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FIVE YEAR SURVIVORSHIP OF UNICOMPARTMENTAL KNEE ARTHROPLASTY USING DEPUY SIGMA HP REPLACEMENT, Jeff Almand, M.D., Mississippi Sports Medicine and Orthopaedics, Jackson, Mississippi.

Introduction

Unicompartmental knee arthritis is a difficult problem to treat, especially when it occurs in the patient younger than 55 years of age. In the literature, there is no clear evidence pointing to whether high tibial osteotomy (HTO) or unicompartmental knee arthroplasty (UKA) is the preferred treatment in this younger age group[1]. However, there is evidence that advanced age does increase the risk of failure when performing HTO[2]. A recent meta-analysis by Fu et al, reviewed the outcomes of HTO vs UKA. In this meta-analysis they concluded that UKA had better functional results and increased walking velocity compared to HTO, which showed a better range of motion profile[1]. When looking at failure rates and revisions, the results between HTO and UKA showed no difference[1]. Their conclusion was that either surgical option is viable when the indications are appropriate, based on the patient.
A 2014 retrospective review evaluating the practice patterns of a private payer insurance database in the United States showed a trend to perform more UKA in patients over the age of 50[3]. It has been shown that UKA is a functional and safe alternative to HTO for the treatment of unicompartmental osteoarthritis within younger cohorts[4-6]. This shift in patient age is likely due to improvement of implants and reproducible surgical technique[3]. This recent evidence supports the trend of moving toward UKA in younger patients.

When the decision is made to proceed with UKA, it is important to consider the implant options, specifically mobile versus fixed bearing. The Oxford (Zimmer Biomet, Warsaw, IN) is the most prominent mobile bearing implant on the market and has shown survivorship ranging from 80.6% at 7 years to 98% at 10 years depending on the study[7]. Difficult surgical technique with this implant has contributed to the variability in survivorship[7]. In the same review, Bonutti, showed the fixed bearing implants had survivorship ranging from 95.7%, 94%, and 91% at 13 years, 10 years, and 13 years respectively[6-8]. The Sigma® High Performance System (DePuy Synthes, Warsaw, IN) is a fixed bearing that we have had success with at 2 years. The primary purpose of this study was to assess the implant survivorship of the system at 5 years, with secondary outcomes being range of motion, and functional scoring during clinical follow up.

Methods and Materials

In this case series, 302 unicompartmental knee arthroplasty operations were done in 257 patients. This was a single center study conducted from August 2008 to November of 2015 and was approved by our institution's Internal Review Board (1oRG0007408), clinical trials.gov ID NCT01656694 and all subjects were consented. Surgeries were performed by fellowship trained surgeons skilled in unicompartmental knee arthroplasty (J.A., T.P. R.K.M, B.J.). Failure was defined as conversion to TKA or revision of the femoral or tibial component. Knee Society Scores, Knee Injury and Osteoarthritis Outcomes Scoring, and range of motion were collected preoperatively, intra-operatively, and post operatively at intervals of 6 weeks, 6 months, 1 year, 2 years, and 5 years.

Inclusion criteria were a diagnosis of isolated medial or lateral compartmental osteoarthritis of the knee. Patient must have attempted and failed conservative management and have undergone unicompartmental

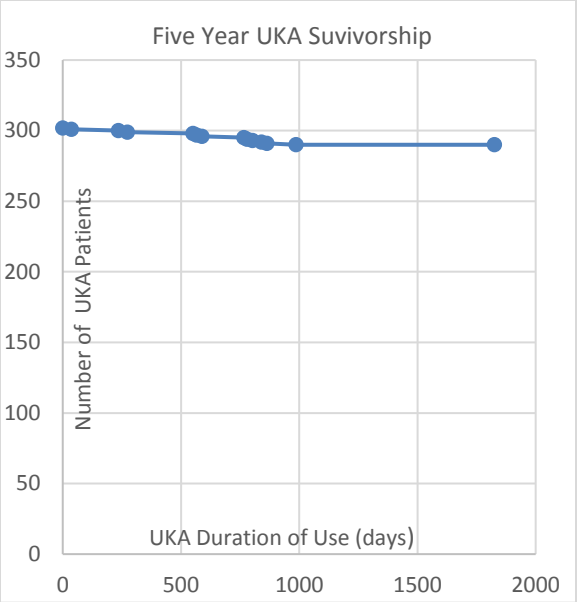
knee arthroplasty. The implant used must have been the Sigma HP partial knee system and been performed by the primary investigator, or sub-investigators all at the same institution. Patient or legally authorized representative must have been able to provide consent. Patients excluded from this study are those who did not receive a UKA by one of the participating surgeons or who did not receive the Sigma HP partial knee implant (DePuy Synthes, Warsaw, IN). Other exclusion criteria were patients lost to follow up for any reason including, but not limited to: refusal to consent, death, or geographic isolation.

