PRE01: Ulnar-Sided Wrist Pathology: Demystifying The "Black Box" of Wrist Surgery

Chair(s): Sanjeev Kakar, MD, FAOA, William B. Kleinman, MD

Program Syllabus

77TH ANNUAL MEETING OF THE ASSH
SEPTEMBER 29 – OCTOBER 1, 2022

822 West Washington Blvd
Chicago, IL 60607
Phone: (312) 880-1900
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PRE01: Ulnar-Sided Wrist Pathology: Demystifying The "Black Box" of Wrist Surgery

Ulnar-sided wrist pain is commonly regarded as the "black box" of hand surgery. Several lesions have been associated with ulnar-sided wrist pain and/or instability. Surrounded by controversy and confusion, the purpose of this case-based interactive course is to present the audience with key understanding of the common pathologies regarding diagnosis and treatment. We will go through some of the most common ulnar wrist pain conditions you will see in your office and provide tips and tricks for appropriate management. We will review salient anatomy, what the appropriate diagnostic tests are, treatment pearls, and how to manage complications that may arise.

LEARNING OBJECTIVES
At the conclusion of this program, the attendee will:

- Have an understanding of the anatomy and pathophysiology of ulnar-sided wrist pain.
- Appreciate the spectrum of management options for TFCC injury.
- Delineate the various treatment options for DRUJ arthritis and their indications and contraindications.

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PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Chair(s): Sanjeev Kakar, MD, FAOA and William B. Kleinman, MD

Description

Ulnar-sided wrist pain is commonly regarded as the “black box” of hand surgery. Several lesions have been associated with ulnar-sided wrist pain and/or instability. Surrounded by controversy and confusion, the purpose of this case-based interactive course is to present the audience with key understanding of the common pathologies regarding diagnosis and treatment. We will go through some of the most common ulnar wrist pain conditions you will see in your office and provide tips and tricks for appropriate management. We will review salient anatomy, what the appropriate diagnostic tests are, treatment pearls, and how to manage complications that may arise.

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Learning Objectives

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- Appreciate the spectrum of management options for TFCC injury.
- Delineate the various treatment options for DRUJ arthritis and their indications and contraindications.

Program

Session Chair(s)
Sanjeev Kakar, MD, FAOA | William B. Kleinman, MD

07:00 AM - 07:05 AM
Introduction
Sanjeev Kakar, MD, FAOA | William B. Kleinman, MD

07:10 AM - 07:25 AM
Anatomy and Biomechanics of the Ulnar Aspect of the Wrist
William B. Kleinman, MD

07:30 AM - 07:45 AM
Nuances in the Examination of the Ulnar Aspect of the Wrist (live demo)
Gregory A. Merrell, MD

07:50 AM - 09:05 AM
Moderator
Sanjeev Kakar, MD, FAOA

07:50 AM - 07:55 AM
Arthroscopic treatment of stable TFCC lesions
Pedro J. Delgado, MD

08:00 AM - 08:05 AM
UT ligament split tears
Sanjeev Kakar, MD, FAOA

08:10 AM - 08:15 AM
Arthroscopic management of unstable TFCC tears
Andrea Atzei, MD

08:15 AM - 08:20 AM
Ulnar shortening osteotomy
David S. Zelouf, MD

08:20 AM - 08:25 AM
Open ligament reconstruction for DRUJ instability
Brian D. Adams, MD

08:30 AM - 08:35 AM
ECU stabilization
Meredith N. Osterman, MD

08:40 AM - 08:45 AM
Darrach procedure and stabilization
Mark E. Baratz, MD

08:50 AM - 08:55 AM
Ulnar head replacement
Mark Ross, FRACS

09:00 AM - 09:05 AM
Achilles Interposition Arthroplasty
Dean G. Sotereanos, MD

09:10 AM - 09:25 AM
BREAK
All Faculty

09:30 AM - 11:00 AM
Interactive case based discussion of common ulnar wrist pain conditions highlighting diagnostic pearls and surgical tips and tricks
Sanjeev Kakar, MD, FAOA | William B. Kleinman, MD | Brian D. Adams, MD | Marion Burnier, MD | David S. Zelouf, MD | Greg Bennett Couzens, MD | David G. Dennison, MD | Brent R. DeGeorge, Jr., MD, PhD | Nina Suh, MD | Reed Hoyer, MD | Steve K. Lee, MD | Ryan P. Calfee, MD, MSc

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Anatomy and Biomechanics of the Ulnar Aspect of the Wrist

William B. Kleinman, MD
Speaker has nothing of financial value to disclose.

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Nuances in the Examination of the Ulnar Aspect of the Wrist (live demo)

Gregory A. Merrell, MD

- Ownership interest: Novosteo
- Royalties or patent beneficiary: Amsurgical
- Researcher: Cartons/Stryker, Axogen, Neuraptive therapeutics

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Arthroscopic treatment of stable TFCC lesions

Pedro J. Delgado, MD

Speaker has nothing of financial value to disclose.

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UT ligament split tears

Sanjeev Kakar, MD, FAOA

- Consultant: Arthrex, Restor3d, OsteoApp
- Individual stocks/stock options: Sonex

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Arthroscopic Ulnotriquetral Ligament Repair

Sanj Kakar MD, FAOA
Professor of Orthopaedic Surgery
Mayo Clinic
Rochester, MN USA

The "Ulnar Fovea Sign" for Defining Ulnar Wrist Pain: An Analysis of Sensitivity and Specificity

Shian Chao Tay, MD, Kazunari Tomita, MD, Richard A. Berger, MD, PhD

From the Department of Orthopedic Surgery, Mayo Clinic College of Medicine, Rochester, MN.

