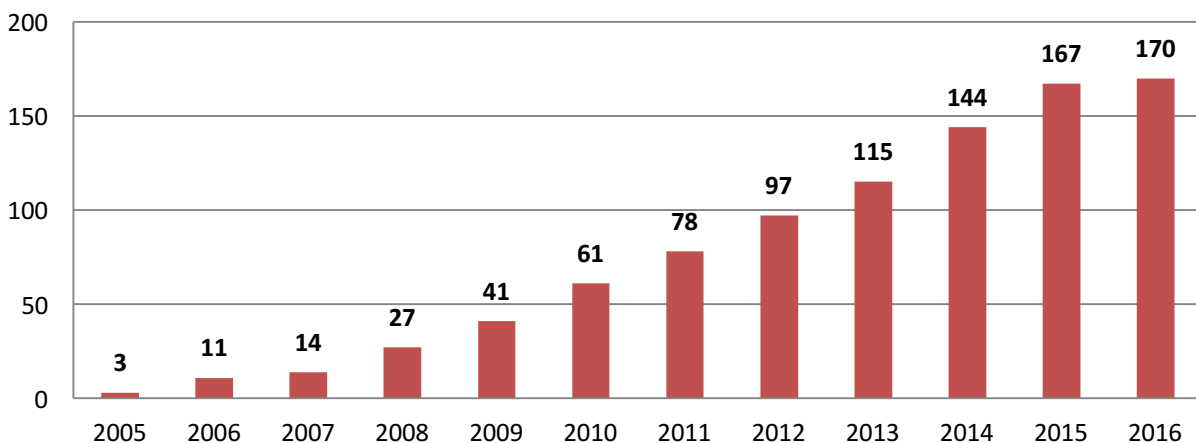
The primary and secondary literature has been very supportive describing innovative clinical pathways based on Arthrosurface technology. 73% of these publications had a supportive assessment or conclusion, 23% mentioned HemiCAP procedures in the context of various treatment spectrums, but refrained from further validation mostly due to pending evidence in the literature at the time of the publication. Four percent were not supportive and favored other treatment options e.g. arthrodesis for treatment of hallux rigidus. Larger patient cohorts and longer term follow-up studies that are currently underway will continue to strengthen the scientific evidence and provide further insight into related procedures.

The following evidence table summarizes the current validation status (Table 1). Quantitative and qualitative parameters have been described in the peer review literature and provide a foundation for value- based approach in modern arthroplasty.

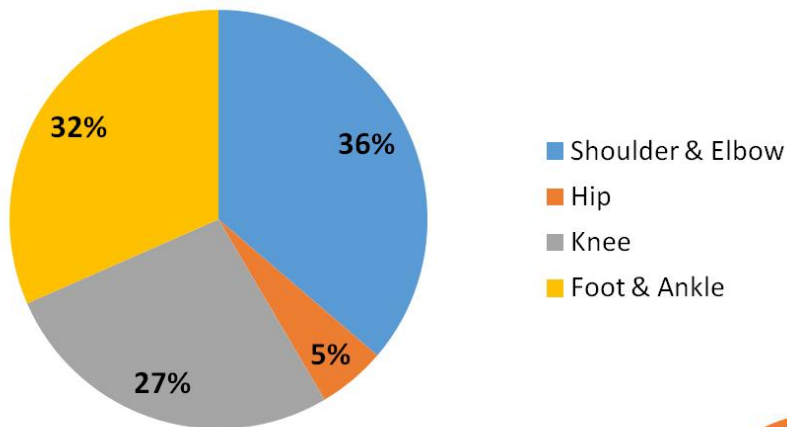
**Table 1:** Peer Review Evidence by Specialty

Scientific Parameter	Shoulder	Knee	Foot & Ankle
Basic Science	✓	✓	✓
Clinical Outcomes Scores	✓	✓	✓
Quality of Life	✓	✓	✓
Patient Satisfaction	✓	✓	✓
Radiographic Assessment	✓	✓	✓
Longest Average Follow-up	3 years (5 years in review)	5 years	5 years

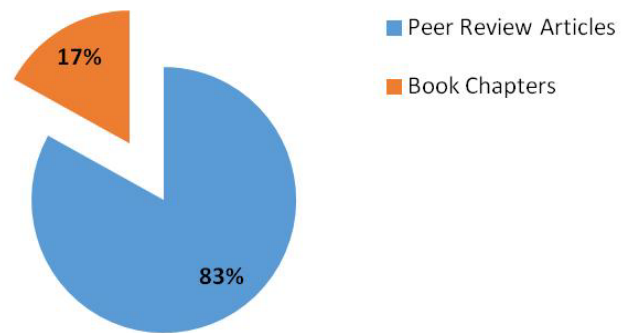
**Cumulative Publications in the  
Primary and Secondary Literature**



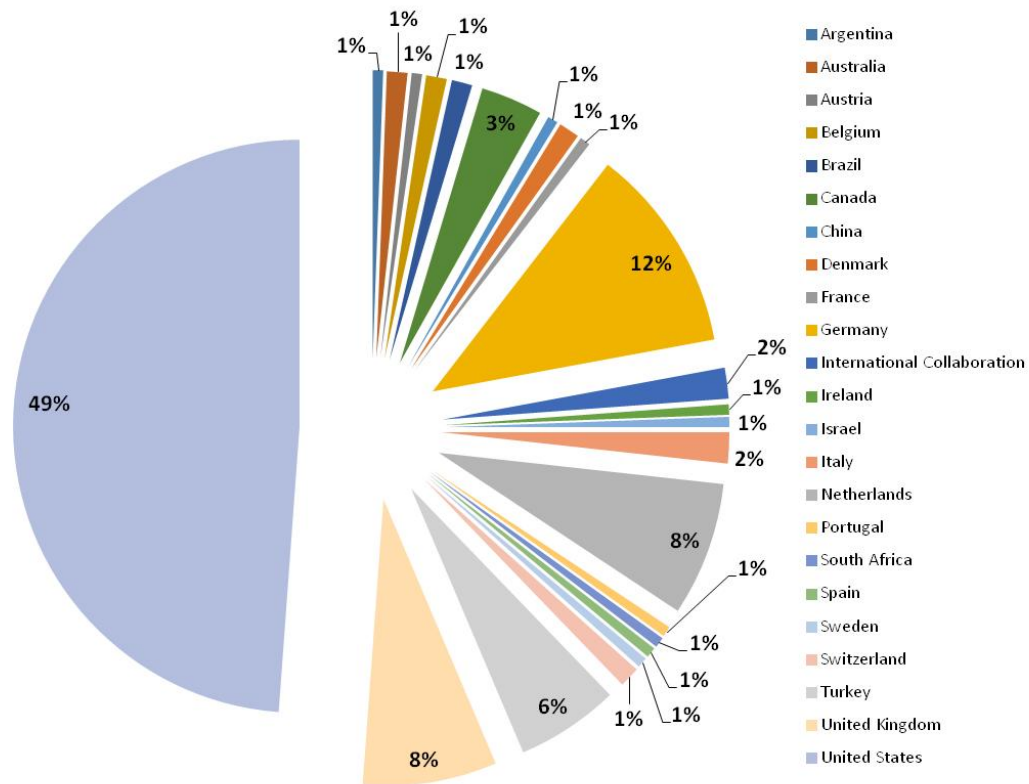
**Publications by Specialty**



**Publication Type**



**Publications by Country**



## II. Shoulder



**Louie**

HemiCAP Shoulder Patient

# 1. Shoulder Registry Review

Stemmed shoulder replacement has been the standard of care in modern shoulder arthroplasty. Ample reports indicate that total shoulder replacement provides better pain relief and functional outcomes when compared to stemmed hemi arthroplasty (1-9). However, longer life expectancy, early joint deterioration in younger

patients and increased functional demands on the implants cautions against the use of stemmed arthroplasty as a primary indication. When combined with the invasiveness of the procedure, poor bone preservation, and the technical challenges of restoring joint height, version, angle and volume, the argument against stemmed arthroplasty, especially in patients under 55 years old becomes more evident.

## Revision Rate (RR)

The Australian Joint Registry  
Revision Rate is based on 100  
observed implant years.

In 2015, the Australian Shoulder Arthroplasty Registry (10) reported for the first time on the 5 year results of HemiCAP (Arthrosurface, Franklin, MA) implantation. Compared to hemi-resurfacing, HemiCAP showed a 5-7 times lower revision rate (RR) at this time point; stemmed hemi arthroplasty had a 5 times greater revision rate; stemmed total shoulder replacement at 5 years ranged from 2 to 6 times higher, and reverse total shoulder arthroplasty at the 5 year time point showed a nearly 3 times higher RR.

Overall, the Stemless Inlay HemiCAP Resurfacing demonstrated the lowest revision rate among all shoulder implant classes: 0.57 revisions per 100 observed implant years. In the context of joint preservation, the treatment of these younger patients (<55 years) is of particular interest: Stemmed Total Shoulder Replacement (TSR), Stemmed Hemi Shoulder Replacement, and Hemi Onlay Resurfacing all showed a 3-4 times higher revision rate than HemiCAP Inlay Resurfacing in this younger age demographic when treated for OA with a primary arthroplasty.

The trend for an increasing revision rate in younger patients also becomes evident, when analyzing age group differences within each arthroplasty class: Stemmed TSR in patients over 75 yrs reported a revision rate of 1.52. The rate increased to 2.64 in patients less than 55 years.

Primary Stemmed Hemi Shoulder Replacement for OA (age >75 years) reported a revision rate of 1.08 and the rate increased to 2.84 when compared to patients under the age of 55 years.

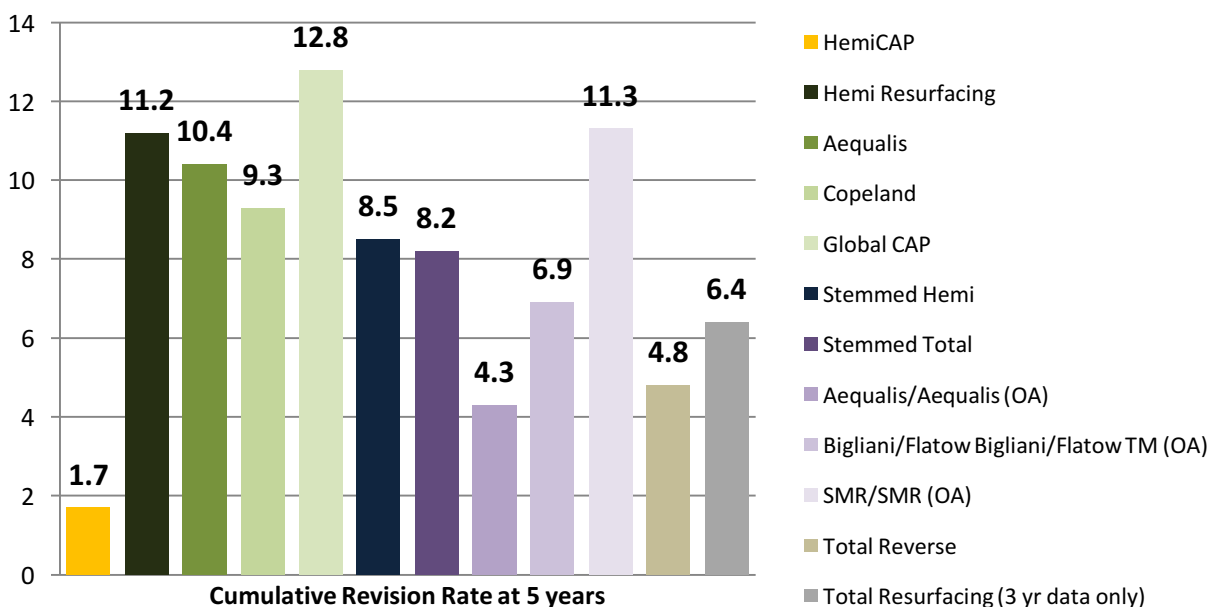
Primary Hemi Onlay Resurfacing for OA (age >75 years) reported a revision rate of 1.42. The rate increased to 2.49 when compared to patients less than 55 years old.

Combined with the technical advantages of stemless inlay resurfacing, the HemiCAP<sup>®</sup> implant proves to be an excellent choice as a new primary arthroplasty solution, particularly for younger patients.

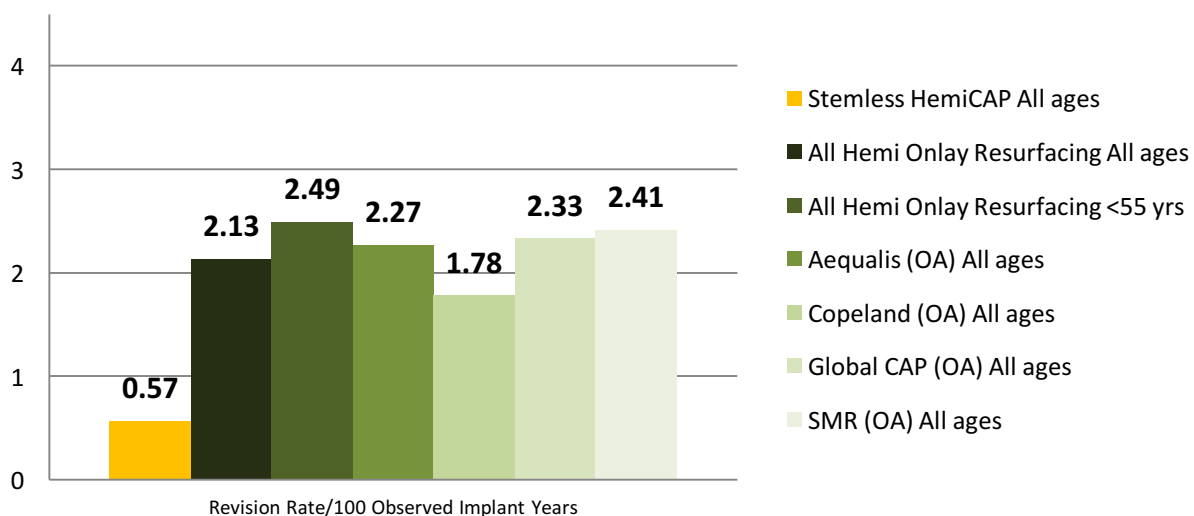
## Nomenclature:

Monograph	Registry	Implant Example
Stemless Inlay Resurfacing	Primary Partial Resurfacing Shoulder Replacement	HemiCAP
Hemi Onlay Resurfacing	Hemi Resurfacing Shoulder Replacement	Copeland etc.
Stemmed Hemi Shoulder Replacement	Stemmed Hemi Shoulder Replacement	Stemmed Global Advantage etc.
Stemmed Total Shoulder Replacement	Total Conventional Shoulder Replacement	Bigliani/Flatow etc.

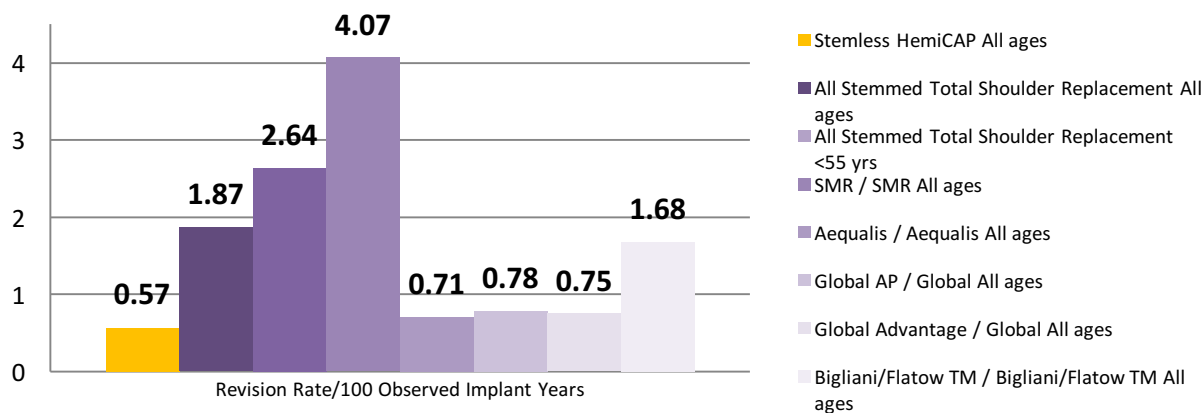
### 5 Year Cumulative Percent Revision Rate in Primary Shoulder Arthroplasty



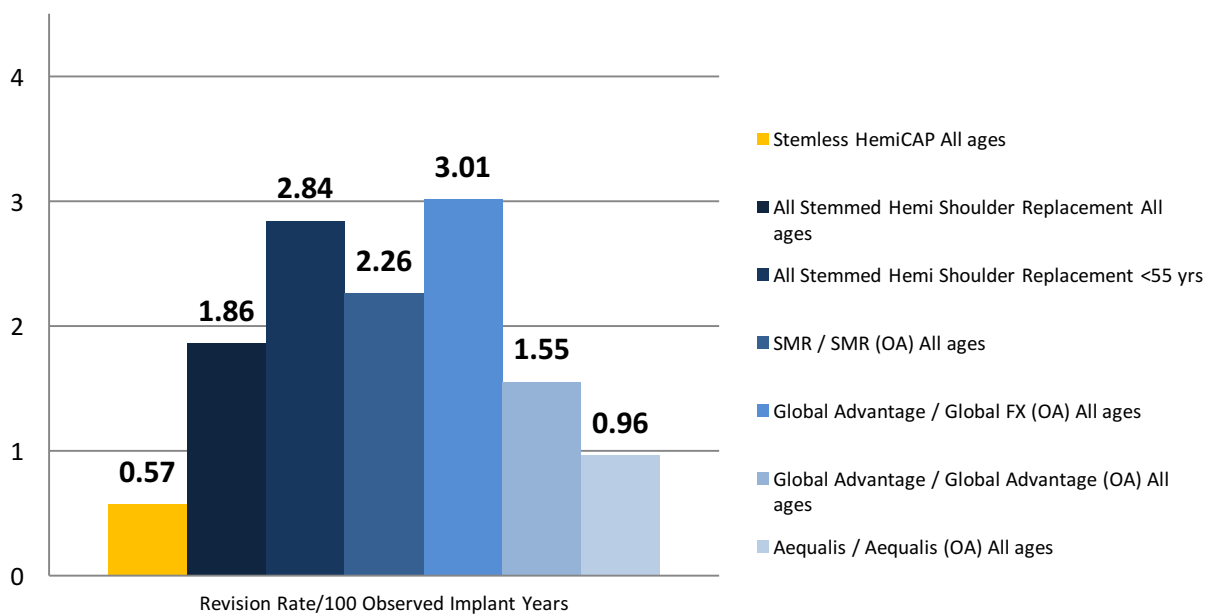
### Revision Rate: Stemless HemiCAP vs. Hemi Onlay Resurfacing



**Revision Rate:  
Stemless HemiCAP vs. Stemmed Total Shoulder Replacement**



**Revision Rate:  
Stemless HemiCAP vs. Stemmed Hemi Shoulder Replacement**





## References

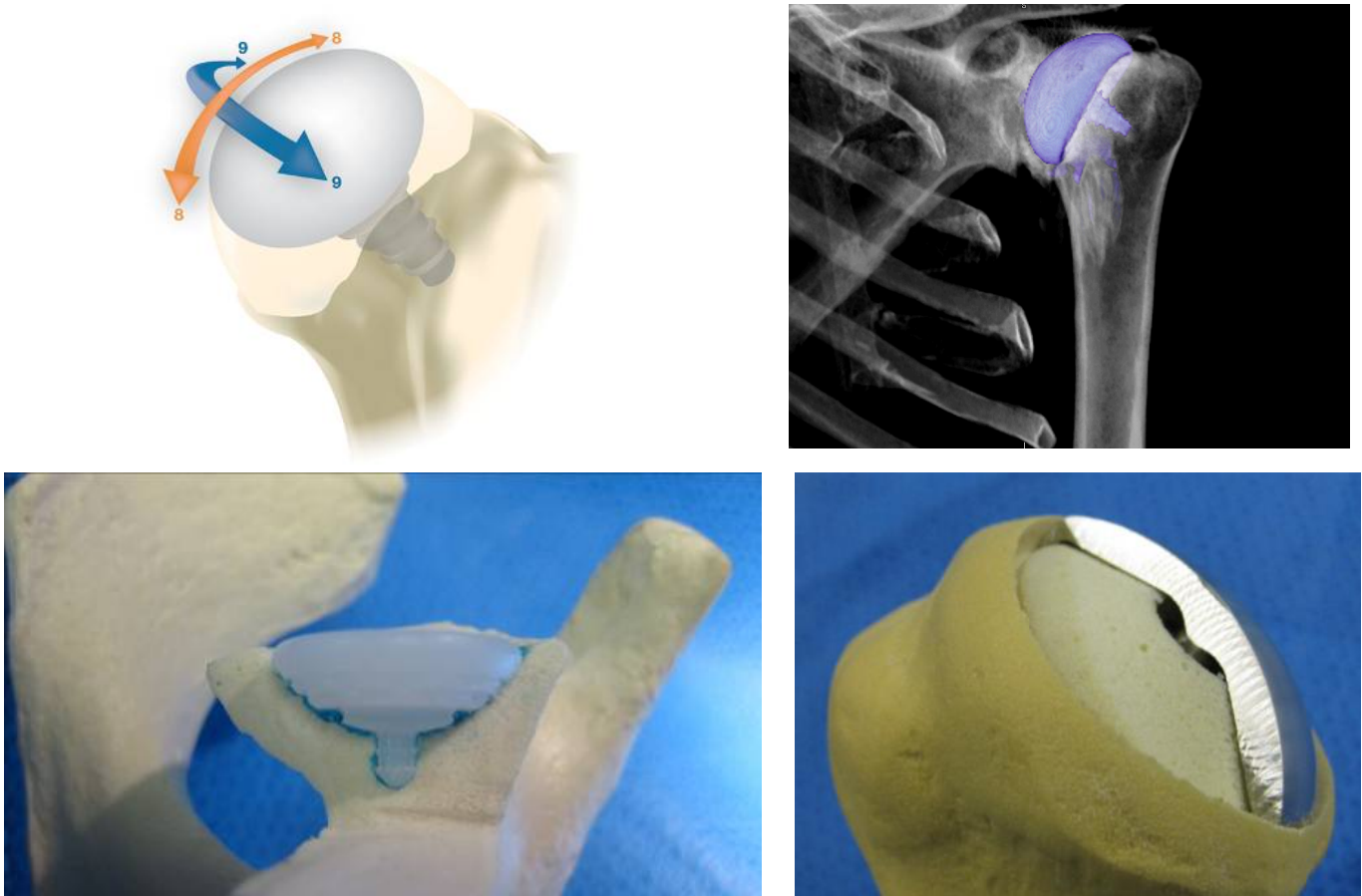
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## 2. Shoulder Publication Summaries

### Basic Science

To date, three peer review publications reported basic science results for the HemiCAP shoulder system. Two were supportive while 1 showed both advantages and drawbacks specifically related to the treatment of Hill Sachs lesions with a circular implant. Positive findings demonstrated that HemiCAP inlay arthroplasty allowed for a better restoration of the intact range of motion within the geometric center of the humeral head compared to stemmed hemi arthroplasty and may in turn lead to limited eccentric wear of the glenoid.



Shoulder & Elbow > Shoulder > Basic Science

2013

## **Biomechanics of Complex Shoulder Instability**

Degen RM, Giles JW, Thompson SR, Litchfield RB, Athwal GS.

Clin Sports Med. 2013 Oct;32(4):625-36

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24079425>

### **SUMMARY**

Identification and treatment of the osseous lesions associated with complex shoulder instability remains challenging. Further biomechanical testing is required to delineate critical defect values and determine which treatments provide improved glenohumeral joint stability for the various defect sizes, while minimizing the associated complications.

### **QUOTE**

“Partial resurfacing HemiCAP (Arthroscopic, Franklin, MA) incompletely fills the HS defect, likely attributable to the geometric differences between the circular implant and wedged shaped defect.”

### **CONCLUSION**

Identification and treatment of the osseous lesions associated with complex shoulder instability remains challenging. Further biomechanical testing is required to delineate critical defect values and determine which treatments provide improved glenohumeral joint stability for the various defect sizes, while minimizing the associated complications.

Shoulder & Elbow > Shoulder > Basic Science

2012

## Biomechanical Comparison of Anatomic Humeral Head Resurfacing and Hemiarthroplasty in Functional Glenohumeral Positions

Hammond G, Tibone JE, McGarry MH, Jun BJ, Lee TQ.

J Bone Joint Surg Am. 2012 Jan 4;94(1):68-76.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22218384>

### SUMMARY

Resurfacing of the humeral head has gained interest as an alternative to traditional hemiarthroplasty because it preserves bone stock and respects the native geometry of the glenohumeral articulation. The purpose of this study was to compare the biomechanics of the intact glenohumeral joint with those following humeral head resurfacing and following hemiarthroplasty. Seven fresh-frozen cadaveric shoulders were tested with the rotator cuff, pectoralis major, and latissimus dorsi musculature loaded with 20 N and the deltoid muscle loaded with 40 N in a custom shoulder testing system. Each specimen was tested in 20°, 40°, 60°, and 80° of vertical abduction. The articular surfaces of the humeral head and the glenoid were digitized to calculate the positions of the geometric center and apex of the humeral head relative to the geometric center of the glenoid at each testing position. The contact area and contact pressures were also measured with use of a Tekscan pressure sensor. The geometric center of the humeral head shifted by a mean (and standard error) of  $2.2 \pm 0.3$  mm following humeral resurfacing and  $4.7 \pm 0.3$  mm following hemiarthroplasty ( $p < 0.0002$ ). The apex of the humeral head was shifted superiorly at all abduction angles following hemiarthroplasty ( $p < 0.03$ ). Both humeral resurfacing and hemiarthroplasty decreased the glenohumeral contact area and increased the peak pressure. Resurfacing more closely restored the geometric center of the humeral head than hemiarthroplasty did, with less eccentric loading of the glenoid. Compared with hemiarthroplasty, humeral resurfacing may limit eccentric glenoid wear and permit better function because the glenohumeral joint biomechanics and the moment arms of the rotator cuff and the deltoid muscle are restored more closely to those of the intact condition.

### QUOTE

“The humeral resurfacing implant was better able to replicate the calculated geometric center of the intact condition than the hemiarthroplasty implant was”

### CONCLUSION

For this reason, resurfacing may better limit eccentric glenoid wear because the glenohumeral joint biomechanics and the moment arms of the rotator cuff and the deltoid muscle are restored more closely to those of the intact condition.

Shoulder & Elbow > Shoulder > Basic Science

2012

## **Moderate to Large Engaging Hill-Sachs Defects: An In Vitro Biomechanical Comparison of the Remplissage Procedure, Allograft Humeral Head Reconstruction, and Partial Resurfacing Arthroplasty**

Giles JW, Elkinson I, Ferreira LM, Faber KJ, Boons H, Litchfield R, Johnson JA, Athwal GS.

J Shoulder Elbow Surg. 2012;21(9):1142-1151

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22036545>

### **SUMMARY**

The management of engaging Hill-Sachs defects (HSD) is controversial. The purpose of this study was to biomechanically compare 3 treatment strategies.

### **MATERIALS AND METHODS:**

Eight specimens were tested on a shoulder simulator. The protocol involved testing 2 unrepaired HSD (30% and 45%), which were then treated with remplissage, humeral head allograft (HHA), and partial resurfacing arthroplasty (PRA). Stability (defect engagement and glenohumeral stiffness) and range of motion (ROM) were measured.

### **RESULTS:**

All 30% and 45% HSDs engaged and dislocated. Remplissage and HHA effectively prevented engagement in all specimens; however, 62% of PRA engaged. No repair exhibited stiffness significantly greater than intact, but 30% and 45% remplissage produced a 74% and 207% increase, respectively, and were significantly greater than the unrepaired states ( $P \leq .047$ ). Stiffness results for HHA and PRA closely matched those of intact. In adduction, remplissage reduced internal-external ROM compared with both defects ( $P \leq .01$ ), but only 30% remplissage caused a significant decrease compared with intact ( $P = .049$ ). In abduction, all repairs reduced ROM compared with HSD ( $P \leq .04$ ), but none compared with intact ( $P \geq 0.05$ ). In extension, remplissage had significantly less ROM than either HHA or PRA ( $P \leq .02$ ).

### **CONCLUSION:**

All procedures improved stability; however, unlike remplissage, results from HHA and PRA closely resembled intact. Remplissage (30% and 45%) improved stability and eliminated engagement but caused reductions in ROM. HHA and PRA re-established intact ROM, but PRA could not fully prevent engagement. The effects of each technique are not equivalent and further studies are required.

## QUOTE

“The partial resurfacing arthroplasty also provided nearly intact ROM and joint stiffness but resulted in partial engagement in some specimens due to the shape mismatch present when reconstructing a wedge-shaped HSD with a circular implant ... To completely reconstruct the HSD without residual defects, a wedge-shaped implant is required. Alternatively, the initial defect could be expanded circularly to match one of the available implants, although this may result in excessive bone removal.”

## CONCLUSION

This study investigated the biomechanical characteristics of 3 treatment options for moderate and large engaging HSDs for their effects on glenohumeral engagement/dislocation, joint stiffness, and ROM. The remplissage procedure was effective at preventing Hill- Sachs lesion engagement; however, it also significantly restricted some shoulder motions. The remplissage procedure also increased joint stiffness compared with the other reconstructions modeled, which is concerning because the clinical significance of this is unknown. The allograft humeral head reconstruction and the partial resurfacing arthroplasty addressed the HSD in a similar fashion by restoring articular congruity. The allograft humeral head reconstruction successfully prevented lesion engagement and resulted in restoration of biomechanical properties to nearly intact values. The partial resurfacing arthroplasty also provided nearly intact ROM and joint stiffness but resulted in partial engagement in some specimens due to the shape mismatch present when reconstructing a wedge-shaped HSD with a circular implant.

## Clinical Science

The 2015 Australian Arthroplasty Registry continued to report the lowest revision rate for HemiCAP Shoulder Implants across all shoulder implant classes (see pages 9-12, Registry Review). The positive 5 year survivorship data from the Australian Arthroplasty Registry is mirrored in the peer review literature.

Sixty-two publications reported on the clinical aspects of HemiCAP inlay arthroplasty in the upper extremity. To date, outcomes have been reported on a number of indications including degenerative joint disease, Hill Sachs lesions, arthrosis, avascular necrosis, and combination therapy with biological glenoid resurfacing. The vast majority of publications have been supportive and highlighted the benefits of the procedure. Similar to other shoulder arthroplasty procedures, young patients with bipolar disease treated with biological glenoid resurfacing did not provide supporting evidence for this combination procedure. However the vast majority of publications concluded that HemiCAP inlay arthroplasty is a joint preserving procedure with a reproducible technique showing great promise with significant improvements in outcome scores, improvement in range of motion, and high patient satisfaction.



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Shoulder & Elbow > Shoulder > Clinical Science

2015

## Outpatient Treatment of Compensated Cuff Arthropathy Using Inlay Arthroplasty With Subscapularis Preservation

McKenna RW, Chandler T

Tech Shoulder Elbow Surg 2015;16(4):115-125

Peer Review Article

[http://journals.lww.com/shoulderelbowsurgery/Abstract/2015/12000/Outpatient\\_Treatment\\_of\\_Compensated\\_Cuff.5.aspx](http://journals.lww.com/shoulderelbowsurgery/Abstract/2015/12000/Outpatient_Treatment_of_Compensated_Cuff.5.aspx)

### SUMMARY

Management of the rotator cuff–deficient shoulder remains challenging particularly for younger patients with higher functional demands. Patients presenting with signs and symptoms of cuff tear arthropathy (CTA) are frequently treated with reverse, total, or hemishoulder arthroplasty. Life expectancy must be taken into consideration when deciding on the treatment path for high-demand patients, particularly in light of significant complication rates and poor revision strategies for reverse shoulder arthroplasty. Subsets of patients presenting with early CTA stage IA are suitable candidates for a less-invasive approach. Intact fulcrum kinematics provide a compensated, deltoid-driven functional improvement when primary and secondary pain generators are addressed. Over the past 7 years, we have followed strict stage-specific selection criteria and treated these patients with a humeroacromial inlay arthroplasty (HemiCAP), which preserves the congruity of the articular surface with minimal bone resection and leaves a clinical exit strategy into total shoulder arthroplasty or hemishoulder arthroplasty if necessary. The procedure allows for a deltoid-splitting approach leaving the subscapularis untouched. This has positive implications for postoperative recovery and prevents possible approach-related complications associated with a subscapularis tenotomy. Patient selection, technical aspects, and adjuvant procedures play an important role and make superior humeral head inlay arthroplasty a safe, effective, and reproducible joint-preserving solution for early-stage compensated CTA.

### QUOTE

“Over the past 7 years, we have followed strict stage-specific selection criteria and treated these patients with a humeroacromial inlay arthroplasty (HemiCAP), which preserves the congruity of the articular surface with minimal bone resection and leaves a clinical exit strategy into total shoulder arthroplasty or hemishoulder arthroplasty if necessary.”

### CONCLUSION

The use of focal superior humeral head resurfacing in compensated cuff arthropathy with humeroacromial arthrosis has distinct advantages: the technique preserves the glenohumeral joint and avoids the bone loss and complications associated with stemmed arthroplasty. The degenerative cycle of early-stage CTA is disrupted, primary and secondary pain generators are addressed effectively, and further muscle imbalance is avoided through a deltoid-splitting approach that leaves the subscapularis tendon intact.

Shoulder & Elbow > Shoulder > Clinical Science

2015

## Management of bone loss in glenohumeral instability

Patel RM, Amin NH, Lynch TS, Miniaci A.

Orthop Clin North Am. 2014 Oct;45(4):523-39.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25199423>

### SUMMARY

This review discusses the evaluation and management of bone loss in glenohumeral instability. The glenohumeral joint may experience a dislocation or subluxation associated with traumatic injury or through repetitive atraumatic events. Nearly 62% of cases with recurrent dislocation have both Hill-Sachs and bony Bankart defects. Treatment of unstable bone defects may require soft-tissue repair, bone grafting, or both, depending on the size and nature of the defects. The most common treatment is isolated soft-tissue repair, leaving the bone defects untreated, although emerging evidence supports directly addressing these bony defects.

### QUOTE

“Reconstituting the articular arc with prosthetic surface implants is another option. This technique uses a round cap-like cobalt-chrome articular component that fills the Hill-Sachs lesion on the posterosuperior humeral head.”

### CONCLUSION

The technique requires technical expertise and accuracy similar to those of allograft reconstruction without the associated potential complications of disease transmission, nonunion, and graft resorption.



Shoulder & Elbow > Shoulder > Clinical Science

2015

## The Glenoid Component in Anatomic Shoulder Arthroplasty

Pinkas D, Wiater B, Wiater JM

J Am Acad Orthop Surg. 2015 May;23(5):317-326.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25829449>

### SUMMARY

Ideal management of the glenoid in anatomic shoulder arthroplasty remains controversial. Glenoid component loosening remains a common source of clinical concern and, in young, active patients, implantation of a glenoid prosthesis is often avoided. Efforts to decrease glenoid loosening have resulted in changes to prosthetic design and implantation techniques. Currently, a wide variety of glenoid component options are available, including metal-backed or all-polyethylene, bone ingrowth or ongrowth, inset, and augmented designs. Additionally, several alternatives are available for the young, active patient, including hemiarthroplasty, nonprosthetic resurfacing, and tissue interposition. Many recent clinical and biomechanical studies have examined these implant options. A thorough knowledge of glenoid anatomy, pathology, implant options, indications, and principles of implantation is necessary to optimize the outcome following anatomic shoulder arthroplasty.

### QUOTE

“HemiCAP glenoid replacement system (Arthrosurface), an inset glenoid component.”

### CONCLUSION

The inlay design permits partial resurfacing of the glenoid, leaving a peripheral rim of bone that potentially improves liftoff resistance and stability.

Shoulder & Elbow > Shoulder > Clinical Science

2015

## **Shoulder prosthetic arthroplasty options in 2014: what to do and when to do it.**

Pinkas D, Wiater JM, Spencer EE Jr, Edwards TB, Uribe JW, Declercq G, Murthi AM, Hertel R

Instr Course Lect. 2015;64:193-202.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25745905>

### **SUMMARY**

The number of shoulder arthroplasty procedures performed in the United States is steadily increasing as a result of an expansion in implant options, clinical indications, and surgical experience. Available options include stemmed implants, short-stemmed or stemless prostheses, fracture-specific designs, resurfacing implants, partial surface replacement, metal-backed or polyethylene glenoid components designed for cementation or bone ingrowth, and reverse total shoulder arthroplasty. Efforts to re-create anatomy, improve outcomes, and avoid complications have resulted in many changes in prosthesis design. Despite these changes, failures still occur, and revision surgery is sometimes necessary. A thorough knowledge of current arthroplasty options, indications, and the principles of implantation is necessary to optimize outcomes after shoulder arthroplasty.

### **QUOTE**

“n/a”

### **CONCLUSION**

n/a

Shoulder & Elbow > Shoulder > Clinical Science

2015

## **Glenoid Bone Loss in Anatomic Shoulder Arthroplasty: Literature Review and Surgical Technique**

Mori D, Abboud JA, Namdari S, Williams GR

Orthop Clin North Am. 2015 Jul;46(3):389-97

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26043052>

### **SUMMARY**

Despite major advances in total shoulder arthroplasty, management of severe posterior glenoid bone loss remains controversial. Several companies have provided alternative treatment options for type C glenoids associated with posterior subluxation of the humeral head. However, preoperative planning, proper selection of glenoid size, and recognition of the operative pitfalls are crucial for successful outcomes. A review of the literature and presentation of the surgical technique for the management of severe posterior glenoid bone loss are presented.

### **QUOTE**

“In rare cases of shoulders with inadequate peripheral or central bone to allow for placement of a pegged glenoid component (type C1 glenoids or revisions) or those thought to be at high risk for bone graft resorption and failure, a Mini Glenoid (Arthrosurface, Franklin, MA, USA) may be used.”

### **CONCLUSION**

Given the limitations associated with asymmetric reaming and bone grafting in the setting of B2 and C glenoids, augmented components may allow for improved outcomes for this difficult treatment population.

Shoulder & Elbow > Shoulder > Clinical Science

2015

## **Focal anatomic resurfacing implantation for bilateral humeral and femoral heads' avascular necrosis in a patient with Hodgkin's lymphoma and literature review**

Bilge O, Doral MN, Miniaci A.

Int J Surg Case Reports 2015; 17:128-132

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26624502>

### **SUMMARY**

**INTRODUCTION:** The femoral and humeral heads are among the most common sites of osteonecrosis. The aim of this case report was to report three years' results for sequential treatment of bilateral, concomitant involvement of humeral and femoral heads with focal anatomic resurfacing implantation in a single patient with Hodgkin's lymphoma and to review the relevant literature, which is relatively scarce.

**PRESENTATION OF CASE:** We present a 48-year-old male patient with concomitant, bilateral femoral and humeral head avascular necrosis. He was diagnosed as Hodgkin's lymphoma in 1984. He had bilateral groin and shoulder pain, lasting for three years and aggravated by joint motions. Radiological evaluations demonstrated bilateral focal osteonecrosis of femoral heads and humeral heads, respectively. Despite conservative treatment, he did not obtain any symptomatic relief. Following the common decision, he was treated with sequential implantations with the HemiCAP® device for both bilateral pathologies, by a single surgeon and standard surgical approaches. Neither intraoperative nor postoperative complication was encountered. After the follow-up period of 36 months after the last surgery, he was symptomless and with normal range of motion for all four joints.

**DISCUSSION:** The bilateral, concomitant involvement of humeral and femoral head in the setting of avascular necrosis is relatively rare. Moreover, the optimal treatment method at earlier stages, in young patients has not been established yet.

**CONCLUSION:** This study is the first report to present the three-years' clinical result of a single, relevant case, who was treated with sequential focal anatomic resurfacing implantations (HemiCAP®) in four aforementioned joints

## QUOTE

“To the best of our knowledge, this study is the first report to present represents the mid-term successful clinical results of focal, anatomic resurfacing implantation for the treatment of a middleaged patient with avascular necrosis of bilateral femur and bilateral humeral heads.”

## CONCLUSION

In summary, the alternative focal, anatomic resurfacing implantation with HemiCAP® in this particular case, having bilateral, focal osteonecrosis of the femoral and humeral heads has functioned well in mid-term.

Shoulder &amp; Elbow &gt; Shoulder &gt; Clinical Science

2015

## Assessment of the Anatomic Neck as an Accurate Landmark for Humeral Head Resurfacing Implant Height Placement.

Chen EJ, Simovitch R, Savoie F, Noel CR.

Bulletin of the Hospital for Joint Diseases . 2015 Supplement 1, Vol. 73, pS28-S32. 5p.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26631192>

### SUMMARY

**Introduction:** Humeral head resurfacing has been described as a more anatomic replacement alternative for proximal humerus arthroplasties when compared to conventional stemmed implants. However, not all studies show that humeral head resurfacing is better at reproducing the proximal humeral anatomy with overstuffing of the joint being a common complication. The purpose of this study was to assess the use of the anatomic neck as a landmark for proper placement of humeral head replacements. **Methods:** Sixty-six cadaveric shoulder CT scans were reconstructed using Mimics to create 3D models of the humerus. After 3D reconstruction, each bone model was analyzed in Rapidform to establish the anatomic neck plane, the humeral head average radius of curvature, and anatomic center of rotation (CoR) using a best fit sphere over the articular surface. Humeral head resurfacing implants (Equinoxe<sup>®</sup>, Exactech, Inc.) were assembled onto the 3D humeral models, selected by matching the closest implant size available with the anatomic radius of curvature. Implants were constrained to match the anatomic neck angle and version and were spaced 2 mm away from the anatomic neck. The 3D distances between the anatomic center of rotation and the implant CoR and the implanted head thickness deviations were measured using Unigraphics to observe anatomic reproduction with the resurfacing implants. **Results:** When placing all resurfacing implants 2 mm from the anatomic neck, the average implant CoR offset from the anatomic CoR was determined to be 1.03 mm  $\pm$  0.75 mm. The average implant Humeral Head Thickness (HHT) deviation from the anatomic HHT was determined to be -0.36 mm  $\pm$  0.84 mm. There were no significant differences in CoR offset or HHT offset between implant sizes used. **Discussion:** Newer generation resurfacing implant designs allow for more anatomic reproduction of the humeral articular surface. Depth of reaming and resurfacing implant height placement are potential pitfalls in humeral head replacement and have been shown to have negative effects on reproducing the CoR and HHT. Using the anatomic neck as a landmark for the depth of reaming has been observed to closely reproduce anatomic HHT and CoR. Further work aims to validate the use of the anatomic neck as a consistent landmark in cadaveric studies and to investigate if these findings are clinically relevant.

### QUOTE

“more closely restored the geometric center than stemmed hemiarthroplasty  
when using an Arthrosurface<sup>®</sup> implant.”

### CONCLUSION

n/a

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Shoulder & Elbow > Shoulder > Clinical Science

2015

## Primary Partial Humeral Head Resurfacing. Outcomes With the HemiCAP Implant

Sweet SJ, Takara T, Ho L, Tibone JE

Am J Sports Med. 2015 Mar;43(3):579-87

Peer Review Article

<http://ajs.sagepub.com/content/early/2015/01/02/0363546514562547.abstract>

### SUMMARY

**Background:** Humeral head defects such as degenerative disease or avascular necrosis are often treated with stemmed hemiarthroplasty or total shoulder arthroplasty. Despite its historical and clinical significance, stemmed humeral head replacement poses inherent technical challenges to placing spherical implants at the anatomically correct head height, version, and neck-shaft angle. **Purpose:** The aim of this study was to assess humeral head inlay arthroplasty as a joint-preserving alternative that maintains the individual head-neck-shaft anatomy. Humeral head inlay arthroplasty also allows intraoperative surface mapping and placement of a contoured articular component that is matched to the patient's defect size, location, and individual surface geometry. **Methods:** This retrospective case series included 19 patients (20 shoulders), with an average age of 48.9 years (range, 32-58 years; 16 men, 3 women). Preoperative diagnoses were osteoarthritis in 16 shoulders and osteonecrosis in 4 shoulders. Pre- and postoperative evaluations included physical examination, radiographic assessment, the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, the Simple Shoulder Test, a pain visual analog scale, and patient satisfaction rating. **Results:** The mean follow-up period was 32.7 months (range, 17-66 months). The mean American Shoulder and Elbow Surgeons score improved from 24.1 to 78.8, mean Simple Shoulder Test score from 3.95 to 9.3, mean visual analog scale score from 8.2 to 2.1, mean forward flexion from 100° to 129°, and mean external rotation from 23° to 43° ( $P < .001$  for all). Radiographic follow-up showed no evidence of periprosthetic fracture, component loosening, osteolysis, or device failure. Patient shoulder self-assessment was 90% poor before surgery and improved to 75% good to excellent at last follow-up; 20% of patients self-rated as somewhat good to somewhat poor, and 5% self-rated as poor. Ninety percent of patients were satisfied with the choice of the procedure. Three patients had postoperative complications unrelated to the implants, including a partial rotator cuff tear treated with physical therapy, preexisting glenoid wear treated with arthroscopic debridement and microfracture, and infection complicated by subscapularis rupture requiring several subsequent surgical procedures but with retention of the implant. **Conclusion:** Humeral head inlay arthroplasty is effective in providing pain relief, functional improvement, and patient satisfaction. Rather than delaying shoulder arthroplasty to end-stage osteoarthritis, humeral head inlay arthroplasty is a promising new direction in primary shoulder arthroplasty for younger and active patients with earlier stage disease.