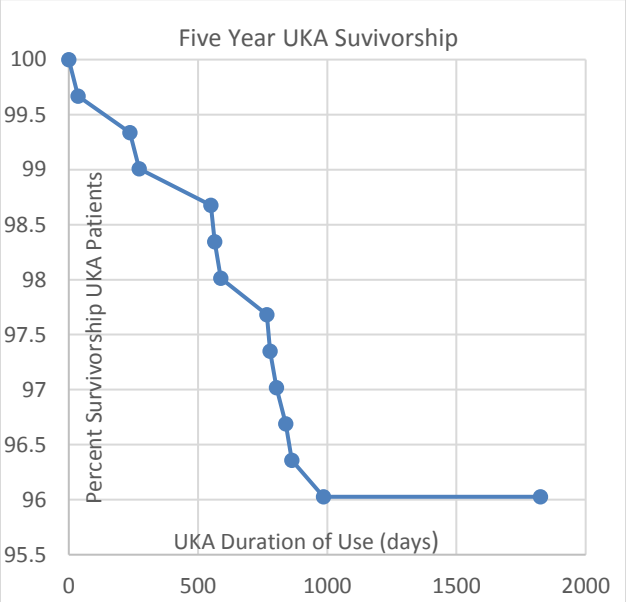
In total, there were 302 UKA performed in 257 patients, 158 were female and 99 were male. The age range was from 35-85 years with a median being 64 years old. The mean BMI was 32.1 and ranged from 20.1 to 57.3. No subjects died, and 7 were lost to follow-up. Routine follow-up included Knee Society Scoring (KSS), radiographic assessments, Knee Injury and Osteoarthritis Outcomes Scoring (KOOS), and range of motion (ROM). The mean follow -up was 60.6 months (range 37 to 83.7 months).

The Kaplan-Meier methodology was used to estimate the implants survival of the DePuy Sigma HP, fixed bearing, unicompartmental arthroplasty implant at 5 years with the event defined as revision for any reason. Mean clinical and patient reported outcomes scores were documented for KSS and KOOS as well as for pre-operative and post-operative range of motion.

Results

The 60 month Kaplan-Meier survivorship estimate was 96%. For a five-year endpoint of 1825 days, the survivorship average was 1776.6 days, with a standard deviation of 244.7 days. 95% confidence interval for survivorship was 1749 days to 1804 days. There were no device failures in the first twelve months, and during the entire study period only 12 of the 302 (4%) UKAs required additional surgery for all causes (defined as “survivorship”), with 8 (2.7%) converted to total knee arthroplasty, (defined as “failure”). One knee received a replaced femoral component, due to stem loosening subsequent to a patient fall. For the cases converted to TKA, five of the eight failures were due to progressive OA. Of the three non-OA related failures, one was due to loosening of the femoral component subsequent to a fall, one was due to formation of a large grade 4 chondral defect, and one was due to aseptic loosening of the femoral component. Three knees received PE spacer exchanges during surgery for various implant-unrelated reasons. Specifically, these implant-unrelated cases involved one seroma synovectomy, one anterior horn lateral meniscus tear repair and one superficial wound infection treatment. The UKA failures due to component loosening occurred shortly after introduction of the Sigma HP and are attributed to learning curve associated with surgical technique. Since the last reported failure (2011) in this study, we have had no further failures. One loose femoral component was revised due to a fall. Fourteen (4.7%) knees underwent other additional surgeries due to meniscus tears (7), excision of masses or bony overgrowths (2), effusions (1), hematomas (1), infections (1), retinacular defects (1), and manipulation (1). Three of those involved polyethylene insert exchanges.