Purpose: Eliciting tenderness in the region of the ulnar fovea is a possibly useful clinical test for defining the source of ulnar-sided wrist pain. Until now, no reports of the clinical sensitivity and specificity of this test have been available. Based on anecdotal observations, a hypothesis was developed stating that ulnar fovea tenderness (positive "ulnar fovea sign") is sensitive and specific in detecting two ulnar-sided wrist conditions: foveal disruption of the distal radioulnar ligaments and ulnotriquetral (UT) ligament injuries.

Methods: The clinical records of 272 consecutive patients with wrist arthroscopy performed by the senior author from 1998 through to 2005 were reviewed. Relevant clinical and surgical data were abstracted. The ulnar fovea sign test is executed by pressing the examiner's thumb distally into the interval between the ulnar styloid process and flexor carpi ulnaris tendon, between the volar surface of the ulnar head and the pisiform. A positive ulnar fovea sign is designated when there is exquisite tenderness that the patient claims replicates their pain, with comparisons made with the contralateral side.

Results: There were a total of 90 foveal disruptions and 68 UT ligament injuries diagnosed during wrist arthroscopy. The ulnar fovea sign was positive in 156 patients. The sensitivity of the fovea sign in detecting foveal disruptions and/or UT ligament injuries was 95.2%. Its specificity was 86.5%.

Conclusions: The hypothesis stating that the ulnar fovea sign is a useful clinical maneuver to detect foveal disruptions and UT ligament tears is supported. The conditions represent 2 common sources of ulnar-sided wrist pain. The differentiation between the 2 conditions may be made clinically, where UT ligament tears are typically associated with a stable distal radioulnar joint and foveal disruptions are typically associated with an unstable distal radioulnar joint. (J Hand Surg 2007;32A:438–444. Copyright © 2007 by the American Society for Surgery of the Hand.)

Type of study/level of evidence: Diagnostic II.

Key words: Ulnar fovea sign, foveal disruption, distal radioulnar ligaments, ulnotriquetral ligament, distal radioulnar joint instability.

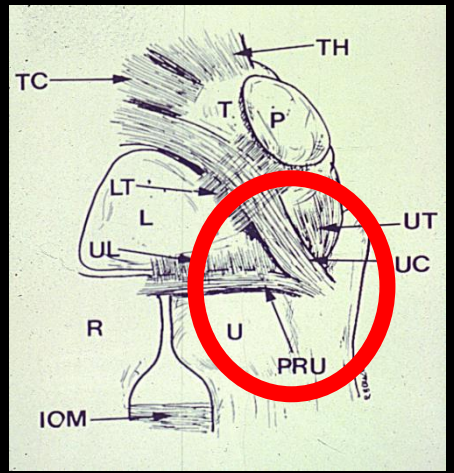
A careful clinical examination remains a key component in the evaluation of wrist pain.[1–5] Together with a thorough history and routine biplanar radiographs, it will dictate subsequent investigations, which could range from ultrasound[6–10] to computed tomographic scans,[11–13] magnetic resonance imaging,[14,15] bone scans,[16,17] arthrography, or arthroscopy.[18,19]

An important component of successful clinical examination is the ability to pinpoint local tenderness by careful and systematic palpation.[2] A clear understanding of the anatomy of the wrist and its ligaments[20–24] will allow the physician to decipher possible pathologic conditions by mentally visualizing the underlying structures in relation to points of tenderness.

Since 1998, the senior author has been documenting the presence of tenderness in the fovea region of the wrist in patients with wrist pain to further define ulnar-sided wrist pain. Anecdotal experience after

“Fovea Sign”

The **"fovea sign"** is carried out by pressing the examiner's thumb distally into the interval between the ulnar styloid process and flexor carpi ulnaris tendon, between the volar surface of the ulnar head and the pisiform.



Sensitivity 95.3%

Specificity 87.9%

Positive Predictive Value = 90.4%
Negative Predictive Value = 94.0%

Positive Likelihood Ratio = 7.88
Negative Likelihood Ratio = 0.053

Three Key Questions To Ask Yourself When Managing Ulnar Wrist Pain?

JB&JS REVIEWS

Ulnar-Sided Wrist Pain

A Critical Analysis Review

David M. Brogan, MD, MSc
Richard A. Berger, MD, PhD
Sanjeev Kakar, MD, FAOA

Investigation performed at the Department of Orthopaedic Surgery, Washington University in St. Louis, St. Louis, Missouri, and the Department of Orthopedic Surgery, Mayo Clinic, Rochester, Minnesota

Abstract

» Ulnar-sided wrist pain encompasses a variety of pathologies including arthritis, tendinopathy, ligament injuries, and instability.

» A careful physical examination can narrow the differential diagnosis, and adjunctive imaging may prove useful to confirm clinical suspicion.

» The mainstay of nonoperative treatment is immobilization, hand therapy, and corticosteroid injections; surgical intervention is dictated by the specific pathology identified, recognizing that multiple pain generators may be present.

» In the absence of distal radioulnar joint instability, when indicated, peripheral capsular repair of the triangular fibrocartilage complex may be an effective procedure for relieving pain. If instability is noted, foveal repair is advocated to restore stability.

» Treatment of distal radioulnar joint arthritis continues to evolve as new implants and techniques emerge.

» Ulnar shortening osteotomy, when indicated, can be a reliable surgical option to reduce pain and improve function.

Categorization Of Ulnar Wrist Pain

- Pain
- Pain with instability
- Pain with arthritis

Distal Radioulnar Joint Pathology
A Difficult Problem To Treat !!!!

- LOW BACK PAIN OF THE WRIST
- Multifactorial pathology
  - Bony Deformity
  - Cartilage injury
  - TFCC disorders
  - Soft tissue injury e.g. ECU instability

- These are NOT mutually exclusive
  - Failure to recognize this → suboptimal results

Is There An Easier Way To Figure This Out ☹???