## QUOTE

“Humeral head inlay arthroplasty with the HemiCAP implant is a promising procedure as a primary arthroplasty intervention. It is particularly beneficial to young, active patients with early degenerative arthritis, osteonecrosis of the humeral head, or traumatic focal cartilage defects. We have shown that patients achieve high satisfaction rates, significant reductions in shoulder pain, and significant improvements in range of motion and activities of daily living”

## CONCLUSION

Humeral head inlay arthroplasty is effective in providing pain relief, functional improvement, and patient satisfaction. Rather than delaying shoulder arthroplasty to end-stage osteoarthritis, humeral head inlay arthroplasty is a promising new direction in primary shoulder arthroplasty for younger and active patients with earlier stage disease.



Shoulder & Elbow > Shoulder > Clinical Science

2015

## Shoulder Osteoarthritis

Banke IJ, Lorenz S

Surgical Atlas of Sports Orthopaedics and Sports Traumatology. Shoulder Osteoarthritis. Springer 2015, pp 97-100

Book Chapter

[http://link.springer.com/chapter/10.1007/978-3-662-43776-6\\_6](http://link.springer.com/chapter/10.1007/978-3-662-43776-6_6)

### SUMMARY

Focal chondral and osteochondral lesions of the humeral head, avascular necrosis, Hill-Sachs and reverse Hill-Sachs lesions, in a biologically young patient (Age < 50 years) and in patients with high functional requirements. Arthroscopically assisted (Partial Eclipse™, Arthrex) or open (HemiCAP™, Arthrosurface) partial resurfacing arthroplasty of the humeral head. The prosthesis is composed of two components, a fixation screw (taper) and the actual resurfacing component, the posterior surface of which should ensure osteointegration.

Symptom specific history: Etiology, Symptoms, functional demands, subjective instability, metal allergy, previous treatment modalities (intraarticular Injections, e.g. cortisone), previous surgeries, relevant concomitant diseases (e. g. rheumatoid arthritis).

Symptom-specific examination: Range of motion (active/passive), painful motion, tenderness and pain on compression, function of the shoulder girdle muscles, stability and Impingement tests. Evaluation of the peripheral nerves (particularly the axillary nerve).

### QUOTE

“Resurfacing prostheses should be implanted so that it lies a little bit below the surrounding cartilage surface. Protrusion of the implant should be avoided as it can lead to glenoid erosion.”

### CONCLUSION

Resurfacing Arthroplasty: Indications: Focal chondral and osteochondral lesions of the humeral head, avascular necrosis, Hill-Sachs and reverse Hill-Sachs lesions, in a biologically young patient (age < 50 years) and in patients with high functional requirements.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## Biologic Resurfacing of the Glenoid with Humeral Head Resurfacing for Glenohumeral Arthritis in the Young Patient

Muh SJ, Streit JJ, Shishani Y, Dubrow S, Nowinski RJ, Gobezie R.

J Shoulder Elbow Surg. 2014 Jan 16. pii: S1058-2746(13)00576-4. epub

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24439248>

### SUMMARY

Resurfacing of the glenoid with an interposition soft tissue graft in conjunction with humeral head arthroplasty has been proposed as an option to improve glenohumeral arthritis in young patients while avoiding the potential complications associated with total shoulder arthroplasty. There currently exist minimal outcomes data for this procedure, and the results have not been consistent. The purpose of this study was to report on the outcomes in our cohort of patients aged younger than 55 years. **METHODS:** A multicenter review of 16 patients who had undergone humeral head arthroplasty with soft tissue interposition grafting of the glenoid was performed. All patients had a minimum follow-up time of 24 months, unless revision surgery was required because of failure of the procedure. **RESULTS:** At a mean follow-up of 60 months, the patients showed improvement in the visual analog scale score for pain from 8.1 to 5.8 ( $P < .05$ ), and the American Shoulder and Elbow Surgeons score improved from 23.2 to 57.7 ( $P < .05$ ). Forward elevation improved from  $128^\circ$  to  $134^\circ$  ( $P = .33$ ), and external rotation improved from  $28^\circ$  to  $32^\circ$  ( $P = .5$ ). Internal rotation showed no improvement. Conversion to a total shoulder arthroplasty was performed in 7 patients (44%) at a mean of 36 months. **CONCLUSIONS:** The optimal management for the young patient with arthritis has not yet been established. Because of the limited improvement in patient outcomes and the relatively high revision rate, biologic resurfacing of the glenoid with humeral head resurfacing is no longer our primary treatment option for young patients and should be used with caution.

### QUOTE

“The humeral head was replaced with a standard hemiarthroplasty prosthesis (Tornier, Saint-Ismier, France) or humeral head resurfacing implant (Arthrosurface, Franklin, MA, USA).”

### CONCLUSION

Our experience using humeral head resurfacing with soft tissue resurfacing of the glenoid to treat young patients with shoulder arthritis has been disappointing because both pain and function are only modestly improved.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## **Durability of Partial Humeral Head Resurfacing**

Delaney RA, Freehill MT, Higgins LD, Warner JJ.

J Shoulder Elbow Surg. 2014 Jan;23(1):e14-22.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/23834995>

### **SUMMARY**

Partial humeral head resurfacing arthroplasty uses a stemless device, which conserves bone and restores normal anatomy. We hypothesized that this does not offer a reasonable alternative to full resurfacing or total shoulder arthroplasty.

### **METHODS:**

We performed a retrospective study of 39 shoulders with focal chondral defects of the humeral head treated with partial resurfacing arthroplasty. A minimum of 2 years' follow-up was reported, unless failure and operative intervention superseded this duration. The mean follow-up period was 51.3 months. The mean age was 45.6 years (range, 27-76 years). Preoperative and postoperative evaluation included history, physical examination, radiographs, and clinical scoring with the American Shoulder and Elbow Surgeons Shoulder Score Index and Subjective Shoulder Value.

### **RESULTS:**

Of the 39 shoulders, 25 (64.1%) showed functional improvement and decreased pain. Significant mean improvements were observed in forward flexion (121° to 152°,  $P = .002$ ), external rotation (37° to 58°,  $P = .0003$ ), mean Subjective Shoulder Value (31% to 74%,  $P < .0001$ ), and ASES score (29 to 70,  $P < .0001$ ). However, at a mean of 26.6 months' follow-up, the failure group included 6 patients (15.3%) who underwent revision and another 4 (10.2%) who were recommended to undergo revision. Patients with no prior or concomitant procedures were rare ( $n = 5$ ) but had the most reliable outcomes with partial resurfacing, with no failures in that group. Of the 24 patients with prior procedures, 5 had undergone revision, and the clinical outcome scores for the remaining patients were consistently lower than those seen in patients without prior procedures.

### **CONCLUSION:**

Concomitant pathology and prior or concomitant surgical procedures potentially impair the outcome of the resurfacing procedure and could be a contraindication. Long-term success remains guarded with this treatment modality, especially in patients whose chondral injury is not an isolated finding.

## QUOTE

“The partial humeral head resurfacing arthroplasty does show promise based on the overall data showing significant improvements in ASES scores, SSV scores, mean forward flexion, and external rotation at more than 2 years’ followup.”

## CONCLUSION

Statistically significant improvements in some patients at a mean of more than 4 years’ follow-up after partial resurfacing arthroplasty were found. However, a higherthan expected number of patients had failure and either required revision or underwent revision, and an additional 10% of patients were found to have complaints of pain at latest follow-up. Patients with no concomitant shoulder pathology showed a good clinical outcome, but these patients only made up 13% of the cohort. Shoulders in which a concomitant procedure was performed still achieved acceptable clinical outcomes; however, shoulders that had undergone prior procedures were at increased risk of failure of partial resurfacing. Thus, long-term success and survival remain guarded with this treatment modality, especially in more complex shoulders.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## Radiographic assessment of prosthetic humeral head size after anatomic shoulder arthroplasty

Alolabi B, Youderian AR, Napolitano L, Szerlip BW, Evans PJ, Nowinski RJ, Ricchetti ET, Iannotti JP

J Shoulder Elbow Surg. 2014 Nov;23(11):1740-6.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=24856628>

### SUMMARY

Restoring the premorbid proximal humeral anatomy during shoulder arthroplasty is critical yet can be difficult because of the deformity of the arthritic head. The purpose of this study was to measure the variation between surgeons and between types of prosthetics in reproducing the anatomic center of rotation (COR) of the humeral head after anatomic shoulder arthroplasty. **METHODS:** The anteroposterior radiographs of 125 stemmed and 43 resurfacing shoulder arthroplasties, performed by 5 experienced surgeons, were analyzed. All patients had primary replacement for treatment of end-stage glenohumeral arthritis. A best-fit circle to preserved nonarticular humeral landmarks was used to define the difference between the anatomic COR and the prosthetic COR. A difference in COR of  $>3.0$  mm was considered clinically significant and analyzed for the cause of this deviation. **RESULTS:** The average deviation of the postoperative COR from the anatomic COR was  $2.5 \pm 1.6$  mm for stemmed cases and  $3.8 \pm 2.1$  mm for resurfacings. Thirty-nine stemmed cases (31.2%) and 28 resurfacings (65.1%) were beyond 3.0 mm of deviation and regarded as outliers. The majority of the stemmed outliers and all resurfacing outliers were overstuffing. An improper humeral head size selection and inadequate reaming were the main reasons for the deviation in stemmed and resurfacing outliers, respectively. **CONCLUSION:** A large percentage of shoulder replacements demonstrated significant deviations from an anatomic reconstruction. Resurfacing arthroplasty exhibited significantly greater deviations compared with stemmed arthroplasty ( $P < .001$ ), indicating that surgeons have more difficulty in restoring the anatomy with resurfacings. Further studies are needed to assess the clinical impact of these deviations.

### QUOTE

“For resurfacings, the Global CAP (DePuy Johnson & Johnson) implant was used in 39 cases, the Aequalis Resurfacing (Tornier) in 2 cases, the Copeland resurfacing (Biomet, Warsaw, IN, USA) in 1 case, and the HemiCAP (Arthrosurface, Franklin, MA, USA) full resurfacing in 1 case.”

### CONCLUSION

This study has demonstrated that a large number of shoulder arthroplasty cases had more than 3 mm of deviation in the postoperative COR relative to the anatomic COR of the humeral head.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## **Shoulder structure and function following the modified Latarjet procedure: a clinical and radiological review**

Garewal D, Evans M, Taylor D, Hoy GA, Barwood S, Connell D

Shoulder and Elbow 2014 6, pp 23–28

Peer Review Article  
<http://onlinelibrary.wiley.com/doi/10.1111/sae.12039/abstract>

### **SUMMARY**

To evaluate the clinical and radiological outcomes of the modified Latarjet procedure for traumatic, antero-inferior glenohumeral joint instability.

### **Methods**

Case series were used with a mean follow-up of 21.3 months for clinical and radiological review and 47.2 months for recurrent instability. Shoulder function was evaluated by clinical examination and validated shoulder scales: Western Ontario Shoulder Stability Index (WOSI), Melbourne Instability Shoulder Score (MISS) and I'Insalata Shoulder Questionnaire. Shoulder structure was evaluated by computed tomography.

### **Results**

Thirty-two cases were enrolled (mean age 27.0 years). One patient reported a redislocation during the follow-up period. Clinical examination revealed that the median external rotation (at 0° and 90° abduction) was reduced on the operative side by 7.5° ( $p < 0.01$ ) and 10° ( $p < 0.001$ ), respectively. Subjective shoulder function was good. Mean (SD) scores on the WOSI, MISS and I'Insalata scales were 78.0 (19.7), 75.8 (11.5) and 89.3 (9.9), respectively. No loss of subscapularis strength was identified ( $p > 0.05$ ). Radiological evaluation revealed a mean (SD) pre-operative glenoid surface area loss of 169.5 (48.5) mm<sup>2</sup> reconstituted surgically by a bone block of 225.4 (73.8) mm<sup>2</sup>. Subscapularis muscle bulk was reduced on the operative side, above the level of the muscle split ( $p < 0.05$ ).

### **Conclusions**

The Latarjet procedure reliably restores lost glenoid surface area, shoulder stability, strength and function. A small loss of external rotation is expected and related to altered subscapularis anatomy.

#### QUOTE

“Revision stabilization surgery consisted of replacement of the coracoid bone graft with iliac crest graft, and restitution of the humeral head bone loss using a metallic segmental resurfacing (hemicap) prosthesis.”

#### CONCLUSION

We conclude that the modified Latarjet procedure provides a reliable stabilization procedure for antero-inferior glenohumeral instability with glenoid bone loss of more than 20%. There is complete reconstitution of glenoid bone surface area, with high rates of bony union. Subscapularis splitting avoids weakness but contributes to loss of external rotation both by the side and in abduction. Range of motion, strength and clinical function appear stable by 6 months to 12 months after surgery, with no statistically significant change in outcome parameters beyond this period. Failure of bone union may predispose to further instability, and we recommend radiological confirmation of union before return to at risk activities.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## **The high failure rate of biologic resurfacing of the glenoid in young patients with glenohumeral arthritis.**

Strauss EJ, Verma NN, Salata MJ, McGill KC, Klifto C, Nicholson GP, Cole BJ, Romeo AA

J Shoulder Elbow Surg. 2014 Mar;23(3):409-19.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24012358>

### **SUMMARY**

The current study evaluated the outcomes of biologic resurfacing of the glenoid using a lateral meniscus allograft or human acellular dermal tissue matrix at intermediate-term follow-up.

**METHODS:** Forty-five patients (mean age, 42.2 years) underwent biologic resurfacing of the glenoid, and 41 were available for follow-up at a mean of 2.8 years. Lateral meniscal allograft resurfacing was used in 31 patients and human acellular dermal tissue matrix interposition in 10. Postoperative range of motion and clinical outcomes were assessed at the final follow-up.

**RESULTS:** The overall clinical failure rate was 51.2%. The lateral meniscal allograft cohort had a failure rate of 45.2%, with a mean time to failure of 3.4 years. Human acellular dermal tissue matrix interposition had a failure rate of 70.0%, with a mean time to failure of 2.2 years. Overall, significant improvements were seen compared with baseline with respect to the visual analog pain score (3.0 vs. 6.3), American Shoulder and Elbow Surgeons score (62.0 vs. 36.8), and Simple Shoulder Test score (7.0 vs. 4.0). Significant improvements were seen for forward elevation (106° to 138°) and external rotation (31° to 51°).

**CONCLUSION:** Despite significant improvements compared with baseline values, biologic resurfacing of the glenoid resulted in a high rate of clinical failure at intermediate follow-up. Our results suggest that biologic resurfacing of the glenoid may have a minimal and as yet undefined role in the management of glenohumeral arthritis in the young active patient over more traditional methods of hemiarthroplasty or total shoulder arthroplasty.

### **QUOTE**

**“Biologic resurfacing of the glenoid, combined with hemiarthroplasty or humeral head resurfacing, was indicated in these patients secondary to their relatively young age, symptomatic bipolar disease, and anticipation of return to overhead activities.”**

### **CONCLUSION**

We believe that biologic resurfacing of the glenoid may have a minimal and as yet undefined role in the management of glenohumeral arthritis in the young, active patient over more traditional methods of hemiarthroplasty or total shoulder arthroplasty.



Shoulder & Elbow > Shoulder > Clinical Science

2014

## Imaging of Prosthetic Joints

Mariotti U, Motta P, Tosco P

Imaging of Prosthetic Joints. Springer 2014, pp 123-134

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-88-470-5483-7\\_12](http://link.springer.com/chapter/10.1007/978-88-470-5483-7_12)

### SUMMARY

The history and development of shoulder arthroplasty dates back to 1892, but the modern era of shoulder arthroplasty began in the mid-1940s with Charles S. Neer II, who redrew the humeral component in 1973. The biomechanical principles of medialization and lowering of the centre of rotation of reverse shoulder prostheses evidencing the importance of this new philosophy were defined by Paul Grammont in 1985. Proximal humeral fractures, gleno-humeral arthritis, osteonecrosis, rheumatoid arthritis, cuff tear arthropathy, pseudo-paralytic shoulders with massive irreparable cuff tears with or without arthritis and proximal humeral malunion are treated with various types of prosthesis. For each type of prosthesis will analyse the history, indications and surgical techniques.

### QUOTE

“Stemless implants have the same indications as the resurfacing implants and may be used in younger patients with a good metaphyseal bone stock, in the presence of deformities and/or osteonecrosis of the humeral head when it cannot be resurfaced.”

### CONCLUSION

The most commonly used resurfacing prosthesis are Biomet Copeland Resurfacing Head, Tornier Resurfacing Head, Zimmer Durom Shoulder Cup, Biomet Copeland EAS Humeral Resurfacing Head, DePuy Global CAP, Arthrosurface HemiCAP and the Syntes Epoca Resurfacing Head.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## Osteoarthritis in Young Patients and Current Treatments

Brzóska R, Błasiak A, Huijsmans PE, Miniaci A, Porcellini G, Solecki W, van der Straeten C

ESSKA Instructional Course Lecture Book. Chapter 1. Springer 2014, pp 3-17

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-53983-1\\_1](http://link.springer.com/chapter/10.1007/978-3-642-53983-1_1)

### SUMMARY

The articular cartilage of the shoulder is not endowed with intrinsic repair abilities; therefore in the presence of diseases, like instability or cuff injury, even minor lesions may rapidly lead to early glenohumeral joint arthritis. The presence of cartilage lesions is not unusual even in young patients, and often they are found during arthroscopic procedures in several pathologic conditions. Less common conditions include glenoid dysplasia and osteochondritis dissecans. The varying thicknesses of the joint cartilage and the different resistance properties of the subchondral bone result in lesions of different depths and widths depending on the resistance offered by the articular surface. Minor cartilage lesions associated with rotator cuff or glenohumeral ligament damage will induce topographically different types of stress on the various areas of the articular surface. Recent and older research findings showed in the shoulder as in the knee, a correlation between cartilage wear and lesion site and between site and symptoms. Several conservative options available to manage shoulder arthritis are directed to alleviate pain, reduce inflammation, and, especially, halt or at least slow down the evolution of arthritis. Such therapies entail changes in lifestyle and systemic and topical drug administration. Viscosupplementation using hyaluronic acid may constitute a helpful treatment option in patients who have shoulder osteoarthritis with an intact rotator cuff, while lesser satisfactory results have been showed in case of rotator cuff tears or advanced osteoarthritis. Several surgical options are available to manage primary shoulder arthritis, including simple arthroscopic joint debridement and more complex techniques such as resurfacing using the fascia lata or meniscus, osteochondral autologous transplantation, resurfacing arthroplasty, and total arthroplasty.

### QUOTE

**“HemiCAP® for Focal Full-Thickness Articular and Osteochondral Defects :**

**Designed to match the shape and contour of the patient’s individual cartilage surface.”**

### CONCLUSION

Indications: Focal full-thickness articular cartilage, Osteochondral defects, Early degenerative defects, Localized avascular necrosis.

Shoulder & Elbow > Shoulder > Clinical Science

2014

## **Joint failure after steroid therapy in tuberculous encephalitis**

Ziskoven C, Richter J, Patzer T, Kircher J, Krauspe R

Scand J Infect Dis. 2014 Jul;46(7):533-6.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=24754480>

### **SUMMARY**

We report a case of multifocal avascular osteonecrosis (AVN) following steroid administration in a case of tuberculous encephalitis in a young patient. The risk of joint-related AVN as a side effect of adjunctive steroid therapy should be taken into consideration when evaluating the dosage and treatment duration in tuberculous encephalitis.

### **QUOTE**

“Because of the severe pain and the advanced destruction of the humeral head, we performed a partial surface replacement of the humeral head with a 4 - 4 mm endoprosthesis button (Hemicap; Arthrosurface, Franklin, MA, USA)”

### **CONCLUSION**

The postoperative course was uneventful. In the follow-up, the patient regained free range of motion and full strength of the left shoulder joint without any impairment in daily activities.

Shoulder &amp; Elbow &gt; Shoulder &gt; Clinical Science

2013

## Joint Resurfacing of the Shoulder and Knee in Athletes

Athiviraham A, Kodali P, Miniaci A.

Springer

Book Chapter

[http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36801-1\\_194-4](http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36801-1_194-4)

### SUMMARY

Recreational athletes are participating in their various sports seemingly well into their fifth decade of life and sometimes longer. Their previous injuries, genetics, and overall physiologic age cause problems with their joints that ultimately limit their level of participation. The older athletes, and sometimes even the younger athletes, present with problems that have failed conservative treatment or joint preservation procedures and now face the possibility of a potentially life-altering and career-ending arthroplasty procedure. Fortunately, there are now bone-preserving resurfacing solutions that may play a role in returning the athletes to their sport. The role of joint resurfacing in athletes is typically limited to disease entities that fail conservative treatment and less invasive surgical options. Resurfacing arthroplasties of the knee and shoulder have been shown to be safe procedures in patients with focal chondral defects who wish to return to a high level of function and activity. Intraoperative mapping of the patient's own joint geometry permits an anatomic surface restoration with preservation of health cartilage and minimal removal of bone stock. Preliminary results show excellent pain relief and functional improvement across a variety of indications. This chapter will focus on the application of resurfacing arthroplasty in the knee and shoulder.

### QUOTE

"In younger patients who require prosthetic arthroplasty surgery, resurfacing arthroplasty is an attractive bone-preserving procedure."

### CONCLUSION

New resurfacing designs offer the ability to target the region of diseased articular cartilage while contouring the prosthesis the adjacent healthy cartilage (Dawson CK 2008). Biomechanical studies have shown that anatomic resurfacing may provide better function than hemiarthroplasty because the normal glenohumeral joint biomechanics and the moment arms of the rotator cuff and deltoid are restored closer to that of the intact condition (Hammond G 2008). In addition, focal resurfacing does not alter the humeral offset or center of rotation (Scalise J 2007).

Shoulder & Elbow > Shoulder > Clinical Science

2012

## Diagnosis and Management of Humeral Head Bone Loss in Shoulder Instability

Skendzel JG., Sekiya JK.

Am J Sports Med. 2012 40(11):2633-44

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22343756>

### SUMMARY

Humeral head bone defects (Hill-Sachs lesions) are caused by anterior shoulder dislocation with impaction of the posterosuperior humeral head onto the anterior glenoid rim. Frequently, these bony lesions are associated with glenohumeral instability, and large lesions may contribute to recurrent instability after failure of a soft tissue repair. To improve outcomes and minimize the risk of persistent instability, a thorough understanding of the biomechanics of humeral bone loss is required. Detection and quantification of clinically relevant humeral head bone loss are performed through an accurate history, physical examination, and interpretation of imaging studies. The diagnosis and treatment options for reverse Hill-Sachs lesions are discussed, and the various treatment options for Hill-Sachs lesions are reviewed, including operative techniques to limit engagement of the deformity by soft tissue transfer, rotational osteotomy, bone grafting, or osteochondral transplantation.

### QUOTE

“For younger, active patients with a humeral head defect, resurfacing arthroplasty is an alternative to reconstruction with osteochondral grafts or a stem.”

### CONCLUSION

Humeral head resurfacing also remains a viable option for focal defects in younger patients.

Shoulder & Elbow > Shoulder > Clinical Science

2012

## The Hill-Sachs Lesion: Diagnosis, Classification, and Treatment

Provencher MT, Frank RM, LeClere LE, Metzger PD, Ryu JJ, Bernhardtson A, Romeo AA.

J Am Acad Orthop Surg 2012;20:242-252

Peer Review Article

<http://www.jaaos.org/content/20/4/242.abstract?etoc>

### SUMMARY

The Hill-Sachs lesion is an osseous defect of the humeral head that is typically associated with anterior shoulder instability. The incidence of these lesions in the setting of glenohumeral instability is relatively high and approaches 100% in persons with recurrent anterior shoulder instability. Reverse Hill-Sachs lesion has been described in patients with posterior shoulder instability. Glenoid bone loss is typically associated with the Hill-Sachs lesion in patients with recurrent anterior shoulder instability. The lesion is a bipolar injury, and identification of concomitant glenoid bone loss is essential to optimize clinical outcome. Other pathology (eg, Bankart tear, labral or capsular injuries) must be identified, as well. Treatment is dictated by subjective and objective findings of shoulder instability and radiographic findings. Nonsurgical management, including focused rehabilitation, is acceptable in cases of small bony defects and nonengaging lesions in which the glenohumeral joint remains stable during desired activities. Surgical options include arthroscopic and open techniques.

### QUOTE

“Limited resurfacing of the defect with a metal implant is done in an attempt to restore the humeral head articular arc. Outcomes have been reported to be positive at 1 to 2 years post implantation. With this technique there is no risk of disease transmission or resorption, as can occur with allograft.”

### CONCLUSION

Osseous lesions of the humeral head create challenging clinical scenarios. The most difficult aspect of these cases involves determining which Hill-Sachs lesions are clinically significant and need to be addressed surgically. Lesion size, orientation, location, and concomitant glenoid bone loss must be evaluated in light of the patient's symptoms.

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Shoulder & Elbow > Shoulder > Clinical Science

2012

## Vascular Necrosis of the Humeral Head: HemiCAP, Cap or Stemmed Solution?

Seitz WH , Miniaci A.

Semin Arthroplasty 23(2):60-67,2012

Peer Review Article

[http://www.semarthroplasty.com/article/S1045-4527\(12\)00045-4/abstract](http://www.semarthroplasty.com/article/S1045-4527(12)00045-4/abstract)

### SUMMARY

Avascular necrosis of the humeral head, as in other joints, can have a spectrum of severity. The degree of humeral head involvement should dictate the degree of prosthetic replacement required to restore congruity and function. In some very early phases of disease, observation or core decompression and supportive bone grafting may be considered. This article will focus on management of later problems where articular subsidence, degeneration, and arthrosis have dictated the need for varying degrees of prosthetic replacement. With a focal area of necrosis and collapse, but maintenance of peripheral articular congruity and subchondral support, a central core articular humeral replacement can be performed using a focal surface replacement or "hemi-cap" implant. For more global surface degeneration with maintenance of a relatively healthy surrounding subchondral bone support, total resurfacing of the articular surface can provide a seamless means of restoring congruity without burning the bridges of complete humeral head excision. When advanced, collapse occurs, and there is not enough supportive bone to provide foundation for a resurfacing implant, a stemmed implant should be considered. When biarticular disease ensues, following humeral head collapse and erosion of the glenoid, more formal total shoulder arthroplasty resurfacing is needed. The approach that will be presented here uses a "straightforward minimalist" conservative approach to the replacement of only the diseased articular surface with preservation of as much bony architecture as possible. This approach provides the surgeon with a process to restore articular congruity while at the same time preserving all viable bony architecture. In young patients, this is important when considering the long-term prospect of the need for future revision surgery.

### QUOTE

"Replacement. of a focal area of necrosis and collapse, but maintenance of peripheral articular congruity and subchondral support, a central core articular humeral replacement can be performed using a focal surface replacement or "hemi-cap" implant."

### CONCLUSION

Focal (hemi-cap) or complete resurfacing is a conservative means of restoring articular congruity to the humeral head. These techniques remove little bone, burn few bridges, offer pain relief, a smooth articular surface for enhanced motion, and provide for easy ability to perform later revision arthroplasty as needed.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## Focal Resurfacing of Humeral-Head Defects

Kodali P, Miniaci A.

Springer

Book Chapter

<http://www.springerlink.com/content/qg025882646j88g8/>

### SUMMARY

Traumatic shoulder instability is extremely common in athletes. It is usually due to abnormal abduction, external rotation, and extension force on the shoulder, causing it to exceed normal limits of glenohumeral motion and resulting in anterior dislocation. A characteristic anteroinferior capsulolabral injury occurs and has been deemed the essential lesion in anterior shoulder instability [1]–[3]. A posterolateral humeral-head defect (Hill-Sachs lesion) is noted in 93% of cases [4]. This bone defect, if large enough, may contribute to failed soft tissue stabilization that occurs in 8–18% of patients [4]–[6]. Large defects lead to an articular arc mismatch that, at lesser degrees of external rotation, will engage with the anteroinferior glenoid, causing instability [7]. Treatment typically entails a combined procedure to address the soft tissue injury and bone defect. For large Hill-Sachs lesions, surgical options include nonanatomic techniques, such as the remplissage procedure [4], [8], or anatomic techniques. Purchase et al. [8] used an arthroscopic remplissage technique and had only a 7% chance of recurrent instability. Anatomic techniques include either matched humeral-head allograft or resurfacing arthroplasty with HemiCAP® (Arthroscopic, Franklin, MA, USA) [9]. Allograft transplantation for Hill-Sachs lesions has been described and yields good outcomes in most case reports [10]–[12].

### QUOTE

“Anatomic techniques include either matched humeral-head allograft or resurfacing arthroplasty with HemiCAP® (Arthroscopic, Franklin, MA, USA).”

### CONCLUSION

To date, we have performed approximately 20 HemiCAP implants, with no recurrent instability (unpublished data). This technique is a promising option for large humeral-head defects associated with shoulder instability, though long-term results remain to be determined.



Shoulder & Elbow > Shoulder > Clinical Science

2011

## **Hill-Sachs Injuries of the Shoulder**

### **When Are These Important and How Should I Manage Them?**

Provencher MT, Rose M, Peace W.

SLACK Incorporated

Book Chapter

<http://www.healio.com/books/orthopedics/%7B958b8724-8ce4-441f-9499-c0dc263e6260%7D/management-of-the-unstable-shoulder-arthroscopic-and-open-repair>

#### **SUMMARY**

Management of the Unstable Shoulder: Arthroscopic and Open Repair presents orthopedic surgeons, sports medicine specialists, therapists, and trainers with state-of-the-art treatment options, such as anatomic repair and precise rehabilitation techniques that will then enable them to provide athletes with the best chance of returning to their sport. The text is accompanied by an instructive video website to illustrate step-by-step techniques on performing arthroscopic and open repairs.

#### **QUOTE**

“HemiCAP, Arthrosurface, Franklin, MA provides an easy solution for the management of patients who do not desire allograft or other bone grafting options.”

#### **CONCLUSION**

In severe cases, allografts or limited resurfacing or arthroplasty should be considered.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## **Glenohumeral Arthritis in the Young Adult**

Provencher MT, Barker JU, Strauss EJ, Frank RM, Romeo AA, Matsen Iii FA, Cole BJ.

Instr Course Lect. 2011;60:137-53.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/21553769>

### **SUMMARY**

Treating glenohumeral arthritis in the young adult remains a significant challenge. There are a variety of etiologies that can lead to this condition, and the diagnosis is often not straightforward. With advances in both surgical techniques and biologic options, the treatment algorithm for patients with glenohumeral arthritis is constantly evolving. When nonsurgical treatment fails, there are a variety of possible surgical options, each with potential benefits. It is helpful to review the diagnostic challenges presented by these patients and understand the palliative, reparative, restorative, and reconstructive surgical options and their associated clinical outcomes, which provide a framework for clinical and surgical decision making.

### **QUOTE**

“An alternative to arthroplasty, the Arthrosurface HemiCAP ... can also be used as a treatment option for pain relief and restoration of function in the shoulder with both focal and diffuse chondral damage.”

### **CONCLUSION**

Young patients with symptomatic degenerative disease of the glenohumeral joint represent a challenge for the treating orthopaedic surgeon. Secondary to the variety of etiologies that can lead to glenohumeral arthritis in the young adult, a thorough understanding of the appropriate workup and initial management of the disease is vital. Palliative, reparative, restorative, and reconstructive surgical options are available, with variable indications and outcomes. The development of a workable treatment algorithm based on the individual patient's pathology and physical demands will help guide the surgeon in the decision-making process. Continued research with an emphasis on correlating new surgical techniques with clinical outcomes is ongoing in an effort to optimize the treatment of patients with symptomatic degenerative disease of the glenohumeral joint.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## Management of Glenohumeral Arthritis in the Young Adult

Denard PJ, Wirth MA, Orfaly RM.

J Bone Joint Surg Am. 2011 May 4;93(9):885-92. Review.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/21543679>

### SUMMARY

The majority of cases of glenohumeral arthritis in older adults are primary osteoarthritis and treatment algorithms are well defined, with shoulder arthroplasty providing reliable pain relief and functional improvement of satisfactory duration. In younger adults, however, diagnoses are more complex and arthroplasty outcomes are less durable. Arthroscopy may be useful both as a diagnostic tool for characterizing lesions and as a therapeutic tool for debridement. Arthroscopic debridement is most likely to benefit patients with mild glenohumeral arthritis, small lesions, and involvement of only one side of the glenohumeral joint. Reconstruction of the humeral joint surface may consist of cartilage repair or reconstruction, resurfacing arthroplasty, or arthroplasty with a stemmed component. Patients treated with hemiarthroplasty avoid glenoid implant loosening, but the procedure provides less predictable pain relief than does total shoulder arthroplasty and may lead to increased postoperative glenoid erosion.

### QUOTE

“Partial resurfacing involves coring a circular trough around an articular defect. An implant with a diameter equal to the core and a curvature matching that of the native humeral head is impacted into the defect.”

### CONCLUSION

Glenohumeral arthritis can be a major source of pain and disability. Adults over sixty years old often tolerate glenohumeral arthritis better than they do hip or knee arthritis, as individuals with lower functional demands can curtail shoulder function to limit activity-related pain. For those with sufficient symptoms, humeral hemiarthroplasty and total shoulder arthroplasty produce excellent and reliable functional improvements with modest concerns regarding longevity of the implant.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## **Posterior Shoulder Dislocation: Systematic Review and Treatment Algorithm**

Paul J., Buchmann S., Beitzel K., Solovyova O., Imhoff AB.

Arthroscopy. 2011 Nov;27(11):1562-72. Epub 2011 Sep 1.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/21889868>

### **SUMMARY**

#### **PURPOSE:**

Posterior shoulder dislocations (PSDs) comprise a small subset of shoulder dislocations, and there are few evidence-based treatment protocols and no actual algorithm for the treatment of PSDs available in the literature. This article provides a systematic review of the literature, as well as an overview of clinical and radiologic diagnostic techniques, and presents an algorithm for treatment of PSDs, including minimally invasive treatment options.

#### **METHODS:**

For a systematic review of current literature, a systematic search was performed in the Medline and Cochrane databases. Journal articles published between January 1940 and June 2010 were taken into account. Studies that only existed as abstracts were not included in the analysis. Broad exclusion criteria consisted of radiologic reports, review articles, case reports, and technical notes. Refined exclusion criteria consisted of a minimum of 4 patients with PSDs operated on by the same surgical technique and clinical outcome documented by a functional shoulder score.

#### **RESULTS:**

The final set of articles for evaluating closed or open techniques included 5 prospective case series and 6 retrospective studies. Within this group, there was no study with a level of evidence higher than Level IV. We present a descriptive comparison of these studies because of the heterogeneity and/or number of patients and the level of evidence. Case reports illustrate the different surgical approaches according to the literature.

#### **CONCLUSIONS:**

PSDs are still a challenge for the treating physician. There are few articles available about PSDs in evidence-based literature, with a limited number of cases. Our algorithm provides guidelines for decision making including minimally invasive treatment options according to the available literature.

## QUOTE

“New prosthetic designs with shaft-less humeral head replacement (e.g., HemiCAP) provide further options for prosthetic treatment especially in younger patients.”

## CONCLUSION

PSDs present a diagnostic challenge for the treating physician. There are few articles available in the evidence-based literature regarding this topic, and the number of cases is often limited. The size of the humeral head impression fracture is essential for decision making; the algorithm provides treatment guidelines according to the size of the lesion. Nonoperative treatment can provide satisfactory results for elderly patients with low demands or those with unstable fractures, but surgical treatment is recommended

to achieve good functional results in other patient populations. Different surgical approaches are explained, discussed, and illustrated with case reports. Orthopaedic surgeons are encouraged to conduct a thorough clinical and radiographic investigation when a PSD is suspected and to treat the injury according to the suggested algorithm.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## **Surface Arthroplasty for Treating Primary and/or Secondary Shoulder Osteoarthritis by Means of the HemiCAP-Arthrosurface® System**

Adalberto Visco, Luis Alfredo Gómez Vieira, Felipe Borges Gonçalves, Luis Filipe Daneu Fernandes, Murilo Cunha Rafael dos Santos, Nivaldo Souza Cardozo Filho, Nicolas Gerardo Gómez Cordero

Rev Bras Ortop. 2011;46(3):288-92

Peer Review Article

[http://www.scielo.br/pdf/rbort/v46n3/en\\_a10v46n3.pdf](http://www.scielo.br/pdf/rbort/v46n3/en_a10v46n3.pdf)

### **SUMMARY**

**Objective:** To present the surgical technique for the HemiCAP-Arthrosurface® system and evaluate our results from this technique for treating primary and/or secondary shoulder osteoarthritis. **Method:** Between June 2007 and June 2009, 10 shoulders of 10 patients (nine with primary osteoarthritis and one with avascular necrosis of the humeral head) underwent surface arthroplasty using the HemiCAP-Arthrosurface® system to correct the problem. The follow-up time ranged from six to 29 months (mean of 17 months). The patients' ages ranged from 62 to 73 years (mean of 67.5 years). Six patients were female and four patients were male. The patients were followed up weekly for the first month after the surgical procedure and every three months thereafter. The clinic evaluation was done using the criteria of the University of California at Los Angeles (UCLA) and a visual analogue pain scale. **Results:** All the patients said that they were satisfied with the results from the surgical treatment, with a mean UCLA score of 30 points and a mean analogue pain score of two points. **Conclusion:** The HemiCAP-Arthrosurface® system for shoulder surgery for a specific group of patients is a technique that preserves the bone stock with good functional and antalgic results.

### **QUOTE**

“As seen, we observed very good postoperative results among our patients.”

### **CONCLUSION**

Treatment of degenerative pathological conditions of the shoulder by means of the HemiCAP-Arthrosurface® system was shown to be a less aggressive surgical technique, with preservation of the bone stock. It was efficient in promoting pain relief, with correction of the lesion/deformity and recovery of the range of motion over a short space of time. With this technique, conversion to total arthroplasty of the shoulder is possible, with the major advantage that the bone stock is preserved. This is a procedure with lower morbidity. It is easy to apply after the technique has been mastered.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## Surface Replacement: The HemiCAP Solution

Lenarz C, Shishani Y, Gobezie R.

Semin Arthroplasty, 2011,22:10-13

Peer Review Article

[http://www.semarthroplasty.com/article/S1045-4527\(11\)00004-6/abstract](http://www.semarthroplasty.com/article/S1045-4527(11)00004-6/abstract)

### SUMMARY

Partial resurfacing of the humeral head with the Hemicap implant has recently become available. Previously, the use of resurfacing in the glenohumeral joint has been used for the treatment of osteoarthritis, cuff tear arthropathy, rheumatoid arthritis, and avascular necrosis. The technique has provided significant pain relief as well as improved function in all pathologies in the available short to midterm follow-up studies. The advent of the Hemicap implant provides the treating physician with an option of a more limited resurfacing for focal defects, such as those occurring with avascular necrosis and Hill-Sachs and reverse Hill Sachs lesions from instability.

### QUOTE

“The use of any resurfacing of the humeral articular surface provides the surgeon with the ability to maintain the anatomic neck as well as the proximal humeral bone stock.”

### CONCLUSION

The Hemicap prosthesis (Arthrosurface) is a new and novel device in the armamentarium of the treating surgeon. It has provided a technique for the management of focal articular lesions of the humeral head. This is particularly applicable in the treatment of humeral head defects associated with instability, avascular necrosis and degenerative changes in the face of proximal humeral deformity. Other advantages include optimization of the position of the humeral articular surface, decreased risk of intraoperative fracture, improved ease of revision if necessary and decreased risk of traumatic periprosthetic fracture with associated stress risers from an intramedullary stem.

Shoulder & Elbow > Shoulder > Clinical Science

2011

## **Use of a Partial Humeral Head Resurfacing System for Management of an Osseous Mechanical Block to Glenohumeral Joint Range of Movement Secondary to Proximal Humeral Fracture Malunion**

Eleftheriou K, Al-Hadithy N, Joshi V, Rossouw D.

Int J Shoulder Surg 2011;5:17-20

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/21660193>

### **SUMMARY**

Malunion of proximal humeral fractures can lead to a severely impaired shoulder function. Loss of motion is often the main issue in patients and can be secondary to osseous, soft-tissue as well as neurological damage to the shoulder. Malunion of the articular surface of the humeral head can lead to pain, chronic degenerative changes secondary to joint incongruity and mechanical block to the range of movement. A 46-year-old otherwise healthy male chef presented with malunion and collapse of his previous plate fixation for a four-part proximal humerus fracture. We describe the first documented case of the use of a focal resurfacing system for dealing with such an osseous mechanical block in the presence of an otherwise preserved articular surface in a high-demand patient. HemiCAP can be successfully used in proximal humeral fracture malunion where there is a localized cartilage defect, allowing restoration of joint congruity while preserving the bone stock.

### **QUOTE**

“The system provides instruments to map and prepare the focal damaged area to allow implantation of a cobalt–chrome and titanium implant that precisely aligns the contours of the articular surface and restores a smooth articular surface at the area of the defect using a range of implants of varying diameters and curvatures.”

### **CONCLUSION**

We therefore suggest another indication of the HemiCAP focal resurfacing (or similar) system that can provide a good solution in certain cases of proximal humeral fracture malunion, where there is a localized surface problem with an otherwise relatively preserved articular surface, allowing restoration of a smooth continuous surface while preserving bone stock.



Shoulder & Elbow > Shoulder > Clinical Science

2010

## Case Reports: Two Cases of Glenohumeral Chondrolysis After Intra-Articular Pain Pumps

Anakwenze OA, Hosalkar H, Huffman GR.

Clin Orthop Relat Res. 2010 Sep;468(9):2545-9. Epub 2010 Jan 29.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20112077>

### SUMMARY

Acute idiopathic chondrolysis in young adults is rare. The etiology often is unknown and outcomes can be devastating owing to rapid development of painful secondary osteoarthritis. There have been some recent reports of chondrolysis after arthroscopic shoulder procedures. Animal and laboratory data suggest chondrolysis is related to the use of intraarticular pain pumps, although there is no conclusive evidence that this is causative in patients.

**CASE DESCRIPTION:** We present two cases of young adults with chondrolysis of the humeral head after intraarticular pain pump use with humeral head resurfacing and biologic glenoid resurfacing.

**LITERATURE REVIEW:** Several authors report glenohumeral chondrolysis after shoulder arthroscopy involving the use of bupivacaine pain pumps. In addition, experimental animal studies have confirmed the presence of chondrolysis after bupivacaine infusion.

**PURPOSES AND CLINICAL RELEVANCE:** These cases provide additional evidence of an important association between postarthroscopic chondrolysis of the glenohumeral joint and the use of bupivacaine pain pumps.

### QUOTE

“At last followup, ... She had returned to competition in NCAA Division I gymnastics during her final year of college without difficulty.”

### CONCLUSION

Our cases add to the evidence of an association between pain pumps and glenohumeral chondrolysis. Additional research is necessary to understand why certain patients have chondrolysis develop and others do not. However, at this time, we do not encourage the use of pain pumps for shoulder cases.