Secondary outcome measures showed improvement of KSS post operatively. There was significant ($p<0.001$) improvement in preoperative to postoperative KSS scores, extension, and flexion.

		Mean	Range
KSS	**Pre-Op**	42.4	20-100
	5 Year	90.2	44-100
	Change	47.8	
Extension	**Pre-Op**	1.6	0-30
	5 Year	0	0
	Change	1.6	
Flexion	**Pre-Op**	124.7	50-145
	5 Year	130.2	115-150
	Change	5.5	
KOOS Pain	**2 Year**	85.4	0-100
	5 Year	89.4	22-100
KOOS Symptoms	**2 Year**	83.5	35-100
	5 Year	89.1	46-100
KOOS Function	**2 Year**	85.2	22-100
	5 Year	88.7	23-100
KOOS Quality of Life	**2 Year**	67.2	0-100
	5 Year	73.6	6-100

Discussion

The present study of 302 UKA performed using the DePuy Sigma HP UKA system showed excellent survivorship and functional improvement in this 5 year follow up study. The device survivorship of 96% at 5 years is higher than what has been previously reported for other fixed bearing UKA devices[4,9,10]. Swank et al showed 12% failure rate when considering all modes of failure at minimum of 4 year follow up[11]. While this is not a comparative study, the results provide early support that the DePuy Sigma HP UKA system outperforms the earlier generation of fixed bearing UKA.

There has been much more interest in the performance of mobile bearing implant design in the literature. Recent literature reports 10 to 15 year survivorship of 94% and 91% respectively[12]. Heller et al reported their results using the Oxford Phase III in 2009. Of 59 knees undergoing medial UKA, 7 were converted to total knee arthroplasty, and all seven were converted within the first 24 months. This was a conversion rate of 11.9% to TKA[13]. Reasons for conversion were aseptic loosening of the tibial component, subsidence of the tibial component, one dislocation of the polyethylene, and unexplained pain[13]. Again, the earlier failure

rate was attributed to the learning curve associated with the technical demands of the implant system. In comparison, the conversion rate to TKA for our study was 3%.

As seen in earlier studies, our failure rate was likely due to a learning curve with the introduction of a new implant. Of the 12 knees requiring further surgery, 8 were converted to TKA and one revision of a femoral component. Three of the failures involved loosening of the femoral component (1.0%), and 5 knees showed evidence of progressive arthritis. These modes of failure are comparable to those documented in prior studies. [4,9,10,11]

We saw a mean improvement of >47 points in Knee Society Scoring with a post op mean of 90.2. We also saw that our patient's pain, function, and quality of life continued to improve from 2 years to 5 years post operatively. O'Donnell *et al* reported a KSS mean of 86 at 9 years using a fixed bearing implant [9] and Pandit *et al* reported a KSS mean of 86.1, in his review of 1000 Oxford phase 3 UKA[14]. Range of motion was improved with a mean post-operative extension of 0 degrees from 1.6 degrees pre-operatively and post-operative flexion of 130 degrees from 124.47 degrees pre-operatively. Pandit reported a mean flexion of 130 degrees in his series.[14]

Our early results show that the DePuy Sigma HP UKA system offers increased functional scores and ROM which is comparable to other implants on the market. The DePuy Sigma High Performance UKA appears to have a very low early failure rate. The short-term data we have presented shows a comparable survivorship and patient satisfaction compared to other, mobile and fixed bearing, unicompartmental knee arthroplasty systems.