The "Four-Leaf Clover" Treatment Algorithm: A Practical Approach to Manage Disorders of the Distal Radioulnar Joint

Sanjeev Kakar, MD,* Marc Garcia-Elias, MD, PhD*†

CME Continuing Medical Education

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David T. Netscher, MD, has no relevant conflicts of interest to disclose.

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David T. Netscher, MD, has no relevant conflicts of interest to disclose. The editorial and education staff involved with this journal-based CME activity has no relevant conflicts of interest to disclose.

Learning Objectives

Upon completion of this CME activity, the learner should achieve an understanding of:

- Osseous constraints of the distal radio-ulnar joint (DRUJ)
- Soft tissue restraints of the DRUJ
- Interrelated multiple causes of disorders of the DRUJ
- Treatment algorithm for disorders of the DRUJ

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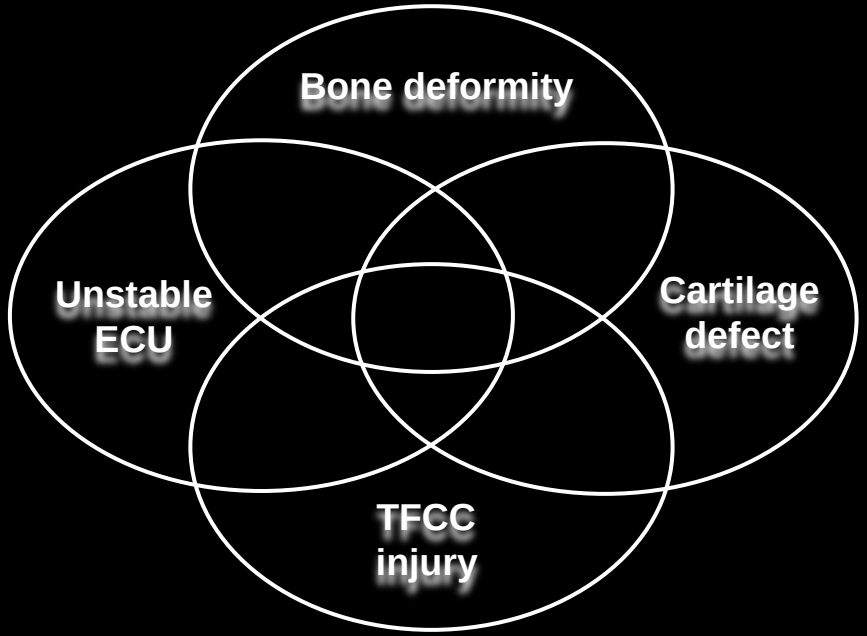
Four Important Questions To Ask



- ✓ Bone deformity ? YES / NO
- ✓ Cartilage damage ? YES / NO
- ✓ TFCC injury ? YES / NO
- ✓ Unstable ECU YES / NO

Post Operative Plan

- Sugar-tong splint: 2 weeks
- Munster cast: 4 weeks
- UT Protocol: 6 weeks

Full Length Article

JHS(E)

Outcomes of ulnotriquetral split tear repair: a report of 96 patients

Nicholas J. Clark, Nicholas Munaretto, David Ivanov, Richard A. Berger and Sanjeev Kakar

Journal of Hand Surgery
(European Volume)
2019, Vol. 44(10) 1036–1040

DOI: 10.1177/1753193419876066
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Abstract

Ninety-six wrists (56 right and 40 left) in 96 patients (36 males and 60 females, mean age 38, range 15–77 years) underwent repair of ulnotriquetral ligament split tears between 2007 and 2016. Mayo wrist scores, visual analogue scale pain scores, and objective measures including grip strength and range of motion were obtained. Patients were assessed after a mean follow-up of 21 months (range 6–112 months). Ulnotriquetral split tear repair resulted in substantial improvements in pain and function. The mean Mayo wrist score improved from 57 preoperatively to 81 postoperatively, with 84% of patients achieving a good or excellent outcome. Pain scores decreased from 5.8 to 1.2. Grip improved from 25 kg to 29 kg. There was no significant change in range of motion of the wrist. Complications were noted in eight patients, with three experiencing continued pain, four with dysaesthesia of the dorsal sensory ulnar nerve, and one superficial infection. Arthroscopic ulnotriquetral split tear repair significantly reduced pain and improved Mayo wrist scores.

Level of evidence: IV

Keywords

Ulnar-sided wrist pain, arthroscopic repair, ulnotriquetral split tear

Thank You For The Privilege Of Your Time

PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Arthroscopic management of unstable TFCC tears

Andrea Atzei, MD

Speaker has nothing of financial value to disclose.

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PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Ulnar shortening osteotomy

David S. Zelouf, MD
● Consultant: Skeletal Dynamics
● Speaker: Skeletal Dynamics

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ASSH Pre 01: Ulnar-sided wrist pathology, ASSH 2022
Ulnar Shortening Osteotomy
9/28/2022
David S. Zelouf, MD
Philadelphia Hand to Shoulder Center

The goal of an ulnar shortening osteotomy is to "unload" the ulnocarpal joint in patients with symptomatic ulnar impaction syndrome. First described by Milch in 1941, USO is indicated for symptomatic ulna positive variance without significant DRUJ incongruity or arthrosis. This may be idiopathic or as a result of a malunited distal radius fracture. In the setting of a distal radius malunion with symptomatic ulnar positive variance, if the patient's pain persists despite time and appropriate non-operative modalities including therapy, splinting and perhaps one or two corticosteroid injections, surgical treatment is appropriate.