Shoulder &amp; Elbow &gt; Shoulder &gt; Clinical Science

2010

## Endoprothetik nach Trauma

Kösters C, Schliemann B, Raschke M.

Springer, Trauma Berufskrankh 2010 · 12:47–52

Peer Review Article

<http://www.springerlink.com/content/g082663728758v9n/>

### SUMMARY

The indication for arthroplasty following trauma is generally established on the basis of the severity and type of the fracture, as well as on patient age. Thus, the initial situation in terms of surgery, as a result of these conditions alone, is significantly worse than in the case of primary endoprosthetic treatment of degenerative joint disease. Surgical planning also requires a more sensitive and usually more intensive diagnostic workup than for elective surgery, in addition to which arthroplasty following trauma is associated with a higher complication rate. For this reason, the present article examines the following questions: Is emergency endoprosthetic treatment following fracture justifiable? How should the procedure be explained to the patient? Does endoprosthetic treatment always represent “programmed surgery” and, if so, when is the optimal time for surgery? Does elective treatment even for simple medial femoral neck fractures count as a classic indication for endoprosthetic treatment following bone fracture? What are the particular surgical features of endoprosthetic fracture treatment and which surgeon can and should perform this type of surgery?

### QUOTE

“Anterior verhakete Humerus- kopfluxationsfraktur, Versorgung mittels Teiloberflächenersatz (HemiCAP®- Prothese), postoperatives Ergebnis im Verlauf, volle Elevation sowie Nacken- und Schürzengriff möglich”

### CONCLUSION

Die sorgfältige präoperative Planung und Diagnostik sowie die optimale Vorbereitung des Patienten auf den bevorstehenden Eingriff sollten nach initial notwendigen Maßnahmen wie externer Transfixation oder Immobilisation zur Weichteilkonsolidierung im Vordergrund stehen. Bestimmte Frakturmuster erfordern auch bei dem Versuch einer Rekonstruktion die Operation in Prothesenbereitschaft. Der Patient muss daher im Vorfeld über die Therapieoptionen und einen möglichen Verfahrenswechsel je nach intraoperativem Befund aufgeklärt werden. Die endgültige Wahl des Verfahrens sollte in Abhängigkeit von Begleitumständen wie Tageszeit, Zustand des Patienten und zur Verfügung stehendem Equipment erfolgen, um das bestmögliche Ergebnis zu erzielen.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## **Glenohumeral Joint Preservation: Current Options for Managing Articular Cartilage Lesions in Young, Active Patients**

Elser F, Braun S, Dewing CB, Millett PJ.

Arthroscopy. 2010 May;26(5):685-96. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20434669>

### **SUMMARY**

This is a review of joint-preservation techniques for the shoulder. Whereas the management of diffuse articular cartilage loss in the glenohumeral joints of elderly and less active patients by total shoulder arthroplasty is well accepted, significant controversy persists in selecting and refining successful operative techniques to repair symptomatic glenohumeral cartilage lesions in the shoulders of young, active patients. The principal causes of focal and diffuse articular cartilage damage in the glenohumeral joint, including previous surgery, trauma, acute or recurrent dislocation, osteonecrosis, infection, chondrolysis, osteochondritis dissecans, inflammatory arthritides, rotator cuff arthropathy, and osteoarthritis, are discussed. Focal cartilage lesions of the glenohumeral joint are often difficult to diagnose and require a refined and focused physical examination as well as carefully selected imaging studies. This review offers a concise guide to surgical decision making and up-to-date summaries of the current techniques available to treat both focal chondral defects and more massive structural osteochondral defects.

### **QUOTE**

“Recently, new partial replacements and stem-less implants for shoulder arthroplasty have been developed that are particularly attractive for use in young patients. These implants preserve anatomy and leave open various options for subsequent revision surgery.”

### **CONCLUSION**

There is growing evidence to support the claim that the progression of chondral injury may be slowed if the time between injury and surgery is minimized in patients with traumatic, recurrent shoulder instability. Although the next decade is certain to bring exciting new technologies to bear on the treatment of focal and diffuse cartilage injury, successful intervention will still depend on the sensitive diagnostic skills and sound, principled decision making of the shoulder surgeon.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## Humeral Head Bone Defects: Remplissage, Allograft, and Arthroplasty

Armitage MS., Faber KJ., Drosdowech DS., Litchfield RB., Athwal GS.

Orthop Clin North Am. 2010 Jul;41(3):417-25.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20497816>

### SUMMARY

The Hill-Sachs lesion is a well-known entity that threatens recurrent instability, but the treatment options are multiple and the surgical indications remain undefined. The evidence for each operative technique is limited to retrospective reviews and small case series without controls. The decision of which technique to use resides with the surgeon. Older, osteopenic patients, especially those with underlying arthritis and large defects, should be managed with complete humeral resurfacing. Humeralplasty is best used in younger patients with good quality bone in an acute setting with small- to moderate-sized bone defects. Partial resurfacing and remplissage are best used with small to moderate lesions, and both require further study. Allograft humeral reconstruction is an established technique for patients with moderate to large defects, and is best applied to nonosteopenic bone. Surgeons must be able to recognize the presence of humeral bone loss via specialized radiographs or cross-sectional imaging and understand its implications. The techniques to manage humeral bone loss are evolving and further biomechanical and clinical studies are required to define the indications and treatment algorithms.

### QUOTE

“Partial resurfacing has not been widely reported as a solution for humeral head defects in shoulder instability. This technique uses a round caplike cobaltchrome articular component to fill the Hill-Sachs lesion and reestablish joint congruity, thus preventing defect engagement.”

### CONCLUSION

The Hill-Sachs lesion is a well-known entity that threatens recurrent instability, but the treatment options are multiple and the surgical indications remain undefined. The evidence for each operative technique is limited to retrospective reviews and small case series without controls. Therefore, the decision of which technique to use resides with the comfort level and expertise of the surgeon.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## Management of Glenohumeral Osteoarthritis in the Young Adult

Wallace A.

Shoulder & Elbow, Volume 2, Issue 1, pages 1–8, January 2010

Peer Review Article

<http://onlinelibrary.wiley.com/doi/10.1111/j.1758-5740.2009.00045.x/full>

### SUMMARY

The development of degenerative joint disease in the young active patient is an increasing and difficult problem. In this review, evidence for the role of nonoperative and operative treatment strategies is assessed with the objective of establishing guidelines for management, and identifying areas for future research. Glucosamine and chondroitin supplements, as well as steroid and hyaluronan injections are probably useful early in the disease. Arthroscopic debridement, capsular release, and microfracture are temporizing measures that can provide pain relief and defer more invasive surgery. Attempts to restore the cartilage surface with osteochondral autologous transplants or autologous chondrocyte implantation may be suitable as second-line therapy for focal defects, although resurfacing of more extensive lesions with biological membranes has proven more difficult. Because prosthetic arthroplasty is relatively contraindicated in young patients, particularly contact athletes, the search for an ideal solution remains elusive, and more clinical and basic science research is needed.

### QUOTE

“Partial prosthetic resurfacing has been proposed as an option for contained defects in the humeral head. The HemiCAP device is a dome-shaped implant available in diameters of 25mm to 40mm with either symmetric or asymmetric curvatures.”

### CONCLUSION

The problem of the degenerate glenohumeral joint in the young adult remains unsolved. For patients with mild symptoms in the early stages of the disease, activity modification, dietary supplements and intra-articular hyaluronan injections are simple and apparently safe options. When non-operative treatment modalities fail, arthroscopy offers an opportunity for staging, debridement and capsular release, which may provide short- to medium-term improvement with relatively low risk, especially in patients with ‘bipolar’ lesions affecting both surfaces.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## Reconstruction of Cartilage Defects in Military Personnel

Frank R, Provencher M.

Tech Orthop. 2010;25: 176–188

Peer Review Article

[http://journals.lww.com/techortho/Abstract/2010/12000/Reconstruction\\_of\\_Cartilage\\_Defects\\_in\\_Military.3.aspx](http://journals.lww.com/techortho/Abstract/2010/12000/Reconstruction_of_Cartilage_Defects_in_Military.3.aspx)

### SUMMARY

Glenohumeral arthritis remains a growing problem in the young, athletic population. This is especially prominent in the military population, as these individuals strenuously and often repetitively load the shoulder joint in ways not commonly encountered in the general population. Many etiologies of glenohumeral arthritis have been described, yet making the diagnosis and choosing among a variety of treatment options remains challenging. Especially important is recognizing lesions that are incidental in nature and distinguishing those from truly symptomatic cartilage defects. On account of continuous advances in both surgical techniques and biologic treatment options, the treatment algorithm is constantly evolving, and choosing appropriate nonoperative as well as surgical treatment options remains a challenge. As always, proper patient selection, regardless of the ultimate operative intervention, is of utmost importance. The purposes of this study are to review the diagnostic challenges presented by these patients, provide a comprehensive discussion of the available palliative, reparative, restorative, and reconstructive surgical options, and finally to discuss clinical outcomes associated with these options.

### QUOTE

“This is a 39-year-old male active duty Navy Chief SEAL with bipolar degenerative changes. He had a humeral head metal resurfacing with a dermal patch to the glenoid. By 7 months after the surgery, he was able to resume nearly full activities as a Navy SEAL. His pain had significantly diminished (from a 7 to a 1 on the Visual Analog pain scale), and remained on active duty.”

### CONCLUSION

The ultimate take-home point for practicing orthopedic surgeons who come across these difficult patients in daily practice is to evaluate each patient as a unique case, taking into account presentation, associated comorbidities that may be causing or contributing to symptoms, and most important patient goals and expectations after any potential operative intervention.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## **Recurrent Shoulder Instability Associated with Bony Defects: A Current Review**

Anakwenze O., Huffman R.

UPOJ Volume 20, 2009-2010,29-35

Peer Review Article

<http://upoj.org/archive/volume-20-spring-2010/>

### **SUMMARY**

The glenohumeral joint is one of great mobility facilitated through the complex interplay of soft tissue and osseous anatomy. Arthroscopic shoulder stabilization has become the standard of care in the surgical management of glenohumeral instability. However, the management of the unstable shoulder associated with a bony defect (glenoid, humeral or combined) can be challenging and preclude arthroscopic treatment. Adequate diagnosis of bony defects is paramount to successful treatment and entails a careful history, clinical exam, and specific radiographic imaging. In general, higher energy shoulder trauma leads to more significant glenoid and/or humeral head defects. In addition, the severity of these defects corresponds with the number and frequency of instability episodes. Non-operative methods of treatment are not sufficient for treating these cases. Although successful arthroscopic management of instability associated with osseous defects has been described, open reconstruction is often indicated.

### **QUOTE**

“HemiCAP resurfacing or traditional hemiarthroplasty is the treatment of choice if fresh allograft is not available or the joint shows signs of post instability arthropathy.”

### **CONCLUSION**

Surgical management using standard hemiarthroplasty with biologic glenoid augmentation using humeral head graft and resurfacing using Graft Jacket secured with suture anchors was effective at significantly improving patient reported pain and instability at up to 2-year follow-up. While we report a successful outcome, we recommend individualized patient care based on specific patient disease and surgeon experience.

Shoulder & Elbow > Shoulder > Clinical Science

2010

## Treatment of Glenohumeral Arthrosis

Boselli KJ., Ahmad CS., Levine WN.

Am J Sports Med. 2010 Dec;38(12):2558-72. Epub 2010 Jun 3. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20522828>

### SUMMARY

The successful diagnosis and treatment of glenohumeral arthrosis in the young and active patient can be challenging to even the most experienced of clinicians. A thorough preoperative evaluation, including a detailed understanding of patient expectations, facilitates the selection of a treatment strategy. Arthroscopy is the gold standard for detecting chondral injuries, and it is increasingly used as an effective first line of management. In patients who fail arthroscopic debridement and reparative techniques, further treatment should proceed with an algorithmic decision-making approach encompassing patient-based and disease-based factors. Restorative and reconstructive techniques may provide improvements in pain and functional outcome while delaying the need for total shoulder arthroplasty, although the longevity of these treatments has yet to be established in the literature. Hemiarthroplasty and total shoulder arthroplasty have historically proven to be the most durable and reliable options in properly selected patients. However, concerns about progressive glenoid erosion and glenoid component loosening have led many to pursue alternative nonarthroplasty techniques for the management of arthrosis in active young individuals.

### QUOTE

“Focal humeral resurfacing is an even newer technique designed for the treatment of small or asymmetric unipolar chondral defects. The humeral implant can address lesions of various sizes by matching its shape and size to the articular surface.”

### CONCLUSION

Arthroscopy remains the gold standard for diagnosis of chondral damage, and it may have a therapeutic value for palliative debridement. The selection of additional treatment strategies depends on both patient-based and disease-based factors. Reparative, restorative, and reconstructive techniques may provide improvements in pain and functional outcome, although their longevity has not yet been well established.



Shoulder & Elbow > Shoulder > Clinical Science

2009

## **Case Series: Combined Large Hill-Sachs and Bony Bankart Lesions Treated by Latarjet and Partial Humeral Head Resurfacing: A Report of 2 Cases**

Grondin P, Leith J.

Can J Surg. 2009 Jun;52(3):249-54.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19503672>

### **SUMMARY**

We present the cases of 2 patients whose shoulders required interventions for both the humeral head and the glenoid to remain stable. We reconstructed the glenoid using a Latarjet procedure, and we treated the Hill–Sachs lesion with focal arthroplasty using the HemiCAP implant (Arthrosurface), a novel approach to the problem.

### **QUOTE**

“At 1 year follow-up, neither patient had experienced a recurrence. Advantages of using the HemiCAP implant over autogenous bone grafting include the absence of donor site morbidity and disease transmission associated with allografts, possibly, a more accurate contouring and a shorter operative time. The implant is more readily available than allografts and avoids problems associated with graft resorption and hardware prominence.”

### **CONCLUSION**

It is worth noting, however, that most patients with bony deficits on both the humeral head and the glenoid can suitably be treated by reconstructing only one of the deficits, but occasionally both defects may require intervention. To date, there are no validated preoperative guidelines for when both procedures are required; intraoperative assessment remains our best tool. When CT scans show that both the humeral head and the glenoid have more than 30% surface loss, the treating physician should be prepared to deal with both problems if instability persists intraoperatively despite fixing one defect.

Shoulder & Elbow > Shoulder > Clinical Science

2009

## Osteonecrosis of the Humeral Head

Harreld KL, Marker DR, Wiesler ER, Shafiq B, Mont MA.

J Am Acad Orthop Surg 2009 17: 345-355.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19474444>

### SUMMARY

Osteonecrosis of the humeral head is considerably less common than osteonecrosis of the hip. However, as in the hip, the interaction between a genetic predisposition and certain risk factors may lead to increased intraosseous pressure, loss of circulation, and eventual bone death. The most common risk factor remains corticosteroid use, which accounts for most reported cases. Radiographic staging and measurement of lesion size are predictive of disease progression and can be used to determine appropriate intervention. Recent studies have reported the use of various treatment modalities such as pharmacologics, core decompression with small-diameter drilling, arthroscopic-assisted core decompression, and bone grafting. Prospective, randomized studies are needed to determine the efficacy of these joint-preserving procedures. Newer resurfacing techniques have a role in treating articular surface loss. Hemiarthroplasty and total shoulder arthroplasty are recommended for patients with end-stage disease.

### QUOTE

“Subtotal resurfacing is done in an attempt to resurface focal chondral defects, as opposed to the entire humeral head. In the setting of a limited chondral defect, this technique has the advantage of preserving the surrounding intact, healthy cartilage.”

### CONCLUSION

The pathogenesis, associated risk factors, and diagnosis of osteonecrosis of the humeral head are not fully understood. The stage of disease is one of the most important factors for determining management. An algorithm may be useful in guiding management. Asymptomatic lesions do not require treatment. Symptomatic lesions are treated with core decompression unless they have other associated joint pathology or mechanical symptoms, and arthroscopy can be used as an adjunct. When these procedures fail, humeral head resurfacing or shoulder arthroplasty (hemiarthroplasty or total) can be performed.

Shoulder & Elbow > Shoulder > Clinical Science

2009

## **Partial Humeral Head Resurfacing and Latarjet Coracoid Transfer for Treatment of Recurrent Anterior Glenohumeral Instability**

Moros C, Ahmad CS.

Orthopedics. 2009 Aug;32(8).

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19708626>

### **SUMMARY**

Bone deficiencies of either the humeral head or glenoid fossa may cause recurrent shoulder instability following soft tissue stabilization procedures. The engaging Hill-Sachs lesion, a major risk factor for instability, has been identified in a majority of patients with recurrent anterior instability. Guidance for surgical management of large humeral head deficiency presents few available options, with even fewer clinical data to support any one technique. Anteroinferior glenoid deficiency has also been a well-documented source of recurrent instability. The Latarjet coracoid transfer procedure corrects the glenoid defect by restoring the architecture of the inferior rim. Although coracoid transfer addresses containment on the glenoid, a concomitant large humeral head defect is at risk for engagement on the corrected glenoid. This article describes a case of a 50-year-old man presenting with recurrent right shoulder dislocations status post-open stabilization procedure 10 years prior. Radiologic evaluation demonstrated a large Hill-Sachs lesion with adjacent chondral derangement and a nonunion bony Bankart lesion. The Arthrosurface HemiCap humeral head resurfacing prosthesis (Arthrosurface Inc, Franklin, Massachusetts) was used to address the Hill-Sachs lesion with a Latarjet coracoid transfer procedure. We were unable to identify examples in the literature of the HemiCap used in the correction of a Hill-Sachs lesion for recurrent anterior instability. The HemiCap prosthesis has the benefit of correcting the Hill-Sachs lesion and adjacent chondral defect while preserving uninvolved articular surface. The combination of surgical interventions produced a successful result.

### **QUOTE**

“The HemiCAP prosthesis has the benefit of correcting the Hill-Sachs lesion and adjacent chondral defect while preserving uninvolved articular surface. The combination of surgical interventions produced a successful result.”

### **CONCLUSION**

The depth of the wedged Hill-Sachs lesion must be taken into consideration when resurfacing, as the device relies on good bony fixation of the tapered post screw, which may prove difficult when dealing with deep lesions.

Shoulder & Elbow > Shoulder > Clinical Science

2009

## Partial Humeral Head Resurfacing for Osteonecrosis

Uribe JW, Botto-van Bemden A.

J Shoulder Elbow Surg. 2009 Sep-Oct;18(5):711-6. Epub 2009 Jan 30.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19186078>

### SUMMARY

The purpose of this study is to present our experience treating patients in the advanced stages of osteonecrosis of the humeral head with partial resurfacing of the humeral head. **METHODS:** This is a prospective series of 12 shoulders in 11 patients diagnosed with osteonecrosis of the humeral head who underwent partial humeral head resurfacing. Their mean age was 56 years. Preoperative and postoperative standardized evaluations included history, physical examination, radiographs, and clinical scoring systems, including the Western Ontario Osteoarthritis of the Shoulder index, Shoulder Score Index derived from the American Shoulder and Elbow Surgeons evaluation form, Constant score, and score on the visual analog scale for pain. The mean follow-up was 30 months. **RESULTS:** Postoperatively, all patients reported significant pain relief. Scores on the visual analog scale for pain improved from 75 preoperatively to 16 postoperatively ( $P < .001$ ). Physical examination showed significant improvements in functional outcomes as well. Forward elevation improved from a mean of 94 degrees preoperatively to 142 degrees postoperatively ( $P < .001$ ). Good to excellent results were also observed for the Western Ontario Osteoarthritis of the Shoulder index, Shoulder Score Index, and Constant score. **CONCLUSIONS:** This prospective series on partial resurfacing of the humeral head for patients with advanced-stage osteonecrosis has shown it to be effective in relieving pain and restoring function.

### QUOTE

“As the outcome scores in this study show, restoring the congruity of the humeral head without altering the softtissue tension, joint volume, joint height, version, or inclination angle allows improved mobility and function.”

### CONCLUSION

This prospective series on partial resurfacing of the humeral head for patients with advanced-stage osteonecrosis has shown it to be effective in relieving pain and restoring function. Although there were no complications in this series, longer follow-up is required to evaluate the survivorship of the implant and its effect on the glenoid.

Shoulder & Elbow > Shoulder > Clinical Science

2009

## Postsurgical Glenohumeral Arthritis in Young Adults

McNickle AG., L'Heureux DR., Provencher MT., Romeo AA., Cole BJ.

Am J Sports Med. 2009 Sep;37(9):1784-91

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19509416>

### SUMMARY

Chondrolysis has been reported as a sequela of arthroscopic shoulder surgery. Although the causes have yet to be fully elucidated, basic science and clinical evidence suggest a multifactorial origin. Surgical treatment in young patients with glenohumeral chondrolysis is particularly challenging, with little outcome data. **HYPOTHESIS:** Glenohumeral chondrolysis has several causes and patterns of presentation. Biological resurfacing is a viable treatment option for symptomatic glenohumeral arthritis. **METHODS:** Twenty patients (mean age, 19.7 years; range, 13.1-33.8) were referred for management of extensive glenohumeral arthritis after arthroscopy glenohumeral surgery (mean time postoperatively, 26 months; range, 3-73). Sixteen patients had an intra-articular pain pump placed for 2 to 3 days; 2 patients demonstrated prominent implants; and 2 had thermal treatment. Patients underwent revision surgery, including 7 biological resurfacings of the glenoid and humeral head, 4 biological resurfacings of the humeral head alone, and 7 other procedures. Eight patients having biological resurfacing were assessed just before the revision surgery, at a mean time of 3.1 years after revision (range, 1.9-6.5), with the American Shoulder and Elbow Surgeon scale and Simple Shoulder Test, Short Form 12 (physical and mental components), and visual analog scale score for pain. **RESULTS:** Patient outcomes scores improved from 51 to 71 (American Shoulder and Elbow Surgeon scale,  $P < .01$ ), 7 to 10 (Simple Shoulder Test,  $P < .02$ ), and 5 to 3 (visual analog scale,  $P < .01$ ). Preoperative range of motion demonstrated modest improvements from 119 degrees to 132 degrees of flexion, 42 degrees to 41 degrees of external rotation, and internal rotation from L2 to T12 level. Two patients required an additional surgery: 1 total shoulder arthroplasty and 1 capsular release with debridement. **CONCLUSION:** Severe glenohumeral arthritis is a devastating postoperative complication of glenohumeral arthroscopy. Although not a universal finding, the use of glenohumeral pain pumps is a concern, as well as suboptimal anchor placement. Biological resurfacing permits modest functional improvement in a challenging shoulder condition.

### QUOTE

"Partial metal resurfacing of the humeral head with a HemiCAP ... and dermal graft to the glenoid ... was performed in 2 patients, as previously described."

### CONCLUSION

More important, this salvage procedure replicates glenohumeral architecture without eliminating the possibility of future arthroplasty. Given the recent implementation of this technique, the long-term outcomes and durability have yet to be elucidated, and additional studies are needed to delineate efficacy of surgical treatment in this challenging cohort of patients.

Shoulder & Elbow > Shoulder > Clinical Science

2009

## Shoulder Resurfacing

Burgess DL, McGrath MS, Bonutti PM, Marker DR, Delanois RE, Mont MA.

J Bone Joint Surg Am. 2009 May;91(5):1228-38.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19411474>

### SUMMARY

Resurfacing is a type of shoulder arthroplasty that involves replacing the humeral joint surface with a metal covering, or cap, thus preserving the bone of the proximal part of the humerus. If the glenoid is also replaced, a current conventional polyethylene glenoid replacement prosthesis or an interposed soft-tissue graft is used. The potential advantages of humeral resurfacing, as compared with conventional shoulder arthroplasty, are: (1) no osteotomy is performed (and thus the head-shaft angle does not have to be addressed); (2) minimal bone resection; (3) a short operative time; (4) a low prevalence of humeral periprosthetic fractures; and (5) ease of revision to a conventional total shoulder replacement, if needed. Outcomes of surface replacement arthroplasty have been comparable with those of arthroplasties with a stemmed prosthesis in numerous short and mid-term follow-up studies. Future studies are required to assess the long-term outcomes of humeral resurfacing and to evaluate alternative surface bearing materials, especially on the glenoid side. Resurfacing appears to be a viable option for shoulder replacement, especially in young patients.

### QUOTE

“This may be useful for the treatment of asymmetric chondral defects of various sizes. The key feature is that the component can be matched by size and shape to the articular surface for partial resurfacing to address lesions of various sizes.”

### CONCLUSION

In conclusion, the success rates of shoulder surface replacement arthroplasty are comparable with, or superior to, those associated with stemmed prostheses at the time of short and mid-term follow-up. Modern designs that include a hydroxyapatite coating may help to reduce the prevalence of radiolucent lines and prosthetic loosening, but additional studies to further assess the rate of this complication at the time of long-term follow-up are needed. In addition, future studies are necessary to evaluate alternative surface bearing materials, especially on the glenoid side, and to determine the long-term success rates.

Shoulder & Elbow > Shoulder > Clinical Science

2008

## Biological Resurfacing of the Humerus in the Athlete

Stanley R, Bradley E.

Oper Tech Sports Med 2008, 16:21-25

Peer Review Article

[http://www.optechsportsmed.com/article/S1060-1872\(08\)00025-7/abstract](http://www.optechsportsmed.com/article/S1060-1872(08)00025-7/abstract)

### SUMMARY

Biological resurfacing of the humeral head may be needed in treating young athletes with cartilage defects associated with osteochondritis dissecans, posttraumatic cartilage injuries, postsurgical defects, avascular necrosis, and idiopathic cartilage defects. Patients must first undergo an extensive trial of nonoperative treatment and arthroscopic debridement before considering biologic resurfacing. Biologic resurfacing can be performed with autologous chondrocyte repair, osteochondral allograft, or osteochondral autograft. A size-matched osteochondral allograft lacks the donor-site morbidity associated with autograft techniques. Adequate preoperative imaging is critical to obtaining an appropriate allograft. Although arthroscopic treatment is often successful, biologic resurfacing of the humeral head with a size-matched osteochondral allograft is indicated in the rare cases in which symptoms persist. Prosthetic replacement is preferable in older patients or those with nonlocalized disease.

### QUOTE

“If patients remain symptomatic 6 months after arthroscopic treatment, partial-surface replacement is an alternative.”

### CONCLUSION

In patients older than 30 years, a prosthetic replacement with a metallic device (HemiCAP) is used.

Shoulder & Elbow > Shoulder > Clinical Science

2008

## Bony Instability of the Shoulder

Bushnell BD., Creighton RA., Herring MM.

Arthroscopy. 2008 Sep;24(9):1061-73. Epub 2008 Jun 30. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/18760215>

### SUMMARY

Instability of the shoulder is a common problem treated by many orthopaedists. Instability can result from baseline intrinsic ligamentous laxity or a traumatic event—often a dislocation that injures the stabilizing structures of the glenohumeral joint. Many cases involve soft-tissue injury only and can be treated successfully with repair of the labrum and ligamentous tissues. Both open and arthroscopic approaches have been well described, with recent studies of arthroscopic soft-tissue techniques reporting results equal to those of the more traditional open techniques. Over the last decade, attention has focused on the concept of instability of the shoulder mediated by bony pathology such as a large bony Bankart lesion or an engaging Hill-Sachs lesion. Recent literature has identified unrecognized large bony lesions as a primary cause of failure of arthroscopic reconstruction for instability, a major cause of recurrent instability, and a difficult diagnosis to make. Thus, although such bony lesions may be relatively rare compared with soft-tissue pathology, they constitute a critically important entity in the management of shoulder instability. Smaller bony lesions may be amenable to arthroscopic treatment, but larger lesions often require open surgery to prevent recurrent instability. This article reviews recent developments in the diagnosis and treatment of bony instability.

### QUOTE

“Prosthetic resurfacing arthroplasty has also gained popularity recently as a means of addressing large Hill-Sachs lesions and other focal deficits of the humeral head.”

### CONCLUSION

In conclusion, most cases of instability of the shoulder usually do not involve a significant osseous lesion. When a contributory bony lesion is involved, however, it can be easily missed and result in failure of attempted surgical repair—usually because the surgeon has unknowingly addressed a bony problem with a soft-tissue solution.



Shoulder & Elbow > Shoulder > Clinical Science

2008

## **Resurfacing Arthroplasty of the Humerus: Indications, Surgical Technique, and Clinical Results**

Scalise J, Miniaci A, Iannotti JP.

Current Orthopaedic Practice 19(4): 443-450,2008

Peer Review Article

[http://journals.lww.com/c-orthopaedicpractice/Abstract/2008/08000/Resurfacing\\_arthroplasty\\_of\\_the\\_humerus\\_.18.aspx](http://journals.lww.com/c-orthopaedicpractice/Abstract/2008/08000/Resurfacing_arthroplasty_of_the_humerus_.18.aspx)

### **SUMMARY**

Resurfacing arthroplasty of the shoulder is not a new concept in orthopedic surgery. Although only a few reports describe the indications, technique, and results, experience with these devices continues to grow. A specific advantage of resurfacing arthroplasty, the concept of a bone-preserving procedure, may prove to be particularly important in younger patients who require prosthetic arthroplasty surgery. The indications and surgical technique are illustrated in this review. Our early clinical results with 2 humeral resurfacing prostheses reflect those of other published reports; namely, favorable clinical outcomes can be expected.

### **QUOTE**

“Although the overall clinical follow-up is short in this group, no evidence of implant interface radiolucencies, osteolysis, or loss of fixation has been observed.”

### **CONCLUSION**

The results available for resurfacing arthroplasty of the humerus indicate that favorable clinical outcomes can be expected. The purported advantages of a humeral resurfacing design over a traditional stemmed humeral component include preservation of humeral bone stock and avoidance of stem-related complications (eg, peri-prosthetic fractures). Newer resurfacing designs offer the potential advantage of selectively targeting the region of the diseased articular cartilage while preserving areas that are yet unaffected. Furthermore, anatomical reconstruction provided by novel aspherical designs results in less glenohumeral joint stresses with the potential of better function. Long-term clinical outcomes are still needed, however.

Shoulder & Elbow > Shoulder > Clinical Science

2008

## Revision Arthroscopic Capsulolabral Reconstruction for Recurrent Instability of the Shoulder

Patel RV, Apostle K, Leith JM, Regan WD.

J Bone Joint Surg Br. 2008 Nov;90(11):1462-7.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/18978266>

### SUMMARY

We have investigated the outcome of arthroscopic revision surgery for recurrent instability of the shoulder after failed primary anterior stabilisation. We identified 40 patients with failed primary open or arthroscopic anterior stabilisation of the shoulder who had been treated by revision arthroscopic capsulolabral reconstruction and followed up for a mean of 36 months (12 to 87). There were 34 men and six women with a mean age of 33.1 years (15 to 48). Details of the patients, the technique of the primary procedure, the operative findings at revision and the clinical outcome were evaluated by reviewing the medical records, physical examination and the use of the Western Ontario shoulder instability index score, the American Shoulder and Elbow Surgeons score and the health status questionnaire 12. Recurrent instability persisted in four patients after the revision arthroscopic procedure. At the final follow-up, the mean American Shoulder and Elbow Surgeons score was 81.1 (17.5 to 99.5) and the mean Western Ontario shoulder instability index score was 68.2 (20 to 98.2). Quality-of-life scoring showed good to excellent results in most patients. Arthroscopic revision capsulolabral reconstruction can provide a satisfactory outcome in selected patients for recurrent instability of the shoulder provided that no large Hill-Sachs lesion is present.

### QUOTE

“An open re-revision with a Bankart repair and a HemiCAP implant was used to treat a large engaging Hill-Sachs lesion.”

### CONCLUSION

We have shown that in carefully selected patients this procedure can provide stability in most and give results comparable with those of primary arthroscopic and open stabilisation procedures. Arthroscopic revision for recurrent instability of the shoulder should be considered as a reliable option for such patients except in the presence of considerable defects of the glenohumeral bone.

Shoulder & Elbow > Shoulder > Clinical Science

2008

## **The Management of Localized Articular Cartilage Lesions of the Humeral Head in the Athlete**

Dawson CK., Rolf RH., Holovacs T.

Oper Tech Sports Med 2008 16:14-20.

Peer Review Article

[http://www.optechsportsmed.com/article/S1060-1872\(08\)00024-5/abstract](http://www.optechsportsmed.com/article/S1060-1872(08)00024-5/abstract)

### **SUMMARY**

Localized articular cartilage lesions of the humeral head can be a source of persistent pain and functional decline in patients who have failed conservative treatment measures. Many are younger, active patients who pose a challenging management decision for surgeons. The goals of treatment should focus on maintaining humeral bone stock, restoring the contour of the articular surface, minimizing soft-tissue disruption, and relieving symptoms. There has been a trend toward humeral resurfacing arthroplasty and away from stemmed components over the past few decades for younger patients potentially requiring future revision surgery. More recently, the HemiCAP resurfacing system (Arthrosurface, Franklin, MA) has been used for localized defects in patients with Hill-Sachs and reverse Hill-Sachs lesions, avascular necrosis, focal chondral defects, and humeral head osteoarthritis. Early, short-term outcome results of the HemiCAP system are encouraging. In this article, we describe our technique for management of localized articular cartilage defects of the humeral head using the HemiCAP resurfacing system.

### **QUOTE**

“In our practice, we have found the HemiCAP system to be beneficial in maintaining humeral bone stock while restoring the anatomic articular surface and contouring the prosthesis to the adjacent healthy cartilage.”

### **CONCLUSION**

In young active patients, we find that localized articular cartilage lesions of the humeral head can be treated successfully with limited resurfacing using the HemiCAP system. Maintaining bone stock, restoring the articular surface geometry, and minimizing soft-tissue disruption allow for future revision procedures if needed in this population. Overall, the short-term results of the HemiCAP resurfacing technique are encouraging, and further investigation is needed to determine long-term outcomes.

Shoulder & Elbow > Shoulder > Clinical Science

2007

## **Allografts in the Treatment of Athletic Injuries of the Shoulder**

Ho J, Miller S.

Sports Med Arthrosc Rev 2007;15:149–157

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/17700375>

### **SUMMARY**

As allogeneic musculoskeletal tissue is readily available, has minimal limitation in size or shape, and carries no donor site morbidity, it has become attractive for use in reconstructive shoulder surgery. Allograft is a viable option for treating osseous defects associated with glenohumeral instability and has been shown to achieve a stable shoulder with good clinical outcomes. Although there are mixed results on the use of allograft as rotator cuff augments or substitutes, new commercially processed materials such as GraftJacket are being tested to address the high failure rates associated with massive rotator cuff repair. Interposition arthroplasty as a treatment for glenohumeral arthritis in the young and active patient is a novel concept in which the arthritic glenoid is biologically resurfaced. Satisfactory results have been described using lateral meniscus and Achilles tendon allograft. Despite the promising reports on the use of allograft in reconstructive shoulder surgery, most of the published literature exists as retrospective, case reports. Additional large, controlled research is needed to prove the efficacy and safety of allograft tissue in the treatment of athletic injuries of the shoulder.

### **QUOTE**

“Resurfacing techniques have recently become available for the treating orthopedic surgeon. HemiCAP is a caplike implant made from cobalt chrome alloy. Theoretical advantages for its use are its maintenance of bone stock, ease of implantation, and rapid recovery time.”

### **CONCLUSION**

Despite the advantages of using allograft in reconstructive shoulder surgery, one must keep in mind that disease transmission and the potential for immune reaction do exist. Moreover, it must be emphasized that the majority of procedures involving allograft are still in the developmental stages. Further large scale, controlled studies are warranted to fully determine the efficacy and safety of allograft tissue in the treatment of athletic injuries of the shoulder.

Shoulder & Elbow > Shoulder > Clinical Science

2007

## **Resurfacing Arthroplasty of the Humerus: Indications, Surgical Technique, and Clinical Results**

Scalise J., Miniaci A., Iannotti JP.

Techniques in Shoulder and Elbow Surgery 8(3):152–160, 2007

Peer Review Article

[http://journals.lww.com/shoulderelbowsurgery/Abstract/2007/09000/Resurfacing\\_Arthroplasty\\_of\\_the\\_Humerus\\_.aspx](http://journals.lww.com/shoulderelbowsurgery/Abstract/2007/09000/Resurfacing_Arthroplasty_of_the_Humerus_.aspx)

### **SUMMARY**

Resurfacing arthroplasty of the shoulder is not a new concept in orthopedic surgery. Although only a few reports describe the indications, technique, and results, experience with these devices continues to grow. A specific advantage of resurfacing arthroplasty, the concept of a bone-preserving procedure, may prove to be particularly important in younger patients who require prosthetic arthroplasty surgery. The indications and surgical technique are illustrated in this review. Our early clinical results with 2 humeral resurfacing prostheses reflect those of other published reports; namely, favorable clinical outcomes can be expected.

### **QUOTE**

“As chondral lesions are located closer to the periphery, they are found to be in a zone that demonstrates less sphericity on the normal humeral head.”

### **CONCLUSION**

The role of glenoid soft tissue interposition arthroplasty with concomitant humeral prosthetic resurfacing has yet to be fully elucidated. Although early experience has demonstrated encouraging results, the durability of the interposed soft tissue has yet to be defined adequately. Nevertheless, in carefully selected patients, this option may prove to be useful when a traditional stemmed humeral component and prosthetic glenoid would necessitate reduction of glenohumeral bone stock. This is particularly germane in younger patients with severe glenohumeral arthritis needing arthroplasty in whom future revision arthroplasty may be required.

Shoulder & Elbow > Shoulder > Clinical Science

2006

## Shoulder Cartilage

Guanche C.

Practical Orthopaedic Sports Medicine and Arthroscopy, LWW, 2006

Book Chapter

<http://www.abebooks.com/Practical-Orthopaedic-Sports-Medicine-Arthroscopy-LWW/6424870367/bd>

### SUMMARY

Full thickness chondral defects and osteochondral defects of the shoulder can cause numerous problems for the patient such as pain, swelling, locking, and may lead to early osteoarthritis. The goals of treatment are to alleviate pain and improve function as well as delay the need for prosthetic replacement of the joint. A variety of alternatives is available to treat these lesions; however, many limitations exist. There are several techniques that include simple debridement that clearly help in the short term, but do not change the natural course of the disease process. In most situations, the best that can be achieved with debridements and abrasions is a fibrocartilaginous covering of the articular surface with poor biomechanical characteristics.

### QUOTE

“The currently available device is a titanium coated shaft portion with an articular bearing surface of a cobalt-chrome alloy (Arthrosurface; Franklin, MA). The device is implanted in the central articular defect either in an open or arthroscopic fashion and recreates the circumference of the humerus.”

### CONCLUSION

The results of resurfacing the cartilage lesions, whether performed with biological tissues or synthetic materials, appear to be promising; however, there is very little large scale or long term data to support the routine use of any one technique over another. The symptomatology associated with the early arthritic shoulder can certainly be improved with the judicious use of the arthroscope; however, appropriate patient selection is critical in this regard as significant radiographic deformities certainly do not improve with this treatment modality.

Shoulder & Elbow > Shoulder > Clinical Science

2006

## Radiology of Shoulder Prostheses

Feldman F.

Semin Musculoskelet Radiol. 2006 Mar;10(1):5-21.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/16514577>

### SUMMARY

This article is chiefly limited to the routine radiographic evaluation of shoulder arthroplasties and guidelines to their interpretation. Other imaging modalities for the evaluation of joint replacements are discussed elsewhere in this issue. The basic types of shoulder reconstructions and some of the shoulder replacement designs in previous and current use at The New York Orthopedic Hospital at Columbia Presbyterian Medical Center are illustrated, along with the indications and contraindications of the various types of reconstructions. Their complications and pertinent anatomy are included.

### QUOTE

“Humeral head surface replacement.”

### CONCLUSION

Right Arthroscopic HemiCAP prosthesis for avascular necrosis in 31-year-old male.

Shoulder & Elbow > Shoulder > Clinical Science

2006

## Treatment of Chondral Defects in the Shoulder

Gomoll A, McCulloch P, Kang R, Cole B.

Oper Tech Orthop 2006, 16:232-243

Peer Review Article

[http://www.optechorthopaedics.com/article/S1048-6666\(06\)00075-9/abstract](http://www.optechorthopaedics.com/article/S1048-6666(06)00075-9/abstract)

### SUMMARY

No formal guidelines have yet been established for the treatment of glenohumeral cartilage defects. Especially in younger and more active patients, where arthroplasty is a less desirable option, treatment decisions continue to represent a challenge. More recently, a number of cartilage repair techniques that have been successfully applied in the knee joint have been used for the treatment of symptomatic chondral defects in the shoulder. This article will provide a concise overview of these techniques and their background, as well as provide the treating physician with a framework for the workup and treatment of such lesions.

### QUOTE

“Restore a smooth and congruent articular surface ... Prosthetic alternative to osteochondral auto- or allograft transfer.”

### CONCLUSION

The treatment of young and active individuals with recalcitrant shoulder pain due to traumatic or degenerative chondral lesions remains a significant challenge. Numerous techniques have been developed to address defects of various sizes, locations and etiologies. We have provided an overview of existing techniques, and attempted to present a framework to assist the surgeons in their decision-making process.



Shoulder & Elbow > Shoulder > Clinical Science

2005

## Articular Resurfacing of the Glenohumeral Joint

Lervick G.

Current Opin Orthop 2005, 16:252—257

Peer Review Article

[http://journals.lww.com/co-ortho/Abstract/2005/08000/Articular\\_resurfacing\\_of\\_the\\_glenohumeral\\_joint.10.aspx](http://journals.lww.com/co-ortho/Abstract/2005/08000/Articular_resurfacing_of_the_glenohumeral_joint.10.aspx)

### SUMMARY

Summary: The treatment of chondral defects and degenerative osteoarthritis of the glenohumeral joint continues to evolve. Magnetic resonance imaging and arthroscopy have improved the recognition and diagnosis of the problem. Evolving joint resurfacing techniques promise to provide pain relief, improved function, and potentially slow or prevent disease progression. Surgical treatments now include cartilage resurfacing techniques such as microfracture, osteochondral autografting or allografting, and autologous chondrocyte implantation. In addition, prosthetic resurfacing techniques involving either a portion or all of the humeral head may be used in more advanced disease. Finally, standard glenohumeral arthroplasty can be considered either alone, or in combination with soft tissue interposition. As the techniques evolve, further scientific study will be necessary to determine which method(s) provide optimal results in both the shortterm and longterm.

### QUOTE

“The design principle is to remove the irregular cartilage and exposed subchondral bone, and restore a smooth, congruent joint surface and potentially minimize further erosion of the humeral and glenoid chondral surfaces.”

### CONCLUSION

The treatment of chondral injuries and degenerative osteoarthritis of the glenohumeral joint in physiologically young patients continues to evolve. Many of the techniques described in this article have yet to be published in the peer reviewed literature. Therefore, broad statements regarding documented clinical efficacy cannot be made at the current time. Further experience and study will be required to determine the ideal indications for any given modality.

Shoulder & Elbow > Shoulder > Clinical Science

2005

## **Nonarthroplasty Treatment of Glenohumeral Cartilage Lesions**

McCarty LP 3rd, Cole BJ.

Arthroscopy. 2005 Sep;21(9):1131-42. Review.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/16171640>

### **SUMMARY**

Treatment of young, active persons with symptomatic cartilage lesions of the glenohumeral joint represents a significant challenge. Diagnosis of glenohumeral chondral defects is not always straightforward and effective treatment requires familiarity with a number of techniques. Low-demand individuals may accept palliative therapy in the form of arthroscopic debridement as a temporizing solution. However, younger, high-demand individuals require a careful, stepwise approach that includes reparative, restorative, and reconstructive strategies. Reparative strategies use marrow-stimulation techniques to induce formation of fibrocartilage. Restorative tactics attempt to replace damaged cartilage with hyaline or hyaline-like tissue using osteochondral or chondrocyte transplantation. Large lesions that are not candidates for reparative or restorative procedures can be approached using reconstruction methods such as biologic resurfacing. This review examines causes of chondral injury in the glenohumeral joint, discusses diagnostic strategies, and presents a practical framework including palliative, reparative, restorative, and reconstructive options with which one can formulate a treatment plan for these patients.

### **QUOTE**

“Specific solutions include focal prosthetic resurfacing (HemiCAP, Arthrosurface, Franklin, MA).”

### **CONCLUSION**

Successful treatment of glenohumeral cartilage injury entails a number of challenges. Identification of a chondral lesion as the source of a patient's complaints may be difficult. A detailed history and physical examination are necessary, but often not sufficient for this purpose, and imaging modalities such as MRI with specialized pulse sequences are typically required.