References

1. Fu D, Li G, Chen K, Zhao Y, Hua Y, Cai Z. Comparison of high tibial osteotomy and unicompartmental knee arthroplasty in the treatment of unicompartmental osteoarthritis: a meta-analysis. J Arthroplasty 2013;28:759-65.
2. Trieb K, Grohs J, Hanslik-Schnabel B, Stulnig T, Panotopoulos J, Wanivenhaus A. Age predicts outcome of high-tibial osteotomy. Knee Surg Sports Traumatol Arthrosc 2006;14:149-52.
3. Nwachukwu BU, McCormick FM, Schairer WW, Frank RM, Provencher MT, Roche MW. Unicompartmental knee arthroplasty versus high tibial osteotomy: United States practice patterns for the surgical treatment of unicompartmental arthritis. J Arthroplasty 2014;29:1586-9.
4. Heyse TJ, Khefacha A, Peersman G, Cartier P. Survivorship of UKA in the middle-aged. Knee 2012;19:585-91.
5. Smith WB, 2nd, Steinberg J, Scholtes S, McNamara IR. Medial compartment knee osteoarthritis: age-stratified cost-effectiveness of total knee arthroplasty, unicompartmental knee arthroplasty, and high tibial osteotomy. Knee Surg Sports Traumatol Arthrosc 2015.
6. Berger RA, Meneghini RM, Jacobs JJ, et al. Results of unicompartmental knee arthroplasty at a minimum of ten years of follow-up. J Bone Joint Surg Am 2005;87:999-1006.
7. Bonutti PM, Dethmers DA. Contemporary unicompartmental knee arthroplasty: fixed vs mobile bearing. J Arthroplasty 2008;23:24-7.
8. John J, Mauffrey C, May P. Unicompartmental knee replacements with Miller-Galante prosthesis: two to 16-year follow-up of a single surgeon series. Int Orthop 2011;35:507-13.
9. O'Donnell T, Neil MJ. The Repicci II(R) unicondylar knee arthroplasty: 9-year survivorship and function. Clin Orthop Relat Res 2010;468:3094-102.
10. Newman J, Pydisetty RV, Ackroyd C. Unicompartmental or total knee replacement: the 15-year results of a prospective randomized controlled trial. J Bone Joint Surg Br 2009;91:52-7.

11. Swank M, Stulberg SD, Jiganti J, Machairas S. The natural history of unicompartmental arthroplasty. An eight-year follow-up study with survivorship analysis. Clin Orthop Relat Res 1993:130-42.
12. Pandit H, Hamilton TW, Jenkins C, Mellon SJ, Dodd CA, Murray DW. The clinical outcome of minimally invasive Phase 3 Oxford unicompartmental knee arthroplasty: a 15-year follow-up of 1000 UKAs. Bone Joint J 2015;97-B:1493-500.
13. Heller S, Fenichel I, Salai M, Luria T, Velkes S. The Oxford unicompartmental knee prosthesis for the treatment of medial compartment knee disease: 2 to 5 year follow-up. Isr Med Assoc J 2009;11:266-8.
14. Pandit H, Jenkins C, Gill HS, Barker K, Dodd CA, Murray DW. Minimally invasive Oxford phase 3 unicompartmental knee replacement: results of 1000 cases. J Bone Joint Surg Br 2011;93:198-204.

2017 MIDDLE EAST EXPERIENCE WITH SAMARITAN'S PURSE, Glen Barden, M.D., Lakeland, Florida.

Presentation is done of the traumatic injuries evaluated and treated at an Emergency Field Hospital approximately ten miles from the Mosul, Iraq area during retaking of the area by Iraqi National Forces from ISIS. This hospital was operated by Samaritan's Purse in co-operation with the World Health Organization. The presenter was a leader of the orthopedic care team for two three week time frames (April and June 2017). The devastating nature of the war injuries to many innocent victims – children, women and men is shown. The care given was through a co-operative effort of local providers and multinational volunteers. This was an encouraging aspect to the scenario. Nature of care given is shown with extensive use of external fixators for multiple extremity management, along with judicial use of internal fixation of certain extremity fractures examples presented. Due to the volume of patients requiring care and the innocence of the victims, there were noted components of both physical and emotional strain on the part of those providing care.

A NOVEL METHOD FOR REMOVAL OF BROKEN PEDICLE SCREWS, J. Abbott Byrd III, M.D., Atlantic Orthopaedics Specialists, Virginia Beach, Virginia.