In the setting of symptomatic ulnar sided wrist pain following a distal radius fracture, when deciding between performing a distal radius osteotomy and USO, I consider whether or not there is more than just a loss of radial length. I also consider whether there has been a loss of inclination and/or alteration in the normal palmar tilt, as well as whether or not there is post traumatic arthritis present. I also consider patient specific factors including age and occupation.

For minor degrees of symptomatic ulnar positive variance in the absence of LT pathology particularly in an "older" individual, one could perform the so called "wafer" procedure. Originally described as an open procedure by Paul Feldon in 1992, many now perform a partial distal ulna resection/"wafer" arthroscopically rather than open. The caveat is that there must be a degenerative central TFCC tear to enable this technique unless one employs DRUJ arthroscopy. Theoretically, the wafer procedure does damage the articular surface and I have had failures particularly in the setting of concomitant LT pathology. In such a situation, I advocate for a more proximal level shortening which may increase the tension in the UL and UT ligaments.

Another option to unload the UC joint is an osteotomy at the neck level. Originally described by Joe Slade in 2007, non-union may be less of an issue as the osteotomy is at the metaphyseal level. The procedure involves a DRUJ arthrotomy with a closing wedge osteotomy and either one or two distal to proximal headless

compression screws for fixation. As shown by Jeff Greenberg in a biomechanical model, the procedure is an effective way to decrease load across the ulnocarpal joint. As the technique does require a DRUJ arthrotomy, a loss of forearm rotation is a concern.

A relatively new technique utilizing a jig system allows an osteotomy at the ulna metaphysis which may allow for faster healing. This jig system employs plate fixation rather than screw fixation and is performed distal to the DOB

If a shortening is performed at the shaft level, factors to consider include the amount of shortening required and the slope of the sigmoid notch as described by Tolat. Theoretically, an ulnar shortening osteotomy in the setting of a Tolat C (reverse oblique sloping sigmoid notch) may result in premature DRUJ arthrosis.

If I have made the decision to shorten the ulna at the shaft level, my goal is roughly 1-2mm ulnar negative variance. The first dedicated osteotomy system was designed by John Rayhack in the early 90's, and I used it on multiple occasions. Most of the current commercially available cutting guides/plating systems are fairly similar to John Rayhack's design. A more proximal osteotomy does increase the tension on the dorsal oblique band of the interosseous ligament and can thus enhance DRUJ stability. More recently, a more distal osteotomy guide has become commercially available and has the advantage of a lower profile plate and perhaps a lower non-union rate as the osteotomy is performed at the metadiaphyseal region, just distal to the distal interosseous ligament.

If a more proximal osteotomy is chosen, one technique that I have employed for more than 25 years employs a freehand transverse osteotomy with fixation utilizing a six hole 3.5mm compression plate. To achieve compression, I employ an articulating tension device proximally after the three distal screws have been placed. Assuming parallel cuts have been made, this results in significant compression at the osteotomy site. One can employ the so called "stacked blades" technique to ensure parallel cuts, but I have been pleased with two separate carefully placed parallel cuts while copiously irrigating with cooled saline solution. I also perform a concomitant wrist arthroscopy to identify and treat associated wrist pathology in all cases. Plate removal is occasionally required, and I typically will wait a minimum of 12 months prior to considering hardware removal. I aim for slightly negative ulnar variance to account for dynamic

variance. Osteotomy healing can at times be difficult to judge and in some cases a CT scan may be helpful, though typically plain films over time will show gradual disappearance of the osteotomy as the ulna heals.

Postoperatively, depending upon which shortening technique is employed, most often I utilize a short arm cast for approximately four to six weeks, especially in a more proximal level shortening where there is a greater tendency for non-union. Though not required for union, in my experience casting discourages heavy use of the limb which may result in a non-union and the need for revision surgery. If a more distal level shortening is performed, in an appropriate patient I will utilize a thermoplast orthosis fashioned a hand therapist to allow easier hygiene.

In general, I have found USO to be a highly predictable procedure with regards to pain relief in the setting of ulnar positive variance. In my experience, arthroscopic TFCC debridement alone is often inadequate for treatment of ulnocarpal abutment syndrome and degenerative TFCC tears. Be mindful that stylocarpal abutment can cause ulnar sided wrist pain and a partial styloidectomy may be all that is necessary rather than a formal shaft shortening. The commercially available jig systems have simplified the procedure but non-union is still the most significant complication of the procedure. I think the incidence can be decreased with proper surgical technique, post-operative immobilization and smoking cessation.

References:

Baek GH, Lee HJ, Gong HS, et al. Long-term outcomes of ulnar shortening osteotomy for ulnocarpal impaction syndrome: at least 5-years follow-up. *Clin Orthop Surg*. 2011;3(4):295-301.

Chen NC, Wolfe SW. Ulna shortening osteotomy using a compression device. *J Hand Surg Am*. 2003;28(1):88-93.

Feldon P, Terrono AL, Belsky MR. Wafer distal ulna resection for TFCC tears and/or ulna impaction syndrome. *J Hand Surg Am.* 1992;17(4):731-737.

Katz DI, Seiler JG III, Bond TC. The treatment of ulnar impaction syndrome: a systematic review of the literature. *J Surg Orthop Adv.* 2010;18($):218-222.

Luria S, Lauder AJ, Trumble TE. Comparison of ulnar-shortening osteotomy with a new Trimed dynamic compression system: clinical study. *J Hand Surg Am.*2008;33(9):1493-1497.

Rayhack JM, Gasser SI, Latta LL, Ouellette EA, Milne EL. Precision oblique osteotomy for shortening of the ulna. *J Hand Surg Am.* 1993;18(5):908-918.

Slade JF III, Gillon TJ. Osteochondral shortening osteotomy for the treatment of ulnar impaction syndrome: a new technique. *Tech Hand Up Extrem Surg* 2007;11(1):74-82.