Shoulder & Elbow > Elbow > Clinical Science

2013

## Partial Distal Humeral Resurfacing of a Trochlear Defect After Elbow Fracture-Dislocation

Kuzel BR, Papandrea RF.

J Shoulder Elbow Surg. 2013 Feb;22(2):e7-11.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/23352480>

### SUMMARY

Although autograft and allograft reconstruction of trochlear defects have been mentioned as options for management of chronic instability, there have been no specific articles addressing their use. Below we describe the off-label use of an Arthrosurface HemiCap Toe Resurfacing implant (Arthrosurface, Franklin, MA, USA) for acute reconstruction of an irreparable trochlear defect in a patient with a variation of VPMRI (varus posteromedial rotatory instability).

### QUOTE

“The patient had returned to his job as a police officer without restrictions. X-rays revealed a healed coronoid fracture. The Arthrosurface implant (Arthrosurface) was in place without evidence of loosening.”

### CONCLUSION

Ultimately, the management goals in patients with acute VPMRI include creating a stable, congruent articulation, thereby minimizing risk for the development of elbow arthritis. Stability is obtained with fixation or neutralization of the coronoid fracture and repair or the LCL. Trochlear osteochondral defects may be seen in VPMRI due to impaction of the coronoid on the trochlea. This report suggests these injuries may be successfully treated with metal resurfacing implants when there is significant irreparable cartilage and bone loss. Metal resurfacing systems offer restoration of joint contour, provide immediate stability, and allow the reproduction of normal joint mechanics without requiring biological healing. Elbow specific implants are currently unavailable; and while they would provide clinical benefit, it is the opinion of the authors that the current FDA classification is hindering their development.

Shoulder & Elbow > Elbow > Clinical Science

2012

## **Secondary Procedures and Surgical Treatment of Distal Humeral Fractures**

Papandrea RF.

Springer, Reoperative Hand Surgery 2012 pp141-164.

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-1-4614-2373-7\\_10](http://link.springer.com/chapter/10.1007/978-1-4614-2373-7_10)

### **SUMMARY**

Every surgeon treating distal humeral fractures understands that perfection is usually an unobtainable goal. Sound surgical treatment with modern implants does usually render a functional and painless elbow, but complications do occur in properly treated distal humeral fractures. Fixation can fail, articular cartilage can be damaged beyond its ability to heal, and non-unions occur for mechanical and biological reasons. Understanding indications for revising distal humeral fracture treatment requires knowledge of extensile exposures to the elbow and current implant technology. Distal humeral articular surfaces that can not be reconstructed can now be partially or totally resurfaced, obviating the need for a salvage with a total elbow implant. Some distal humeral revisions are best treated with a linked total elbow implant. When considering revising a distal humeral fracture fixation, it is imperative to align patient and surgeon expectations and ensure both parties understand what potential complications can occur during any revision.

### **QUOTE**

“The HemiCap by Arthrosurface has some components that can be utilized for partial distal humerus replacement.”

### **CONCLUSION**

The articular device designed for the distal first metacarpal head is convex with varying geometries. This can be utilized to resurface focal defects on the capitellum. Likewise, the femoral component of the patellar-femoral device may be utilized to cover some isolated trochlear defects.

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# III. Knee

**Letia**

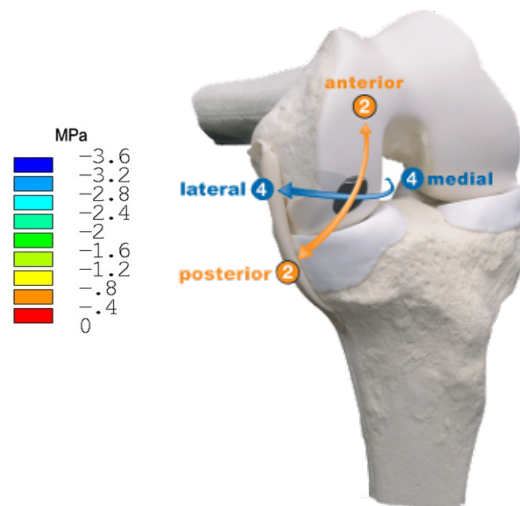
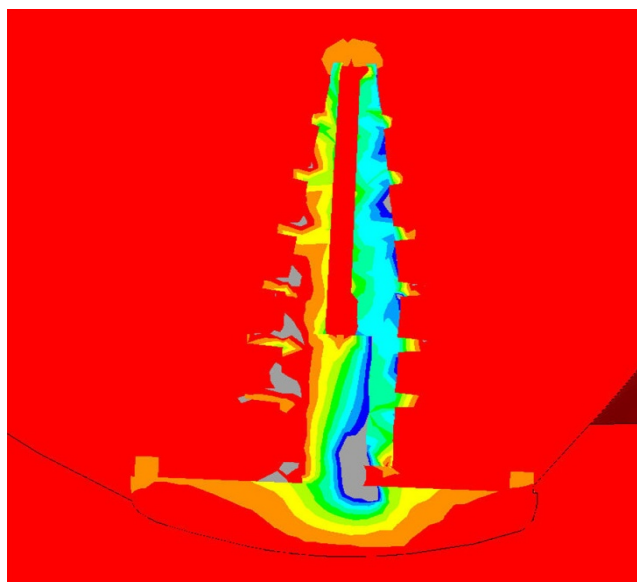
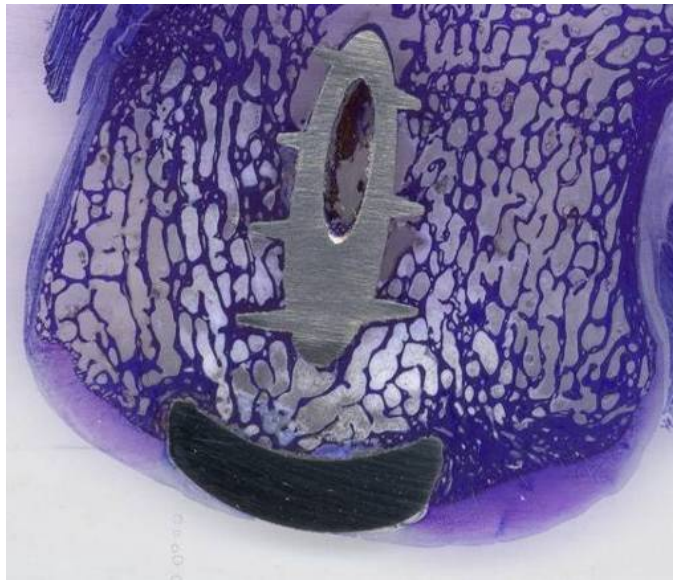
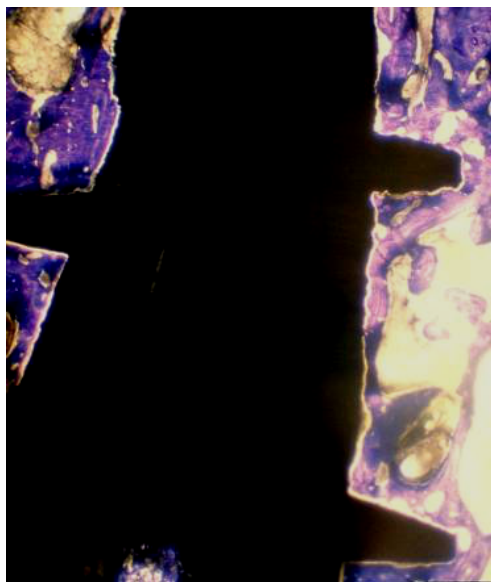
HemiCAP Knee Patient



# 1. Knee Publication Summaries

## Basic Science

Five publications reported on HemiCAP basic science studies investigating arthrosis of the tibiofemoral joint (4), and the use of patellofemoral inlay arthroplasty in the surface reconstruction of focal defects (1). All were supportive of the procedure. No deleterious effects were found on the opposing cartilage with integration into the surrounding bone and no significant increase in contact pressure was reported. One additional basic science report on competitive metallic resurfacing made a reference to the Arthrosurface concept.



Knee > Focal Condyle > Basic Science

2011

## Effects of a Surface Matching Articular Resurfacing Device on Tibiofemoral Contact Pressure: Results from Continuous Dynamic Flexion-Extension Cycles

Becher C, Huber R, Thermann H, Ezechieli L, Ostermeier S, Wellmann M, von Skrbensky G.

Arch Orthop Trauma Surg. 2011 Mar;131(3):413-9.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/20967546>

### SUMMARY

The application of a defect-size metal implant for the treatment of focal articular cartilage lesions of the femoral condyle is of potential concern resulting in cartilage damage to opposing biological structures. This in vitro study aims to determine the tibiofemoral contact pressure with a contoured articular partial femoral resurfacing device under continuous dynamic pressure loads. **METHODS:** Peak and area contact pressures were determined in eight fresh-frozen cadaveric specimens using a pressure-sensitive sensor placed in the medial compartment above the menisci. All knees were tested in the untreated condition and after implantation of the prosthetic device in the weight-bearing area of the medial femoral condyle. A robotic knee simulator was used to test each knee under continuous pressure load for 400 s during 40 dynamic knee bending cycles (5°-45° flexion) with body weight ground reaction force (GRF). The GRF was adjusted to the living body weight of the cadaver donor and maintained throughout all cycles. **RESULTS:** Comparison of the untreated condition to focal inlay resurfacing showed no statistically significant differences ( $P \leq 0.05$ ) between all testing conditions. The average maximum peak contact pressure across all 40 flexion cycles increased by 5.1% after resurfacing compared to the untreated knees. The average area contact pressure essentially stayed the same (+0.9%). **CONCLUSION:** The data suggest that resurfacing with the contoured articular prosthetic device does not pose any immediate deleterious effects to the opposing surfaces based on peak and area contact pressure in a continuous dynamic in vitro application. However, long-term in vivo effects remain to be evaluated.

### QUOTE

“The data suggest that resurfacing with the contoured articular prosthetic device does not pose immediate deleterious effects to the opposing surfaces based on peak and area contact pressure in an in vitro application.”

### CONCLUSION

It appears that an appropriately positioned surface matching implant suggests biomechanical safety and may not result in deleterious effects on surrounding biological structures in an in vivo application.

Knee > Focal Condyle > Basic Science

2011

## **Finite Element Simulations of a Focal Knee Resurfacing Implant Applied to Localized Cartilage Defects in a Sheep Model**

Manda K, Ryd L, Eriksson A.

J Biomech. 2011 Mar 15;44(5):794-801.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/21300358>

### **SUMMARY**

Articular resurfacing metal implants have recently been tested in animal models to treat full thickness localized articular cartilage defects, showing promising results. However, the mechanical behavior of cartilage surrounding the metal implant has not been studied yet as it is technically challenging to measure in vivo contact areas, pressures, stresses and deformations from the metal implant. Therefore, we implemented a detailed numerical finite element model by approximating one of the condyles of the sheep tibiofemoral joint and created a defect of specific size to accommodate the implant. Using this model, the mechanical behavior of the surrounding of metal implant was studied. The model showed that the metal implant plays a significant role in the force transmission. Two types of profiles were investigated for metal implant. An implant with a double-curved profile, i.e., a profile fully congruent with the articular surfaces in the knee, gives lower contact pressures and stresses at the rim of the defect than the implant with unicurved spherical profile. The implant should be placed at a certain distance into the cartilage to avoid damage to opposing biological surface. Too deep positions, however, lead to high shear stresses in the cartilage edges around the implant. Mechanical sealing was achieved with a wedge shape of the implant, also useful for biochemical sealing of cartilage edges at the defect.

### **QUOTE**

**“A defect-sized biocompatible metallic articular resurfacing implant can be used to treat localized cartilage defects in the joints, e.g. HemiCAP®.”**

### **CONCLUSION**

The study supports the idea of using a metal resurfacing implant for the treatment of full thickness cartilage defects. It emphasizes the need for an individualized implant geometry, and shows that there is an optimum position of a specific implant slightly below the flush placement. The larger the defect size, closer the implant should be to flush. Our simulations indicate that treating cartilage defects with metal implants is mechanically advantageous.

Knee > Focal Condyle > Basic Science

2009

## **Tibiofemoral Contact Mechanics With a Femoral Resurfacing Prosthesis and a Non-Functional Meniscus**

Becher C, Huber R, Thermann H, Tibesku CO, von Skrbensky G.

Clin Biomech (Bristol, Avon). 2009 Jun 25.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19560241>

### **SUMMARY**

Increased contact stress with a femoral resurfacing prosthesis implanted in the medial femoral condyle and a non-functional meniscus is of concern for potential deleterious effects on tibiofemoral contact mechanics. **METHODS:** Peak contact pressures were determined in seven fresh frozen human cadaveric specimens using a pressure sensitive sensor placed in the medial compartment above the menisci. A knee simulator was used to test each knee in static stance positions (5 degrees/15 degrees/30 degrees/45 degrees) and through 10 dynamic knee flexion cycles (5-45 degrees) with single body weight ground reaction force which was adjusted to the living body weight of the cadaver donor. All specimens were tested in three different conditions: untreated knee (A); flush implantation of a 20mm resurfacing prosthesis (HemiCAP) in the weight bearing area of the medial femoral condyle (B); complete radial tear at the posterior horn of the medial meniscus with the femoral resurfacing device in place (C). **FINDINGS:** On average, flush device implantation resulted in no statistically significant differences when compared to the untreated normal knee. The meniscal tear resulted in a significant increase of the mean maximum peak contact pressures by 63%, 57%, and 57% (all  $P < 0.05$ ) at 15 degrees, 30 degrees and 45 degrees static stance positions and 78% ( $P < 0.05$ ) through the dynamic knee flexion cycle. No significant different maximum peak contact pressures were observed at 5 degrees stance position. **INTERPRETATION:** Although the condition of a meniscal tear without the resurfacing device could not be compared, possible effects of reduced meniscal tissue and biomechanical integrity of the meniscus must be considered in an in vivo application.

### **QUOTE**

“Flush device implantation resulted in no statistically significant differences when compared to the untreated normal knee.”

### **CONCLUSION**

In conclusion, the data suggests that resurfacing with the prosthetic device alone with an intact meniscus does not lead to significant increase in tibiofemoral peak contact pressure. However, results confirm that a non-functional meniscus leads to a biomechanical disadvantage. Possible effects of reduced meniscal tissue and biomechanical integrity of the meniscus must be considered in an in vivo application.



Knee > Focal Condyle > Basic Science

2008

## Effects of a Contoured Articular Prosthetic Device on Tibiofemoral Peak Contact Pressure: A Biomechanical Study

Becher C, Huber R, Thermann H, Paessler HH, Skrbensky G.

Knee Surg Sports Traumatol Arthrosc. 2008 Jan;16(1):56-63.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/17934718>

### SUMMARY

Many middle-aged patients are affected by localized cartilage defects that are neither appropriate for primary, nor repeat biological repair methods, nor for conventional arthroplasty. This in vitro study aims to determine the peak contact pressure in the tibiofemoral joint with a partial femoral resurfacing device (HemiCAP, Arthrosurface Inc., Franklin, MA, USA). Peak contact pressure was determined in eight fresh-frozen cadaveric specimens using a Tekscan sensor placed in the medial compartment above the menisci. A closed loop robotic knee simulator was used to test each knee in static stance positions (5 degrees /15 degrees /30 degrees /45 degrees ) with body weight ground reaction force (GRF), 30 degrees flexion with twice the body weight (2tBW) GRF and dynamic knee-bending cycles with body weight GRF. The ground reaction force was adjusted to the living body weight of the cadaver donor and maintained throughout all cycles. Each specimen was tested under four different conditions: Untreated, flush HemiCAP implantation, 1-mm proud implantation and 20-mm defect. A paired sampled t test to compare means (significance,  $P < \text{or} = 0.05$ ) was used for statistical analysis. On average, no statistically significant differences were found in any testing condition comparing the normal knee with flush device implantation. With the 1-mm proud implant, statistically significant increase of peak contact pressures of 217% (5 degrees stance), 99% (dynamic knee bending) and 90% (30 degrees stance with 2tBW) compared to the untreated condition was seen. No significant increase of peak contact pressure was evaluated with the 20-mm defect. The data suggests that resurfacing with the HemiCAP does not lead to increased peak contact pressure with flush implantation. However, elevated implantation results in increased peak contact pressure and might be biomechanically disadvantageous in an in vivo application.

### QUOTE

“On average, comparison of the untreated normal knee with flush device implantation demonstrated neither statistically significant differences in peak contact pressure during the dynamic knee-bending cycle nor static testing (5 , 15 , 30 , 45 ) or two times body weight GRF at 30 static testing.”

### CONCLUSION

The data suggest that resurfacing with the HemiCAP with flush implantation does not lead to significantly increased peak contact pressure.

Knee > Focal Condyle > Basic Science

2006

## **Safety of, and Biological and Functional Response to, a Novel Metallic Implant for the Management of Focal Full-Thickness Cartilage Defects: Preliminary Assessment in an Animal Model Out to 1 Year**

Kirker-Head CA, Van Sickle DC, Ek SW, McCool JC.

J Orthop Res. 2006 May;24(5):1095-108.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/16609973>

### **SUMMARY**

Focal full-thickness cartilage lesions of the human medial femoral condyle (MFC) can cause pain and functional impairment. Affected middle-aged patients respond unpredictably to existing treatments and knee arthroplasty may be required, prompting risk of revision. This study assesses the safety of, and biological and functional response to, a metallic resurfacing implant which may delay or obviate the need for traditional arthroplasty. The anatomic contour of the surgically exposed MFC of six adult goats was digitally mapped and an 11 mm diameter full-thickness osteochondral defect was created. An anchor-based Co-Cr resurfacing implant, matching the mapped articular contour, was implanted. Each goat's contralateral unoperated femorotibial joint was used as a control. Postoperative outcome was assessed by lameness examination, radiography, arthroscopy, synoviocentesis, necropsy, and histology up to 26 (n = 3) or 52 (n = 3) weeks. By postoperative week (POW) 4, goats demonstrated normal range of motion, no joint effusion, and only mild lameness in the operated limb. By POW 26 the animals were sound with only occasional very mild lameness. Arthroscopy at POW 14 revealed moderate synovial inflammation and a chondral membrane extending centrally across the implant surface. Radiographs at POWs 14 to 52 implied implant stability in the operated joints, as well as subchondral bone remodeling and mild exostosis formation in the operated and contralateral unoperated joints of some goats. By POW 26, histology revealed new trabecular bone abutting the implant. At POWs 26 and 52 MFC cartilage was metachromatic and intact in the operated and unoperated femorotibial joints. Proximal tibiae of some operated and unoperated limbs demonstrated limited subchondral bone remodeling and foci of articular cartilage fibrillation and thinning. The chondral membrane crossing the prosthesis possessed a metachromatic matrix containing singular and clustered chondrocytes. Our data imply the safety, biocompatibility, and functionality of the implant. Focal articular damage was documented in the operated joints at POWs 26 and 52, but lesions were much reduced over those previously reported in untreated defects. Expanded animal or preclinical human studies are justified.

#### QUOTE

“The biocompatibility of the device was reflected in the way it became integrated into the MFC with new bone abutting both the anchor and resurfacing components ... no implant instability was apparent either radiographically, histologically, or on manual examination.”

#### CONCLUSION

In summary, while data interpretation had some limitations in this pilot study, we were able to derive useful preliminary data pertaining to the safety of the implant and the functional and biological response to its use. The potential value of the implant as a clinical management tool is implied. All six goats retained excellent range of motion in the operated joint and clinical outcomes were very good. Although focal articular changes were documented in operated joints, the pathology was much reduced over that encountered in previous caprine osteochondral defect studies.<sup>30–34</sup> Expanded preclinical or clinical human studies are justified.



Knee > Patellofemoral > Basic Science

2009

## **Patellofemoral Kinematics After Limited Resurfacing of the Trochlea**

Provencher M, Ghodadra N, Verma N, Cole BJ, Zaire S, Shewman E, Bach B.

J Knee Surg. 2009;22:310-316

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19902726>

### **SUMMARY**

Patellofemoral kinematics after a limited resurfacing of the trochlea was investigated. Patellofemoral contact pressure, area, and force were measured for intact state; after creation of a 20-mm full-thickness trochlear defect; and after trochlear resurfacing implant (Arthrosurface) in serial flexion positions (45 degrees, 60 degrees, 75 degrees). In the defect state, edge loading and peak contact forces were highest at the periphery. The chondral defect increased peak contact force (13 to 18 N,  $P < .01$ ) and peak contact pressure (23 to 31 kg/cm<sup>2</sup>,  $P < .02$ ) compared with the intact state. Peak contact pressure and force were restored to 90% ( $P < .01$ ) and 88% ( $P < .01$ ). Implantation of the device restored contact area to 85% of the intact state. Limited resurfacing of the trochlea restores contact area, peak pressure, and peak force to the intact state. These findings highlight the potential clinical use of limited patellofemoral resurfacing in trochlear chondral defects.

### **QUOTE**

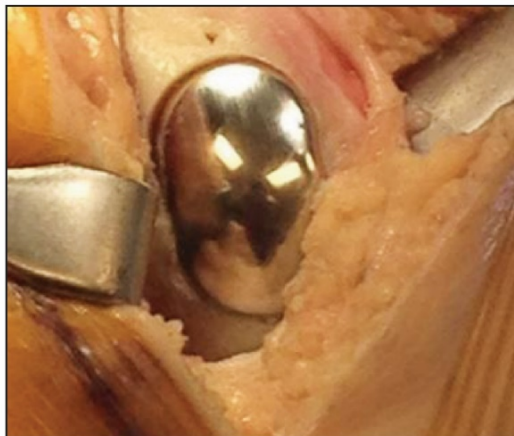
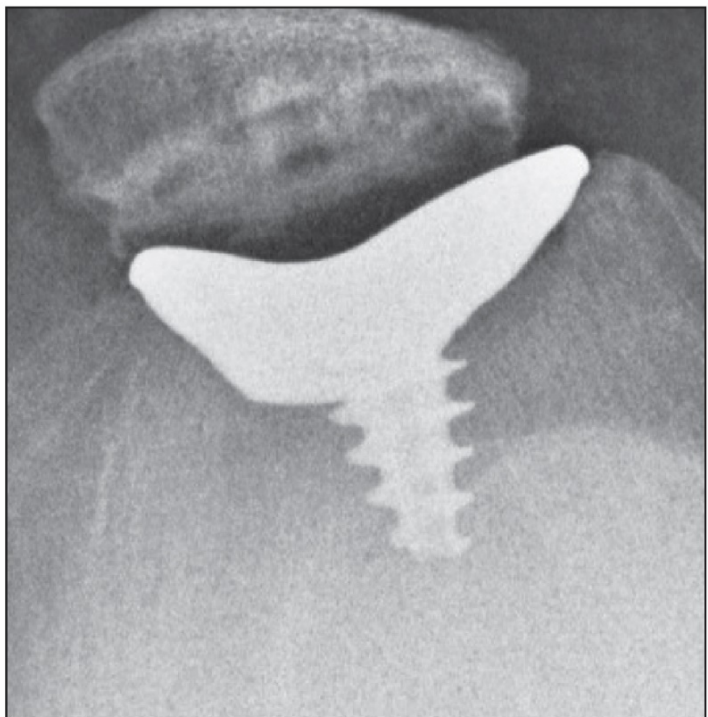
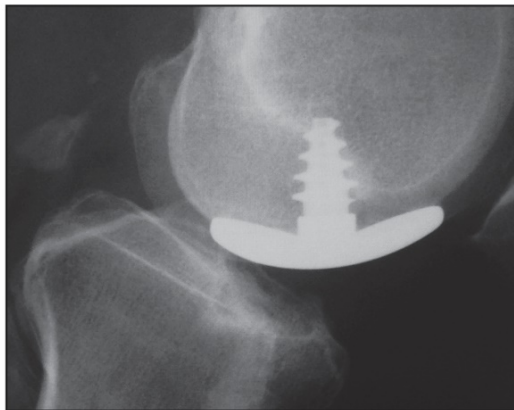
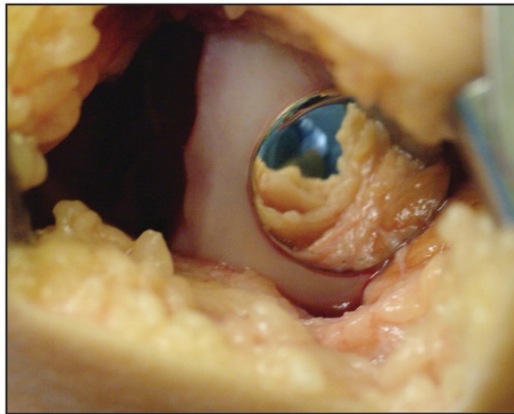
“Limited patellofemoral arthroplasty implants have been developed to preserve bone stock while reproducing the complex anatomy of the trochlear groove.”

### **CONCLUSION**

The results of this study suggest that the limited trochlear resurfacing provides a unique and favorable alternative to prior implant designs by providing anatomic re-approximation of the patellofemoral surface and knee contact pressures.

## Clinical Science

The literature on tibiofemoral and patellofemoral inlay resurfacing continues to expand. The availability of custom fitting implants that are specific to the patient's joint contour and defect size found promising acceptance in the literature. The combination of contoured joint restoration and successful outcomes was highlighted by the majority of publications. At the transition from biological cartilage repair and joint replacement, inlay arthroplasty provides a secondary, or tertiary layer in the long term treatment of joint arthrosis and arthritis. Success and survivorship should be seen in the context of focal joint preservation surgery where inlay arthroplasty extends precursor treatments with "mini salvage" form fitting implants.



Knee > Focal Condyle > Clinical Science

2016

## Cartilage Injury Treatment

Brittberg M

Arthroscopy and Sport Injuries. 2016 pp 323-329

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-319-14815-1\\_39](http://link.springer.com/chapter/10.1007/978-3-319-14815-1_39)

### SUMMARY

Loss of cartilage function may lead to a painful joint with a decreased mobility. Several factors, i.e. epidemiological, biochemical and morphological, are associated with cartilage destruction; however, only trauma is known directly to cause osteoarthritis. It is well known that once the cartilaginous tissue has been destroyed, the intrinsic reparative ability is poor; therefore, it is extremely important to increase knowledge about the cartilage, the tissue reaction to trauma and the intrinsic attempts to repair the defects as well as extrinsic methods.

### QUOTE

“Mini metal arthroplasties (MMA) with small custom-made metal implants treatment place in the sportsmen is also difficult to tell. It might be a solution for the recreational sportsmen, but more and longer follow-ups are needed to be able to give advice.”

### CONCLUSION

n/a

Knee > Focal Condyle > Clinical Science

2015

## **Avascular necrosis complicating chondral resurfacing techniques**

Thompson SM, Saso A, Raval P, Jones M, Williams AM

Knee Surg Sports Traumatol Arthrosc. 2015 Jul 23.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/26202139>

### **SUMMARY**

Autologous chondrocyte implantation (ACI) and mosaicplasty have become established operations used to treat full-thickness chondral lesions in the knee and elsewhere. Although complications of both have been documented, there are no previous reports of avascular necrosis (AVN) complicating these procedures. Awareness of AVN as a complication of ACI might have prompted an earlier diagnosis, with possible non-surgical treatment or more minor surgery being possible. At the very least, an appropriate form of management could have been initiated earlier, so shortening the period of disability and suffering for the patient.

### **QUOTE**

“In the light of the findings on arthroscopy, a HemiCAP<sup>®</sup> procedure was undertaken. At 24 months, the patient is asymptomatic.”

### **CONCLUSION**

A 50-year-old man presented with a painful right knee and history of 16 prior surgeries to the same knee ... The patient was referred onto a specialist centre where ACI was performed, only to exacerbate the discomfort. Five years after his first procedure, he had a mosaicplasty and an upper tibial osteotomy with a partial improvement. The plate used for the osteotomy was removed a year later, with no subsequent surgery. On presentation 7 years after the mosaicplasty, there was medial pain, worsened by walking. There was no associated swelling, but an inability to trust his knee, and catching and locking.

... MRI revealed significant oedema deep to the region of mosaicplasty with an appearance in keeping with AVN. Treatment was with Hemicap, and at 12 months, the patient is asymptomatic. Histological analysis of bone removed confirmed AVN.

Knee > Focal Condyle > Clinical Science

2015

## Treatment of full-thickness femoral cartilage lesions using condyle resurfacing prosthesis

Laursen JO, Lind M

Knee Surg Sports Traumatol Arthrosc. 2015 Jul 29.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/26220332>

### SUMMARY

**PURPOSE:** The HemiCAP® implant for femoral resurfacing treatment of cartilage lesions was introduced in 2003. We present outcome from a prospective cohort study of 61 patients with both trochlear and condylar lesions treated with the HemiCAP® implant.

**METHODS:** From 2007 to 2012, 61 patients were treated with femoral resurfacing using the HemiCAP implant. There were 36 femoral condyle implants and 25 trochlear implants. Indication for treatment with HemiCAP implant was symptomatic cartilage lesion at the femoral condyle demonstrated by MRI or arthroscopy, which was ICRS grade 3-4 and size less than 4 cm<sup>2</sup>. There were 24 males and 37 females with a median age of 49 (range 35-65) years. Patients were followed for 2 years with Knee Society subjective outcome scores (KSS), pain scores and radiographic evaluations and for 7 years with complications and reoperations.

**RESULTS:** At 2-year follow-up, mean KSS was improved from 52 (6.2) to 90 (7.9), mean KSS function score was improved from 45 (7.5) to 92 (8.3), and mean Pain score improved from 7.1 (0.7) to 1.8 (1.7). Twenty-three per cent of implants were revised within 7 years to arthroplasty due to progression of cartilage lesions, progression of osteoarthritis, or increased knee pain. No difference between females and males was found for reoperation rate.

**CONCLUSION:** The present study demonstrated improved subjective outcome and reduced pain after femoral resurfacing using the HemiCAP implant in a relatively large cohort of patients with symptomatic cartilage lesions. A concerning 23 % reoperation rate with conversion to arthroplasty was found. Femoral resurfacing implantation treatment can be a temporary treatment for cartilage lesions expected to develop into osteoarthritis and for younger patients not eligible for arthroplasty treatment.

### QUOTE

“The present study demonstrated improved subjective outcome and reduced pain after femoral resurfacing using the HemiCAP implant in a relatively large cohort of patients with symptomatic cartilage lesions.”

### CONCLUSION

Femoral resurfacing implantation treatment can be a temporary treatment for cartilage lesions expected to develop into osteoarthritis and for younger patients not eligible for arthroplasty treatment.

Knee > Focal Condyle > Clinical Science

2015

## Gonarthrosis

Kraus TM, Blanke IJ, Lorenz S

Surgical Atlas of Sports Orthopaedics and Sports Traumatology. Springer 2015, pp 303-312

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-662-43776-6\\_20](http://link.springer.com/chapter/10.1007/978-3-662-43776-6_20)

### SUMMARY

The tibiofemoral resurfacing arthroplasty fills the gap between the biological treatment procedures and a unicondylar knee prosthesis. The cartilage or osteochondral lesion is replaced on the tibial and/or the femoral side. Such a small anatomical implants allows maintaining the surrounding bone, cartilage and meniscus. Focal resurfacing arthroplasty is indicated when a corrective osteotomy is not recommended based on the lower limb alignment and at the same time an OATS ("osteochondral autograft transfer system") or MACT (matrix- associated chondrocyte implantation) are not considerable options due to advanced age of the patient.

The arthroscopically assisted implantation allows a minimally invasive procedure. Arthroscopic visualization allows accurate placement of the implant. The minimal amount of bone loss make the rehabilitation easier and if necessary, implantation of a unicompartmental or total knee prosthesis in the future.

Symptom specific history: onset and duration of complaints, symptoms (pain intensity and location), subjective stability, previous surgery, age.

Symptom specific examination: axial alignment, gait, range of motion, tenderness/tenderness on percussion, exclusion of concomitant instability or meniscal lesion.

### QUOTE

**"Arthroskopisch assistierter Oberflächenersatz des medialen Kompartiments."**

### CONCLUSION

Aufgrund geringer Knochenresektion ist der Wechsel auf Totalendoprothesen problemlos möglich.

Knee > Focal Condyle > Clinical Science

2014

## **The Use of a Prosthetic Inlay Resurfacing As a Salvage Procedure for a Failed Cartilage Repair**

Dhollander AA, Almqvist KF, Moens K, Vandekerckhove PJ, Verdonk R, Verdonk P, Victor J

Knee Surg Sports Traumatol Arthrosc. 2014 Apr 22.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/24752537>

### **SUMMARY**

This study was designed to describe the clinical and radiographical outcome of the HemiCAP® resurfacing system as a salvage treatment for a failed index cartilage procedure.

**METHODS:** Fourteen patients were treated consecutively and clinically prospectively followed for a mean period of  $26.1 \pm 12.8$  months. All patients were previously treated for their cartilage lesion. Radiographical data were analysed based on the Kellgren and Lawrence system.

**RESULTS:** The patients involved in this study demonstrated a gradual clinical improvement in time. However, radiographically significant osteoarthritic changes were observed during the follow-up period. The position of the HemiCAP® resurfacing system was adequate in all cases, and no signs of loosening were observed during the follow-up period.

**CONCLUSIONS:** The HemiCAP® resurfacing system is feasible as a salvage treatment for a failed index cartilage procedure and resulted in a gradual clinical improvement. However, the favourable clinical outcome was not confirmed by the radiographical findings.

### **QUOTE**

“The most important finding of the present study is that the HemiCAP resurfacing system is feasible as a salvage treatment for a failed index cartilage procedure.”

### **CONCLUSION**

The proposed resurfacing system can be used in a day by day clinical practice as a possible solution to treat patients with a failed index cartilage repair.

Knee > Focal Condyle > Clinical Science

2014

## **Management of Osteochondritis Dissecans of the Knee.**

Thompson SM, Jones M, Lavelle JR, Williams A.

J Sports Rehab 2014;23(3):216-222

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25115156>

### **SUMMARY**

The etiology of osteochondritis dissecans is hypothesized as repetitive microtrauma, resulting in an interruption of blood supply. Due to the location of the most common lesions on the medial femoral condyle, impingement of either the medial tibial spine or inferior pole of the patella against the adjacent medial femur may be responsible. It is much more common in athletic males than other groups. This article reviews the current treatment options for lesions around the knee.

### **QUOTE**

“Finally, surgical options could also include limb realignment with osteotomy to offload the OCD defect or focal replacements such as Hemicap (TM Arthrosurface).”

### **CONCLUSION**

n/a



Knee > Focal Condyle > Clinical Science

2014

# **Focal resurfacing implants in the knee and partial knee replacements**

Jermin P, Yates J, McNicholas M

Orthopaedics and Trauma (2014) in Press

Peer Review Article  
<http://dx.doi.org/10.1016/j.mporth.2014.11.006>

## **SUMMARY**

Treating the chronically painful knee has never been more challenging. We are now faced with a growing population of increasingly demanding patients presenting with knee pathology that is not responding to conservative measures. This has paved the way for revolutionary techniques to treat the knee, with the aim of preserving as much of the native joint as possible for as long as possible. Finding the best, evidence-based, surgical solutions for patients presenting with focal pathology within the knee is complex, given the multiple modalities of treatments available. It is therefore crucial for healthcare professionals and patients to be appraised of the available treatments and their outcomes, to enable fully informed decisions. This paper presents an overview of the current evidence and treatment options available when considering resurfacing implants and partial knee replacements in the treatment of focal lesions and arthritis in the knee.

## **QUOTE**

“Due to the limitations of cartilage regenerative procedures, focal resurfacing implants have been developed to provide a more targeted solution than conventional arthroplasties, and these aim to ‘bridge the gap’ between these two treatment modalities. There are few such implants available on the market at present. One of the earlier devices is the HemiCAP.”

## **CONCLUSION**

The orthopaedic surgeon has an increasingly challenging and exciting role to play when treating cartilaginous pathologies within the knee. The surgeon needs to know the detailed requirements of each individual patient. Only this knowledge will allow them to select the right implant or device for the right patient at the right time.

Knee > Focal Condyle > Clinical Science

2013

## Focal Femoral Condyle Resurfacing

Brennan SA., Devitt BM., O'Neill CJ., Nicholson P.

Bone Joint J. 2013 Mar;95-B(3):301-4.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/23450011>

### SUMMARY

Focal femoral inlay resurfacing has been developed for the treatment of full-thickness chondral defects of the knee. This technique involves implanting a defect-sized metallic or ceramic cap that is anchored to the subchondral bone through a screw or pin. The use of these experimental caps has been advocated in middle-aged patients who have failed non-operative methods or biological repair techniques and are deemed unsuitable for conventional arthroplasty because of their age. This paper outlines the implant design, surgical technique and biomechanical principles underlying their use. Outcomes following implantation in both animal and human studies are also reviewed.

### QUOTE

“There are currently no long-term follow-up data for the use of these devices. Although short- and medium-term results appear promising, these need to be confirmed with larger patient cohorts in order to better define in which patients good results can be expected.”

### CONCLUSION

Early results for focal femoral inlay resurfacing suggest it to be an effective reconstructive option for large (up to 20 mm in diameter) full-thickness cartilage and osteochondral lesions of the knee in middle-aged patients. With revision rates of 16.7% at three years, patients should be appropriately warned of the as yet unknown long-term outcome and surgeons should proceed with caution until such results define the role of this treatment.

Knee > Focal Condyle > Clinical Science

2013

## Limited Arthroplasty for Osteoarthritis of the Knee

Griesser MJ., Miniaci A.

JBJS Reviews 2013;1(2) 1-10.

Peer Review Article  
<http://reviews.jbjs.org/content/1/2/e3>

### SUMMARY

Conceptually, so-called limited arthroplasty techniques for the treatment of osteoarthritis of the knee are an attractive future alternative for selected patient populations. It is important to manage patient expectations and to educate patients with informed preoperative discussion of the available options, including early focal resurfacing and delayed total arthroplasty. Important intraoperative considerations include ensuring adequate implant defect coverage, recessing implant components just below the articular surface, careful mapping of the defect to ensure appropriate curvature of the implant, and confirming uniform cement coverage. Tibiofemoral alignment should be corrected before or at the same time as placement of limited arthroplasty devices such as inlay components. Limited arthroplasty techniques are currently being employed in orthopaedics, with encouraging short-term results; however, additional long-term results are necessary before definitive recommendation for or against their use can be made.

### QUOTE

“The transition from biologic treatment strategies to joint resurfacing offers biomechanical and clinical advantages because of the availability of custom-fitting implants specific to the size of the defect and the contour of the native surface geometry.”

### CONCLUSION

Established biological procedures for focal cartilage repair have been expanded through new approaches involving smaller knee implants and patient-specific prosthetic inlays. The combination of new techniques and implants allows us to simultaneously address pathology and preserve healthy tissue, offering a joint-preservation strategy that is consistent with the goals of early intervention.

Knee > Focal Condyle > Clinical Science

2012

## HemiCAP-Implantat

Ilg A

Knieeilersatz. Patellofemorale und femorotibiale Teilendoprothesen. Kapitel 2. Deutscher Ärzte-Verlag, 2012, pp 69-77

Book Chapter  
<http://shop.aerzteverlag.de/buecher/buch.asp?grid=218&id=2490>

### SUMMARY

Die Behandlung von Knorpelschäden stellt nach wie vor für den behandelnden Chirurgen eine große Herausforderung dar. Obwohl Knorpelschäden nicht zwangsläufig zu Beschwerden führen, ist bislang unklar, zu welchem Zeitpunkt diese symptomatisch werden. Es gilt jedoch als gesichert, dass diese fortschreiten und zu signifikanten Schmerzen und zur Beeinträchtigung der Gelenkfunktion führen können.

### QUOTE

“In allen 3 Studien konnten nach Hemi-CAP-Implantation keine Implantatdissoziationen, Lockerungszeichen der Prothese, Implantatmigrationen oder periprothetische subchondrale Zysten festgestellt werden.”

### CONCLUSION

Die HemiCAP-Prothese stellt eine neue optimale Therapiealternative zur Versorgung von fokalen vollschichtigen Knorpel- und osteochondralen Defekten bei Patienten dar, die weder für biologische Therapieverfahren noch für ein konventionelles Knieendoprothetisches Verfahren infrage kommen.

Knee > Focal Condyle > Clinical Science

2012

## Treatment of Osteonecrosis of the Knee

Beyzadeoglu T, Onal A.

European Instructional Lectures 12. 2012, 193-201

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-27293-6\\_16](http://link.springer.com/chapter/10.1007/978-3-642-27293-6_16)

### SUMMARY

The term osteonecrosis encompass three different disorders with different symptoms, aetiologies and characteristics: spontaneous, secondary, and post-arthroscopic osteonecrosis of the knee. These three entities have non-specific symptoms and radiological findings at early phases but all have the potential of progress to late stage disabling joint disease with different rates. Clinical assessment and radiographic findings are useful for differentiating these three entities from other conditions with similar onsets. Different treatment modalities have been used with varying success for each type and stage. While spontaneous and post-arthroscopic osteonecrosis have a higher potential to regress, secondary osteonecrosis generally leads to end-stage disease with multiple joint involvement. The term osteonecrosis (ON) was firstly described by Ahlbäck et al. as “a radiolucent lesion in the medial femoral condyle” in 1968. Preliminary studies characterized this entity as a late onset disorder with a greater prevalence in women. Later studies reported three different conditions encompassed by ON with different symptoms, aetiologies, age of onset and characteristics: spontaneous osteonecrosis of the knee, secondary osteonecrosis of the knee, and post-arthroscopic osteonecrosis of the knee. Because of the risk of progress to end-stage osteoarthritis, clinicians should identify and manage the disease for optimal outcomes. Diagnosis, classification and management of these disorders are still controversial because of the low number of comparative prospective studies and low incidence. Current opinions about aetiology, diagnosis and treatment of osteonecrosis of the knee addressing each sub-type separately are reviewed here.

### QUOTE

“Post-operative AP and lateral radiographies of the same patient 2 years after limited resurfacing arthroplasty: Joint curvature is smooth on both views without any evidence of collapse.”

### CONCLUSION

Limited re-surfacing arthroplasty is a novel technique for the treatment of focal chondral lesions that preserves subchondral bone. In our institution, we have performed limited re-surfacing arthroplasty for two knees with stage 2 spontaneous osteonecrosis of medial femoral condyle combined with core decompression. The mean KSS improved from 64 before surgery to 98 at a mean follow-up of 23 months. There was no radiographic collapse in both patients.

Knee > Focal Condyle > Clinical Science

2011

## Current Concepts of Articular Cartilage Repair

Schindler OS

Acta Orthop Belg. 2011 Dec;77(6):709-26

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22308614>

### SUMMARY

Articular cartilage provides a vital function in the homeostasis of the joint environment. It possesses unique mechanical properties, allowing for the maintenance of almost frictionless motion over a lifetime. However, cartilage is vulnerable to traumatic injury and due to its poor vascularity and inability to access mesenchymal stem cells, unable to facilitate a satisfactory healing response. Untreated chondral defects are thus likely to predispose patients to the development of osteoarthritis. Reconstitution and repair of articular cartilage is dependent on the neosynthesis or implantation of cartilage matrix elements, a goal which can be achieved through a variety of surgical means. Commonly used repair techniques include marrow stimulation, structural osteo-articular autografts or chondrocyte implantation. Despite substantial differences in the complexity and technical application of each method, all are united in the endeavour to restore joint function and prevent joint degeneration. Anyone attempting to treat cartilage defects must possess a basic understanding of the physiology of cartilage growth, and relevant factors affecting cartilage healing and repair. Furthermore, knowledge of the biomechanics and kinematics of the knee are essential in order to appreciate the forces acting on joint surfaces and repair tissues. Although clinical success is dependent on appropriate patient selection, accurate clinical assessment, definition of root causes and application of the right choice of treatment modality, the ultimate outcome of any intervention remains heavily reliant on the surgeon's proficiency in the technical aspects of the chosen surgical procedure.

### QUOTE

“Metallic partial resurfacing implants like the HemiCAP<sup>®</sup> knee implant (Arthrosurface, Franklin, Mass., USA) targeting patients typically between the ages of 40 and 60 years, who have focal condylar defects and are likely to undergo partial or total knee replacement surgery in the future. The procedure is intended to bridge the gap between biologic procedures and conventional joint replacement and like osteochondral plug implantation can be performed through a mini arthrotomy.”