The fatigue failure rate of pedicle screws is reported as around 3%. It is often necessary to remove these screws during spinal revision surgery. The technique described in this paper allows for quick removal while preserving bone and allows for replacement of a new screw in the old track.
The technique involves using a metal cutting bit to fashion a post on the end of the distal screw fragment which is then removed by a special screwdriver that has a slot cut into the end of it.

ULNAR NERVE INJURY IN PEDIATRIC MIDSHAFT FOREARM FRACTURES: A CASE SERIES REVISITED, Gary M. Lourie, M.D., Andrew Federer, M.D., Dennis Devito, M.D., The Hand and Upper Extremity Center of Georgia, Atlanta, Georgia.

Background
Injury to the ulnar nerve in both bone forearm fractures is an uncommon but reported entity in the pediatric population. Though several case reports have commented on this occurrence, the literature lacks a larger case series on the subject or a treatment guideline recommendation. The goal of the study is to describe a midshaft forearm fracture pattern that places the ulnar nerve at risk in the pediatric population and provide seven clinical case examples describing the injury pattern and treatment methods. Additionally, cadaver

dissection was performed further describing the pattern and anatomic considerations when treating these patients.

Methods
Charts were reviewed for seven pediatric patients diagnosed and treated with midshaft forearm fractures with associated ulnar nerve injury. In addition, a literature review and cadaver dissection were performed and treatment recommendations were made based upon the timing of treatment.

Results
On initial radiographs all patients (7/7) had a specific fracture pattern including a proximal ulnar spike, volar angulation, and significant displacement at the mid-distal third junction of the ulna. Five patients underwent surgical treatment and two were treated with conservative measures. The ulnar nerve was found to be entrapped within the fracture site of one patient with an open fracture along with partial transection of the nerve, and four patients were found to have the nerve encased in hypertrophic scar tissue or bony callus upon surgical exploration at 3 to 12 months post injury.

Conclusion
Although rare, ulnar nerve injuries associated with midshaft forearm fractures can have debilitating morbidity if not detected in a timely manner. The ulnar nerve lies in a precarious position in the middle to distal one-third forearm and is bound by anatomic constraints that place the nerve at risk of injury. In open injuries with deficits or if there is immediate change in neurologic function following reduction, acute operative exploration is warranted. The authors recommend frequent serial neurological examinations and in cases where ulnar nerve injury continues to progress, EMG/NCS is recommended at 8-12 weeks. If EMG/NCS and neurological examination continue to show progressive neurological deficit, consideration to late exploration (>3 months) may be warranted for these patients. These patients are thought to likely have the ulnar nerve encased within hypertrophic scar tissue or bony callus.

MONITORING MICRO-MOTION OF ORTHOPAEDIC IMPLANTS UTILIZING IN VIVO WIRELESS SENSORS, John D. Lucey, M.D., Weaverville, North Carolina.

The need for refining the diagnostic accuracy of component loosening of orthopedic implants is discussed. Rather than depend upon the standard imaging studies presently used, a new technique using implanted in vivo wireless sensors is presented. In both a simulated and experimental setting, using near field proximity induction technology, a sensor placed at a distance 7 mm from the tip of a simulated prosthesis is capable of measuring position shifts with an accuracy of 50 microns or better. At a 12.5 mm. sensor to target distance the accuracy is still better than 100 microns. Continued refinement of the system is ongoing.

TOTAL KNEE REPLACEMENT RELIEVES PAIN – HOW?, R.S. Mathews MD, PhD. Penn Medicine, Penn Surgery Institute and Lancaster General Health, Pennsylvania.

TKR relieves 85% of knee pain at 1 year post op whilst chronic knee pain persists in up to 15%. The new science of the brain provides "eye opening clues" as to the cause. In our 160 TKR, at Penn Medicine, Penn Surgery Institute and Lancaster General Health, we had one deep infection, one peri-prosthetic fracture, 3 episodes of deep vein thrombosis and 2 episodes of stiffness requiring lysis of adhesions.

85% of the TKR and revision TKR had an improvement of at least 15% of their pain at 1 year (a clinically important difference). (By the osteoarthritic outcome score, mean score of pain, symptoms, ADL's and quality of life subscales (39/40 pg 1606)).