Tatebe M, Nakamura R, Horii E, Nakao E. Results of ulnar shortening osteotomy for ulnocarpal impaction syndrome in wrists with neutral or negative ulnar variance. *J Hand Surg Br*. 2005;30(2):129-132.

PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Open ligament reconstruction for DRUJ instability

Brian D. Adams, MD

- Consultant: Smith & Nephew, TriMed, Stryker, Xiros
- Royalties or patent beneficiary: Smith & Nephew, Extremity Medical

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Open TFCC Repair, DRUJ Ligament Reconstruction & Sigmoid Notch Osteoplasty

Brian D. Adams, M.D.

My preferred technique for TFCC Repair

A 4 cm incision is made between the 5th and 6th extensor compartments, extending proximally from the level of the ulnar styloid. The 5th compartment is opened, except for its distal portion, and the extensor digiti minimi tendon is retracted radially. An L-shaped flap is created in the DRUJ capsule, with one limb made along the dorsal rim of the sigmoid notch and the other just proximal and parallel to the dorsal radioulnar ligament. Care is taken not to cut the dorsal radioulnar ligament. Proximal-ulnar retraction of this flap exposes the articular surfaces of the distal radioulnar joint and the proximal surface of the TFCC (Fig. 2). The integrity of the TFCC and its potential for repair are determined. If it is attenuated and can not be repaired to the fovea of the ulnar head or its substance is inadequate to provide joint stability, then proceed to reconstruct the radioulnar ligaments. Debride granulation tissue from the fovea but retain the functioning remnants of the TFCC, especially any remaining portion of the palmar radioulnar ligament and the attached ulnocarpal ligaments. However, a central tear in the disk can be debrided to smooth margins. The ECU sheath should not be opened or dissected from the ulnar groove during the procedure, as preserving the sheath will maintain its important stabilizing function for the ulnocarpal joint. If an ulnar styloid nonunion is present, resect the styloid by subperiosteal sharp dissection volar to the ECU sheath. To bring the styloid into view, extend the skin incision distally and retract the skin ulnarly while protecting the dorsal cutaneous branch of the ulnar nerve. Alternatively, the fragment can be excised through the previous ulnocarpal capsulotomy described below, but the ECU sheath should not be excessively mobilized.

An ulnocarpal capsulotomy is made parallel to the dorsal radioulnar ligament, extending from the radial edge of the lunate fossa to the ECU sheath but the sheath is not opened. Care is taken not to cut the dorsal radioulnar ligament.

The TFCC is reattached to the fovea with transosseous sutures. Using a 0.062” Kirschner wire, 2 holes are created in the distal ulna that extend from the dorsal aspect of the ulnar neck to the fovea. Two double-armed, horizontal mattress sutures of 2-0 absorbable monofilament, or other suture of surgeon’s preference, are placed through the ulnar periphery of the TFCC by passing the needles through the ulnocarpal capsulotomy to exit proximal to the TFCC next to the fovea. The sutures are then passed through the bone holes, with one limb of each suture through each tunnel. By applying tension of one set of suture limbs the TFCC is held firmly against the fovea while the other suture is tied. The sutures are tied with the joint reduced and the forearm in neutral rotation. The dorsal DRUJ capsule is closed. If the capsule and retinaculum are closed together with slight imbrication but not excessively imbricated so as to avoid loss of motion. The extensor digiti minimi is left subcutaneous.

A long arm splint is applied with the forearm rotated 20º towards the most stable joint position, eg, in supination for dorsal instability. The splint is converted to a long arm cast at 2 weeks followed by a short arm cast at 4 weeks, which is worn for an additional 2 weeks. A removable splint is then used for 4 weeks while motion is regained. Strengthening and resumption of activities is typically delayed until pain is minimal and motion recovered. The results of TFCC repair are generally very good. DRUJ stability is achieved and motion and strength are recovered is most cases.

My Preferred Technique for DRUJ Ligament Reconstruction

A 4 cm incision is made between the 5th and 6th extensor compartments, extending proximally from the level of the ulnar styloid. The 5th compartment is opened, except for its distal portion, and the extensor digiti minimi tendon is retracted radially. An L-shaped flap is created in the DRUJ capsule, with one limb made along the dorsal rim of the sigmoid notch and the other just proximal and parallel to the dorsal radioulnar ligament. Care is taken not to cut the dorsal radioulnar ligament. Proximal-ulnar retraction of this flap exposes the articular surfaces of the distal radioulnar joint and the proximal surface of the TFCC. The integrity of the TFCC and its potential for repair are determined. If it is attenuated and can not be repaired to the fovea of the ulnar head or its substance is inadequate to provide joint stability, then proceed to reconstruct

the radioulnar ligaments. Debride granulation tissue from the fovea but retain the functioning remnants of the TFCC, especially any remaining portion of the palmar radioulnar ligament and the attached ulnocarpal ligaments. However, a central tear in the disk can be debrided to smooth margins. The ECU sheath should not be opened or dissected from the ulnar groove during the procedure, as preserving the sheath will maintain its important stabilizing function for the ulnocarpal joint. If an ulnar styloid nonunion is present, resect the styloid by subperiosteal sharp dissection volar to the ECU sheath. To bring the styloid into view, extend the skin incision distally and retract the skin ulnarly while protecting the dorsal cutaneous branch of the ulnar nerve. Alternatively, the fragment can be excised through the previous ulnocarpal capsulotomy, but the ECU sheath should not be excessively mobilized.