### CONCLUSION

The choice of treatment, which may best suit the patient, is dependent on a number of variables and pertain to those relating to the patient (e.g. biological age, physical demands) and the defect (e.g. response to previous surgery, location, size). A blanket approach should hence be avoided and treatment of cartilage lesions individualized.

Knee > Focal Condyle > Clinical Science

2011

## Minimum 5-year Results of Focal Articular Prosthetic Resurfacing for the Treatment of Full-Thickness Articular Cartilage Defects in the Knee

Becher C, Kalbe C, Thermann H, Paessler HH, Laprell H, Kaiser T, Fechner A, Bartsch S, Windhagen H, Ostermeier S.

Arch Orthop Trauma Surg. 2011 Aug;131(8):1135-43.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/21643800>

### SUMMARY

The purpose of this study was to evaluate the results of a contoured focal articular femoral condyle resurfacing prosthetic in the treatment of full-thickness cartilage and osteochondral defects at the medial femoral condyle of the knee beyond 5 years. **METHODS:** In a multicenter case series, preoperative and follow-up scores of the Knee Injury and Osteoarthritis Outcome Score (KOOS), SF-36 and Tegner activity scale were evaluated. Standard radiographs were performed to evaluate the progression of osteoarthritis. Patients were also asked to report their satisfaction. **RESULTS:** A total of 21 patients were included in this study. The average follow-up was 5.3 years. The average age at the time of resurfacing was 54 years. Average KOOS scores significantly ( $P \leq 0.005$ ) improved for pain (51.1 to 77.6), symptoms (57.9 to 79.5), activities of daily living (ADL) (58.8 to 82.4), sports (26.3 to 57.8) and quality of life (QOL) (34.4 to 55.0). The Tegner activity level improved significantly ( $P \leq 0.02$ ) from 2.9 to 4. The physical health value of the SF-36 increased by 15.2 to 46.9 compared to the preoperative value. The mental health value almost (51.2) remained unchanged. As many as 16/21 of the patients in this series were satisfied with their outcome and would have the operation again. Radiographic results demonstrated solid fixation, preservation of joint space and no change in the osteoarthritic stage. **CONCLUSIONS:** The device appears to be an effective reconstructive treatment option for large full-thickness cartilage and osteochondral lesions of the knee in middle-aged patients.

### QUOTE

"All patients in our series had previously failed conservative treatment and the vast majority underwent single or repeat biological procedures prior to focal prosthetic resurfacing. The study looked specifically at middle-aged patients without kissing lesions and advanced grade cartilage degeneration in other compartments that would benefit the most from a limited resurfacing treatment."

### CONCLUSION

By using validated outcome measures and standard radiographs, we have demonstrated clinically meaningful improvements in the majority of patients and radiological safety after focal prosthetic resurfacing for the treatment of full-thickness cartilage and osteochondral defects at the medial femoral condyle at a minimum follow-up of 5 years.

Knee > Focal Condyle > Clinical Science

2011

## **Prosthetic Inlay Resurfacing for the Treatment of Focal, Full Thickness Cartilage Defects of the Femoral Condyle: A Bridge Between Biologics and Conventional Arthroplasty**

Bollars P, Bosquet M, Vandekerckhove B, Hardeman F, Bellemans J.

Knee Surg Sports Traumatol Arthrosc. 2012 Sep;20(9):1753-9.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22076054>

### **SUMMARY**

Localized full thickness defects of the femoral condyle can be highly symptomatic. Treatment options for these lesions are numerous in young patients, however they become increasingly challenging in middle aged and older patients. In order to delay traditional joint replacement procedures and to provide a soft tissue and bone sparing alternative, this study assess a focal inlay resurfacing procedure.

**METHODS:** Between 2004 and 2008, a consecutive series of 27 patients were treated with the Arthroscopic HemiCAP(®) Focal Femoral Condyle Resurfacing Prosthesis and were assessed to study the clinical benefit of this procedure. Outcome measures included the KOOS, IKDC, HSS and WOMAC as well as physical and radiographic evaluation.

**RESULTS:** Nineteen patients met the inclusion/exclusion criteria, 18 were available for review at a median follow-up of 34 months (range 20-57). The median age was 49 years (range 43-78). 63% had early arthritis, 5.2% localized osteonecrosis, and 31.6% had a focal traumatic full thickness defect. The follow-up total WOMAC score averaged  $90.1 \pm 9.3$ , The KOOS showed very good to excellent scores in all domains and also when compared to age-matched normative data. Significant improvement was seen with the HSS Score. On IKDC examination, 83.4% had normal or nearly normal results.

**CONCLUSION:** Focal femoral condyle resurfacing demonstrated excellent results for pain and function in middle-aged, well selected patients with full thickness cartilage and osteochondral defects. Patient profiling and assessment of confounding factors, in particular mechanical joint alignment; meniscal function; and healthy opposing cartilage surfaces, are important for an individual treatment approach and successful outcomes.



#### QUOTE

“KOOS and WOMAC subscales showed very good to excellent levels at a follow-up of almost 3 years. Our results agree and confirm the conclusion drawn by Becher et al. in their recent publication stating that the device was an effective treatment option for large lesions of the knee in middle-aged patients.”

#### CONCLUSION

The results of our study show that resurfacing with a Focal Femoral Condyle Resurfacing Prosthesis demonstrates excellent results for pain and function in middle aged patients with full thickness cartilage and osteochondral defects meeting the inclusion criteria. The procedure adds to the existing range of focal cartilage procedures and successfully bridges biological treatment options to standard joint replacement allowing a continuation of localized management. The procedure further supports an individualized treatment approach throughout the management of knee arthrosis and arthritis. Soft tissues and bone stock are preserved providing a delayed exit strategy for traditional arthroplasty as a primary indication.

Knee > Focal Condyle > Clinical Science

2011

## **Surgical implants and technologies for cartilage repair and preservation of the knee**

Stroh DA, Johnson AJ, Mont MA.

Expert Rev Med Devices 8(3): 39-356,2011.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/21542707>

### **SUMMARY**

Focal lesions of the articular cartilage of the knee can be managed with a variety of products and technologies in an attempt to restore function to the afflicted joint and forestall the need for possible total knee arthroplasty. Among these approaches are non-implant-based procedures (arthroscopic chondroplasty and microfracture), grafting procedures (autografts/mosaicplasty and allografts), cell-based procedures (autologous chondrocyte implantation) and nonbiologic implants (metallic plugs and cell-free polymers). For each clinically established procedure there are also a number of investigational variations that aim to improve the in vivo quality of the regenerated/restored cartilage surface. This article analyzes existing and developing non-implant- and graft-based technologies for the repair or restoration of the articular cartilage of the knee based on a review of the published literature.

### **QUOTE**

“Intraoperative mapping of surface contours around the defect are of paramount importance.”

### **CONCLUSION**

In all, the appropriateness of defect-sized metallic implants has yet to be determined, although such implants would be highly useful in bridging the time span between injury and total joint arthroplasty, prolonging the time before a revision might become necessary.

Knee > Focal Condyle > Clinical Science

2010

## **Treatment of articular cartilage lesions of the knee**

Falah M, Nierenberg G, Soudry M, Hayden M, Volpin G.

International Orthopaedics. 2010;34(5):621-630.

Book Chapter  
<http://www.ncbi.nlm.nih.gov/pubmed/?term=2903160>

### **SUMMARY**

Treatment of articular cartilage lesions in the knee remains a challenge for the practising orthopaedic surgeon. A wide range of options are currently practised, ranging from conservative measures through various types of operations and, recently, use of growth factors and emerging gene therapy techniques. The end result of these methods is usually a fibrous repair tissue (fibrocartilage), which lacks the biomechanical characteristics of hyaline cartilage that are necessary to withstand the compressive forces distributed across the knee. The fibrocartilage generally deteriorates over time, resulting in a return of the original symptoms and occasionally reported progression to osteoarthritis. Our purpose in this study was to review the aetiology, pathogenesis and treatment options for articular cartilage lesions of the knee. At present, autologous cell therapies, growth factor techniques and biomaterials offer more promising avenues of research to find clinical answers.

### **QUOTE**

“Focal chondroplasty by Co—Cr metallic implants, for the management of full-thickness cartilage defects in an animal model, was reported by Kirker-Head et al. After one year follow-up, the chondral lesions were much reduced by radiographs, related to their sizes at implantation day.”

### **CONCLUSION**

Their results implied the safety, biocompatibility and functionality of the implant.

Knee > Focal Condyle > Clinical Science

2010

## Articular Cartilage Surgery in the Knee

Schindler OS

Orthopaedics and Trauma. Volume 24, Issue 2 , Pages 107-120, April 2010

Peer Review Article

[http://www.orthopaedicsandtraumajournal.co.uk/article/S1877-1327\(10\)00028-X/abstract](http://www.orthopaedicsandtraumajournal.co.uk/article/S1877-1327(10)00028-X/abstract)

### SUMMARY

Although articular cartilage has extraordinary mechanical properties, able to maintain almost frictionless motion over a lifetime, it is vulnerable to traumatic injury and subsequent degeneration. Poor vascularity and inability to access undifferentiated cell populations that would facilitate a response to injury, are responsible for articular cartilage's limited ability to self-repair. The creation of cartilage repair tissue hence relies on the implantation or neosynthesis of cartilage matrix elements. This goal is achievable through a variety of repair techniques including marrow stimulation, the use of autologous or synthetic structural grafts or chondrocyte implantation. Although there are substantial differences in the complexity and technical application of each method, they are all united in the endeavour to restore joint function and prevent joint degeneration. The surgeon attempting to treat cartilage defects is required to possess not only a basic understanding of the physiology of cartilage growth, healing and repair, but also of biomechanics and kinematics of the knee, in order to appreciate the forces acting on the joint surfaces. Clinical success or failure will depend on appropriate patient selection, accurate clinical assessment, definition of the root cause and application of the right choice of treatment modality. Any therapy plan must include subsequent treatment options, which may become necessary should the first-line management fail to ameliorate symptoms.

### QUOTE

“Metallic partial re-surfacing implants, like the HemiCAP<sup>®</sup> knee implant (Arthrosurface), may be appropriate for patients typically between the ages of 40 and 60 years who have focal condylar defects and who are likely to undergo knee replacement surgery in the future.”

### CONCLUSION

The procedure is intended to bridge the gap between biologic procedures and conventional joint replacement, and like osteochondral plug implantation can be performed through a miniarthrotomy.

Knee > Focal Condyle > Clinical Science

2010

## **The Subchondral Bone in Articular Cartilage Repair: Current Problems in the Surgical Management**

Gomoll AH, Madry H, Knutsen G, van Dijk N, Seil R, Brittberg M, Kon E.

Knee Surg Sports Traumatol Arthrosc. 2010 Apr;18(4):434-47. Epub 2010 Feb 4. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20130833>

### **SUMMARY**

As the understanding of interactions between articular cartilage and subchondral bone continues to evolve, increased attention is being directed at treatment options for the entire osteochondral unit, rather than focusing on the articular surface only. It is becoming apparent that without support from an intact subchondral bed, any treatment of the surface chondral lesion is likely to fail. This article reviews issues affecting the entire osteochondral unit, such as subchondral changes after marrow-stimulation techniques and meniscectomy or large osteochondral defects created by prosthetic resurfacing techniques. Also discussed are surgical techniques designed to address these issues, including the use of osteochondral allografts, autologous bone grafting, next generation cell-based implants, as well as strategies after failed subchondral repair and problems specific to the ankle joint. Lastly, since this area remains in constant evolution, the requirements for prospective studies needed to evaluate these emerging technologies will be reviewed.

### **QUOTE**

“Focal knee resurfacing implants may be appropriate for elderly patients as a less invasive option for resurfacing localized and deep osteochondral defects.”

### **CONCLUSION**

The understanding of joint homeostasis and the interaction of cartilage and subchondral bone continues to evolve. After years of focusing almost exclusively on treating the easily accessible surface lesion, it is becoming apparent that without a healthy subchondral bed, the entire osteochondral unit is likely to fail. The future of cartilage repair lies in better diagnostics to properly recognize alterations in the subchondral bone that might compromise isolated cartilage repair, as well as advanced treatment options that will allow us to replace the entire osteochondral unit, should this become necessary. To this end, tissue-engineering

techniques will be needed to generate a ready supply of osteochondral transplants that address the issues of limited autograft availability, as well as concerns over the use of allografts.

Knee > Focal Condyle > Clinical Science

2010

## **TruFit CB Bone Plug: Chondral Repair, Scaffold Design, Surgical Technique and Early Experiences**

Melton J, Wilson A, Chapman-Sheath P, Cossey A.

Expert Rev Med Devices. 2010 May;7(3):333-41.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20420556>

### **SUMMARY**

#### **Abstract**

The TruFit CB osteochondral scaffold plug is a commercially available and licensed scaffold implant for the treatment of chondral and osteochondral defects of the knee. A number of surgical techniques have been described that are designed to achieve neocartilaginous tissue cover of a chondral defect, but many result in fibrocartilage tissue, not type II collagen hyaline cartilage. This fibrocartilage layer can fail with high shear forces in the knee joint, and lead to ongoing articular surface irregularity and subsequent secondary arthritic change. Recent research and clinical interest has focused on employing tissue-engineering techniques utilizing scaffolds in an attempt to obtain cartilage repair tissue that is histologically and biomechanically superior. The TruFit CB implant is one such device. This article describes the techniques of attempted chondral repair and the problems that can be experienced. Current concepts in chondral scaffold design are discussed, and the surgical technique and early experiences with the TruFit CB implant are presented.

### **QUOTE**

“This is not strictly cartilage repair, as it involves replacement of deficient cartilage with a metal disc. Animal testing in a goat model has shown that the implants can appear stable on radiographs with normal joint range of motion and no joint effusion at 4 weeks”

### **CONCLUSION**

Chondral scaffolds and tissue-engineering techniques remain a very exciting development in the treatment of a common but challenging management issue facing the orthopedic community.

Knee > Focal Condyle > Clinical Science

2008

## Arthrosurface Tecnico Chirurgico nel Ginocchio

Buda R., Ferruzzi A., Ghermondi R. Cavallo M., Giannini S.

Encyclopedie Medico-Chirurgicale (Elsevier Italia) Tecniche chirurgiche. Chirurgia Ortopedica 01-08-435, 2008 8p.

Book Chapter

<http://www.emcortopedia.it/cont/ginocchio-femore/articoli/arthrosurface-tecnica-chirurgica-ginocchio.asp>

### SUMMARY

Le lesioni osteocondrali focali sono evenienze frequenti, in particolare nel ginocchio, a livello dei condili femorali o dell'articolazione femororotulea. Queste lesioni, se non adeguatamente trattate, costituiscono l'avvio di un processo che porta all'instaurarsi di artrosi precoce. Nella maggior parte dei casi risulta quindi necessario ricorrere alla chirurgia per ripristinare una superficie articolare regolare. Le tecniche proposte in letteratura sono numerose, ma il trattamento delle lesioni osteocondrali focali di grado III o IV di medie o grandi dimensioni rappresenta ancora oggi un problema terapeutico: le tecniche biologiche o di ingegneria tissutale sono maggiormente indicate nei pazienti giovani. Il limite di applicabilità di queste metodiche è fissato a 50 anni; oltre questo limite si ricorre alla chirurgia protesica tradizionale o a quella mini-invasiva. Il sistema HemiCap® si pone nel panorama della chirurgia protesica mini-invasiva come un dispositivo in grado di ripristinare a livello della sede di lesione una superficie liscia e regolare, che segue la fisiologica curvatura articolare, con i vantaggi di una ridotta invasività e senza precludere l'eventuale ricorso a successive procedure più invasive. Trattandosi di un sistema mini-invasivo, i limiti di applicabilità sono definiti dalle dimensioni della protesi (la protesi deve coprire almeno l'80% della superficie della lesione). Nel ginocchio il sistema è disponibile per l'applicazione a livello sia dei condili femorali sia dell'articolazione femororotulea.

### QUOTE

“L'HemiCAP® consente di ripristinare una superficie liscia sulla quale è possibile il carico pressorio con un minimo impatto chirurgico sull'osso sottostante: questo è vantaggioso sia per la cinematica dell'articolazione, sia nell'ottica di una futura revisione dell'impianto.”

### CONCLUSION

Infatti è possibile ripristinare una superficie liscia e regolare, che segue la fisiologica curvatura articolare, con i vantaggi di un'invasività molto ridotta sulle componenti articolari, una bassa alterazione delle condizioni biomeccaniche, nessuna controindicazione a eventuali successive procedure più invasive, e un ridotto rischio di complicanze correlate con l'intervento chirurgico. La tecnica di impianto risulta semplice, consentendo una rapida curva di apprendimento da parte del chirurgo ortopedico. Queste caratteristiche rendono l'HemiCAP® un dispositivo efficace, sicuro e maneggevole.

Knee > Focal Condyle > Clinical Science

2007

## Miniarthroplastik am Knie bei Osteonekrose

Kelberine F.

Springer 2007, Kapitel 22, 113-4.

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-540-71480-4\\_22](http://link.springer.com/chapter/10.1007/978-3-540-71480-4_22)

### SUMMARY

Herr G. 52-jährig, Landwirt, betreibt als Ausgleichssport Squash und Jogging. Er erscheint in der Sprechstunde wegen linksseitiger Kniebeschwerden mit Knacken beim in die Hocke gehen und rezidivierenden Gelenksergüssen. Vor 10 Monaten wurde am linken Kniegelenk eine Arthroskopie vorgenommen. Dabei wurde ein osteocartilaginärer Sequester vom medialen Femurkondyl entfernt, eine Affektion, die beim Patienten bereits seit seiner Adoleszenz bekannt war. Die klinische Untersuchung zeigte einen diskreten Erguss sowie eine Druckdolenz am medialen Gelenkspalt. Das Kniegelenk ist gut beweglich und stabil. Eine Arthro-CT-Untersuchung dokumentiert einen großen Defekt axial am medialen Femurkondylus.

### QUOTE

“Ein neues Implantat mit kleinem Oberflächenersatz, das bei fehlenden anderen intraartikulären Laesionen genau die Defektzone ausfüllt: Microcap von Arthrosurface.”

### CONCLUSION

18 Monate nach Eingriff zeigte das Kniegelenk klinisch und radiologisch ein gutes Resultat.



Knee > Focal Condyle > Clinical Science

2006

## Articular Cartilage: Injury Pathways and Treatment Options

Simon T, Douglas J.

Sports Med Arthrosc Rev 2006; Sep - Volume 14 - Issue 3 - pp 146-154

Peer Review Article

[http://journals.lww.com/sportsmedarthro/Abstract/2006/09000/Articular\\_Cartilage\\_\\_Injury\\_Pathways\\_and\\_Treatment.6.aspx](http://journals.lww.com/sportsmedarthro/Abstract/2006/09000/Articular_Cartilage__Injury_Pathways_and_Treatment.6.aspx)

### SUMMARY

Articular cartilage injury and degeneration is a frequent occurrence in synovial joints. Treatment of these articular cartilage lesions are a challenge because this tissue is incapable of quality repair and/or regeneration to its native state. Nonoperative treatments endeavor to control symptoms, and include anti-inflammatory medication, viscosupplementation, bracing, orthotics, and activity modification. Techniques to stimulate the intrinsic repair (fibrocartilage) process include drilling, abrasion, and microfracture of the subchondral bone. Currently, the clinical biologic approaches to treat cartilage defects include autologous chondrocyte implantation, periosteal transfer, and osteochondral autograft or allograft transplantation. Newer strategies employing tissue engineering being studied involve the use of combinations of progenitor cells, bioactive factors, and matrices, and the use of focal synthetic devices. Many new and innovative treatments are being explored in this exciting field. However, there is a paucity of prospective, randomized controlled clinical trials that have compared the various techniques, treatment options, indications and efficacy.

### QUOTE

“Metal surface devices intended to repair localized articular cartilage lesions. An example of such a device is the resurfacing prosthesis [HemiCAP]. This is an anchor-based Co-Cr-Mo alloy implant device that has a surface contour intended to match the articular surface at the treatment site.”

### CONCLUSION

Nevertheless, this area continues to inspire the imagination of clinicians and researchers alike and has a promising and exciting future for patient care that will expand in the coming years as this technology is incorporated into clinical arena.

Knee > Focal Condyle > Clinical Science

2006

## Issues in Articular Cartilage Repair

Downs BH., Jones M., Miniaci A.

US Musculoskeletal Review 2006, 38-42

Peer Review Article

[http://www.touchophthalmology.com/sites/www.touchoncology.com/files/migrated/articles\\_pdfs/Downs.pdf](http://www.touchophthalmology.com/sites/www.touchoncology.com/files/migrated/articles_pdfs/Downs.pdf)

### SUMMARY

Articular cartilage provides a low-friction and highly durable gliding surface for joints, but because it is hypocellular, avascular, aneural, and alymphatic, it has minimal reparative potential. Partial-thickness cartilage lesions are known to lack reparative potential and once arthritic changes are seen radiographically, further progression is likely. Articular cartilage injury is common; 5–10% of young, active patients with an acute hemarthrosis of the knee after a specific traumatic event will have a focal chondral injury.

### QUOTE

“Mapping of the articular cartilage surface is performed, based on the insertion of a titanium screw into the base of the defect. This allows replacement with an implant matching the size, shape, and contour of the articular cartilage defect.”

### CONCLUSION

As shown in the pictures, this implant allows restoration of a smooth and continuous load-bearing surface. The goal of the implant is to resurface the articular cartilage defect to improve function and shield the surrounding articular cartilage. This procedure can be performed with minimally invasive arthroscopically-assisted techniques and requires very little bone removal.

Knee > UniCAP > Clinical Science

2016

## **Treatment of full-thickness cartilage lesions and early OA using large condyle resurfacing prosthesis: UniCAP<sup>®</sup>**

Laursen JO

Knee Surg Sports Traumatol Arthrosc. 2016 Jan 29.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26826028>

### **SUMMARY**

**PURPOSE:** The UniCAP<sup>®</sup> implant for femoral resurfacing treatment of large cartilage lesions and early OA was introduced in 2006. The outcome of the present study is from a prospective cohort study of 64 patients, followed 2 years clinically and 7 years for revisions.

**METHODS:** From 2009 to 2013, 64 patients were treated with femoral resurfacing using the UniCAP implant. Indication for treatment with UniCAP implant was symptomatic huge cartilage lesion or early OA at the femoral condyle demonstrated by MRI or arthroscopy, which was ICRS grades 3-4 and more than 4 cm<sup>2</sup>. There were 28 males and 36 females with a median age of 51 (range 35-65) years. Patients were followed for 2 years clinically with Knee Society subjective outcome scores (KSS), pain scores and radiographic evaluations and for 7 years with complications and reoperations.

**RESULTS:** At 2 years, the follow-up mean KSS improved from 49 (6.9) to 88 (17.1), the mean KSS function score improved from 46 (8.0) to 90 (17.1), and the mean Pain score improved from 7.4 (0.5) to 2.3 (1.4). 47 % of the implants were revised within 7 years to arthroplasty due to the progression of cartilage lesions, progressing of osteoarthritis or increased knee pain. The reoperation rate did not show any significant difference between females and males. The Kaplan-Meier survival rate was 50 % at 7 years, no difference among females and males.

**CONCLUSION:** The present study demonstrated an improved subjective outcome and reduced pain after femoral resurfacing using the UniCAP<sup>®</sup> implant in a relatively large cohort of patients with symptomatic large cartilage lesions or early OA. A 47 % reoperation rate with conversion to arthroplasty was found. The femoral resurfacing implantation can be a temporary treatment for large cartilage lesions or early OA that is expected to develop into osteoarthritis. For younger patients who are ineligible for arthroplasty treatment, this implant can offer a temporary solution.

## QUOTE

“The present study demonstrated an improved subjective outcome and reduced pain after femoral resurfacing using the UniCAP<sup>®</sup> implant in a relatively large cohort of patients with symptomatic large cartilage lesions or early OA.”

## CONCLUSION

The femoral resurfacing implantation can be a temporary treatment for large cartilage lesions or early OA that is expected to develop into osteoarthritis. For younger patients who are ineligible for arthroplasty treatment, this implant can offer a temporary solution.

Knee > UniCAP > Clinical Science

2014

## **Inlay Joint Resurfacing and High Tibial Osteotomy (HTO) in Middle-Aged Athletes**

Beyzadeoglu T, Onal A, Menderes Caglar M

Sports Injuries, Springer-Verlag Berlin Heidelberg 2014, pp 1-10

Book Chapter

[http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36801-1\\_201-1](http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36801-1_201-1)

### **SUMMARY**

The treatment of symptomatic chondral defects in weight-bearing areas of the knee in active middle-aged athletes is still controversial. Biological treatment options often fail and joint replacements surgeries are not suitable for this demographic due to early loosening and high failure rates. High tibial osteotomy is the treatment of choice for knee arthritis with varus malalignment, but contraindications and mechanical complications limit its use. The combination of high tibial osteotomy with inlay resurfacing demonstrates a promising new direction in combination therapy possibly benefitting mechanical properties and survival rates.

### **QUOTE**

“Inlay resurfacing combined with HTO is targeting a normalized anatomy. The resurfacing implants restore joint congruency, and HTO is addressing the mechanical malalignment.”

### **CONCLUSION**

High tibial osteotomy combined with inlay resurfacing arthroplasty is a promising treatment method for active middle-aged athletes with severe medial joint narrowing and cartilage defects. Anatomic realignment can be maintained by addressing the varus deformity of the proximal tibia and the intra-articular defect separately, and the mechanical complications associated with overcorrection are eliminated. Long-term follow-up studies are needed to verify the reliability of this procedure.

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Knee > UniCAP > Clinical Science

2013

## Small Implants in Knee Reconstruction

Miniaci A.

Springer

Book Chapter  
<http://www.springer.com/medicine/orthopedics/book/978-88-470-2654-4>

### SUMMARY

Cartilage lesions in the knee are common and can be highly symptomatic. The biological treatment spectrum offers a wide range of cartilage procedures that address these lesions from different perspectives: Palliative interventions (debridement) aim at lesion stabilization and the removal of mechanical symptoms. Reparative (marrow stimulation techniques), restorative (chondral, osteochondral transplantation), and reconstructive (allograft, prosthetics) procedures target defect filling and surface reconstructions, while corrective procedures (osteotomy) take aim at the underlying disease process. All but palliative and prosthetic reconstructive measures require prolonged rehabilitation to ensure adequate biological response, remodeling, and healing.

### QUOTE

“First-intervention metallic prosthetics should follow the treatment concepts of biological procedures: a minimally invasive approach, joint preservation through maintenance of healthy soft tissues and bone stock, and biomechanical stability combined with a new contoured joint surface that counteracts lesion propagation.”

### CONCLUSION

The introduction of small knee implants over the past decade has stimulated the discussion on the continuum of care for knee arthrosis and arthritis. Established biological procedures for focal cartilage repair have been expanded through new reconstructive procedures utilizing patientspecific prosthetic inlays that simultaneously address the pathology and preserve healthy tissues. These treatment strategies follow surgeon-driven joint preservation goals that are consistent with localized repair in early-intervention cartilage repair. The 2- to 5-year clinical results support HemiCAP resurfacing as a viable treatment option, although larger patient series with long-term follow-up are needed to establish the full spectrum of clinical performance criteria and related outcomes.

Knee > UniCAP > Clinical Science

2014

## UniCAP as an Alternative for Unicompartmental Arthritis

Miniaci A.

Clin Sports Med. 2014 Jan;33(1):57-65.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24274845>

### SUMMARY

Medial tibiofemoral arthrosis is a disabling disease, particularly for active middle-aged patients who have failed conservative and biological precursor treatments. The UniCAP Bipolar Knee Resurfacing System (Arthrosurface, Incorporated, Franklin, Massachusetts) was introduced in 2008 to add a new layer to reconstructive joint surgery, allowing for a delay in traditional joint replacement procedures. It utilizes intraoperative, 3-dimensional joint surface mapping to fit and implant defect-sized components that are matched to the individual joint surface.

### QUOTE

“In light of the high incidence of failed cartilage precursor treatments, tibiofemoral resurfacing not only maintained bone, articular cartilage, and meniscal function, but also performed well in concomitant ACL reconstruction and high tibial osteotomy when indicated.”

### CONCLUSION

UniCAP resurfacing is a promising new treatment option, although larger patient series are needed to further substantiate patient selection criteria and clinical performance. As the appropriate indications for this procedure continue to be defined, long term follow-up data will be reported.

Knee &gt; UniCAP &gt; Clinical Science

2013

## Microartroplastia de Superficie y Osteotomía Tibial de Apertura Simultánea

Rivarola Etcheto H, Autorino CM, Palanconi M, Collazo C, Mainini S, Codesido M, Salinas EA.

ARTROSCOPIA | VOL. 20, Nº 1 : 202-205 | 2013

Peer Review Article

<http://www.revistaartroscopia.com.ar/index.php/ediciones-anteriores/2013/volumen-20-numero-1/89-volumen-05-numero-1/volumen-20-numero-1/612-microartroplastia-de-superficie-y-osteotomia-tibial-de-apertura-simultanea>

### SUMMARY

The degenerative knee joint characterized by exposure of subchondral bone in young and middle-aged patients with sports expectancy is currently a challenge for the specialist. Given the failure of medical treatment, the surgical indication should be based on the analysis of a number of factors, such as patient's expectations, dominant symptoms, alignment, stability and lesional area. The case reports associate two procedures which has found no published reference. The surgery consisted of associate: a) Replacement of articular cartilage with a focal surface arthroplasty ("Arthroscopy NR") with, b) Open high tibial osteotomy in the same procedure. We describe the methodology used for the surgical decision consisting of a multifactorial systematic analysis.

### QUOTE

"Recientemente se ha incorporado en el mercado un nuevo diseño de hemiprótosis de dimensión reducida, la cual facilita la realización de una genuina "microartroplastia"; fueron diseñadas sendas variedades aplicables a los compartimientos femorotibiales y patelofemoral."

### CONCLUSION

La enfermedad articular degenerativa en el adulto activo de edad media es una entidad nosológica de consulta creciente. Habiendo llegado la etapa de tratamiento quirúrgico, la elección terapéutica es más compleja para el paciente mayor y poco activo, ya que el tratamiento debe procurar preservar las áreas articulares aparentemente no comprometidas.



Knee > Patellofemoral > Clinical Science

2015

## **A matched-pair comparison of inlay and onlay trochlear designs for patellofemoral arthroplasty: no differences in clinical outcome but less progression of osteoarthritis with inlay designs**

Feucht MJ, Cotic M, Beitzel K, Baldini JF, Meidinger G, Schöttle PB, Imhoff AB

Knee Surg Sports Traumatol Arthrosc. 2015 Aug 1.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/26231153>

### **SUMMARY**

**PURPOSE:** To compare clinical and radiographic results after isolated patellofemoral arthroplasty (PFA) using either a second-generation inlay or onlay trochlear design. The hypothesis was that an inlay design will produce better clinical results and less progression of tibiofemoral osteoarthritis (OA) compared to an onlay design.

**METHODS:** Fifteen consecutive patients undergoing isolated PFA with an onlay design trochlear component (Journey™ PFJ, Smith & Nephew) were matched with 15 patients after isolated PFA with an inlay design trochlear component (HemiCAP® Wave, Arthrosurface). Matching criteria were age, gender, body mass index, and follow-up period. An independent observer evaluated patients prospectively, whereas data were compared retrospectively. Clinical outcome was assessed using WOMAC, Lysholm score, and pain VAS. Kellgren-Lawrence grading was used to assess progression of tibiofemoral OA.

**RESULTS:** Conversion to total knee arthroplasty was necessary in one patient within each group, leaving 14 patients per group for final evaluation. The mean follow-up was 26 months in the inlay group and 25 months in the onlay group (n.s.). Both groups displayed significant improvements of all clinical scores ( $p < 0.05$ ). No significant differences were found between the two groups with regard to the clinical outcome and reoperation rate. No significant progression of tibiofemoral OA was observed in the inlay group, whereas 53 % of the onlay group showed progression of medial and/or lateral tibiofemoral OA ( $p = 0.009$ ).

**CONCLUSION:** Isolated PFA using either a second-generation inlay or onlay trochlear component significantly improves functional outcome scores and pain. The theoretical advantages of an inlay design did not result in better clinical outcome scores; however, progression of tibiofemoral OA was significantly less common in patients with an inlay trochlear component. This implant design may therefore improve long-term results and survival rates after isolated PFA

#### QUOTE

“None of the patients in the inlay group showed progression of tibiofemoral OA. In contrast, the onlay group showed significant progression of tibiofemoral OA in the medial and lateral compartment, with 53 % of the patients showing progression of medial and/or lateral tibiofemoral OA.”

#### CONCLUSION

The theoretical advantages of an inlay design did not result in better clinical outcome scores compared to an onlay design. However, progression of tibiofemoral OA was significantly less common in patients with an inlay trochlear component.

Knee > Patellofemoral > Clinical Science

2015

## **Prospective Evaluation of Anatomic Patellofemoral Inlay Resurfacing: Clinical, Radiographic, and Sports-Related Results After 24 Months**

Imhoff AB, Feucht MJ, Meidinger G, Schöttle PB, Cotic M.

Knee Surg Sports Traumatol Arthrosc. 2015;23(5):1299-1307

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24310926>

### **SUMMARY**

To prospectively evaluate the clinical, radiographic, and sports-related outcomes at 24 months after isolated and combined patellofemoral inlay resurfacing (PFIR).

**METHODS:** Between 2009 and 2010, 29 consecutive patients with patellofemoral osteoarthritis (OA) were treated with the HemiCAP® Wave Patellofemoral Resurfacing System (Arthrosurface, Franklin, MA, USA). Based on preoperative findings, patients were divided into two groups: group I, isolated PFIR (n = 20); and group II, combined PFIR with concomitant procedures to address patellofemoral instability, patellofemoral malalignment, and tibiofemoral malalignment (n = 9). Patients were evaluated preoperatively and at 24 months postoperatively. Clinical outcomes included WOMAC, subjective IKDC, Pain VAS, Tegner activity score, and a self-designed sports questionnaire. Kellgren-Lawrence grading was used to assess progression of tibiofemoral OA. The Caton-Deschamps Index was used to assess differences in patellar height.

**RESULTS:** Twenty-seven patients (93 %) were available for 24-month follow-up. Eighty-one per cent of the patients were either satisfied or very satisfied with the overall outcome. Significant improvements in the WOMAC, subjective IKDC, and Pain VAS were seen in the overall patient cohort and in both subgroups. The median Tegner score and sports frequency showed a significant increase in the overall patient cohort and in group II. The number of sports disciplines increased significantly in both subgroups. No significant progression of tibiofemoral OA or changes in patellar height were observed.

**CONCLUSION:** Patellofemoral inlay resurfacing is an effective and safe procedure in patients with symptomatic patellofemoral OA. Significant improvements in functional scores and sports activity were found after both isolated and combined procedures.

## QUOTE

“Eight different implants with varying offsets and radii of curvature allow for a patient-specific geometry match.”

## CONCLUSION

Patellofemoral arthroplasty using the HemiCAP Wave Patellofemoral Resurfacing Prosthesis is an effective and safe procedure in patients with symptomatic patellofemoral OA. Significant improvements in functional scores and sporting activities were found after both isolated and combined procedures. Detailed preoperative assessment of the underlying condition should be paired with concomitant procedures if necessary.

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Knee > Patellofemoral > Clinical Science

2014

## Patellofemoral Resurfacing Arthroplasty in the Active Patient

Farr J, Grelsamer R, Imhoff A, van der Merwe W, Cotic M, Arendt E, Dahm D.

Springer, pp 131-150, 2014

Book Chapter

<http://link.springer.com/book/10.1007%2F978-1-4614-4157-1>

### SUMMARY

Middle-aged patients with advanced isolated patellofemoral (PF) chondrosis/arthrosis want to remain active. Unfortunately, most of these individuals are not good candidates for realignment alone with or without cartilage restoration. Historically, these patients might have been considered candidates for patellectomy, but long-term follow-up has pointed out the morbidity of that procedure, which makes it an unacceptable option for these patients. Some arthroplasty proponents consider total knee replacement (TKA) as the “gold standard” for treating isolated PF arthritis. However, TKA changes the kinematics of the knee and often limits knee flexion, leaving many patients unable to remain as active as their partial knee replacement counterparts; moreover, TKA carries the risk of loosening for which the only solution remains a major revision. While patellofemoral resurfacing arthroplasty (PFA) has been available as long as TKA, it has a checkered past as a treatment for isolated PF arthritis. Fortunately, with newer generation implants and the recognition of the surgical technique’s unique features, many patients have very satisfactory outcomes. In those satisfied patients, activity recommendations must be based both on what the knee can do kinematically and on what the PFA will tolerate from a wear and loosening standpoint. With current material and implant methods, patients must be cautioned to minimize component overload, which may result in polyethylene (when present) wear and loosening; however, activities that maintain cardiopulmonary fitness and general conditioning can generally be allowed.

### QUOTE

“The key for success of the procedure is to accurately differentiate between the indications for a combined or isolated procedure.”

### CONCLUSION

Compared to other implants, the advantage of this implant is its inlay design which fits optimally into the trochlea groove of the femur. By leaving the congruent surface of the trochlea, there will be less overstuffing compared to onlay implants, and thus there will be an anatomical surface with minimal friction in the patellofemoral joint involving reduced subchondral pressure.

Knee > Patellofemoral > Clinical Science

2014

## Operative Therapie der Isolierten Patellofemoralen Arthrose

Dirisamer F, Anderl C, Liebensteiner M, Hochreiter J

Orthopade. 2014, May;43(5):432-9.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24728300>

### SUMMARY

The treatment of patellofemoral arthritis places high demands on orthopedists. The exact analysis of the underlying pathobiomechanical relationships is the basis for every therapy decision.

**METHODS:** Soft tissue procedures, such as medial patellofemoral ligament (MPFL) reconstruction for stabilization and bone interventions for alignment optimization (e.g. tuberosity transfer and corrective osteotomy) can play a role in treatment. In cases of advanced patellofemoral arthrosis these interventions can be used as well as in combination with partial joint replacement. For the choice of implant the use of anatomical prosthesis types is recommended because with these components the number of additional procedures can be reduced.

**CONCLUSION:** The success of patellofemoral prosthetics depends mainly on the recognition of biomechanical deviations. If these can be corrected the risk of implant failure can be reduced.

### QUOTE

“Das Inlay Design ermooeglicht auch die individuelle Auswahl (intraoperatives Mapping) unterschiedlicher Kombinationen mediolateraler und sagittaler Implantatkrueemmungen.”

### CONCLUSION

Neben dem reinen Ersatz der defekten Gelenkoberflaeche mit einem Implantat ist die Korrektur begleitender pathobiomechanischer Faktoren entscheidend fuer den Therapieerfolg.

Knee &gt; Patellofemoral &gt; Clinical Science

2014

## Patellotrochlearer Ersatz

Cotic M, Imhoff AB

Orthopade. 2014 Oct;43(10):898-904.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25154928>

### SUMMARY

Although patellofemoral arthroplasty has been used for more than 30 years, it is still a challenging subject in orthopedics. The reason for this are the complex kinematics of the patellofemoral joint which are influenced by dynamic and static factors. New implant concepts that incorporate multiple coronal and sagittal curvatures and surface controlled inlay implantation show a positive direction in modern patellofemoral arthroplasty. The purpose of this work is the review of the literature on patellofemoral arthroplasty and the presentation of our own experience. We present indications and surgical techniques of patellofemoral arthroplasty as well as the most important aspects of preoperative evaluation. The patellofemoral joint can be reconstructed using either an inlay or an onlay prosthesis. Both arthroplasty concepts are discussed. Additional pathologies like chronic patellofemoral instabilities due to dysplasia, valgus/varus or rotational malalignment, and soft-tissue alterations are addressed with concomitant procedures. Both inlay and onlay arthroplasty have demonstrated good functional outcome scores in patients with patellofemoral osteoarthritis. Patients with patellofemoral instability and/or trochlear dysplasia may benefit more from patellofemoral arthroplasty than patients with primary osteoarthritis because not only pain but also secondary pathologies are addressed. Patellofemoral arthroplasty is an effective and safe procedure if the indication criteria are respected and the specific surgical technique is used. However, comparative results on current inlay and onlay prostheses have not been published in the literature to date.

### QUOTE

“Im Gegensatz zu einer Onlayprothese wird bei einer Inlayprothese die Trochlea nicht neu kreiert sondern alleinig die geschädigte Gelenkfläche ersetzt. Dadurch vermeidet man ein Overstuffing des patellofemorale Gelenks, da das Inlay der Gelenkoberfläche angepasst wird.”

### CONCLUSION

Der funktionelle Anspruch und das Alter des Patienten sollten in jede Indikationsplanung miteinbezogen werden. Bei Inlayprothesen ist eine geringere Knochenresektion nötig als bei Onlayprothesen. Inlayprothesen vermeiden ein patellotrochleares Overstuffing. Für die patellofemorale Arthrose verantwortliche Begleitpathologien sollten auf jeden Fall durch kombinierte Verfahren adressiert werden.

Knee > Patellofemoral > Clinical Science

2013

## **Focal Full Thickness Articular Cartilage Lesions Treated with an Articular Resurfacing Prosthesis in the Middle-Aged**

Hobbs H., Ketse-Matiwane N., van der Merwe W., Posthumus M.

SA Orthop J 2013,12(4):41-46.

Peer Review Article

[http://www.scielo.org.za/scielo.php?pid=S1681-150X2013000500008&script=sci\\_arttext](http://www.scielo.org.za/scielo.php?pid=S1681-150X2013000500008&script=sci_arttext)

### **SUMMARY**

**INTRODUCTION:** Localised full thickness articular defects of the knee are common and disabling in the middle-aged. There are numerous treatment options for articular defects, the results of which are unpredictable in this age group. The purpose of this study was to evaluate a focal articular resurfacing prosthesis used in the treatment of these defects. **METHODS:** A consecutive series of patients treated between 2005 and 2010 with a HemiCAP<sup>®</sup> resurfacing procedure were retrospectively reviewed. Follow-up scores of the KOOS, IKDC, SF-36 and patient satisfaction were obtained. Radiographic evaluation was also obtained. **RESULTS:** Twenty-two patients met the inclusion criteria. Nineteen patients were followed-up 4.7 ± 5.9 years after surgery. Three patients had revision surgery and were not followed up. The patients were 44.7 ± 5.9 years old. The follow-up KOOS scores demonstrated comparable scores on the pain and activities of daily living sub-scales when compared to normative data; however, the sports (P<0.001) and quality of life (P=0.001) sub-scales scores were lower in the HemiCAP<sup>®</sup> patients when compared to normative data. Only the physical functioning sub-scale score of the SF-36, and not the other seven sub-scale scores, was lower (P=0.016) in the HemiCAP<sup>®</sup> patients when compared to normative data. General patient satisfaction revealed that 79% considered their result as very good or excellent. **CONCLUSION:** HemiCAP<sup>®</sup> articular resurfacing is an effective treatment option for pain in the middle-aged patient with a focal articular cartilage defect in the knee.

### **QUOTE**

“The HemiCAP<sup>®</sup> focal isolated articular resurfacing procedure is proving to be a novel and successful treatment for middle-aged patients with focal full thickness cartilage lesions.”

### **CONCLUSION**

Results reported here, as well as previously published data, demonstrate that this treatment may bridge the gap between biological healing and conventional arthroplasty. An additional benefit of the use of the HemiCAP<sup>®</sup> articular resurfacing procedure is that it does not compromise or affect further surgery, if required in the future.



Knee &gt; Patellofemoral &gt; Clinical Science

2010

## Therapie der Patellofemoralen Arthrose beim jungen Patienten

Schöttle PB., Latterman C.