At 5-15 years post op, chronic pain and neuropathic pain persists in 30% of younger than 60 year old patients, and 20% of older than 60 year old patients.

An explosion in pain and stress research, in humans via MRI advancements, immune histochemical, electrode, EM (electron microscopic studies) and animal studies, as well as brain immunohisto glia studies of normal and scared brain and knee diseased tissue of chronic knee pain and neuropathic pain, patients provides important clues.

THE HISTOPATHOLOGY OF GLENOHUMERAL OSTEOARTHRITIS AND ITS CLINICAL IMPLICATIONS, Matson A.P[1], Kunkel Z.[2], Bernal-Crespo VA[3], Finley S[1], Little D [2,4], Garrigues G[1]
[1]Department of Orthopaedic Surgery, Duke University, Durham, NC
[2]Departments of Basic Medical Sciences, [3] Department of Comparative Pathobiology and [4] Department of Biomedical Engineering, Purdue University, West Lafayette, IN 47907

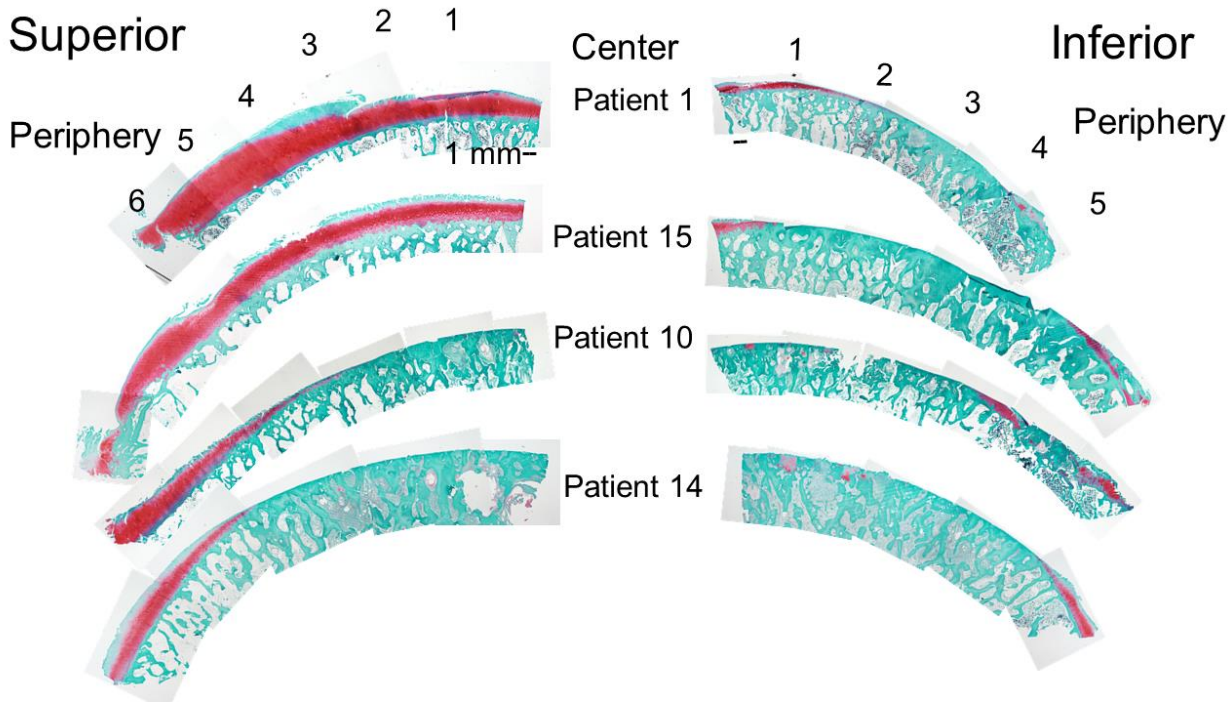
Introduction
Glenohumeral osteoarthritis (GOA) is a common degenerative condition, however histopathologic patterns of wear for end-stage disease have not been described. The aims of the present study were to a) to describe the histopathology of humeral head articular wear patterns in patients with end-stage GOA and b) to identify clinical or radiographic parameters that can predict wear patterns observed histopathologically in order to guide clinical decision-making surrounding joint-sparing procedures.