A palmaris longus tendon graft or a different graft of similar length and size (I now frequently use a strip of the FCU tendon of similar size to the PL which is exposed distally through the same volar incision used to pass the graft, along with a more proximal incision in the forearm to transect the tendon strip. Avoid the tendency to harvest a large cross-sectional graft) is harvested and a suture is placed in each end to make it easier to pass through bone tunnels and tissue. Prepare the site for the tunnel in the radius by elevating the periosteum from the dorsal margin of the sigmoid notch. Under fluoroscopic control, a guide wire for a 2-3 mm cannulated drill bit is driven through the radius a few millimeters proximal to the lunate fossa and radial to the articular surface of the sigmoid notch. Wire placement is chosen so that a tunnel large enough for the graft ($\approx$ 4-6 mm diameter) can be created without disrupting the subchondral bone of the radiocarpal joint or the sigmoid notch. True PA and lateral fluoroscopic views are necessary to confirm accurate placement. Do not plunge through the volar cortex during wire insertion to avoid injuring volar structures. A 2-3 mm cannulated drill bit is used to create a pilot tunnel. Using standard drill bits, the tunnel is progressively enlarged to accommodate the tendon graft.

If the sigmoid notch is incompetent due to the natural shape of the sigmoid notch or from trauma, then a sigmoid notch osteoplasty is indicated. The incompetency typically involves the volar rim. The surgical method that I prefer is a modification of the method described by Wallwork and Bain. The technique is described below. A slightly longer volar incision is helpful when also performing an osteoplasty.

If a corrective osteotomy for a distal radial malunion is planned in conjunction with radioulnar ligament reconstruction, it is easier but not mandatory to create the radial tunnel before performing the osteotomy. However, the tunnel must be created parallel to the malaligned lunate fossa to avoid penetrating the articular surface. In addition, graft insertion and tensioning should not be done until the bony correction is completed.

An obliquely directed tunnel is created in the distal ulna between the fovea and the ulnar neck. To expose the fovea, flex the wrist while retracting the ECU sheath ulnarly and the TFCC remnants distally. Apply the same cannulated drilling technique used for the radius to ensure accurate placement of the tunnel. The guide wire is inserted through the fovea and directed to exit the ulnar neck just volar to the ECU. Retracting the incision ulnarly exposes the wire's exit site from the ulnar neck. Apply the cannulated drill bit over the leading end of the guide wire and drill a pilot tunnel from the ulnar neck to the fovea. Drilling in this in a retrograde direction will reduce the risk of fracturing the ulnar neck and injuring the carpus. Carefully enlarge the tunnel with standard drill bits to allow passage of both limbs of the graft.

An alternative and perhaps easier technique especially in a wrist with reduced flexion is to create the ulnar tunnel by first making a hole in the outer cortex on the subcutaneous border of the ulna just volar to the ECU tendon using a standard 3.5 mm drill bit aimed perpendicular to the cortex. The guide is inserted through this hole and drilled to exit the fovea under direct vision. The 3.5 mm cannulated drill bit is used to make the pilot tunnel. The tunnel is enlarged with standard drill bits as needed.

The volar opening of the radial tunnel is exposed through a 3 cm longitudinal volar incision extending proximally from the proximal wrist crease and located between the ulnar neurovascular bundle and the finger flexor tendons. Retract the neurovascular bundle ulnarly and the finger flexors radially to expose the tunnel's opening. Inserting a blunt probe through the tunnel from the dorsum will help identify the site. Using a suture passer, the graft is passed through the tunnel, leaving its volar limb about 3 cm longer. A straight hemostat is passed from dorsal to volar over the ulnar head and under (proximal) to any remnant of

the TFC. Penetrate the volar DRUJ capsule and open the hemostat slightly to increase the size of the capsular rent. Grasp the volar limb of the graft with the hemostat and pull it through the capsule and into the dorsal surgical exposure.

Using a suture passer, both limbs of the graft are passed through the tunnel in the distal ulna from the fovea to the ulnar neck. Ensure the limbs were directed proximal to any TFC remnants prior to entering the fovea. At the ulnar neck, a curved hemostat is passed under the ECU in an ulnar direction. The dorsal limb is grasped and pulled back through this track. Using a ligature passer, the volar limb is passed volarly around the ulnar neck with care not to injure or entrap the ulnar neurovascular bundle. Both limbs should now lie near the dorsal-radial aspect of the ulnar neck. With the forearm in neutral rotation, pull the limbs taut while compressing the DRUJ and make the first throw of a surgeon's knot with the two limbs. Pull the limbs extremely taut against the ulnar neck and secure the graft tension with 3-0 nonabsorbable sutures (Figs 8,9). An additional half-hitch can be made to further strengthen the fixation.

Alternative methods are used to tension and secure the graft when it is too short to tie around the ulnar neck. One alternative is to make an additional hole in the ulna neck and weave one limb through this hole and tie it to the other limb over the small bone bridge between the holes. Another alternative is to use the floor of the ECU sheath. In this method, the ECU sheath is opened at the level of the ulnar neck but not over the ulnar head. One limb of the graft is passed subperiosteally at the ulnar neck under the ECU sheath floor, which is typically substantial, and then passed back over the sheath but beneath the ECU tendon. It is then tied to the other graft limb.

Close the dorsal DRUJ capsule and the extensor retinaculum together with 3-0 sutures for the neck of the ulna to the distal edge of the sigmoid notch with minimal or no imbrication, leaving the EDQ tendon subcutaneous over the DRUJ. The more distal, intact retinaculum will provide sufficient guidance for the EDQ and prevent bowstringing. Although I rarely pin the DRUJ as part of this procedure, such pinning is the surgeon's discretion. Residual instability, obesity and patient compliance are among the factors that influence this decision. If pinning is done, the pin should be placed at least 2 cm proximal to the ulnar tunnel to reduce the risk of ulnar fracture and large enough to resist breaking. To be prepared to extract a broken pin, one technique is to leave the leading end of the pin prominent within the subcutaneous tissues on the radial aspect of the distal forearm. The pin should be temporarily advanced through the skin to cut its point off and then backed up. If irritation of the superficial radial nerve develops, the pin can be backed up further postoperatively.