Arthroskopie Volume 23, Number 3, 215-223

Peer Review Article

<http://www.springerlink.com/content/m33924r383r62273/>

### SUMMARY

The treatment of patellofemoral arthritis (PFA) is still challenging even today. The etiology of PFA in particular is less clearly defined than arthritic diseases of other joints. Isolated PFA can be due many different pathomorphologies which can lead to the complete symptoms of PFA alone or in combination. As a rule the degeneration is caused by simple local trauma or by continuous overload or misalignment. Therefore, a targeted diagnostic concerning the localization and the etiology has to be performed. In comparison to a generalized arthrosis, isolated patellofemoral arthritis might develop in a different manner and compared to other regions of the knee joint patellofemoral degeneration has an atraumatic origin in most cases. Therefore, the variety of chondral treatments successfully used in other joints show different outcomes in the patellofemoral joint. As there are no studies which investigated either the therapy of cartilage defects in correlation to the pathomorphology or investigated combined techniques, a gold standard for the treatment of focal arthritis and its causes has not yet been found. However, to achieve satisfying results it is necessary to treat not only the cartilaginous or osteochondral defects but also the underlying pathomorphology. Therefore, even in young patients with severe patellofemoral degeneration due to trochlear dysplasia with permanent patellar dislocation and hyperpression, it would be justified to implant a patellofemoral prosthesis. Hereditary dysplasia of the trochlea can be rectified so that instability and degeneration can be corrected simultaneously. In summary, the optimal treatment depends on the extent and localization of the cartilage defect. Except for direct defects of the cartilage caused by trauma, an additional intervention to treat the causing factor has to be considered to adjust the alignment and tracking of the patellofemoral joint and therefore lower a non-physiological pressure.

## QUOTE

“Dabei wird die Prothese entsprechend der Trochleakrümmung und -tiefe gewählt und der Knochen nicht gesägt, sondern die Defektzone gefräst. Somit ist ein Overstuffing nicht mehr wahrscheinlich und die Gefahr eines postoperativen Schmerzsyndroms und einer Bewegungseinschränkung deutlich geringer.”

## CONCLUSION

Es kann festgestellt werden, dass beim Ersatz des patellären Gleitlagers das Verwenden einer physiologischen Form deutlich bessere Ergebnisse erzielt und dass Patienten mit instabilitätsbedingten Arthrosen mit der Implantation deutlich zufriedener sind, da nicht nur die Schmerzen, sondern in den meisten Fällen auch die Instabilität durch die Schaffung eines zuvor nur minder ausgebildeten Gleitlagers behoben werden. Bei einem massiven Malalignment muss jedoch neben der Therapie des Knorpels auch die ossäre Morphologie berücksichtigt und in Form von Osteotomien behoben werden, um ähnlich wie bei der Ätiologie des Knorpelschadens keine zu hohen Drücke und damit eine verfrühte Lockerung des Oberflächenersatzes zu riskieren

Knee > Patellofemoral > Clinical Science

2008

## **Focal Anatomic Patellofemoral Inlay Resurfacing: Theoretic Basis, Surgical Technique, and Case Reports**

Davidson PA, Rivenburgh D.

Orthop Clin North Am. 2008 Jul;39(3):337-46, vi.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/18602562>

### **SUMMARY**

Prosthetic patellofemoral inlay resurfacing is a novel treatment concept for degenerative and focal arthrosis of the patellofemoral joint. The theoretic basis of this type of arthroplasty entails recreating ambient anatomy based upon intraoperative topographic mapping. The implant is intrinsically stable by virtue of the inset position relative to the surrounding joint surface. Articular resurfacing, rather than traditional replacement arthroplasty, represents an extension of the concepts of biologic joint restoration. Early results have shown great efficacy. This surgery may be appropriate for a wide variety of indications, including younger patients and those with focal patellofemoral disease concurrent with morphologic or alignment abnormalities.

### **QUOTE**

“The HemiCAP resurfacing platform technology ... reflects a new paradigm in joint resurfacing, based on intraoperative joint surface mapping, making use of a corresponding patient specific implant.”

### **CONCLUSION**

This system allows for restoration of complex geometric surfaces in a variety of morphologic and pathologic states.

Knee > Patellofemoral > Clinical Science

2008

## **Patellofemoral Resurfacing Arthroplasty: Literature Review and Description of a Novel Technique**

Cannon A, Stolley M, Wolf B, Amendola A.

Iowa Orthop J. 2008;28:42-8. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/19223947>

### **SUMMARY**

There are a variety of operative and non operative modalities that can be used to address patellofemoral pain secondary to arthrosis. Patellofemoral Arthroplasty (PFA) is one of the latest alternatives designed to address the pain caused by severe, isolated osteoarthritis (OA) of the patellofemoral joint (PFJ). in the past, PFA has experienced variable success rates, and as a result many surgeons prefer Total Knee Arthroplasty. Arthrosurface, Inc. (Patellofemoral HemiCAP) has developed a new, minimally invasive, anatomic resurfacing technique with advantages to the performance of the traditional PFA components that may provide more consistent success rates. this paper outlines the surgical procedure for the patellofemoral HemiCAP for isolated PF arthrosis.

### **QUOTE**

“The advantage of this technique is to perform an anatomical resurfacing by minimizing the amount of bone resection, replacing the degenerative component of the joint and maintain the normal mechanics of the joint.”

### **CONCLUSION**

The Arthrosurface HemiCAP provides a limited resurfacing technique that allows immediate rehabilitation, and a return to activity as tolerated. If there is progression of tibiofemoral arthrosis and a TKA is required, this implant can be easily revised as a primary procedure without compromise of the bony preparation for the TKA.

Knee > Cartilage Repair > Clinical Science

2015

## **Nanofractured autologous matrixinduced chondrogenesis (NAMIC<sup>®</sup>) - Further development of collagen membrane aided chondrogenesis combined with subchondral needling: A technical note.**

Benthien JP, Behrens P

Knee. 2015 Oct;22(5):411-5.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/26190333>

### **SUMMARY**

**PURPOSE:** This technical note introduces a further development of the autologous matrix induced chondrogenesis (AMIC<sup>®</sup>) technology for regenerative surgery of cartilage defects considering latest data in the literature. The potential of subchondral mesenchymal stem cell stimulation for cartilage repair is combined with a membrane technique to enhance efficiency of cartilage regeneration. The nanofractured autologous matrixinduced chondrogenesis (NAMIC<sup>®</sup>) procedure is suitable for the knee, hip, ankle, shoulder and elbow joints.

**METHODS:** A standardized subchondral needling procedure (nanofracturing) is combined with fixation of a collagen I/III membrane to regenerate cartilage defects. Its advantages over microfracturing are smaller holes, deeper perforation into the subchondral space, a standardized procedure and earlier rehabilitation of the patient. The collagen membrane protects the blood clot forming after nanofracturing. The NAMIC<sup>®</sup> procedure may be performed arthroscopically alone, or in a combined arthroscopic setting with a mini-arthrotomy.

**RESULTS:** This is a further development of the AMIC<sup>®</sup> technology which allows earlier rehabilitation of the patient. The procedure is standardized. Early clinical results are encouraging. Nevertheless, caution is advised in the evaluation of this method as in that of any cartilage regenerating method.

**CONCLUSION:** The development of standardized subchondral regenerative procedures is important as only reliable clinical studies will give non-biased results. The NAMIC<sup>®</sup> procedure and the nanofracturing associated with it could be a promising step. As the rehabilitation period may be significantly shortened there is an earlier re-integration of the patient into the working life as compared to the AMIC<sup>®</sup> procedure.

## QUOTE

“Nanostructuring is performed, keeping in mind that each hole has a defined length of nine millimeters and a diameter of one millimeter.”

## CONCLUSION

The NAMIC© procedure further develops the collagen membrane induced chondrogenesis procedures (AMIC©). Small holes in combination with subchondral needling and a stable, reliable membrane could provide a method to achieve reproducible results and a standardized procedure. The latest theoretical results in cartilage regeneration in the literature seem to confirm this further development. The postoperative rehabilitation is shortened by 2/3 as compared to the traditional AMIC© procedure. First results are encouraging and compared well to the AMIC© procedure.

Knee > Cartilage Repair > Clinical Science

2013

## **Intraoperative Biologische Augmentation am Knorpel**

Behrens P., Varoga D., Niemeyer P., Salzmann G.

Arthroskopie May 2013, Volume 26, Issue 2, pp 114-122

Peer Review Article

<http://link.springer.com/article/10.1007/s00142-012-0737-5>

### **SUMMARY**

The scientific evidence for local cartilage repair techniques has significantly improved in recent years; however, there is still no consensus on the best possible therapeutic approach. Compared to two-stage therapy, single-stage procedures inherently have medical and socioeconomic benefits that play an important role in determining the future of cartilage repair. The goal of this manuscript is to provide an overview on single-stage augmentation procedures for the treatment of isolated cartilage defects of the knee. All techniques share the common principle of stimulating the regeneration capacity through biological augmentation.

### **QUOTE**

“Somit besteht eine tiefere, standardisierte subchondrale Markraumeröffnung ohne thermische Schädigung.”

### **CONCLUSION**

Die Nanofrakturierung mit der Einmalnadel bietet hierbei eine konsistente und bessere Platzierung der subchondralen Kanäle im Defektbereich.

Knee > Cartilage Repair > Clinical Science

2013

## Reviewing Subchondral Cartilage Surgery: Considerations for Standardised and Outcome Predictable Cartilage Remodelling

Benthien JP, Behrens P.

Int Orthop. 2013 Nov;37(11):2139-45.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/23917852>

### SUMMARY

The potential of subchondral mesenchymal stem cell stimulation (MSS) for cartilage repair has led to the widespread use of microfracture as a first line treatment for full thickness articular cartilage defects. Recent focus on the effects of subchondral bone during cartilage injury and repair has expanded the understanding of the strengths and limitations in MSS and opened new pathways for potential improvement. Comparative studies have shown that bone marrow access has positive implications for pluripotential cell recruitment, repair quality and quantity, i.e. deeper channels elicited better cartilage fill, more hyaline cartilage character with higher type II collagen content and lower type I collagen content compared to shallow marrow access. **METHODS:** A subchondral needling procedure using standardised and thin subchondral perforations deep into the subarticular bone marrow making the MSS more consistent with the latest developments in subchondral cartilage remodelling is proposed. **RESULTS:** As this is a novel method clinical studies have been initiated to evaluate the procedure especially compared to microfracturing. However, the first case studies and follow-ups indicate that specific drills facilitate reaching the subchondral bone marrow while the needle size makes perforation of the subchondral bone easier and more predictable. Clinical results of the first group of patients seem to compare well to microfracturing. **CONCLUSION:** The authors suggest a new method for a standardised procedure using a new perforating device. Advances in MSS by subchondral bone marrow perforation are discussed. It remains to be determined by clinical studies how this method compares to microfracturing. The subchondral needling offers the surgeon and the investigator a method that facilitates comparison studies because of its defined depth of subchondral penetration and needle size.

### QUOTE

“Consistent needle diameter and a smaller perforation footprint introduces less trauma to the subchondral bone plate and subarticular bone marrow.”

### CONCLUSION

Microfracture's shortcomings such as shallow marrow access, inconsistent depth, large diameter perforation, and intra-channel bone compaction have implications for quantity and quality of cartilage repair, subchondral bone stability, and rehabilitation requirements. Deeper marrow access with its improvement of cartilage character and volume provides a new direction. Thin, stop-controlled, deep needle perforation without associated thermal injury allows for a systematic and less traumatic treatment approach and benchmark testing in future clinical investigations.



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## IV. Foot & Ankle

**Jack**

Bi-lateral HemiCAP

Toe Patient



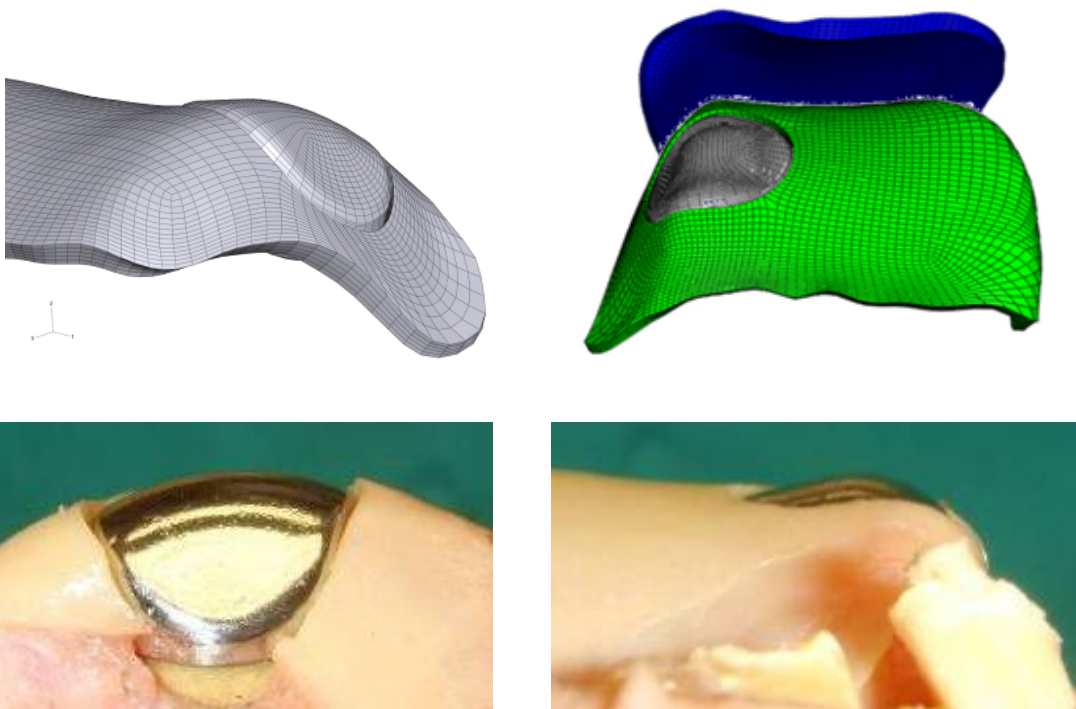
## A. Ankle



# 1. Ankle Publication Summaries

## Basic Science

Two articles reported original results from HemiCAP basic science studies of the talus; one additional publication referenced earlier results. All investigations resulted in positive findings and conclusions and described the implant as a stable solution that restores joint contour and joint biomechanics while preventing excessive implant pressure.



Foot & Ankle > Talus > Basic Science

2013

## **Current concepts: tissue engineering and regenerative medicine applications in the ankle joint**

Correia SI, Pereira H, Silva-Correia J, Van Dijk CN, Espregueira-Mendes J, Oliveira JM, Reis RL.

J R Soc Interface. 2013 Dec, 18;11(92):20130784.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/24352667>

### **SUMMARY**

Tissue engineering and regenerative medicine (TERM) has caused a revolution in present and future trends of medicine and surgery. In different tissues, advanced TERM approaches bring new therapeutic possibilities in general population as well as in young patients and high-level athletes, improving restoration of biological functions and rehabilitation. The mainstream components required to obtain a functional regeneration of tissues may include biodegradable scaffolds, drugs or growth factors and different cell types (either autologous or heterologous) that can be cultured in bioreactor systems (in vitro) prior to implantation into the patient. Particularly in the ankle, which is subject to many different injuries (e.g. acute, chronic, traumatic and degenerative), there is still no definitive and feasible answer to 'conventional' methods. This review aims to provide current concepts of TERM applications to ankle injuries under preclinical and/or clinical research applied to skin, tendon, bone and cartilage problems. A particular attention has been given to biomaterial design and scaffold processing with potential use in osteochondral ankle lesions.

### **QUOTE**

“Concerning focal defects, a non-biological solution developed by van Dijk's group presented promising results by means of contoured focal metallic replacement.”

### **CONCLUSION**

Injured subchondral bone, as in OCDs, is less effective in supporting the overlying cartilage, and this might be one of the reasons explaining the greater difficulty for cartilage repair in these situations.



Foot & Ankle > Talus > Basic Science

2010

## **Effect of Implantation Accuracy on Ankle Contact Mechanics with a Metallic Focal Resurfacing Implant**

Anderson D, Tochigi Y, Rudert J, Vaseenon T, Bron T, Amendola A.

J Bone Joint Surg Am, 2010 June, 1490-1500

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/20516325>

### **SUMMARY**

**BACKGROUND:** Talar osteochondral defects can lead to joint degeneration. Focal resurfacing with a metallic implant has shown promise in other joints. We studied the effect of implantation accuracy on ankle contact mechanics after focal resurfacing of a defect in the talar dome.

**METHODS:** Static loading of seven cadaver ankles was performed before and after creation of a 15-mm-diameter osteochondral defect on the talar dome, and joint contact stresses were measured. The defect was then resurfaced with a metallic implant, with use of a custom implant-bone interface fixture that allowed fine control (in 0.25-mm steps) of implantation height. Stress measurements were repeated at heights of -0.5 to +0.5 mm relative to an as-implanted reference. Finite element analysis was used to determine the effect of implant height, post axis rotation, and valgus/varus tilt over a motion duty cycle.

**RESULTS:** With the untreated defect, there was a 20% reduction in contact area and a 40% increase in peak contact stress, as well as a shift in the location of the most highly loaded region, as compared with the values in the intact condition. Resurfacing led to recovery of 90% of the contact area that had been measured in the intact specimen, but the peak contact stresses remained elevated. With the implant 0.25 mm proud, peak contact stress was 220% of that in the intact specimen. The results of the finite element analyses agreed closely with those of the experiments and additionally showed substantial variations in defect influences on contact stresses across the motion arc. Talar internal/external rotations also differed for the unfilled defect. Focal implant resurfacing substantially restored kinematics but did not restore the stresses to the levels in the intact specimens.

**CONCLUSIONS:** Focal resurfacing with a metallic implant appears to have the potential to restore normal joint mechanics in ankles with a large talar osteochondral defect. However, contact stresses were found to be highly sensitive to implant positioning.



#### QUOTE

“Resurfacing a talar osteochondral defect with an implant that restores the joint contour, that provides immediate stability, and that reproduces normal joint mechanics, without requiring biological potential, offers advantages over existing resurfacing techniques.”

#### CONCLUSION

In conclusion, focal resurfacing with a metallic implant appears to hold promise as a means to restore more quasiphysiologic contact mechanics in ankles with a large talar osteochondral defect, appreciably reducing biomechanical aberrations presumed to be responsible for whole-joint cartilage degeneration.

Foot & Ankle > Talus > Basic Science

2010

## **Novel Metallic Implantation Technique for Osteochondral Defects of the Medial Talar Dome: A Cadaver Study**

van Bergen CJ., Zengerink M., Blankevoort L., van Sterkenburg MN., van Oldenrijk J., van Dijk CN.

Acta Orthop. 2010 Aug;81(4):495-502.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20515434>

### **SUMMARY**

**BACKGROUND AND PURPOSE:** A metallic inlay implant (HemiCAP) with 15 offset sizes has been developed for the treatment of localized osteochondral defects of the medial talar dome. The aim of this study was to test the following hypotheses: (1) a matching offset size is available for each talus, (2) the prosthetic device can be reproducibly implanted slightly recessed in relation to the talar cartilage level, and (3) with this implantation level, excessive contact pressures on the opposite tibial cartilage are avoided.

**METHODS:** The prosthetic device was implanted in 11 intact fresh-frozen human cadaver ankles, aiming its surface 0.5 mm below cartilage level. The implantation level was measured at 4 margins of each implant. Intraarticular contact pressures were measured before and after implantation, with compressive forces of 1,000-2,000 N and the ankle joint in plantigrade position, 10 dorsiflexion, and 14 plantar flexion.

**RESULTS:** There was a matching offset size available for each specimen. The mean implantation level was 0.45 (SD 0.18) mm below the cartilage surface. The defect area accounted for a median of 3% (0.02-18) of the total ankle contact pressure before implantation. This was reduced to 0.1% (0.02-13) after prosthetic implantation.

**INTERPRETATION:** These results suggest that the implant can be applied clinically in a safe way, with appropriate offset sizes for various talar domes and without excessive pressure on the opposite cartilage.

### **QUOTE**

“Our study shows that accurate and reproducible implantation of this novel metallic implant can be achieved, preventing excessive prosthetic pressure.”

### **CONCLUSION**

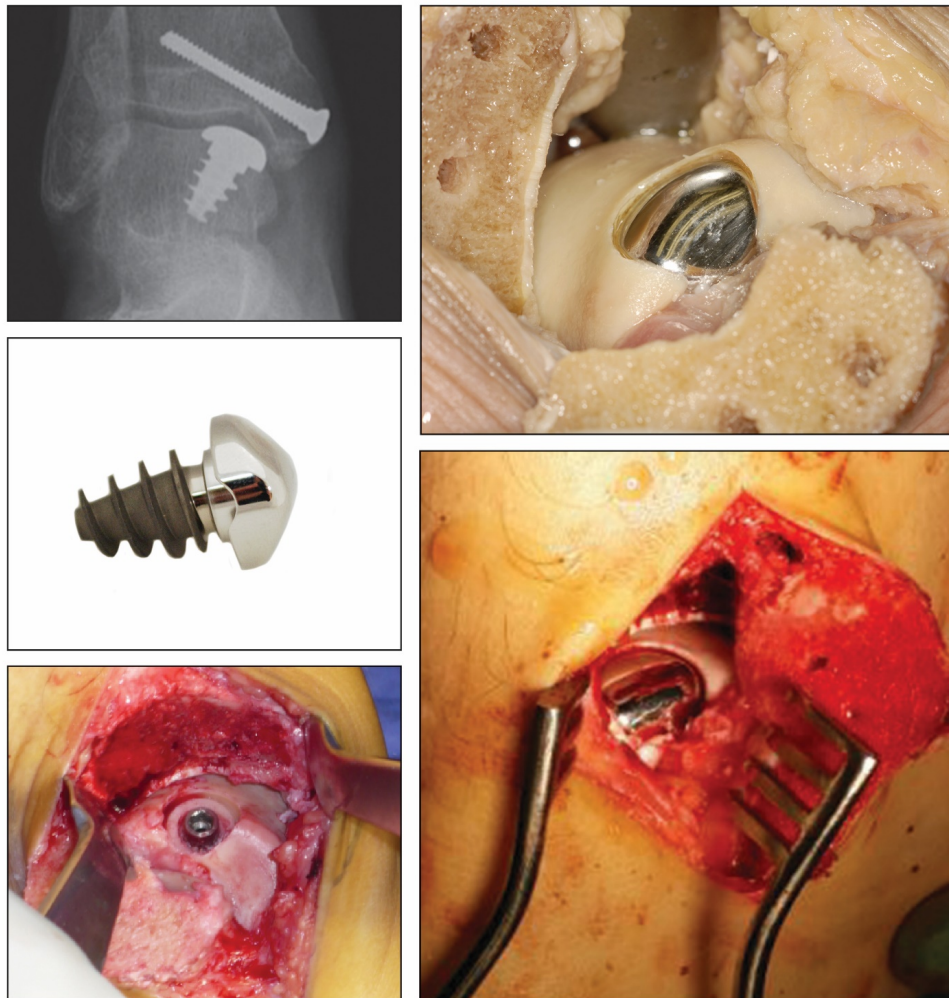
The results suggest that the implant can be used clinically in a safe way, but the effectiveness and safety of this treatment option should be evaluated in a clinical study.

## Clinical Science

Focal HemiCAP Talus Resurfacing presents a unique arthroplasty solution for patients with unmet needs: According to a meta-analysis published by Zengerink et al. (1), 76% of primary biological procedures are successful; however, 24% of patients fail these procedures and present a clinical challenge. HemiCAP resurfacing extends the local treatment into revision procedures and avoids an ankle fusion or total ankle arthroplasty. At the same time, these late stage options are preserved for the future. The international HemiCAP experience since 2007 has been very positive. Arthrosurface is currently working with FDA to make Talus HemiCAP resurfacing available for US patients.

Across the vast majority of publications, significant outcomes improvement and/or early return to sport were reported in patients with secondary or tertiary focal interventions using HemiCAP Inlay Arthroplasty.

1) Treatment of osteochondral lesions of the talus: a systematic review. Maartje Zengerink, Peter A. A. Struijs, Johannes L. Tol, Cornelis Niek van Dijk. *Knee Surg Sports Traumatol Arthrosc.* 2010 February; 18(2): 238–246.



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Foot & Ankle > Talus > Clinical Science

2016

## **Effects of Pulsed Electromagnetic Fields on Return to Sports After Arthroscopic Debridement and Microfracture of Osteochondral Talar Defects: A Randomized, Double-Blind, Placebo-Controlled, Multicenter Trial.**

Reilingh ML, van Bergen CJ, Gerards RM, van Eekeren IC, de Haan RJ, Sierevelt IN, Kerkhoffs GM, Krips R, Meuffels DE, van Dijk CN, Blankevoort L.

Am J Sports Med. 2016 Feb 22. pii:0363546515626544.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/?term=26903214>

### **SUMMARY**

**Background:** Osteochondral defects (OCDs) of the talus usually affect athletic patients. The primary surgical treatment consists of arthroscopic debridement and microfracture. Various possibilities have been suggested to improve the recovery process after debridement and microfracture. A potential solution to obtain this goal is the application of pulsed electromagnetic fields (PEMFs), which stimulate the repair process of bone and cartilage.

**Hypothesis:** The use of PEMFs after arthroscopic debridement and microfracture of an OCD of the talus leads to earlier resumption of sports and an increased number of patients that resume sports.

**Study Design:** Randomized controlled trial; Level of evidence, 1.

**Methods:** A total of 68 patients were randomized to receive either PEMFs (n = 36) or placebo (n = 32) after arthroscopic treatment of an OCD of the talus. The primary outcomes (ie, the number of patients who resumed sports and time to resumption of sports) were analyzed with Kaplan-Meier curves as well as Mann-Whitney U, chi-square, and log-rank tests. Secondary functional outcomes were assessed with questionnaires (American Orthopaedic Foot and Ankle Society ankle-hindfoot score, Foot and Ankle Outcome Score, EuroQol, and numeric rating scales for pain and satisfaction) at multiple time points up to 1-year follow-up. To assess bone repair, computed tomography scans were obtained at 2 weeks and 1 year postoperatively.

**Results:** Almost all outcome measures improved significantly in both groups. The percentage of sport resumption (PEMF, 79%; placebo, 80%;  $P = .95$ ) and median time to sport resumption (PEMF, 17 weeks; placebo, 16 weeks;  $P = .69$ ) did not differ significantly between the treatment groups. Likewise, there were no significant between-group differences with regard to the secondary functional outcomes and the computed tomography results.

**Conclusion:** PEMF does not lead to a higher percentage of patients who resume sports or to earlier resumption of sports after arthroscopic debridement and microfracture of talar OCDs. Furthermore, no differences were found in bone repair between groups.

#### QUOTE

“I patient reported postoperative paresthesia of the dorsum of the foot and persistent deep ankle pain after a new distortion at 4-month follow-up. This patient was treated with a HemiCAP.”

#### CONCLUSION

In conclusion, applying PEMFs after arthroscopic debridement and microfracture of an OCD of the talus does not lead to earlier resumption of sports or to a higher percentage of patients who resume sports. Furthermore, PEMFs do not lead to functional and radiologic improvements up to 1-year follow-up.

Foot &amp; Ankle &gt; Talus &gt; Clinical Science

2015

## Computed tomography analysis of osteochondral defects of the talus after arthroscopic debridement and microfracture.

Reilingh ML, van Bergen CJ, Blankevoort L, Gerards RM, van Eekeren IC, Kerkhoffs GM, van Dijk CN.

Knee Surg Sports Traumatol Arthrosc. 2015 Dec 28.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26713327>

### SUMMARY

**PURPOSE:** The primary surgical treatment of osteochondral defects (OCD) of the talus is arthroscopic debridement and microfracture. Healing of the subchondral bone is important because it affects cartilage repair and thus plays a role in pathogenesis of osteoarthritis. The purpose of this study was to evaluate the dimensional changes and bony healing of talar OCDs after arthroscopic debridement and microfracture.

**METHODS:** Fifty-eight patients with a talar OCD were treated with arthroscopic debridement and microfracture. Computed tomography (CT) scans were obtained at baseline, 2 weeks postoperatively, and 1 year postoperatively. Three-dimensional changes and bony healing were analysed on CT scans. Additionally, clinical outcome was measured with the American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score and numeric rating scales (NRS) for pain.

**RESULTS:** Average OCD size increased significantly ( $p < 0.001$ ) in all directions from  $8.6$  (SD  $3.6$ )  $\times$   $6.3$  (SD  $2.6$ )  $\times$   $4.8$  (SD  $2.3$ ) mm (anterior-posterior  $\times$  medial-lateral  $\times$  depth) preoperatively to  $11.3$  (SD  $3.4$ )  $\times$   $7.9$  (SD  $2.8$ )  $\times$   $5.8$  (SD  $2.3$ ) mm 2 weeks postoperatively. At 1-year follow-up, average defect size was  $8.3$  (SD  $4.2$ )  $\times$   $5.7$  (SD  $3.0$ )  $\times$   $3.6$  (SD  $2.4$ ) mm. Only average defect depth decreased significantly ( $p < 0.001$ ) from preoperative to 1 year postoperative. Fourteen of the 58 OCDs were well healed. No significant differences in the AOFAS and NRS-pain were found between the well and poorly healed OCDs.

**CONCLUSION:** Arthroscopic debridement and microfracture of a talar OCD leads to an increased defect size on the direct postoperative CT scan but restores at 1-year follow-up. Only fourteen of the 58 OCDs were filled up completely, but no differences were found between the clinical outcomes and defect healing at 1-year follow-up.

### QUOTE

“One patient did not undergo the final CT scan as she underwent a HemiCAP<sup>®</sup> procedure during follow-up because of persisted deep ankle pain.”

### CONCLUSION

n/a

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Foot & Ankle > Talus > Clinical Science

2015

## **Treatment of Osteochondral Lesions of the Talus With Bone Marrow Stimulation and Chitosan–Glycerol Phosphate/Blood Implants (BST-CarGel)**

Vilá Y Rico J, Dalmau A, Chaqués FJ, Asunción J

Arthroscopy Tech 2015;4(6): e663-667

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=26870643>

### **SUMMARY**

Bone marrow stimulation (BMS) techniques represent the first-line treatment for unstable osteochondral lesions of the talus or after conservative treatment failure. These techniques are intended to penetrate the subchondral bone to elicit bleeding and allow precursor cells and cytokines from bone marrow to populate the lesion. However, the fibrocartilaginous repair tissue arising after marrow stimulation confers inferior mechanical and biological properties compared with the original hyaline cartilage. The limitations of BMS can be overcome by the use of the soluble chitosan-based polymer BST-CarGel (Piramal Life Sciences, Laval, Quebec, Canada). When mixed with freshly drawn autologous whole blood and applied to a lesion surgically prepared by BMS, BST-CarGel acts as a natural bioscaffold that increases the quantity and improves the residency of the blood clot formed in the cartilage lesion, enhancing the local healing response. The use of BST-CarGel has been previously described in the knee and hip joints with successful results. We describe the arthroscopic technique for BST-CarGel application in combination with BMS techniques for the treatment of osteochondral lesions of the talus.

### **QUOTE**

“Although both nanofracture and standard microfracture can be used to reach the marrow cells, we strongly recommend using the less invasive nanofracture. A nanofracture technique produces smaller and deeper holes, disrupting less surface area and penetrating deeper to reach the bone marrow. This will ultimately result in an increase in cell recruitment, which may positively influence the outcome of the cartilage repair.”

### **CONCLUSION**

Nanofracture is performed with an Arthrosurface NanoFx instrument (Arthrosurface, Franklin, MA), producing standardized holes measuring 1 mm in radius and 9 mm in depth. To confirm that BMS has been performed adequately, fat droplets and blood emerging from the subchondral bone should ideally be observed after reduction of the irrigation pressure.

Foot & Ankle > Talus > Clinical Science

2015

## Arthroscopy of the Ankle: New Approaches

Roche AJ, Calder JD

Sports Injuries pp1683-1700

Book Chapter

[http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36569-0\\_141#page-1](http://link.springer.com/referenceworkentry/10.1007%2F978-3-642-36569-0_141#page-1)

### SUMMARY

The practice of ankle arthroscopy is constantly evolving. The very nature of the techniques generated and the published literature available mean that surgical procedures can often gain and lose popularity among surgeons in equal measures and directly influence their practices worldwide. This chapter aims to educate the reader on current techniques being generated around ankle arthroscopy but also to provide balanced opinions based on clinical expertise and the evidence-based medicine available. It may not be an exhaustive appraisal of every technique but focuses on major conditions and procedures performed. It is possible that in 5 years, techniques may change again for newer discoveries or revert back to more established methods, the classic example being the original Broström procedure. The generation of diverse biomaterials can lead to technique changes that are not applicable to every surgeon due to practicing laws in certain countries, but despite these restrictions, it is hoped that readers will find the content beneficial.

### QUOTE

“The use of HemiCAP<sup>®</sup> resurfacing implants (Arthrosurface Inc., Franklin, MA ...”

### CONCLUSION

n/a



Foot & Ankle > Talus > Clinical Science

2014

## Arthrosurfacing in Talar Osteochondral Lesions

Doral MN, Huri G, Turhan E, Dönmez G, Kaya D

Sports Injuries. Springer 2014, pp 1-11

Book Chapter

[http://link.springer.com/referenceworkentry/10.1007/978-3-642-36801-1\\_145-1](http://link.springer.com/referenceworkentry/10.1007/978-3-642-36801-1_145-1)

### SUMMARY

Osteochondral lesions of the talus (OLT) are frequently challenging problems for orthopaedic surgeons. Although the talar cartilage has remarkable stiffness to compression and elasticity, it is susceptible to injury and has limited regenerative capability. The treatment strategy mainly is based on classification, diameter, stage, and depth of the lesion as well as patients' age and level of activity, presence of kissing lesions, and lower limb alignment. Debridement, curettage, antegrade/retrograde drilling, microfracture, and mosaicplasty are the most frequently used treatments for osteochondral talar lesions.

### QUOTE

"Resurfacing of talar osteochondral defects is a promising option, especially for revision cases."

### CONCLUSION

It restores joint congruency, improves immediate stability of ankle, allows early rehabilitation, and reproduces normal joint mechanics.

Foot & Ankle > Talus > Clinical Science

2014

## **Osteochondral Lesions. HemiCAP Implantation**

van Dijk CN

Ankle Arthroscopy. Osteochondral Lesions. Chapter 8, Springer 2014, pp 176-180

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-35989-7\\_8](http://link.springer.com/chapter/10.1007/978-3-642-35989-7_8)

### **SUMMARY**

A patient with OCD typically experiences deep ankle pain on or after activity. This chapter describes the cause of this pain. For diagnosis, additional diagnostics are often needed. The preferred diagnostic strategy is mentioned. For treatment, the most important treatment options are described in detail. It concerns debridement and bone marrow stimulation for primary lesions of <15 mm. Retrograde drilling is for large cystic lesions. Fixation is for large osteochondral defects (> 15 mm in size). Osteochondral transplants, calcaneal osteotomy, and application of a HemiCAP are considered for treatment of secondary osteochondral defects.

### **QUOTE**

“In case primary treatment fails, one of the options is to insert a metal implant (HemiCAP®, Arthrosurface Inc., Franklin, MA). This treatment option is the preferred treatment for secondary or larger lesions. We treat lesions up to 2 cm with this method.”

### **CONCLUSION**

To determine the radius of the talar curvature, a contact probe is used to measure four indexing points. A matching offset size of the articular component is chosen and a trial cap is placed for final verification of proper fit. The surface of the trial cap must be slightly below the articular cartilage surface. If satisfied, the articular component is placed and aligned. With a slight tap, the taper interlock is engaged.

Foot & Ankle > Talus > Clinical Science

2014

## **Osteochondral Lesions of the Talus (O.L.T.) Metallic Inlay Implants**

Parker L, Goldberg AJ, Singh D

European Surgical Orthopaedics and Traumatology. The EFORT Textbook. Springer 2014, pp 3731

Book Chapter  
[http://link.springer.com/referenceworkentry/10.1007/978-3-642-34746-7\\_252](http://link.springer.com/referenceworkentry/10.1007/978-3-642-34746-7_252)

### **SUMMARY**

Osteochondral lesions of the talus are a challenging entity for the Orthopaedic surgeon. Here we present an overview of the pathophysiology, presentation, classification, and treatment strategies employed in their management.

### **QUOTE**

Online access pending

### **CONCLUSION**

Online access pending

Foot & Ankle > Talus > Clinical Science

2014

## **Preoperative Planning for Osteochondral Defects**

van Eekeren IC, Kievit AJ, van Dijk CN

Talar Osteochondral Defects. Chapter 6. Springer 2014, pp 51-54

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-45097-6\\_6](http://link.springer.com/chapter/10.1007/978-3-642-45097-6_6)

### **SUMMARY**

For operative treatment of talar osteochondral defects (OCD), several surgical treatment options are available. Each surgical technique has its specific indication. Debridement and bone marrow stimulation is the first treatment of choice in primary defects <15 mm in diameter. Large cystic lesions can be treated by retrograde drilling. Fixation is for large lesions, most often posttraumatic. Secondary treatment options are osteochondral autograft transfer (OATS), HemiCAP, and autologous chondrocyte implantation (ACI). In case of malalignment, a sliding calcaneal osteotomy can be indicated. For each treatment, a careful preoperative planning is needed.

### **QUOTE**

“For secondary lesions, OATS, HemiCAP, allograft, or ACI can be indicated depending on the location of the lesion, preference, and experience of the surgeon.”

### **CONCLUSION**

For preoperative planning, however, a CT scan is preferred, because it visualizes the exact location and size of the lesion. A CT is required for size and location, and curvature of the talus can be checked by a 3D reconstruction. Specific for the OATS procedure, it is important to check the ipsilateral knee for any pathology. An allograft has to be matched before operation, while the exact fit of a metal implant and OATS are determined intraoperatively.

Foot & Ankle > Talus > Clinical Science

2014

## Return to Sports

van Eekeren IC, van Dijk CN

Talar Osteochondral Defects. Chapter 13. Springer 2014, pp 113-118

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-45097-6\\_13](http://link.springer.com/chapter/10.1007/978-3-642-45097-6_13)

### SUMMARY

Osteochondral defects (OCD) of the talus often occur after traumatic sprains of the ankle [35]. These lesions can have a severe impact on the quality of life [23, 35]. In case of persisting symptoms, treatment by means of excision and bone marrow stimulation (ECBS) is the gold standard [29]. The primary focus of the rehabilitation after ECBS of an osteochondral defect in the talus is to return to the pre-injury activity level. For athletes, the time in which they can return to pre-injury activity level is also important.

### QUOTE

“After placement of a metal implant by means of an osteotomy of the medial malleolus, patients are kept in a plaster non-weight-bearing cast for 1 or 2 weeks. This is continued with a functional brace for 4–5 weeks. The total period of nonweight-bearing is 6 weeks.”

### CONCLUSION

The average time to return to work is 11 weeks (range, 2– 25.6). In our series 75 % wished to go back to running or sports. This was achieved in 25.5 weeks (range 7.1–57.4) by 66.7 % of the patients.

Foot & Ankle > Talus > Clinical Science

2014

## Talar Dome Resurfacing with the HemiCAP Prosthesis

Reilingh ML, van Dijk CN

Talar Osteochondral Defects. Chapter 17. Springer 2014, pp 145-150

Book Chapter  
[http://link.springer.com/chapter/10.1007/978-3-642-45097-6\\_17](http://link.springer.com/chapter/10.1007/978-3-642-45097-6_17)

### SUMMARY

#### Take-Home Points

- A new metallic implantation technique for secondary osteochondral defects of the medial talar dome appears to be a promising treatment option.
- The surface of the prosthetic device should be placed slightly recessed relative to the surrounding surface of the talar cartilage.
- Clinical and radiological short-term follow-up are encouraging; however, more patients and longer follow-up are clearly needed to draw any firm conclusions.

### QUOTE

“We reported the first clinical case report of the talus implant in which the patient was able to play korfbal (contact sports) at the preinjury level after 1 year and continued to play at this level at 2 years follow-up”

### CONCLUSION

In summary, the metallic implantation technique appears to be a new promising treatment option for osteochondral defects of the medial talar dome after failed primary treatment.

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Foot & Ankle > Talus > Clinical Science

2014

## The Use of HemiCAP for the Treatment of Osteochondral Lesions

van Bergen CJ, van Eekeren IC, Reilingh ML, Gerards R, van Dijk CN

Oper Tech Ortho Vol 24, Issue 3, September 2014, pp 190–194

Peer Review Article

<http://www.sciencedirect.com/science/article/pii/S1048666614000512>

### SUMMARY

Osteochondral defects of the talus are located on the medial talar dome in most cases. Arthroscopic debridement and microfracture is the preferred primary treatment for defects up to 15 mm. The optimal secondary treatment for osteochondral defects of the talus after failed primary surgical treatment has yet to be determined. Current methods such as osteochondral autograft transfer have disadvantages including donor site morbidity. A metal resurfacing inlay implant with a diameter of 15 mm (HemiCAP) was developed for treatment of osteochondral defects of the medial talar dome. The operative approach by means of a medial malleolar osteotomy and the implantation technique is reproducible. Intra-articular contact stresses are acceptable with proper implantation, that is, recessed relative to the adjacent cartilage level. A prospective study evaluated the clinical effectiveness. Overall, 20 consecutive patients were studied for a mean period of 3 years (range: 2-5 years). There was statistically significant reduction of pain and improvement of validated ankle outcome scores and quality of life scores. One patient required a reoperation for the osteochondral defect. The promising clinical outcomes indicate that the metal implantation technique is a reasonable alternative to current secondary treatment methods for osteochondral defects of the medial talar dome after failed previous treatment.

### QUOTE

“The operative technique has been found safe and reproducible over the years.”

### CONCLUSION

The metal resurfacing inlay implant is a promising treatment option for OCDs of the medial talar dome after failed primary treatment.

Foot & Ankle > Talus > Clinical Science

2013

## **Mid-term Follow-Up of Talar Dome Resurfacing Surgery Using the HemiCAP Device for Osteochondral Lesions: Review of 3 Cases**

Holten C., Gudipati S., Budgen A.

The Foot and Ankle Online Journal 2013 6 (2): 1

Peer Review Article

<http://faoj.org/2013/02/01/mid-term-follow-up-of-talar-dome-resurfacing-surgery-using-the-hemicap-device-for-osteochondral-lesions-review-of-3-cases/>

### **SUMMARY**

**Background:** Surgical management of talar osteochondral defects is a rapidly advancing area of foot and ankle surgery. The HemiCAP resurfacing is a new surgical technique in foot and ankle orthopaedics. This device provides a Cobalt-Chromium articular prosthetic component that allows partial resurfacing for localized talar dome defects. The effectiveness, safety and follow-up have yet to be established for this surgical method.

**Methods:** A prospective case series review of three cases using the HemiCAP articular resurfacing component for osteochondral defects of the talar dome. The patient mean age was 55 years (range 46-65). All patients were male. Each case had a large medial talar dome defect measuring between 10-20mm on pre-operative MRI or CT. Each patient underwent scoring using the visual analogue scale (VAS), AOFAS Ankle-Hindfoot scale and Kaikkonen scale pre-operatively, at 1 year and 3 years. Routine post-operative clinical follow-up took place at 2, 6, 12 weeks, 12, 24, 36 months for all cases and they were assessed clinically for pain, range of motion (ROM) and wound problems. Serial radiographic assessment was performed to observe any signs of metal work loosening and osteolysis of the tibio-talar joint.

**Results:** Full ROM of tibio-talar joint was achieved in all cases 4 months post-operatively under physiotherapy guidance. Mean follow-up period was 38 months (range 36 to 41 months). Improved patient scoring after surgical implantation of a HemiCAP talar dome resurfacing device was noted in all cases. Kaikkonen score noted an improvement by 25-35 points and this was maintained at the 3 year review. An AOFAS scoring improvement of 39-44 points was also observed and maintained at the 3 year follow-up. A 3 point reduction in VAS pain scoring was also demonstrated after surgery. All patients returned to routine daily activities and work by 5 months post-operatively.

**Discussion:** We have demonstrated the use of HemiCAP articular resurfacing component in maintaining a good improvement for patients at mid-term follow-up for joint-preserving surgical management of symptomatic large talar dome defects, however, larger studies with long-term follow-up are required.



#### QUOTE

“Improved patient scoring after surgical implantation of a HemiCAP talar dome resurfacing device was noted in all cases. Kaikkonen score noted an improvement by 25-35 points and this was maintained at the 3 year review. An AOFAS scoring improvement of 39-44 points was also observed and maintained at the 3 year follow-up.”

#### CONCLUSION

Our study highlights this technique as offering good clinical outcomes for surgical management of large talar dome lesions at medium term follow-up.

Foot & Ankle > Talus > Clinical Science

2013

## **Osteochondral Lesions of the Talus: Size, Age, and Predictors of Outcomes**

Deol PP., Cuttica DJ., Smith WB., Berlet GC.