Methods
Seventeen humeral heads were harvested from patients undergoing anatomic total shoulder arthroplasty for end-stage osteoarthritis. Specimens were divided radially into eight wedge-shaped regions, and each region was subdivided into central and peripheral sections. Histologic analysis included measurements of cartilage and subchondral bone thickness, as well as grading cartilage loss using the Osteoarthritis Research Society (OARSI) and Modified Mankin scoring systems. Clinical variables including patient history, physical exam, functional evaluations, and radiographic assessments were also recorded.

Results
As a whole cartilage damage was most severe in central versus peripheral regions ($p < 0.01$), and in inferior versus superior regions ($p = 0.02$). Within regions, comparison between central and peripheral wear yielded a distinction between patients with “focal” wear versus those with “homogenous” wear. Compared to patients with “homogeneous wear”, those with “focal” wear younger and had more pain, stiffness, and subjective dysfunction preoperatively.

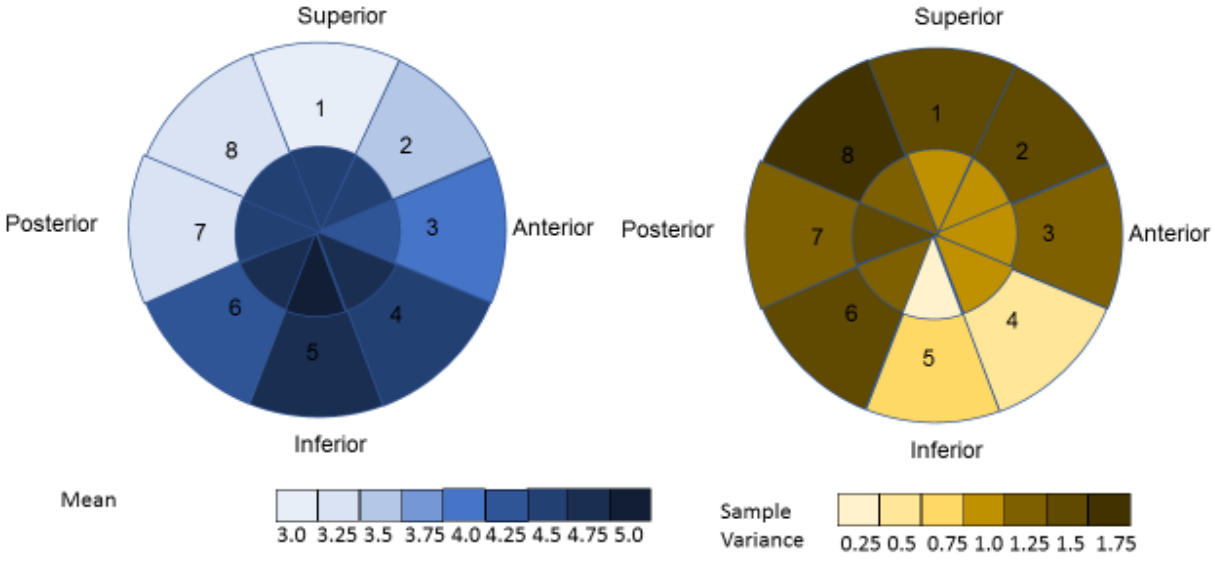
Conclusion
Predictable cartilage wear patterns in GOA include central and inferior cartilage damage and loss. There could be a distinction between patients with more focal versus diffuse wear, which may manifest clinically and serve to guide joint-sparing procedures aimed at restoring motion in select patients with more focal cartilage loss.

Figure 1.



Composite cartilage thickness maps for select patients.

Figure 2.



Heat maps demonstrating OARSI score (left) and score variance (right) by region for whole group means.

FACTORS ASSOCIATED WITH ABERRANT OPIOID BEHAVIOR IN PEDIATRIC ORTHOPAEDIC SURGICAL PATIENTS, Gregory Mencio, M.D., Vanderbilt, Nashville, Tennessee.