Immobilize the extremity in a long-arm cast with the forearm in neutral rotation for 3 weeks. A sugar-tong splint is discouraged because it may not control forearm rotation sufficiently. A well-molded short arm cast is applied for an additional 3 weeks that allows some motion about the neutral forearm position. A well-molded, ulnar-gutter wrist splint is used for an additional 3 weeks to prevent the extremes of forearm rotation and wrist deviation. Exercises are performed during this time, including active wrist motion, gentle hand and forearm strengthening and active but not passive forearm rotation. Supination and pronation are typically regained gradually over 4 to 6 months and thus passive motion is not necessary and may be detrimental. Near full activity is usually permitted after 4 months if grip strength and wrist motion are almost recovered, however heavy lifting and impact loading are discouraged for another 2 months.

My Preferred Technique for Osteoplasty of a Deficient Sigmoid Notch
(Modification of the technique described by Wallwork NA, Bain GI)

In patients with a history of a fracture involving the sigmoid notch or a naturally shallow notch on plain radiographs, a preoperative CT is recommended to evaluate the rims of the notch and the shape of the ulnar head. A sigmoid notch osteoplasty can be considered as an isolated procedure or to complement a ligament reconstruction. The osteoplasty increases the prominence of a rim to create a better bony buttress. Because the osteotomies are proximal to the radioulnar ligament, ligament tension is increased which also improves joint stability. In the procedure described by Wallwork and Bain, parallel osteotomies are made, with one just proximal to the lunate fossa and the other at the proximal margin of the sigmoid notch**.** A third osteotomy is made in the longitudinal plane 5 mm from the articular surface of the notch and between the first two cuts. If the osteoplasty is being performed in conjunction with a DRUJ ligament reconstruction, then

I prefer to make the radius tunnel before making the osteoplasty. I make the longitudinal osteotomy at the opening of the tunnel. An very narrow osteotome (e.g., AO chisel) is carefully advanced and with each increment it is levered in an ulnar direction to produce a thin, slightly curved osteocartilaginous flap. The wedge-shaped defect is filled with a bone graft harvested from the distal radius or ulna (only a small bone graft is necessary). Wallwork and Bain described fixing the construct with Kirschner wires, however I do not use this technique. When a osteoplasty is used in conjunction with a ligament reconstruction, graft stability can be gained without Kirschner wires. Since the radial tunnel for the ligament reconstruction lies radial to the osteotomy, the ligament graft passes directly over the bone graft and oseteochondral flap and provides good fixation of the construct. As the primary method for stabilizing the graft or when used in conjunction with a ligament reconstruction of the DRUJ, sutures can be placed through the soft tissues overlying the osteoplasty just proximal and distal to the ligament graft.

The reported results of the procedure are very limited but the concept appears sound. Wallwork and Bain had a good result when used as the sole procedure to treat palmar instability in a patient with a flat sigmoid notch. My experience using this procedure is typically in conjunction with a ligament reconstruction or a TFCC open repair to the fovea when the notch is naturally flat or has been damage by trauma.

REFERENCES

1. Adams B. Anatomic reconstruction of the distal radioulnar ligaments for DRUJ instability. Tech Hand Upper Extrem Surg 2000;4:154-160.
2. Adams BD, Berger RA. An Anatomic Reconstruction of the Distal Radioulnar Ligaments for Posttraumatic Distal Radioulnar Joint Instability. J Hand Surg 2002; 27A:243-251.
3. Wallwork NA, Bain GI: Sigmoid notch osteoplasty for chronic volar instability of the distal radioulnar joint: a case report. J Hand Surg. 26A(3):454-9, 2001.
4. Adams BD. Distal Radioulnar Ligament Reconstruction. In: Operative Techniques in Orthopedic Surgery, 2nd Edition. Lippincott Williams & Williams & Wilkins / Wolters Kluwer. 2016
5. Adams BD, Leversedge FJ. Distal Radioulnar Joint. In: Green's Operative Hand Surgery 7th Edition. Philadelphia, PA: Elsevier, 2016:479-515.

PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

ECU stabilization

Meredith N. Osterman, MD
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PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Darrach procedure and stabilization

Mark E. Baratz, MD

- Royalties or patent beneficiary: Integra

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PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Ulnar head replacement

Mark Ross, FRACS

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● Speaker: Newclip Technics, Integra, Depuy Synthes
● Royalties or patent beneficiary: Newclip Technics, Integra

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Arthroplasty in the hand: what works and what doesn't?

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Abstract

This review describes the different possibilities for arthroplasties at the proximal interphalangeal joint, thumb carpometacarpal joint, distal radioulnar joint, metacarpophalangeal joint and the wrist. For each joint, the indication for arthroplasty is explained, the surgical technique with the suitable implant is described and a brief summary of the outcomes reported in the literature is given.

Keywords

Arthroplasty, finger, wrist, distal radioulnar joint, methods, outcomes

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Introduction

We review and describe the different possibilities, indications, surgical techniques and a brief summary of arthroplasties at the proximal interphalangeal (PIP) joint, thumb carpometacarpal (CMC) joint, distal radioulnar joint (DRUJ), metacarpophalangeal (MCP) joint and the wrist.

PIP joint arthroplasty

Indication

The goal for reconstruction of PIP joint arthritis is a pain-free restoration of a functional mobility and stability. To choose the correct PIP joint procedure, the degree of instability and deformity must be taken in account and include the bone and soft tissue conditions and any underlying chronic disease (Herren, 2017, 2019; Srnec et al., 2017). Pre-existing deformity and instability in the PIP joint are difficult to correct with implant arthroplasty, especially in cases of greater than 30° of deviation in the coronal plane. Arthroplasty also has a limited role, for example, in swan neck and boutonnière deformities.