Foot Ankle Clin. 2013 Mar;18(1):13-34

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/23465946>

### **SUMMARY**

In this article, our research on osteochondral lesions of the talus (OLTs) is summarized, the orthopedic literature is reviewed, and the direction of future research and treatment trends are discussed. Our research has explored the role of lesion size, significance of marrow edema, relationship of patient age, importance of lesion containment, and role of a stable cartilage lesion cap in the prognosis and outcomes of these lesions. We have identified smaller sized lesions, younger patients and contained lesions as independent predictors of success for the operative treatment of OLTs. Our data should facilitate the development of a more comprehensive treatment algorithm to more accurately predict success in operative management of these lesions.

### **QUOTE**

“Resurfacing may also have a role in larger lesions because larger lesions had a shift in peak stress toward the lesion, with an overall decrease in ankle contact area, which could lead to progressive deterioration.”

### **CONCLUSION**

Although longterm results are unavailable, the development of metal inlay implants represents a promising approach to this challenge.

Foot & Ankle > Talus > Clinical Science

2013

## **Treatment of Osteochondral Defects of the Talus with a Metal Resurfacing Inlay Implant After Failed Previous Surgery: A prospective Study**

van Bergen CJ., van Eekeren IC., Reilingh ML., Sierevelt IN., van Dijk CN.

Bone Joint J. 2013 Dec;95-B(12):1650-5

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24293595>

### **SUMMARY**

We have evaluated the clinical effectiveness of a metal resurfacing inlay implant for osteochondral defects of the medial talar dome after failed previous surgical treatment. We prospectively studied 20 consecutive patients with a mean age of 38 years (20 to 60), for a mean of three years (2 to 5) post-surgery. There was statistically significant reduction of pain in each of four situations (i.e., rest, walking, stair climbing and running;  $p \leq 0.01$ ). The median American Orthopaedic Foot and Ankle Society ankle-hindfoot score improved from 62 (interquartile range (IQR) 46 to 72) pre-operatively to 87 (IQR 75 to 95) at final follow-up ( $p < 0.001$ ). The Foot and Ankle Outcome Score improved on all subscales ( $p \leq 0.03$ ). The mean Short-Form 36 physical component scale improved from 36 (23 to 50) pre-operatively to 45 (29 to 55) at final follow-up ( $p = 0.001$ ); the mental component scale did not change significantly. On radiographs, progressive degenerative changes of the opposing tibial plafond were observed in two patients. One patient required additional surgery for the osteochondral defect. This study shows that a metal implant is a promising treatment for osteochondral defects of the medial talar dome after failed previous surgery.

### **QUOTE**

“Of these 12 patients, 11 resumed sports during follow-up. The level of sports decreased in five patients, was equal in four, and improved in two compared with their level prior to developing symptoms. Two additional patients, who did not play sports before the symptoms, started playing sports during follow-up. The median time to resumption of sports was 17 weeks.”

### **CONCLUSION**

This technique is a promising treatment for OCDs of the medial talar dome after failed previous treatment.

Foot & Ankle > Talus > Clinical Science

2012

## **Osteochondral talar lesions and defects**

Seiter JL, Seiter KP Jr.

Clin Podiatr Med Surg. 2012 Oct;29(4):483-500.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=23044058>

### **SUMMARY**

**KEY POINTS:** Talar dome lesions are known by a variety of antiquated misleading nomenclature. The primary leading causes of talar dome lesions are typically traumatic ankle fractures and sprains. Talar dome lesions may be underdiagnosed because of improper workups for ankle pain. Acute talar dome lesions that are minor or mild may be treated with conservative care options in some situations. Severe acute or chronic problematic talar dome lesions can be addressed with various surgical intervention.

### **QUOTE**

“Benefits of the procedure were to provide a means of replacing the defect without any secondary morbidity sites associated with autografts, risk of disease transmission with allografts, or time delay for incorporation of biological grafts.”

### **CONCLUSION**

Concerns have been expressed both about this published work and, recently, verbally at an expert panel discussion at the American College of Foot and Ankle Surgeons 2012 Scientific Conference about the need for clinical trials with patients reporting good long-term outcomes before this procedure can be recommended as a viable treatment option.

Foot & Ankle > Talus > Clinical Science

2012

## **Novel Metal Implantation Technique for Osteochondral Defects of the Medial Talar Dome**

Reilingh ML, van Bergen CJA, van Dijk CN

Techniques in Foot & Ankle Surgery: March 2012 - Volume 11 - Issue 1 - p 45–49

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2917574/>

### **SUMMARY**

The optimal treatment for large osteochondral defects of the talus or secondary treatment after failed primary surgical treatment is yet to be determined. A metal implant with a diameter of 15mm has been developed for treatment of these lesions of the medial talar dome. The approach by means of a medial malleolar osteotomy and the implantation technique are outlined. The surgical technique is safe and reproducible, and short-term clinical results are promising.

### **QUOTE**

“We performed a prospective case series of 15 patients with a clinical follow-up of 1 year. The median AOFAS improved from 69 (range, 42 to 75) preoperatively to 87 (range, 58 to 100) at 1 year ( $P = 0.001$ ).”

### **CONCLUSION**

The metallic implantation technique appears to be a promising treatment option for ODs of the medial talar dome after failed primary treatment.

Foot & Ankle > Talus > Clinical Science

2012

## **Novel Metal Implantation Technique for Secondary Osteochondral Defects of the Medial Talar Dome- One-Year Results of a Prospective Study**

van Bergen CJAA., Reiling ML., van Dijk CN.

Fuß & Sprunggelenk 10 (2012) 130-137

Peer Review Article

<http://www.sciencedirect.com/science/article/pii/S1619998712000499>

### **SUMMARY**

There is no optimal treatment for large osteochondral defects of the talus or for lesions after failed primary surgical treatment. A metal implant has been developed for these cases. The authors report 15 patients with a large defect of the medial talar dome treated with this implant after failed prior surgical treatment. Various outcome measures were recorded prospectively, including numeric rating scales (NRS) of pain for different situations, American Orthopaedic Foot and Ankle Society (AOFAS) Ankle and Hindfoot clinical rating System, Foot and Ankle Outcome Score (FAOS), and Short Form 36 (SF-36). After one year follow-up, there was significant improvement in the NRS, AOFAS, four of five subscales of the FAOS, and the SF-36 physical component scale. There were four minor complications that resolved within the study period. On radiographs, there were no signs of progressive degenerative changes. These short term results are promising but more patients and longer follow-up are needed to draw firm conclusions.

### **QUOTE**

“The metallic implantation technique appears to be promising treatment option for osteochondral defects of the medial talar dome after failed primary treatment.”

### **CONCLUSION**

In summary, the metallic implantation technique appears to be promising treatment option for osteochondral defects of the medial talar dome after failed primary treatment. Although the clinical and radiological results of this prospective case series with one year follow-up are encouraging, more patients and longer follow-up are clearly needed to draw any firm conclusions and determine if the results continue with time.

Foot & Ankle > Talus > Clinical Science

2012

## **Treatment Options for Chondral and Osteochondral Lesions of the Talus**

Becher C., Plaab C., Waizy H., Stukenborg-Colsman C., Thermann H.

Fuß & Sprunggelenk 10 (2012) 114—120

Peer Review Article

<http://www.sciencedirect.com/science/article/pii/S1619998712000517>

### **SUMMARY**

The treatment of chondral and osteochondral lesions of the talus reflects a challenging therapeutic problem. In recent years, the imaging and treatment options have undergone a constant development. Choosing an adequate treatment option requires a detailed clinical and imaging evaluation of the pathology. Thereby, individual factors of the patients which could influence the results of treatment have to be considered. Aim of this article is to provide an overview of the established treatment options with consideration of influencing factors to develop an appropriate treatment concept.

### **QUOTE**

“Alternativ besteht seit kurzem auch die Möglichkeit der Implantation eines lokalen metallischen Oberflächenersatzes (HemiCAP).”

### **CONCLUSION**

Das Behandlungsspektrum für die Behandlung von chondralen und osteochondralen Läsionen bietet eine Vielzahl von Optionen. Eine adäquate Analyse der Pathologie und patientenindividuelle Faktoren sind zu beachten.

Foot & Ankle > Talus > Clinical Science

2011

## **Tertiary Osteochondral Defect of the Talus Treated by a Novel Contoured Metal Implant**

van Bergen CJ., Reilingh ML., van Dijk CN.

Knee Surg Sports Traumatol Arthrosc. 2011 Jun;19(6):999-1003

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/21409468>

### **SUMMARY**

The primary treatment of most osteochondral defects of the talus is arthroscopic debridement and bone marrow stimulation. There is no optimal treatment for large lesions or for those in which primary treatment has failed. We report a 20-year-old female patient with persistent symptoms after two previous arthroscopic procedures. Computed tomography showed a cystic defect of the medial talar dome, sized 17×8×8 mm. The patient was treated with a novel contoured metal implant. At 1 and 2 years after surgery, the patient reported considerable reduction in pain and had resumed playing korfbal at competitive level. Level of evidence IV.

### **QUOTE**

“The metallic implantation technique appears to be a promising treatment for osteochondral defects of the medial talar dome after failed primary treatment.”

### **CONCLUSION**

Focal resurfacing with a metallic implant appears to have the potential to restore normal joint mechanics in ankles with a large talar osteochondral defect.



Foot & Ankle > Talus > Clinical Science

2010

## **Osteochondral Defects of the Talus: Surgical Treatment and Rehabilitation**

Ooij B., Kaas L., Reilingh ML., van Dijk CN.

Archivio di Ortopedia e Reumatologia. 2010, Volume 121, Number 4, Pages 17-18

Peer Review Article

<http://www.springerlink.com/content/0301r321n140vm20/>

### **SUMMARY**

Un difetto osteocondrale sintomatico dell'astragalo è una lesione a carico della cartilagine talare e dell'osso subcondrale, causa di dolore profondo a carico dell'articolazione tibio-tarsica e/o di limitazione dell'articolazione, rigidità, sensazione di blocco e gonfiore. La visualizzazione di questo tipo di lesione non è sempre possibile utilizzando la radiologia tradizionale, ma sono spesso necessari per riconoscerla esami di secondo livello come TAC o RMN. Il trattamento iniziale è conservativo. Le possibilità di trattamento chirurgico includono il "debridement" (artroscopico), il "curettage", la stimolazione midollare, la fissazione del frammento, trapianti ossei, autotrapianti cartilaginei, impianto di condrociti autologhi o HemiCAP. Questo articolo di revisione fornisce una visione d'insieme delle attuali tecniche chirurgiche nel trattamento delle lesioni osteocondrali dell'astragalo, con particolare attenzione alla riabilitazione post-operatoria.

### **QUOTE**

"The set of 15 offset sizes was designed to correspond with the anatomy of various talar dome curvatures."

### **CONCLUSION**

The metallic implantation technique seems to be a promising treatment for secondary osteochondral defects of the talus.

Foot & Ankle > Talus > Clinical Science

2008

## Treatment of Osteochondral Defects of the Talus

van Bergen CJ., de Leeuw PA., van Dijk CN.

Rev Chir Orthop Reparatrice Appar Mot. 2008 Dec;94(8 Suppl):398-408.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19046699>

### SUMMARY

This review article provides a current concepts overview of osteochondral defects of the talus, with special emphasis on treatment options, their indications and future developments. Osteochondral defects of the talar dome are mostly caused by a traumatic event. They may lead to deep ankle pain on weight-bearing, prolonged swelling, diminished range of motion and synovitis. Plain radiographs may disclose the lesion. For further diagnostic evaluation, computed tomography (CT) and magnetic resonance imaging (MRI) have demonstrated similar accuracy. Computed tomography is preferred for preoperative planning. Treatment options are diverse and up to the present there is no consensus. Based on the current literature, we present a treatment algorithm that is mainly guided by the size of the lesion. Asymptomatic or low-symptomatic lesions are treated nonoperatively. The primary surgical treatment of defects up to 15 mm in diameter consists of arthroscopic debridement and bone marrow stimulation. For large cystic talar lesions, retrograde drilling combined with a bone graft is an important alternative. In adolescents or in (sub)acute situations, in which the fragment is 15 mm or larger, fixation of the fragment is preferred. Osteochondral autograft transfer and autologous chondrocyte implantation (ACI), with or without a cancellous bone graft, are recommended for secondary cases as well as large lesions.

### QUOTE

“Our research group is currently investigating the applicability of a novel resurfacing technique of the medial talar dome by means of a contoured metal implant (HemiCAP<sup>®</sup>, Arthroscopic Inc., Franklin, MA, USA)”

### CONCLUSION

Tissue engineering techniques, artificial plugs and resurfacing by metal implants might become reasonable alternatives in the future.

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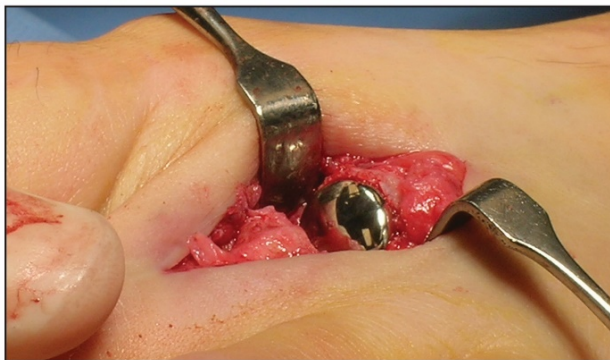
## B. Forefoot



# 1. Forefoot Publication Summaries

## Clinical Science

Overall, the vast majority of publications in the primary and secondary literature showed supportive evidence on HemiCAP resurfacing as a motion preserving alternative to arthrodesis with substantial clinical improvement, high patient satisfaction and excellent prosthetic fixation. Outcomes scores from multiple series demonstrate equal or better results when compared to fusion. This has been shown in form of randomized comparison and literature analysis.



Foot & Ankle > Toe > Clinical Science

2015

## **Resurfacing of the Metatarsal Head to Treat Advanced Hallux Rigidus**

Kline AJ, Hasselman CT

Foot Ankle Clin N Am -20:(3): 451-463,2015

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/26320559>

### **SUMMARY**

Advanced stages of hallux rigidus are usually treated with various arthroplasties or arthrodesis. Recent results with resurfacing of the metatarsal head have shown promising results and outcomes similar or superior to those of arthrodesis. In this article, the authors show their preoperative decision making, surgical techniques, postoperative management, results, and a comparative literature review to identify metatarsal head resurfacing as an acceptable technique for the treatment of advanced hallux rigidus in active patients. Key points in this article are adequate soft tissue release, immediate rigid fixation of the components, and appropriate alignment of the components.

### **QUOTE**

“In the authors’ series of over 500 cases there has been no evidence of implant loosening or osteolysis around the HemiCAP implant to date.”

### **CONCLUSION**

When compared with previous reports of hemiarthroplasty and joint fusion, current results of metatarsal head resurfacing demonstrate equivalent or better results for range of motion, pain reduction, and patient satisfaction.

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Foot & Ankle > Toe > Clinical Science

2015

## Hemiarthroplasty for Hallux Rigidus: Mid-Term Results

Gheorghiu D, Coles C, Ballester J

J Foot Ankle Surg. 2015 Mar 3. pii: S1067-2516

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/25746772>

### SUMMARY

Hallux rigidus is a progressive osteoarthritic condition affecting the first metatarsophalangeal joint that causes pain and stiffness, with a marked reduction in dorsiflexion. Joint arthrodesis has previously been the standard treatment of hallux rigidus; however, new surgical techniques have evolved and first metatarsophalangeal joint hemiarthroplasty is now a viable option. The present retrospective study reviewed the data from the 11 patients (12 feet) who had undergone first metatarsophalangeal joint hemiarthroplasty with the HemiCAP prosthesis. Postoperatively, all feet were clinically and radiologically assessed and scored using the hallux metatarsophalangeal-interphalangeal scale developed by the American Orthopaedic Foot and Ankle Society and the Foot and Ankle Disability Index score. Follow-up examinations were performed at a mean of 47 (range 36 to 48) months and showed a mean postoperative American Orthopaedic Foot and Ankle Society score of 66.5 (range 22 to 92) and mean Foot and Ankle Disability Index score of 63.7 (range 26.9 to 98.1). Of the 12 feet, 5 (41.7%) were reported to be pain free at the follow-up examination, 3 (25%) had mild pain, 2 (16.7%) had moderate, and 2 (16.7%) severe pain. Furthermore, 5 feet (42%) displayed no evidence of radiologic subsidence and 7 feet (58%) displayed a mean subsidence of 2.71 (range 1 to 6) mm. Hemiarthroplasty is designed to maintain the joint range of movement and allow easy conversion to arthrodesis, if required. In the present study, most patients continued to have a limited range of movement with only reasonable levels of satisfaction. Most patients continued to experience some level of pain postoperatively. The HemiCAP prosthesis has recently been adapted to include a dorsal flange. This might improve the range of dorsiflexion not seen with the traditional model.

### QUOTE

“Some patients will not be enthusiastic about the idea of joint arthrodesis because they wish to retain an active lifestyle, which is not always possible with a first MTPJ fusion a first MTPJ fusion is not always compatible.”

### CONCLUSION

Arthrosurface, who presented the first HemiCAP prosthesis >10 years ago, have recently changed the design, introducing a dorsal flange intended to improve roll-off during dorsiflexion and prevent osteophyte regrowth. The new design might help improve the range of dorsiflexion not seen with the traditional model.



Foot &amp; Ankle &gt; Toe &gt; Clinical Science

2015

## Short-Term Clinical Outcomes After First Metatarsal Head Resurfacing Hemiarthroplasty for Late Stage Hallux Rigidus.

Meriç G, Erduran M, Atik A, Köse O, Ulusal AE, Akseki D.

J Foot Ankle Surg. 2015 Mar-Apr;54(2):173-8

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=25491484>

### SUMMARY

The purpose of the present study was to evaluate the short-term results of metatarsal head resurfacing hemiarthroplasty in the treatment of advanced hallux rigidus. We reviewed 14 consecutive patients (5 males [35.71%], 9 females [64.29%]; mean age,  $58.7 \pm 7.4$  years). These patients underwent first metatarsal head resurfacing hemiarthroplasty (HemiCAP®) for hallux rigidus from March 2010 to September 2012 at our institution. According to the Coughlin and Shurnas clinical and radiographic classification, 10 feet (71.43%) were classified as grade III and 4 (28.57%) as grade IV. We clinically rated all patients before surgery and at the final follow-up visit using the American Orthopaedic Foot and Ankle Society hallux metatarsophalangeal-interphalangeal scale, the visual analog scale for pain, and first metatarsophalangeal joint (MTPJ) range of motion. The mean follow-up duration was  $24.2 \pm 7.2$  (range 12 to 36) months. The mean preoperative hallux metatarsophalangeal-interphalangeal scale score was  $33.9 \pm 9.8$  (range 22 to 59), and it increased to  $81.6 \pm 10.1$  (range 54 to 96;  $p < .05$ ) postoperatively. The mean preoperative 10-cm visual analog scale for pain score was  $8.4 \pm 0.9$  (range 7 to 10), which decreased to  $1.21 \pm 1.2$  (range 0 to 5;  $p < .05$ ) postoperatively. The mean preoperative MTPJ range of motion was  $22.8^\circ \pm 7.7^\circ$  (range  $15^\circ$  to  $45^\circ$ ), which increased to  $69.6^\circ \pm 11.8^\circ$  (range  $50^\circ$  to  $90^\circ$ ;  $p < .05$ ) postoperatively. None of the 14 patients experienced component malalignment or loosening, infection, or neurovascular compromise during the follow-up period. One patient (7.14%) experienced postoperative pain and subsequently underwent first MTPJ arthrodesis. From the results of our investigation, first MTPJ arthroplasty is an effective treatment modality that can reduce pain and increase motion in the case of advanced hallux rigidus.

### QUOTE

“Short term clinical satisfactory functional results and statistically significant improvements with high patient satisfaction rates can be obtained with the HemiCAP.”

### CONCLUSION

First MTPJ hemiarthroplasty is an alternative method when HR is too severe for cheilectomy and decompression. If the patient prefers a mobile joint, hemiarthroplasty could be a desirable alternative to arthrodesis. Hemiarthroplasty appears to be an effective treatment method that recovers both great toe function and first MTPJ motion, without affecting strength or stability.

Foot & Ankle > Toe > Clinical Science

2014

## **Interpositionsarthrodese des Großzehengrundgelenkes versus Verlängerungsarthrodese mit Scarf-Osteotomie: Eine prospektive Fallkontrollstudie**

Altenberger S, Kriegelstein S, Volkering C, Röser A, Gottschalk O, Walther M

Fuß & Sprunggelenk. Vol 12, Issue 4, December 2014, pp 215–222

Peer Review Article

<http://www.sciencedirect.com/science/article/pii/S1619998714001299>

### **SUMMARY**

Arthrodesis of the first metatarsophalangeal joint using the distraction scarf osteotomy is a proper alternative for salvage first metatarsophalangeal arthrodesis with interposition of autologous iliac crest bone graft.

A lower complication rate and a shorter period of reduced weight bearing can be perceived as advantage, while producing similarly good results in the FFI-D score. Additionally there is a reduced patient morbidity due to the eliminated bone graft harvesting.

Based on our results we currently prefer arthrodesis using the distraction scarf osteotomy in case of compensating length differences less than 1 cm.

### **QUOTE**

“Im Falle eines notwendigen Längenausgleichs bei Versagen einer Hemicap-Prothese wurden die Knochendefekte mit Beckenkamm-Spongiosa aufgefüllt.”

### **CONCLUSION**

Die Scarf-Verlängerungsarthrodese des Großzehengrundgelenkes stellt aber letztlich bei moderaten Längenausgleichs bis 1cm eine gute Therapiealternative zur verbreiteten Interpositionsarthrodese als Revisionsverfahren der Vorfußchirurgie dar.

Foot & Ankle > Toe > Clinical Science

2014

## Lesser Metatarsal Metallic Hemiarthroplasty

Feinblatt J, Smith WB

Techniques in Foot & Ankle Surgery, December 2014 | Volume 13 | Issue 4 | pp: 199-205

Peer Review Article

[http://journals.lww.com/techfootankle/Abstract/2014/12000/Lesser\\_Metatarsal\\_Metallic\\_Hemiarthroplasty.6.aspx](http://journals.lww.com/techfootankle/Abstract/2014/12000/Lesser_Metatarsal_Metallic_Hemiarthroplasty.6.aspx)

### SUMMARY

The literature on treatment of advanced arthritic changes in the lesser metatarsophalangeal joints is sparse. Options include fusion, resection or interpositional arthroplasty, biological resurfacing, as well as silastic or metallic joint replacement. Little data surround the use of a metallic hemiarthroplasty of the lesser metatarsal heads, and clinical outcomes data for the mid-term to long-term results is currently nonexistent.

### QUOTE

“The HemiCAP implant (Arthrosurface, Franklin, MA) has been used for both hallux rigidus as well as lesser MPJ pathology.”

### CONCLUSION

Although short-term results have been good for the hallux, no data are available specifically for the lesser metatarsal heads.

Foot & Ankle > Toe > Clinical Science

2013

## **Comparison of Arthrodesis, Resurfacing Hemiarthroplasty, and Total Joint Replacement in the Treatment of Advanced Hallux Rigidus**

Erdil M., Elmadağ NM., Polat G., Tunçer N., Bilsel K., Uçan V., Erkoçak O.F, Sen C.

J Foot Ankle Surg. 2013 Sep-Oct;52(5):588-93

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=23659913>

### **SUMMARY**

The purpose of the present study was to compare the functional results of arthrodesis, resurfacing hemiarthroplasty, and total joint replacement in hallux rigidus. The data from patients treated from 2006 to 2010 for advanced stage hallux rigidus were retrospectively reviewed. A total of 38 patients who had at least 2 years (range 24 to 66 months, mean 31.1) of follow-up were included in the present study. Of the 38 patients, 12 were included in the total joint replacement group (group A), 14 in the resurfacing hemiarthroplasty group (group B), and 12 in the arthrodesis group (group C). At the last follow-up visit, the functional outcomes were evaluated using the American Orthopaedic Foot and Ankle Society-Hallux Metatarsophalangeal Interphalangeal (AOFAS-HMI) scale, visual analog scale (VAS), and metatarsophalangeal range of motion. Significant improvements were seen in the AOFAS-HMI score, with a decrease in the VAS score in all 3 groups. According to the AOFAS-HMI score, no significant difference was found between groups A and B. However, in group C, the AOFAS-HMI scores were significantly lower than in the other groups owing to the lack of motion. According to the final VAS scores, no significant difference was found between groups A and B; however, the VAS score had decreased significantly more in group C than in the other groups. No major complications occurred in any of the 3 groups. After 2 years of follow-up, all the groups had good functional outcomes. Although arthrodesis is still the most reliable procedure, implant arthroplasty is also a good alternative for advanced stage hallux rigidus.

## QUOTE

“Currently, fourth generation implants (HemiCAP , Arthrosurface) can be used with minimal bone resection. This treatment method allows the surgeon to preserve the MTP joint motion and metatarsal length, avoid causing changes in the articular contour or weakness in the intrinsic muscles, and apply joint decompression.”

## CONCLUSION

In conclusion, good mid-term functional results can be obtained with all 3 procedures for advanced staged HR. Metatarsal resurfacing and TJR will give patients the opportunity for painless MTP joint motion without an increased complication rate. Also, metatarsal resurfacing provides the opportunity for preserving motion with minimal bone resection and a shorter tourniquet time. Arthrodesis is still the most reliable surgical procedure; however, it should be used only as a salvage procedure in the treatment of high-grade HR, just as in other joints of the musculoskeletal system.

Foot & Ankle > Toe > Clinical Science

2013

## **Current Concept in First Metatarsophalangeal Joint Replacement**

Wang C., MA X., Wang X., Huang J., Zhang C., Chen L.

J Chinese Clinical Med 2013;126 (16)

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/23981631>

### **SUMMARY**

First metatarsophalangeal joint (MTPJ) degenerative diseases are not rare pathological changes in adult forefoot.<sup>1, 2</sup> It mainly includes hallux rigidus, hallux limitus and hallux valgus.<sup>3</sup> Its progressive nature makes it hardly respond well to conservative treatment. Traditional surgical techniques, such as cheilectomy, Keller resection and arthrodesis are effective procedures but remain controversial due to none of them can achieve excellent results in all patients especially the end-stage conditions. Thus, great amount of efforts have been dedicated in MTPJ replacement despite many negative reports. This technique has aroused many controversies over the past decades due to its prematurity. Nevertheless, it has been improved in many aspects such as prosthesis material, design as well as surgical indications. This review would not only update the advancements and recognitions in recent years, but also presented the major disputed areas.

### **QUOTE**

“The HemiCAP was designed to resurface the metatarsal head. Its articular surface was made from cobalt chrome alloy while the stem is a cannulated, tapered titanium screw that allows for solid primary fixation in the metatarsal head. Both materials were biocompatible and have been used in diversity of joint replacement implants.”

### **CONCLUSION**

First MTPJ mobility not only allows for different kind of footwears to be worn, but also assists in maintaining of gait pattern, balance and normal stance.

Foot & Ankle > Toe > Clinical Science

2013

## Hállux Rígídu: Prospective Study of Joint Replacement with Hemiarthroplasty

Dos Santos AL., Duarte FA., Seito CA., Ortiz RT., Sakaki MH., Fernandes TD.

Acta Ortop Bras. 2013 Mar;21(2):71-5

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/24453646>

### SUMMARY

To report the results of medium-term follow-up after deploying Arthrosurface-HemiCap in patients with diagnosis of Hállux Rígídu (HR).

**METHOD:** Eleven patients underwent partial Arthroplasty of the first metatarsal-phalangeal joint. Six women and five men with an average age 51.9 years (46 to 58 years) and average postoperative follow-up of 3.73 years (3-4 years); were classified through the Kravitz system and evaluated by the American Orthopaedic Foot and Ankle Society (AOFAS) scales for hállux, Visual Analogical Scale (VAS) - analog functional pain - and range of motion in the first metatarsal joint in preoperative, postoperative after six months and present post-operative.

**RESULTS:** The results show significant improvement of the three analyzed parameters, both for overall analysis and for pre and post-operative comparisons individually. The comparative analysis of each variable in the six months and the current postoperative periods do not show statistically significant differences, indicating maintenance of parameters during this interval.

**CONCLUSION:** hemiarthroplasty of first metatarsophalangeal joint is a reproducible and safe option for the surgical treatment of hállux rígídu II and III, with significant improvement of the evaluated parameters for the studied population. Level of Evidence IV, Case Series.

### QUOTE

“The system allows anatomic reconstruction of the articular surface of the metatarsal head, joint decompression, preservation of the extensor mechanism of the first ray and range of motion gain; it also allows the association with osteotomies of the proximal phalange, and thus, the correction of large hállux deformities.”

### CONCLUSION

The hemiarthroplasty of the 1st metatarsophalangeal is a reproducible and safe option for the surgical treatment of Hállux Rígídu II and III, with significant improvement in articular range of motion, functional AOFAS scale and decreased pain by VAS score for the population studied.

Foot & Ankle > Toe > Clinical Science

2013

## **Metatarsal Head Resurfacing for Advanced Hallux Rigidus**

Kline AJ., Hasselman CT.

Foot Ankle Int. 2013 May;34(5):716-25.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/23407017>

### **SUMMARY**

Advanced stages of first metatarsophalangeal (MTP) arthritis have traditionally been treated with various arthroplasties or arthrodesis. Studies suggest the outcomes of arthrodesis are superior to those of metallic joint replacement; however, complications and suboptimal outcomes in active patients still remain with arthrodesis of the first MTP joint. This study reports results of patients with advanced MTP arthritis who underwent metallic resurfacing of the metatarsal side of the MTP joint.

**METHODS:** From 2005 to 2006, 26 patients (30 implants) with stage II or III hallux rigidus underwent resurfacing with the HemiCAP® implant and consented to participate in a study comparing pre- and postoperative radiographs, range of motion (ROM), American Orthopedic Foot and Ankle Society, and Short Form 36 Health Survey (SF-36) scores. Average age of these patients was 51 years. Patients were assessed at a mean of 27 months with outcome measures and contacted at 60 months to assess current symptoms and satisfaction.

**RESULTS:** Assessment at 27 months demonstrated statistically significant improvements in ROM, AOFAS, and SF-36 scores ( $P < .05$ ) when compared to baseline. Mean preoperative AOFAS scores improved from 51.5 to 94.1. Mean active ROM improved from 19.7 to 47.9 degrees. Mean passive ROM improved from 28.0 to 66.3 degrees. Mean RAND SF-36 physical component score improved significantly from 66.7 to 90.6. Average time for return to work was 7 days. At 60 months, all patients reported excellent satisfaction with their current state and would repeat the procedure. Implant survivorship was 87% at 5 years. Of the 30 implants, 4 were revised at 3 years.

**CONCLUSION:** The results at 5 years were very promising. Preservation of joint motion, alleviation of pain, and functional improvement data were very encouraging. Because minimal joint resection was performed, conversion to arthrodesis or other salvage procedures would be relatively simple if further intervention became necessary.



## QUOTE

“The HemiCAP<sup>®</sup> prosthesis is a novel approach to the treatment of arthritis of the first metatarsophalangeal joint because it is the first metallic implant to resurface the metatarsal head.”

## CONCLUSION

This is the first longer term report on a fourth generation, screw fixation, MTP resurfacing implant that demonstrated durability of the procedure with excellent pain relief and functional improvement at an average follow-up of 5 years. The technique allowed for joint preservation keeping healthy cartilage and subchondral bone functional. At the same time, future conversion to arthrodesis remains a viable option if the condition requires further treatment. The goal of contemporary joint preserving surgery is to relieve pain and improve and maintain joint function. MTP resurfacing provided a viable alternative to joint fusion for appropriately selected patients with grade 2 or 3 hallux rigidus.

Foot & Ankle > Toe > Clinical Science

2012

## **International Advances in Foot and Ankle Surgery. Hallux Rigidus: First Metatarsal Head Resurfacing**

Stone H.

Springer 2012

Book Chapter

<http://www.springerlink.com/content/978-0-85729-608-5/#section=963717&page=1>

### **SUMMARY**

Over the last 10–15 years, there has been an impetus to determine the best surgical alternative for hallux rigidus. A myriad of surgical options have been proposed. These include cheilectomy, metatarsal osteotomy, proximal phalangeal osteotomy, interpositional arthroplasty, hemiarthroplasty, total joint arthroplasty, and arthrodesis.

### **QUOTE**

“The author’s short-term and intermediate results reveal that 80% of patients have a good to excellent outcome.”

### **CONCLUSION**

Metatarsal head resurfacing is a viable option for hallux rigidus. Proper patient selection, surgical expertise, and appropriate postoperative care are crucial to the long-term success of this procedure.

Foot & Ankle > Toe > Clinical Science

2012

## **Lesser Metatarsal Head Resurfacing Procedure for Freiberg's Infracton**

Goecker, RM.

McGlamry's Comprehensive Textbook of Foot and Ankle Surgery, Chapter 2, 2012

Book Chapter  
[http://www.podiatryinstitute.com/pdfs/Update\\_2010/2010\\_02.pdf](http://www.podiatryinstitute.com/pdfs/Update_2010/2010_02.pdf)

### **SUMMARY**

Book Chapter. No Abstract Available

### **QUOTE**

“The Arthrosurface HemiCAP metatarsal head resurfacing implant technique is easy to perform and is minimally invasive with a low learning curve.”

### **CONCLUSION**

This procedure allows removal of the diseased bone but at the same time requires minimal resection of subchondral bone and it preserves enough viable bone stock for an appropriate metatarsal parabola and for future treatment options if needed.

Foot & Ankle > Toe > Clinical Science

2012

## Early results of HemiCAP® Resurfacing Implant

Aslan H., C İtak M., Baş EG., Duman E., Aydın E., Ateş Y.

Acta Orthop Traumatol Turc. 2012;45(7):17-21.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=Early+results+of+HemiCAP%C2%AE+Resurfacing+Implant>

### SUMMARY

Metallic implants in the first metatarsophalangeal (MTP) joint have been used for many years in the treatment of hallux rigidus (HR). The HemiCAP(®) prosthesis is the first implant used for resurfacing the metatarsal head in HR treatment. The aim of our study was to evaluate the early results of the HemiCAP(®) prosthesis for the treatment of HR. **METHODS:** A total of 27 toes of 25 patients with MTP arthritis of the great toe were treated with an Arthrosurface(®)HemiCAP(®) resurfacing implant. The average follow-up time was 37.6 (range: 30 to 43) months. All patients were evaluated clinically and radiographically. Postoperative satisfaction and function were scored according to the American Orthopaedic Foot and Ankle Society (AOFAS) score. Pain was assessed with the use of a visual analogue scale (VAS) ranging from 0 to 10, with 0 indicating the absence of pain and 10 describing the worst pain imaginable. **RESULTS:** Mean preoperative AOFAS score improved from 40.94 (range: 25 to 63) to 85.1 (range: 54 to 98) at the final follow-up ( $p<0.0001$ ). Preoperative average VAS pain scores improved from 8.30 preoperatively to 2.05 at the final follow-up ( $p<0.0001$ ). The average MTP joint range of motion (ROM) the improved from 14.36 degrees preoperatively to 54.38 degrees at the final follow-up. No radiologic loosening or osteolysis was observed in patients with HemiCAP(®) implant. **CONCLUSION:** The early results of the HemiCAP(®) implant on the metatarsal head are promising. However, studies over a longer period involving more patients would be beneficial in terms of defining and reviewing the stability of the implant and any innovations in the treatment strategy for HR.

### QUOTE

“Strikingly, we found that at the final followup, the difficulty in wearing shoes was eliminated postoperatively in all of the 25 patients who had presented with this complaint.”

### CONCLUSION

We believe that early results for the use of the HemiCAP® implant on the metatarsal head in the treatment of HR are promising. However, studies with a longer follow-up period involving more patients would be beneficial in terms of defining and reviewing the stability of the implant and any innovations in the treatment strategy of HR.

Foot & Ankle > Toe > Clinical Science

2012

## **End-Stage Hallux Rigidus: Cheilectomy, Implant, or Arthrodesis?**

Peace RA., Hamilton GA.

Clin Podiatr Med Surg. 2012 Jul;29(3):341-53

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/22727376>

### **SUMMARY**

End-stage arthritis of the first metatarsophalangeal joint (MTPJ) typically results in an exophytic process with marked limitation of motion. Pain may occur from the degenerative process itself and/or the bone spur formation that may become directly inflamed from shoe gear. The best surgical treatment for end-stage arthrosis of the big toe joint continues to be a controversial topic despite hallux rigidus being recognized clinically for more than 100 years. Although joint-sparing procedures are considered, arthrodesis is recommended, as this procedure is definitive and produces predictable results.

### **QUOTE**

“A metallic hemiarthroplasty designed for replacement of the head of the first metatarsal, the HemiCAP (ArthroSurface, Franklin, MA), has been available since 2005. The HemiCAP implant is composed of 2 parts: an articular cap made from a cobalt chrome alloy and a central fixation component made of titanium.”

### **CONCLUSION**

With end-stage hallux rigidus, the biomedical literature advocates arthrodesis over cheilectomy and implant arthroplasty.

Foot & Ankle > Toe > Clinical Science

2012

## **Metatarsal Head Resurfacing Hemiarthroplasty in the Treatment of Advanced Stage Hallux Rigidus: Outcomes in the Short-Term**

Erdil M., Bilsel K., Imren Y., Mutlu S., Güler O., Gürkan V., Elmadağ NM., Tuncay I.

Acta Orthop Traumatol Turc. 2012;46(4):281-5.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/22951760>

### **SUMMARY**

The aim of this study was to evaluate the short-term outcomes of metatarsal head metal resurfacing hemiarthroplasty in patients with advanced stage hallux rigidus.

**METHODS:** The study included 14 feet (4 left, 10 right) of 12 patients (10 female, 2 male; mean age:  $63 \pm 5$ ; range: 55 to 71 years) who underwent metatarsal head metal resurfacing hemiarthroplasty (HemiCAP) between 2007 and 2010. Additionally, capsular release and periarticular osteophyte debridement were performed. Staging was made according to Coughlin and Shurnas' clinical and radiological grading system. Hallux valgus and intermetatarsal angles were measured using pre and postoperative standing AP and lateral foot views. Clinical assessment was made with first metatarsophalangeal joint range of motion, the AOFAS (American Orthopaedic Foot and Ankle Society) hallux metatarsophalangeal-interphalangeal scale and satisfaction level.

**RESULTS:** Mean follow up was 19.5 (range: 14 to 26) months. Two patients had bilateral involvement. According to Coughlin and Shurnas' clinical and radiological grading system, nine feet were Stage 3 and five feet were Stage 4. According to the AOFAS scale, results of eight feet (57.1%) were excellent, four feet (28.6%) were good and two feet (14.3%) were moderate. Mean total AOFAS score increased by 26.2 points postoperatively ( $p < 0.05$ ). Mean range of motion of the first metatarsophalangeal joint improved significantly from a preoperative  $22.2 \pm 5.6$  (range: 10 to 28) degrees to a postoperative  $56.3 \pm 9.6$  degrees ( $p < 0.05$ ). Mean hallux valgus angle decreased from a preoperative 14.3 (range: 9 to 17) degrees to a postoperative 11.1 (range: 4 to 13) degrees and the mean intermetatarsal angle increased from a preoperative 10.5 (range: 8 to 14) degrees to a postoperative 10.8 (range: 8 to 15) degrees. Patient satisfaction levels were very good in 10 feet (71.4%), good in 3 (21.4%), and moderate in one (7.2%). Complications included metatarsalgia aggravated by long walks in one patient and hypoesthesia of the great toe in three patients. Push-off power of the great toes was measured as 4/5 in three cases, and 5/5 in others.

**CONCLUSION:** Metatarsal head metal resurfacing hemiarthroplasty provides high patient satisfaction level and good functional outcome in the short-term, in the surgical treatment of advanced stage hallux rigidus refractory to conservative treatment options.

#### QUOTE

“In our study, we obtained significant improvements in the AOFAS scale and joint motion with metatarsal head resurfacing for the treatment of high-grade HR with metatarsal head resurfacing arthroplasty.”

#### CONCLUSION

In conclusion, short-term good functional results and high patient satisfaction rates can be obtained with metatarsal head resurfacing arthroplasty with HemiCAP<sup>®</sup> prosthesis in cases of severe Hallux Rigidus that does not benefit from conservative treatment.

Foot & Ankle > Toe > Clinical Science

2012

## Surgical Management of Hallux Rigidus

Deland JT., Williams BR.

J Am Acad Orthop Surg. 2012 Jun;20(6):347-58

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/22661564>

### SUMMARY

Hallux rigidus is the most common degenerative joint pathology of the foot. Untreated, it may result in notable limitations in gait, activity level, and daily function. Positive outcomes can be achieved with nonsurgical management; surgery is recommended for the sufficiently symptomatic patient for whom nonsurgical measures are unsuccessful. Surgery is selected based on grade of involvement. Early to mid-stage hallux rigidus is best managed with cheilectomy or cheilectomy and proximal phalanx osteotomy. Arthrodesis and arthroplasty are reserved for late-stage hallux rigidus.

### QUOTE

“Hasselman and Shields<sup>53</sup> assessed 25 patients with grade 2 or 3 hallux rigidus who had been treated with the HemiCAP (Arthroscopic, Franklin, MA). Patient satisfaction was 100%, and no implant failures were noted.”

### CONCLUSION

Management of hallux rigidus is determined based on the degree of joint degeneration and patient lifestyle.



Foot & Ankle > Toe > Clinical Science

2011

## **A Comparison of the Effects of First Metatarsophalangeal Joint Arthrodesis and Hemiarthroplasty on Function of Foot Forces using Gait Analysis**

Callaghan MJ., Whitehouse SJ., Baltzopoulos V., Samarji, RA.

The Foot and Ankle Online Journal 2011 4 (12): 1

Peer Review Article

<http://faoj.org/2011/12/01/a-comparison-of-the-effects-of-first-metatarsophalangeal-joint-arthrodesis-and-hemiarthroplasty-on-function-of-foot-forces-using-gait-analysis/>

### **SUMMARY**

**Background:** Arthroplasty or hemiarthroplasty for hallux rigidus of the first metatarsophalangeal (1st MTPJ) is thought to lead to greater joint motion and improved gait function. There have been no studies to compare the effects of 1st MTPJ arthrodesis and hemiarthroplasty on joint kinetics, kinematics and plantar pressures of foot and lower limb. **Methods:** A retrospective, case series pilot study approximately 22 months post operation. Subjects had either arthrodesis or a NorthStar HemiCAP hemiarthroplasty for osteoarthritis of the 1st MTPJ. All had plantar pressure, kinetic and kinematic gait analysis as well as the Foot and Ankle Outcome Score (FAOS), and 1st MTPJ range of motion (ROM). **Results:** For the hemiarthroplasty subjects the mean ROM on the non-operated 1st MTPJ was 490(SD23) but only 190 (SD16) on the operated side. Kinetic and kinematic results for both operations were similar. Plantar peak pressure data showed that the arthrodesis group took more pressure under the 1st MTPJ in the stance phase. The arthrodesis group had higher FAOS scores (mean 95.6 SD 5.1) than the hemiarthroplasty group (mean 72.2 SD 18.8) indicating more satisfaction with their surgery. **Conclusions:** Arthrodesis of the 1st MTPJ better FOAS scores, improved peak plantar pressure over the medial foot compared to a 1st MTPJ hemiarthroplasty. There were minimal differences in kinetic and kinematic data. Hemiarthroplasty patients had considerably reduced 1st MTPJ ROM compared to their non-operated side. We conclude that the North Star HemiCAP cannot be recommended at this time for the management of hallux rigidus. Arthrodesis remains the surgical treatment of choice.

### **QUOTE**

“This study aimed to compare a small group of subjects who had undergone arthrodesis or hemiarthroplasty using the HemiCAP prosthesis for hallux rigidus using several gait parameters.”

### **CONCLUSION**

Arthrodesis of the 1st MTPJ results in better FOAS scores, improved peak plantar pressure over the medial foot compared to a 1st MTPJ hemiarthroplasty. There were minimal differences in kinetic and kinematic data. In the hemiarthroplasty patients, 1st MTPJ ROM was considerably reduced compared to their no-operated side.

Foot & Ankle > Toe > Clinical Science

2011

## Quantitative Review of Operative Management of Hallux Rigidus

Maffulli N., Papalia R., Palumbo A., Del Buono A., Denaro V.