Nontherapeutic use of opioids is increasing and may be indicated by aberrant opioid behavior (AOB). The purpose of this study was to determine the variability of postoperative opioid prescriptions within an academic pediatric orthopaedic practice, the incidence of AOB, and risk factors associated with exhibiting these behaviors. A retrospective review was performed of patients who underwent one of 25 common pediatric orthopaedic procedures. Opioid prescriptions within 6 months preoperatively and postoperatively were reviewed using a controlled substance monitoring database. Twenty patients were reviewed from each of the 25 procedures (n=500). Prescriptions varied considerably within and between each procedure. Overall, 15.6% of patients exhibited at least one AOB. The patients who demonstrated AOB were prescribed significantly more opioids at discharge, which suggests that excess opioid dosing contributes to AOB. Adolescents and those who had received an opioid prescription within a 6-month preoperative period were more likely to display AOB. Preoperative identification of patients at risk of opioid misuse and postoperative opioid-dosing guidelines may decrease the prevalence of adverse outcomes associated with opioid use.

MINIMUM 10-19 YEARS' FOLLOW-UP OF THE STAR TOTAL ANKILE PERFORM IN THE USA, James Nunley, M.D., Duke University Medical Center, North Carolina.

This is a report of the results after a minimum of 10 years' follow-up in a cohort of patients who underwent the Scandinavian Total Ankle Replacement (STAR) in the United States.

Methods
Between 1998 and 2007, 88 patients with 90 STAR total ankle replacements performed at a single institution were followed prospectively with pre op and then yearly post op VAS, AOFAS ankle and hindfoot scores, and Buechal - Pappas scores. 12 patients died, and 12 were lost to follow-up, leaving 58 ankles with greater than 10 years of follow-up. Range: 10–19 years. There were 42 males, 46 females.

Results
Overall survival rate: 88% at 10–19 years. There was significant improvement of the VAS pain scale from pre-op to latest follow-up, and, similarly, there was an increase in the AOFAS ankle hindfoot scale. Five patients had removal of the prosthesis (0.5–14 years post-op) and a successful TTC arthrodesis (four were for malalignment, and one for infection). Four patients had revision to a new prosthesis. Two patients underwent amputation: one for infection unrelated to the prosthesis, 11 years post-op, and one from a traumatic motorcycle accident, four years post-op. 17 patients required poly exchange +/- grafting of a cyst. Range: 4–16 years post op.

Conclusion
Implant survival, patient satisfaction, pain relief, and function were high in STAR ankle replacement patients at a minimum of 10–19 years post-op.

UPDATE ON AFRICA MISSION - KAGONDO ST. JOSEPH HOSPITAL, NINE YEARS OF PROGRESS, Wendelin Schaefer, M.D., Incline Village, Nevada.

In the past nine years we have established visits from Tanzanian Orthopaedic surgeons on a monthly basis. In the past year residents in orthopaedic surgery also accompany the orthopaedic surgeons to

further their training. We have funded the installation of the Zirkle SIGN system, digital x-ray system and a water collection system to harvest rainwater from the hospital rooftops. Some difficult cases of children's hands burned in cooking fires and treatment of congenital dislocations of the knee were presented.

DURATION OF NARCOTIC THERAPY IN ADULT SPINAL SURGERY PATIENTS: USE OF A NEW PROTOCOL, David C. Urquia, M.D., Penn Medicine, Penn Surgery Institute and Lancaster General Health, Augusta, Maine.

The duration of prescription narcotic therapy in pre- and post-operative adult spine patients was evaluated. 2017 narcotic prescription data from the Maine Prescription Monitoring Program (PMP) website was reviewed. Related recent literature and unpublished data on narcotic therapy used to support the conclusions of this study.

Conclusion

Narcotic therapy beyond the acute phase of injury or surgery may have a negative impact on surgical outcomes, and lead to misuse.

Final Recommendations

1. For preoperative and acute spinal conditions, narcotic therapy should be limited to the acute phase only (1-14 days).
2. The duration of postoperative narcotic therapy should be limited to the first 3 to 14 days.