Br Med Bull. 2011;98:75-98.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/21239418>

### SUMMARY

Surgical techniques for the management of hallux rigidus include cheilectomy, Keller resection arthroplasty, arthrodesis, Silastic implantation, phalangeal or metatarsal osteotomy, capsular arthroplasty, partial or total joint replacement, interposition arthroplasty. However, the optimal management is controversial. SOURCES OF DATA: We performed a comprehensive search of CINAHL, Embase, Medline and the Cochrane Central Registry of Controlled Trials, from inception of the database to 2 November 2010. Sixty-nine articles published in peer reviewed journals were included in this comprehensive review. AREAS OF AGREEMENT: Cheilectomy and first metatarsal or phalangeal corrective osteotomy may provide better outcome for patients with early and intermediate hallux rigidus (Stages I-II), while arthrodesis or arthroplasty are indicated to manage more severe conditions. The Coleman Methodology Score showed great heterogeneity in terms of study design, patient characteristics, management methods and outcome assessment and generally low methodological quality. AREAS OF CONTROVERSY: Definitive conclusions on the use of these techniques for routine management of patients with hallux rigidus are not possible. Given the limitations of the published literature, especially the extensive clinical heterogeneity, it is not possible to compare outcomes of patients undergoing different surgical procedures and determine clear guidelines. GROWING POINTS: To assess whether benefits from surgery, validated and standardized measures should be used to compare the outcomes of patients undergoing standard surgical procedures.

### QUOTE

“Regardless of grading, high rate of satisfactory outcomes associated with ROM preservation have been obtained after implantation of hemiarthroplasty.”

### CONCLUSION

Since there is a lack of long-term follow-up studies, up to date hemiarthroplasty can be considered an alternative to fusion only in patients who wish to maintain a functional ROM for severe hallux rigidus.

Foot & Ankle > Toe > Clinical Science

2010

## Late Hematogenous Infection of First Metatarsophalangeal Joint Replacement: A Case Presentation

Stone PA., Barnes ES., Savage T., Paden M.

J Foot Ankle Surg. 2010 Sep-Oct;49(5):489.e1-4. Epub 2010 Jun 29.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20591694>

### SUMMARY

Late hematogenous infection of previously asymptomatic orthopedic implants is extremely rare and usually associated with total joint replacements, such as those of the hip or knee. We present the case of an otherwise healthy female who developed a deep space infection 18 months after a first metatarsophalangeal joint implant arthroplasty. The patient presented with pain and swelling at the site, and over the course of several days developed fever and tachycardia and leukocytosis. Cultures of the surrounding soft tissues and the implant grew *Streptococcus pneumoniae*. The patient reported a 1- to 2-week history of symptoms consistent with an upper respiratory tract infection and it is believed that this distant focus of infection was the probable source of late hematogenous seeding of the first metatarsophalangeal joint implant.

### QUOTE

“The characteristics of the case reported here resemble those of other published accounts of hematogenous infections in prosthetic implants in the hip and knee.”

### CONCLUSION

It is routine to screen preoperatively for existing silent foci of infection, particularly in the urinary tract, intestine, teeth, throat, or sinuses, and to administer prophylactic antibiotics accordingly. The possibility of late hematogenous seeding, however, is less obvious and often not brought to the attention of the patient, family physician, or surgeon, until the implant has become infected. The case described in this article illustrates the importance of a careful explanation of this risk to patients undergoing artificial joint implantation, and we believe that it is important to educate patients about this potential long-term complication of artificial joint implantation.

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Foot & Ankle > Toe > Clinical Science

2010

## **Surgical Treatment of Hallux Rigidus Using a Metatarsal Head Resurfacing Implant: Mid-term Follow-up**

Carpenter B., Smith J., Motley T., Garrett A.

J Foot Ankle Surg. 2010 July - August;49(4):321-325

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20610200>

### **SUMMARY**

The treatment of advanced hallux rigidus remains controversial, with many authors discussing arthrodesis versus arthroplasty. The purpose of this study is to report mid-term outcomes after implantation of a motion-preserving metatarsal head-resurfacing prosthetic and to present our technical considerations and modifications to the published technique to further enhance the clinical benefit of the procedure. Thirty-two implantations were performed in 30 patients. Twenty-three patients were women, 9 men. The average age was 62.8 years (range, 39-86 years). Patients were graded at baseline according to Hattrup and Johnson and completed the American Orthopaedic Foot & Ankle Surgery metatarsophalangeal clinical rating system preoperatively and postoperatively and a patient satisfaction question at final follow-up. Seventy-two percent of implantations were grade III hallux rigidus and 28% were grade II. The average follow-up was 27.3 months (range, 12-43 months). The mean change score for the overall American Orthopaedic Foot & Ankle Surgery scale was 236.8% (SD = 146.62, confidence interval [CI] = 186-287.6). A similar result was achieved between grade II (250.9%, SD = 240.3, CI = 93.9-407.9) and grade III (231.3%, SD = 95.83, CI = 195.14-270.46). No implants were revised or removed, and all patients stated that they were happy with their outcome and would repeat the procedure again if needed. In conclusion, metatarsal head resurfacing in combination with joint decompression, soft tissue mobilization, and debridement can achieve excellent results in grade II and III hallux rigidus. Salvage arthrodesis remains an option if future revisions are indicated.

### **QUOTE**

“When asked if they were satisfied with their outcome, 100% of the patients said they were and all patients indicated they would undergo the procedure again if necessary.”

### **CONCLUSION**

In conclusion, after conservative treatment has failed in moderate to severe hallux rigidus, metatarsal head resurfacing provides key benefits and excellent outcomes after mid-term follow-up.

Foot & Ankle > Toe > Clinical Science

2010

## **Arthrosurface HemiCAP Resurfacing**

San Giovanni TP

Operative Techniques in Orthopaedic Surgery Chapter 21, Wolters Kluwer 2010

Book Chapter

[http://www.lww.com/webapp/wcs/stores/servlet/product\\_Operative-Techniques-in-Orthopaedic-Surgery\\_11851\\_-1\\_9012052\\_Prod-9780781763707](http://www.lww.com/webapp/wcs/stores/servlet/product_Operative-Techniques-in-Orthopaedic-Surgery_11851_-1_9012052_Prod-9780781763707)

### **SUMMARY**

Book Chapter. No Abstract Available

### **QUOTE**

“The lack of radiographic loosening is encouraging with this design, and it may serve as a model for future development.”

### **CONCLUSION**

Design changes have been made for a second-generation HemiCAP with a dorsal flange and a more gradual dorsal curvature to the implant.

Foot & Ankle > Toe > Clinical Science

2009

## Hallux Rigidus: Arthroplasty or Not?

Giannini S., Vannini F., Bevoni R., Francesconi D.

European Instructional Lectures, 2009, Volume 9, VIII, 239-246

Book Chapter  
<http://www.springerlink.com/content/w42q6342t415851n/>

### SUMMARY

Hallux rigidus (HR) is characterized by restriction of motion at first metatarsophalangeal joint (MPTJ). The gradual onset of pain and limitation of dorsi-flexion at the MPTJ is characteristic of the disease process, although often there may be a normal range of plantar-flexion. The great toe is either fixed in plantar-flexion or limited in dorsi-flexion because of the proliferation of bone around the articular surface of the head of the first metatarsal, particularly on the dorsal aspect. The severity of the degenerative changes is markedly dependent on the duration of symptomatology.

### QUOTE

“The same philosophy of minimal bone resection in order to preserve MTP joint function, is shared by the hemi-contoured articular prosthesis HemiCAP Arthrosurface, with encouraging results.”

### CONCLUSION

Larger, prospective randomized studies directly comparing the various soft-tissue interpositional spacer materials or Arthrosurface may assist in determining the optimal spacer for performing interpositional arthroplasty.

Foot & Ankle > Toe > Clinical Science

2009

## Meta-Analysis of First Metatarsophalangeal Joint Implant Arthroplasty

Cook E., Cook J., Rosenblum B., Landsman A., Giurini J., Basile P.

J Foot Ankle Surg. 2009 Mar-Apr;48(2):180-90.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19232970>

### SUMMARY

Management of late-stage degenerative joint disease of the first metatarsophalangeal joint (MPJ) is a complex topic that is frequently the source of debate among foot and ankle surgeons. Several surgical interventions have been described to treat this condition. One of the most contested of these treatments is implant arthroplasty of the first MPJ. The primary aim of this meta-analysis was to evaluate the clinical benefit of first MPJ implant arthroplasty in regard to patient satisfaction. Reviewers formally trained in meta-analysis abstraction techniques searched databases and indices using medical subject heading terms and other methods to identify all relevant studies published since 1990. Initially, 3874 citations were identified and evaluated for relevance. Abstract screening produced 112 articles to be read in entirety, of which 47 articles studying 3049 procedures with a mean 61.48 (SD 45.03) month follow-up met all prospective inclusion criteria necessary for analysis. Overall crude patient satisfaction following first MPJ implant arthroplasty was 85.7% (95% confidence interval: 82.5%-88.3%). When adjusting for lower quality studies (retrospective, less than 5 years of follow-up, higher percent of patients lost to follow-up), the overall patient satisfaction increased to 94.5% (89.6%-97.2%) in the highest-quality studies. This adjustment also significantly decreased heterogeneity across studies (crude  $Q = 184.6$ , high-quality studies  $Q = 2.053$ ). Additional a priori sources of heterogeneity were evaluated by subgroup analysis and meta-regression. In regards to patient satisfaction, this comprehensive analysis provides supportive evidence to the clinical benefit of first MPJ implant arthroplasties.

### QUOTE

“4th generation: material metallic, design hemi and total implants that have a threaded stem.”

### CONCLUSION

In conclusion, implant arthroplasty for first MPJ endstage degenerative joint disease appears to be effective in improving patient satisfaction.

Foot & Ankle > Toe > Clinical Science

2009

## **Complications and Salvage of Elective Central Metatarsal Osteotomies**

Derner R., Meyr AJ.

Clin Podiatr Med Surg 26 (2009) 23–35

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/19121751>

### **SUMMARY**

In order to provide proper treatment intervention, the foot and ankle surgeon must develop a further understanding of the pathoanatomy and pathomechanics leading to specific surgical complications of central metatarsal osteotomies. In addition to providing the authors' experiences and potential solutions with regard to these complications, a clear definition of the progression of the complication course is presented. The specific complications of floating toe deformity, metatarsalphalangeal joint stiffness, recurrent metatarsalgia, transfer lesions, malunions, and nonunions are discussed.

### **QUOTE**

“The Arthrosurface is a two-piece device with a Cobalt chrome articular cap and fixation component. The fixation component is a titanium screw, which is inserted into the head of the metatarsal. Once the exact measurement has been determined, the cap is impacted into the fixation component. Currently and most commonly, the second metatarsal has been replaced.”

### **CONCLUSION**

Currently and most commonly, the second metatarsal has been replaced. This implant appears to articulate well with the proximal phalanx base and provides more than adequate motion. Studies are needed to determine its long-term efficacy, but early results in the authors' experience are promising.



Foot & Ankle > Toe > Clinical Science

2009

## **First Metatarsal Head Osteoarticular Transfer System for Salvage of a Failed HemiCAP-Implant: A Case Report**

Hopson M., Stone P., Paden M.

J Foot Ankle Surg. 48(4):483-487, 2009

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/19577728>

### **SUMMARY**

Osteochondral defects are frequently seen in patients with hallux limitus. Historically, such patients have been treated with cheilectomy, arthroplasty, osteotomy, fusion, and other joint destructive procedures. We present a case of a 54-year-old man who presented with a failed hemicapimplant of the first metatarsal head. Seven months after his initial implant surgery, the patient was still experiencing pain and limited function despite conservative treatment efforts. In an effort to salvage the joint, an osteoarticular transfer system procedure was undertaken. After removal of the 12-mm hemicap implant, a 15 x 12 mm osteochondral plug was taken from the ipsilateral femoral condyle and press fit into the defect in the first metatarsal head. At 6 weeks postoperatively, complete consolidation of the graft was observed radiographically. By 6 months postoperatively, the patient was able to walk more than 15 miles per week without pain while wearing regular shoes. He was subsequently discharged at 1-year postoperatively, at which time he neither described nor demonstrated any signs or symptoms related to hallux limitus/rigidus. To our knowledge, this particular technique has not been previously reported for lesions of this size in the first metatarsal head.

### **QUOTE**

“Patients in this situation still have the option of first MTPJ fusion without grafting, because the length of the first metatarsal remains uncompromised when this implant is used.”

### **CONCLUSION**

In the case that we have described in this report, an OATS procedure proved to be useful for restoration of first MTPJ function. At the 1-year postoperative visit, the patient indicated that he was very satisfied and able to walk pain-free in regular shoes.

Foot & Ankle > Toe > Clinical Science

2009

## Hallux Rigidus: MTP Implant Arthroplasty

Sullivan MR.

Foot Ankle Clin. 2009 Mar;14(1):33-42.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/19232990>

### SUMMARY

Hallux rigidus or osteoarthritis of the first metatarsophalangeal joint is characterized by pain, stiffness of the joint, and alterations of gait. The appeal of joint arthroplasty for hallux rigidus is similar to its benefits in other joints in the body. The ideal implant should relieve pain, restore motion, improve function, and maintain joint stability. Numerous implants have been described for the hallux metatarsophalangeal joint. This article discusses various implant options along with clinical outcomes and complications.

### QUOTE

“The authors believe that the screw fixation component may provide a stronger construct and be less likely to loosen.”

### CONCLUSION

There are no long-term data on the effectiveness of this device for the treatment of hallux rigidus.

Foot & Ankle > Toe > Clinical Science

2008

## What's New in Foot and Ankle Surgery

Marx RC., Mizel MS.

J Bone Joint Surg Am. 2008 Apr;90(4):928-42. Review. Page 937.

Peer Review Article  
<http://jbjs.org/content/90/4/928>

### SUMMARY

Botto-van Bemden and SanGiovanni reported on the early follow-up results of twenty-four first metatarsal head resurfacing procedures that were performed with use of the hemi-contoured articular prosthesis (HemiCAP; Arthroscopic, Franklin, Massachusetts) for the treatment of advanced hallux rigidus. Concomitant osseous and soft-tissue procedures were included for the correction of deformity and improvement of dorsiflexion motion.

### QUOTE

“After an average duration of follow-up of twelve months, the average AOFAS score improved from 54.7 preoperatively to 70 postoperatively, the average visual analog pain score improved from 6.4 to 3.5, and average dorsiflexion increased from 20.2° to 51°.”

### CONCLUSION

While the authors considered this prosthesis to be a reliable alternative for the treatment of advanced hallux rigidus, the device was recommended primarily for the treatment of arthritis pain and not for the restoration of motion.

Foot & Ankle > Toe > Clinical Science

2008

## Forefoot Deformity

Watson T.

Techniques in Foot & Ankle Surgery 2008 Mar;7(1):1

Peer Review Article

[http://journals.lww.com/techfootankle/Citation/2008/03000/Forefoot\\_Deformity.2.aspx](http://journals.lww.com/techfootankle/Citation/2008/03000/Forefoot_Deformity.2.aspx)

### SUMMARY

Treatment of the adult forefoot remains a dynamic and ever-changing environment of new techniques, innovative product design and often, an examination of old school techniques revamped for the modern era. In fact, over the past 5 years, I can think of no area in foot and ankle surgery that has developed more interest and discussion than some of the techniques described in this special focus issue on the forefoot.

### QUOTE

“The Arthrosurface HemiCAP prosthesis presents a modern day solution for hallux rigidus.”

### CONCLUSION

Where past implants have failed to beat the hallux metatarsophalangeal joint fusion results, there is hope that this implant will be a viable option for patients.

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Foot & Ankle > Toe > Clinical Science

2008

## Resurfacing of the First Metatarsal Head in the Treatment of Hallux Rigidus

Hasselman C., Shields N.

Techniques in Foot &amp; Ankle Surgery 7(1):31–40, 2008

Peer Review Article

[http://journals.lww.com/techfootankle/Abstract/2008/03000/Resurfacing\\_of\\_the\\_First\\_Metatarsal\\_Head\\_in\\_the.7.aspx](http://journals.lww.com/techfootankle/Abstract/2008/03000/Resurfacing_of_the_First_Metatarsal_Head_in_the.7.aspx)

### SUMMARY

Surgical techniques for the treatment of hallux rigidus have evolved during the past decade. Previously, main treatments were cheilectomy for earlier stages of hallux rigidus and resection arthroplasty or arthrodesis for advanced stages. Although arthrodesis has been considered the "gold standard" for advanced hallux rigidus, in younger and more active patients, activity, functional, and shoe wear limitations are undesirable outcomes of this procedure. Alternative surgical procedures have been developed for advanced hallux rigidus, with varying outcomes and complications. Endoprosthetic replacement, which has been well described in the past and revisited recently, has higher complication rates than more traditional approaches. Hemiarthroplasty using various prosthetic resurfacings of the phalangeal base has been reported with variable success rates as well. Soft tissue interpositional arthroplasty has been shown to have inconsistent results and significant stiffness. The Arthrosurface HemiCAP prosthesis has been described for the treatment of full-thickness chondral and osteochondral defects of the shoulder, hip, and knee with high success rates to date. More recently, the technology was expanded to allow for metallic resurfacing of the first metatarsal head as an alternative technique with the potential to maintain motion and function. By using this implant alone or combined with soft tissue interpositional arthroplasty, or proximal phalanx osteotomies, even severe forms of hallux rigidus can be treated. During the past 30 months, the authors have treated more than 100 patients with hemiarthroplasty of the first metatarsophalangeal joint using the HemiCAP prosthesis (Arthrosurface Inc, Franklin, Mass). To date, there have been 2 failures, one from infection and the other from a related procedure. Twenty-five of the first 30 patients with stage II or III hallux rigidus consented to participate in a follow-up study. The mean age of these patients was 51 years. Mean follow-up was 20 months. The mean postoperative increase in range of motion of the joint was 42 degrees (baseline, 23 degrees; postoperative, 65 degrees). The mean American Orthopaedic Foot and Ankle Society and 36-item Short-Form Health Survey Questionnaire scores were 82.1 and 96.1, respectively. All patients were very satisfied with their results and said that they would have the procedure performed again. Although long-term follow-up is still needed, the short-term results are very promising. In addition, future treatment options are maintained because of minimal bone resection at the time of HemiCAP implantation, and conversion to arthrodesis or resection arthroplasty can be performed should the need arise.

## QUOTE

“The HemiCAP technique is minimally invasive, with only subchondral bone resection needed for its implantation. Viable bone stock is therefore preserved, and future treatment options including joint fusion are maintained should the condition require further intervention.”

## CONCLUSION

In summary, the use of the HemiCAP implant to resurface the metatarsal head in hallux rigidus has shown very promising short-term results. Longer follow-up is needed to determine the durability of this implant and long-term functional outcomes. Future studies to determine the optimal technique for addressing coexisting phalangeal involvement are also needed.

Foot & Ankle > Toe > Clinical Science

2006

## **Implant Arthroplasty of the First Metatarsalphalangeal Joint**

Burks JB.

Clin Podiatr Med Surg. 2006 Oct;23(4):725-31, vi.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/17067890>

### **SUMMARY**

Few topics in foot and ankle surgery incite as much debate as artificial replacement of the great toe joint. As with other implant arthroplasty procedures, such as the hip and knee, the first metatarsalphalangeal joint (MTPJ) has most assuredly had its share of failed designs. This article reviews the shortcoming of nonimplant procedures and discusses the advantage of the Arthrosurface system, a new implant that has been used in all major joints to replace degenerative areas and postpone the need for total joint replacement.

### **QUOTE**

“Implants of the first MTPJ, if used in the correct patient, can offer significant reduction in preoperative pain and increase the patient’s range of postoperative activity. This article reviews the shortcomings of nonimplant procedures and discusses the advantages of a newer implant for preservation of motion in this joint. This article focuses on the Arthrosurface (Franklin, MA) system, which has been used in all major joints not as a total implant, but to replace degenerative areas and postpone the need for total joint replacement. The device, when used in the first MTPJ, can anatomically mimic the entire surface of the first metatarsal head and essentially function as a replacement for the entire degenerated surface.”

### **CONCLUSION**

The Arthrosurface implant for degeneration of the great toe appears to be a viable and indeed beneficial implant for many patients.

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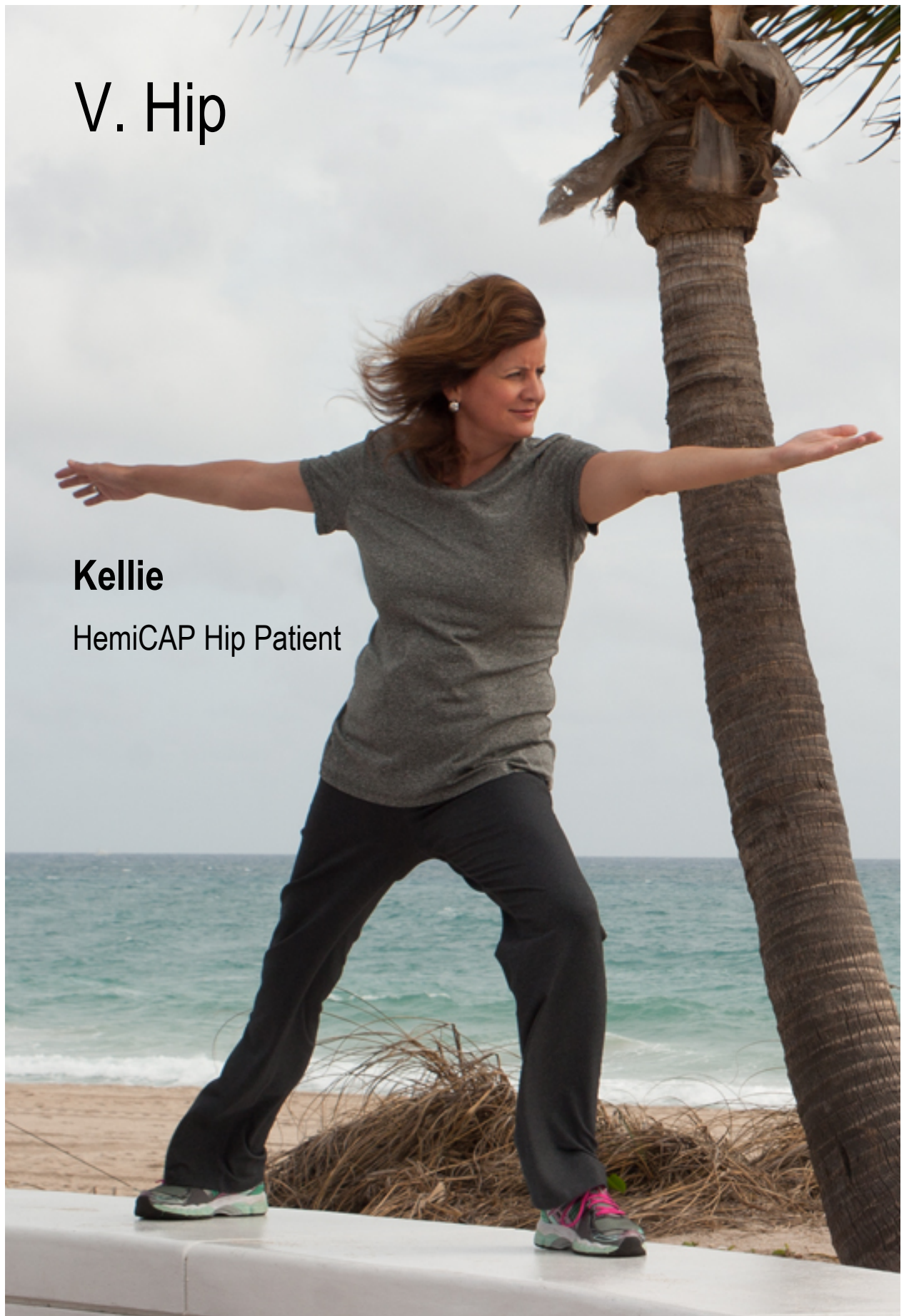
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**V. Hip**

**Kellie**

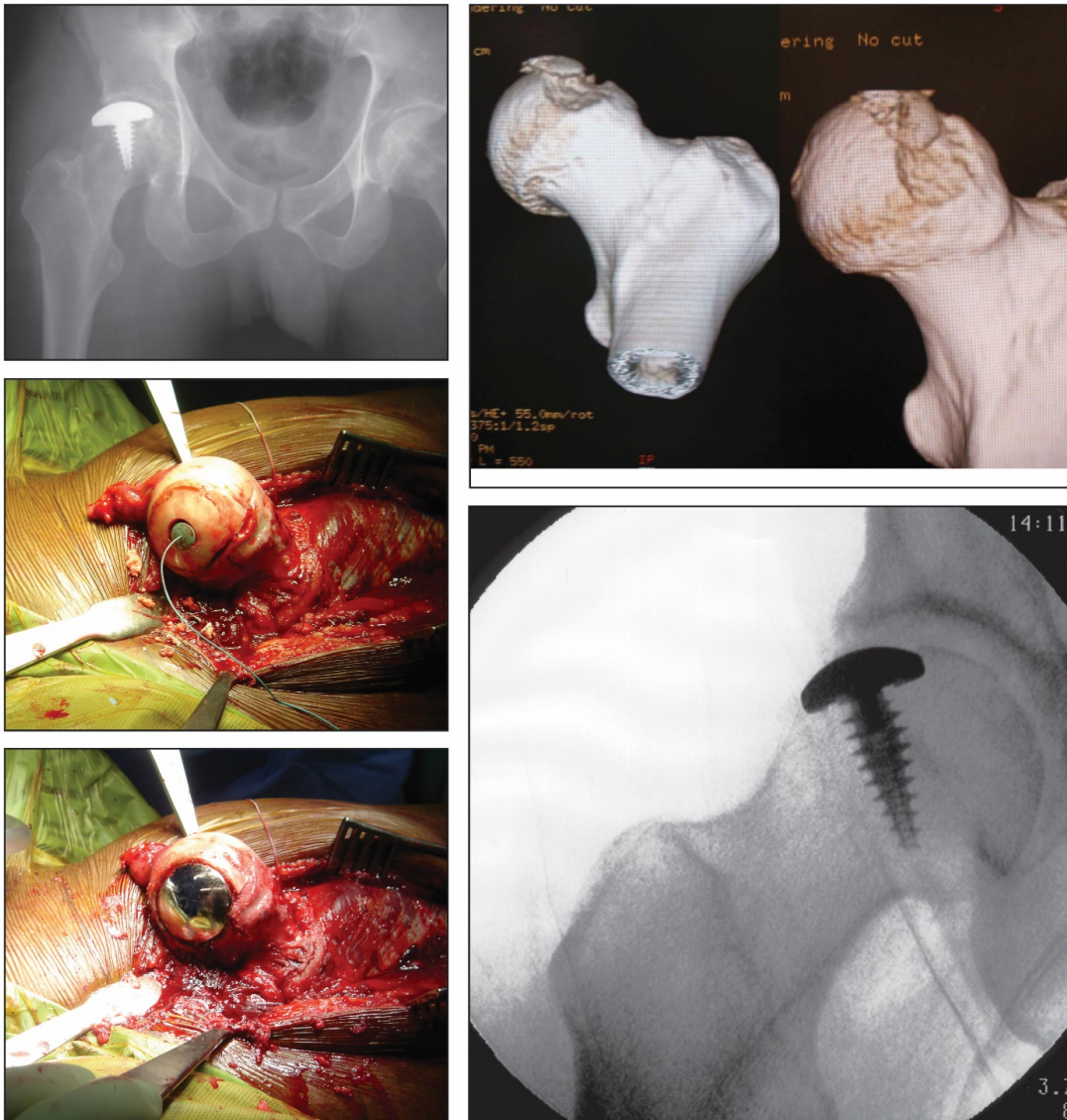
HemiCAP Hip Patient



# 1. Hip Publication Summaries

## Clinical Science

HemiCAP Hip Inlay Arthroplasty is targeted at avascular necrosis (AVN) of the femoral head in the young and active patient. During the earlier stages, the disease is limited to the femoral head and benefits from a joint preserving focal treatment approach with the HemiCAP implant. Similar to other focal treatments, disease staging is important when selecting patients for this procedure. Intraoperatively, adequate defect coverage with the articular component is important to contain the lesion within the new resurfacing implant. Particularly for Perthes Disease in younger patients, HemiCAP Inlay Arthroplasty has been favorably described as a joint preserving procedure.



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Hip > Femoral Head > Clinical Science

2015

## **Treatment of osteonecrosis of the femoral head with focal anatomic-resurfacing implantation (HemiCAP): preliminary results of an alternative option.**

Bilge O, Doral MN, Yel M, Karalezli N, Miniaci A

J Orthop Surg Res. 2015 Apr 28;10(1):56

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/25924980>

### **SUMMARY**

**BACKGROUND:** The optimal treatment of osteonecrosis of the femoral head has not been established yet. The aim of this study was to report preliminary clinical results of focal anatomic-resurfacing implantation for the treatment of osteonecrosis of the femoral head.

**METHODS:** Five patients (four male, one female) with seven surgical procedures, ages between 37 and 52 with an average age of 45.2 (+/- 7.2), diagnosed as femoral head avascular necrosis and who were unresponsive to conservative management or had failed previous surgical treatments were treated with a focal anatomic femoral head resurfacing between the years 2011-2012 and were retrospectively reviewed. Five patients with at least two years of follow-up, one left hip, two right hips, and two patients with bilateral hip surgery were included in this review. After safe surgical dislocation of the hip, full exposure of the femoral head was established. A focal-resurfacing implant matching patient anatomy and femoral head curvature was performed accordingly. Neither intraoperative or postoperative complications nor revision ensued. Visual analogue scores and Harris Hip Scores were recorded both preoperatively and at postoperative 2 years for all seven surgeries.

**RESULTS:** The mean follow-up period was 26.6 +/- 3.8 months, with a range between 24-33 months. The mean visual analogue scores were 8.9 +/- 0.9 preoperatively and 2.3 +/- 1.0 postoperatively at year two ( $p = 0.017$ ). Harris Hip Scores at postoperative follow-up were found to improve significantly from good to excellent scores (86.0 +/- 7.9), compared with preoperative poor scores (26.7 +/- 11.8) ( $p = 0.018$ ). The clinical improvements in visual analogue scores (VAS) and Harris Hip Scores were also found to correlate with each other ( $p < 0.05$ ).

**CONCLUSIONS:** In the present study, the alternative technique of focal anatomic hip resurfacing with HemiCAP® yielded preliminary successful results for the treatment of osteonecrosis of the femoral head. To the best of our knowledge, this is the first case series in the literature, reporting functional clinical results with the use of a focal anatomic-resurfacing implant for the treatment of focal femoral head osteonecrosis.

#### QUOTE

“Another advantage is that in case of progression of osteoarthritis, or implant failure or fracture at any time, there is always a chance to revise to primary total hip arthroplasty.”

#### CONCLUSION

Focal anatomic hip resurfacing with HemiCAP<sup>®</sup> yielded preliminary successful results for the treatment of osteonecrosis of the femoral head.

Hip > Femoral Head > Clinical Science

2015

## **Femoral head reduction osteoplasty for fracture dislocation: a surgical technique**

CS Bartlett, CE Birch

Injury 2015;46(8): 1689-1694.

Peer Review Article

<http://www.sciencedirect.com/science/article/pii/S0020138315001345>

### **SUMMARY**

**Background:** Femoral head fractures with subchondral impaction and cartilage loss are difficult to treat successfully. Although multiple surgical management options have been described, no one technique has proven superior, particularly in the young high-demand population.

**Technique:** A femoral head reduction osteoplasty was performed following a surgical dislocation of the hip. A peripherally based wedge of bone was resected off the damaged central third of the head followed by reduction and fixation of the remaining fragments. This technique resulted in a smaller yet congruent femoral head.

**Methods:** A healthy 40-year old labourer sustained a traumatic crush injury while at work, resulting in a left femoral head fracture dislocation with an associated posterior wall acetabular fracture. Significant femoral head impaction and cartilage loss limited the treatment options.

**Results:** Intraoperative reduction and postoperative imaging demonstrated near anatomic reconstruction of femoral head with a congruent hip joint. Superiorly at the level of resection, the medial–lateral diameter was reduced by 5–6 mm (approximately 12–15% the diameter of the original head) by the osteoplasty. At five years, Harris Hip Score was 86, Oxford Hip Score 36, and UCLA score 89. Hip abductor strength was full, range of motion near normal, and the patient ambulated without analgesia. Radiographs demonstrate a congruent joint and patchy avascular necrosis without collapse. The patient maintained full employment as a labourer.

**Conclusions:** Femoral head reduction osteoplasty is a viable option that may produce durable intermediate-term results for complex femoral head fracture with superior impaction and chondral damage.

### **QUOTE**

“Alternatively, some have reported success with local resurfacing utilising the HemiCAP System (Arthroscopic, Franklin, MA, USA).”

### **CONCLUSION**

This implant can fill circular chondral defects due to focal damage but was not optimal for this patient due to the long narrow area of damage.

Hip > Femoral Head > Clinical Science

2014

## Frühzeitige OP kann Schlimmeres verhindern

Schauwecker J, Banke I, Wilken F, Gollwitzer H

MMW - Fortschritte der Medizin. October 2014, Volume 156, Issue 17, pp 47-51

Peer Review Article

<http://link.springer.com/article/10.1007/s15006-014-3526-4>

### SUMMARY

Degenerative Veränderungen des Hüftgelenks haben eine hohe Prävalenz und sind von großer medizinischer und volkswirtschaftlicher Bedeutung. Denn trotz inzwischen sehr guter Ergebnisse von Hüftgelenksendoprothesen bestehen insbesondere bei jüngeren Patienten im Verlauf erhöhte Versagensraten. Wichtigstes therapeutisches Ziel ist es daher, fortgeschrittene Knorpelschäden und degenerative Veränderungen zu verhindern und das natürliche Gelenk möglichst lange zu erhalten. Neben konservativen Therapiemaßnahmen stehen dafür verschiedene gelenkerhaltende Operationsmöglichkeiten zur Verfügung.

### QUOTE

“Hüftkopfnekrose. Teilersatz des Hüftkopfes (Hemicap) bei ausgedehnter und großflächig eingebrochener Hüftkopfnekrose.”

### CONCLUSION

Durch frühe gelenkerhaltende Operationen kann häufig die Entwicklung bzw. das Fortschreiten einer Arthrose verhindert und das natürliche Hüftgelenk bewahrt werden.



Hip > Femoral Head > Clinical Science

2014

## **Osteochondral lesion of the hip treated with partial femoral head resurfacing. Case report and six-year follow-up**

Lea MA, Barkatali B, Porter ML, Board TN

Hip Int 2014; 24 (4): 417-420

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=24817402>

### **SUMMARY**

This case describes a case of an osteochondral lesion in the femoral head and its treatment by partial resurfacing of the femoral head using the HemiCAP (Contoured Articular Prosthetic) hip resurfacing system.

**CASE HISTORY:** A 19-year-old patient who complained of 15 months of worsening left hip pain. X-rays and MR scan revealed a large osteochondral lesion.

**SURGERY:** A Ganz approach to the hip in the lateral position was used. The osteochondral lesion was identified, lying superiorly and centrally on the head, in the weight bearing zone. The osteochondral fragment was removed and HemiCAP prosthesis applied.

**OUTCOME:** At six-year follow-up the patient remains pain free clinically. And radiographic follow-up shows no evidence of loosening.

**CONCLUSION:** There are multiple methods of treatment described in the literature for osteochondral lesions; but treatments for defects of the femoral head are few. We conclude that partial hip resurfacing using the HemiCAP prosthesis is an effective treatment for osteochondral defects of the femoral head.

### **QUOTE**

“When reviewed in clinic initially at six weeks postoperatively the patient had a full range of pain free movement and was able to mobilise without pain.”

### **CONCLUSION**

Partial hip resurfacing is an effective joint preserving treatment for osteochondral defects of the femoral head.



Hip > Femoral Head > Clinical Science

2012

## **Partial Hip Resurfacing for an Osteochondral Defect of the Femoral Head**

Mahmud T, Naudie DD.

JBJS Case Connector 2012; 2(2):1-6.

Peer Review Article  
<http://dx.doi.org/10.2106/JBJS.CC.K.00018>

### **SUMMARY**

We present the case of a twenty-four-year-old patient referred with right hip pain and mechanical symptoms, who we treated with open surgical dislocation, removal of osteochondral loose bodies, femoral osteochondroplasty, and partial femoral hip resurfacing with the HemiCAP device. We obtained institutional review board approval for this retrospective report. The patient was informed that data concerning the case would be submitted for publication, and he provided consent.

### **QUOTE**

“We were extremely encouraged by the clinical outcome at the five-year follow-up. This may be partly related to the osteochondroplasty and also because the prosthesis filled the central head defect.”

### **CONCLUSION**

We conclude that this novel treatment has functioned well for our patient in the midterm. Additional trials and studies need to be performed to assess the long-term effectiveness of this treatment in preventing secondary degenerative change in the native hip in this patient group.

Hip > Femoral Head > Clinical Science

2010

## **Chondral Lesions of the Hip: Microfracture and Chondroplasty**

Yen YM, Kocher MS.

Sports Med Arthrosc Rev 2010; Jun;18(2):83-9. Review.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/20473126>

### **SUMMARY**

Hip arthroscopy has become increasingly popular over the past several years as the techniques have evolved to be able to address both the peripheral and central compartments of the hip. The main indications for hip arthroscopy 10 years ago were diagnostic and debridement procedures such as removal of loose bodies, labral resection, synovectomy, and cartilage debridement. Advances in this field have now expanded to include reconstruction and repair of the labrum, recontouring of the acetabulum and head-neck junction, cartilage salvage, and repair and releases of the tendons around the hip joint. We detail in this article chondral injuries that occur in the hip joint and arthroscopic procedures to address these issues. We routinely perform chondroplasty in cases where there is a partial thickness tear of articular cartilage. Full thickness defects are addressed with microfracture which follows closely the guidelines established for the knee. As our understanding of chondral injuries and their causes grows, future efforts will focus on prevention.

### **QUOTE**

“The treatment of existing cartilage injuries of the hip has mainly been adapted from studies on the knee. These techniques include chondroplasty, abrasion arthroplasty, osteochondral drilling, osteoarticular autograft or allograft, HemiCAP resurfacing, autologous chondrocyte implantation (ACI), or microfracture.”

### **CONCLUSION**

As the experience with hip arthroscopy expands, so, too, will the ability to recognize the various injury patterns to the chondral surfaces of the hip. As our understanding of the pathologic processes contributing to chondral injury of the hip joint improves, perhaps we will be able to intervene preventing the progression to osteoarthritis.

Hip > Femoral Head > Clinical Science

2009

## **Partial Resurfacing with Varus Osteotomy for an Osteochondral Defect of the Femoral Head**

Van Stralen RA, Haverkamp D, Van Bergen CJ, Eijer H.

Hip Int. 2009 Jan-Mar;19(1):67-70.

Peer Review Article

<http://www.ncbi.nlm.nih.gov/pubmed/?term=Partial+resurfacing+with+varus+osteotomy+for+an+osteochondral+defect+of+the+femoral+head>

### **SUMMARY**

Osteochondral defects of the femoral head represent a major challenge and various modern treatment options exist. We report a 16-year-old male with a large (3 x 3 cm) osteochondral defect of the femoral head that was treated with a partial resurfacing prosthesis combined with a high varusosteotomy, performed by surgical dislocation of the hip. Two years after surgery the patient was progressing well without complications.

### **QUOTE**

“The main advantages offered by partial resurfacing besides preserving the joint are early rehabilitation and full weight bearing. Furthermore in case of implant failure, revision to total hip arthroplasty is comparable to primary arthroplasty.”

### **CONCLUSION**

The combination of the partial resurfacing prosthesis with a limited varus osteotomy offered a joint-preserving technique with an excellent short-term result in our patient. However, it remains unclear to what extent these results can be attributed to the partial resurfacing, to the osteotomy, or to the combination of these procedures. Furthermore, longer term follow-up is required to gain more insight in the results of the procedure. Despite these limitations of this case-report, the combined procedure may offer a potential solution for circumscribed osteochondral defects of the femoral head in young patients.

Hip > Femoral Head > Clinical Science

2006

## **Partial Hemi-Resurfacing of the Hip Joint-A New Approach to Treat Local Osteochondral Defects?**

Jäger M., Begg MJ., Krauspe R.

Biomed Tech (Berl). 2006;51(5-6):371-6.

Peer Review Article  
<http://www.ncbi.nlm.nih.gov/pubmed/17155875>

### **SUMMARY**

There is currently renewed interest in articular resurfacing for the treatment of damaged hip-joint cartilage. In contrast to these implants, which involve endoprosthetic replacement of both articulating surfaces, we present a new joint-preserving technique that allows treatment of local osteochondral defects of the femoral head by partial hemi-resurfacing. In this study we describe the operative and technical aspects and problems for partial hemi-resurfacing of the hip joint and critically discuss indications for this procedure in one case. To guarantee an adequate view of the situs, we recommend a surgical approach involving trochanter flip osteotomy, followed by surgical dislocation of the hip joint. Besides partial hemi-resurfacing of the osteochondral defect, this approach allows treatment of associated labral tears and cartilage defects of the hip joint at the same time. For adequate implant fixation, good bone quality is required. Furthermore, osteochondral defects of limited extent and excellent patient compliance are essential for clinical success. In particular, prominence of the implant has to be avoided, which can lead to an irregular joint surface and may induce further cartilage destruction. Long-term studies on statistical populations will show if partial articular hemi-resurfacing is a bone-preserving and useful therapeutic alternative to hemi-resurfacing caps in the treatment of osteochondral hip-joint defects, especially in young patients.

### **QUOTE**

“The implant level should be approximately 0.5 mm below the articular cartilage.”

### **CONCLUSION**

Partial hemiarthroplasty may represent a new alternative for young patients with a defined osteochondral defect that is limited in extent and adequate bone quality.

Hip > Femoral Head > Clinical Science

2005

## **Current trends in Hip Arthroscopy: A Review of Injury Diagnosis, Techniques and Outcome Scoring**

Schenker ML, Martin R, Weiland DE, Philippon MJ.

Current Opin Orthop 16:89-94,2005.

Peer Review Article

[http://www.researchgate.net/publication/232208119\\_Current\\_trends\\_in\\_hip\\_arthroscopy\\_a\\_review\\_of\\_injury\\_diagnosis\\_techniques\\_and\\_outcome\\_scoring](http://www.researchgate.net/publication/232208119_Current_trends_in_hip_arthroscopy_a_review_of_injury_diagnosis_techniques_and_outcome_scoring)

### **SUMMARY**

Purpose of review: Arthroscopy of the hip has become increasingly popular in the past decade. As a result, issues of diagnosing hip pathologies, surgical techniques, and outcomes measurement, have been critical focus points in this field. The point of this review is to compile recent research articles related to hip arthroscopy diagnosis, techniques, and outcomes measurement. Recent findings: Most of the recent research in injury diagnosis of intra-articular hip disorders has been related to magnetic resonance arthrography. Commonly performed arthroscopic surgical techniques include: labral repair/debridement, thermal capsulorrhaphy/capsular plication, thermal chondroplasty/microfracture/partial femoral surface replacement, and osteochondroplasty. Lastly, a new outcomes measuring instrument, the Hip Outcome Score (HOS), has been developed to assess outcomes in high-performing patients with hip injuries. Summary: Because arthroscopy of the hip is a relatively new field, issues of diagnosing, treating, and measuring outcomes in these patients have been of increasing interest. Basic science and clinical (retrospective and prospective) studies are still needed to optimize surgical procedures and assess long-term outcomes.

### **QUOTE**

“Patients with larger focal chondral defects on the femoral head may require partial femoral surface replacement (Arthrosurface, Franklin, MA).”

### **CONCLUSION**

This analysis of the most recent articles related to hip arthroscopy has revealed many current issues about injury diagnosis, surgical technique, and outcomes measurement. Clinical observation has indicated that commonly performed arthroscopic techniques, such as labral repair, osteochondroplasty, and thermal capsulorrhaphy/chondroplasty, are highly beneficial to a wide range of patient types. However, there is still a need for both basic science and clinical studies to provide more information on how we should address intra-articular hip pathologies.

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## The Active Alternative to Total Joint Replacement