Surgical technique

The use of the different surgical approaches should be guided by the local joint requirement, the surgeons experience and the implant used (Cheah and Yao, 2016; Yamamoto and Chung, 2018).

The dorsal approach is the most widely used and technically least demanding. It is also required when certain soft tissue conditions, such as mild swan neck or boutonnière deformity, are to be corrected at the same time.

The volar approach does not violate the extensor tendons but is technically more demanding. Pre-existing tendon imbalances are more difficult to correct from this approach. However, an existing swan neck deformity can be corrected through this approach.

The lateral approach has similar advantages as the dorsal approach but leaves the central slip intact.

None of these approaches clearly show superiority. In a series of a surface replacement implant

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comparing three different approaches, it could be shown that the dorsal approach had the best overall range of motion, the volar approach the best flexion with the most extension deficit and the Chamay approach, with a V-shaped extensor tendon flap, had the highest incidence of complications (Bodmer et al., 2020).

Choice of implant

The choice of implant depends on the surgeon's experience, the local anatomical situation and the chosen surgical approach. Silicone devices, which act as joint spacers, are by far the most forgiving implants. Two-component joints need an adequate bone stock and should be inserted, if possible, without cementing. Correct placement, with the goal of restoring the biomechanical centre of rotation, needs some experience.

Outcomes

The complication incidence in PIP arthroplasty is noteworthy and varies in the literature from 2% to 13% (Takigawa et al., 2004). Implant failure, especially for silicone spacers, implant loosening and joint dislocation in two-component implants are often observed. Silicone implants tends to produce more postoperative finger deviations and instability compared with surface-replacing implants (Forster et al., 2018). However, reoperations defined as subsequent surgeries without implant modifications were fewer for silicone arthroplasties compared with more complex implants. Revision surgery gave good to moderate pain relief, no change in the range of motion and a high recurrence of joint deformity (Herren et al., 2014).

Most series have shown that patients with rheumatoid arthritis (RA) had a poorer outcome due to pre-existing deformity that could not be corrected with the implant (Takigawa et al., 2004).

Overall, the results of this procedure in PIP joint destruction are quite uniform regardless of the implant. Pain relief is good to excellent, the average range of motion for almost all implants, including the newer designs, is 40°–60° and there is a high recurrence of pre-existing deformities, especially in silicone arthroplasty. The preoperative range of motion could rarely be improved, and no clear correlation between preoperative mobility and postoperative range of motion is to be expected (Herren and Simmen, 2000). The authors' recommendations for PIP joint arthroplasty are shown in Table 1.

Thumb CMC joint replacement

Indication

Osteoarthritis of the thumb CMC joint is a common cause of pain and functional disability in the hand. If conservative measures fail then surgery can be offered. Surgery mostly includes excision arthroplasty (with or without interposition) or replacement arthroplasty.

Comparing implant arthroplasty with excision arthroplasty suggests an overall lower complication incidence for the non-implant surgeries (Ganhewa et al., 2019). However, studies comparing the two techniques suggest that replacements have faster and better pain relief, stronger grip, improved range of motion and faster convalescence (Craik et al., 2017). There is no doubt that there is increasing consideration of implant arthroplasty as an option in the management of this disorder.

Surgical technique

The best approach to the CMC I joint is dorsal. Take care to avoid injury to the small but important radial

Table 1. Authors' recommendations for proximal interphalangeal joint arthroplasty.

Indication	All painful arthritic/arthropathic/destroyed proximal interphalangeal (PIP) joints, including index finger, with decent bone stock and residual joint stability and deviation of less than 30° in the coronal plane to the lateral. Swan neck and Boutonnière deformity are difficult to reconstruct and are indicated with care.
Implant	According to the experience of the surgeon and availability. Two component implants provide more lateral stability but tend to produce more complications. Silicone is still the gold standard and more forgiving in terms of implantation, but provide limited lateral stability, especially in the long term.
Surgical details	According to the local requirements and experience. Dorsal approach with central tendon splitting is the gold standard. The volar approach gives similar clinical results and might be indicated to correct swan neck deformity, but it is technically more difficult.
Special considerations	Patients need to be informed about the outcomes to be expected. These include an active range of motion of 40°–60° and a possible need for revision and/or fusion.

sensory nerves. There is a small window between the abductor pollicis longus laterally and endangering the radial artery if straying too far medially. It is best to reflect the extensor pollicis brevis medially and go through its bed. The dorsal capsule can be opened longitudinally as a proximally based flap or as an L-shaped flap. Radial-sided approaches are described but the author has no experience with these.

Choice of implant

Silicone was a mainstay for many years, but initial excellent results were complicated by dislocation, subluxation and particulate synovitis developing after a substantial interval (Bezwada et al., 2002; Lehmann et al., 1998; Minami et al., 2005). Pyrocarbon as an interposition after partial trapezium resection has been reported to yield variable results with 56% to 90% patient satisfaction and 0% to 20% need for revision (Barrera-Ochoa et al., 2014). Interposition arthroplasty with different materials, biodegradable or not, have mostly failed (Huang et al., 2015b).

Hemi-arthroplasty devices are less popular than total arthroplasty (ball and socket) devices. Outcomes and revision incidences are extremely variable (Ganhewa et al., 2019).

Total arthroplasty implants are currently very similar and differ only in cup design and whether they have single or double articulating surfaces. The hypothetical advantage of a dual articulation (so called third generation devices) is that there is likely to be less impingement between the neck of the implant and the cup as well as more dispersion of forces, which thereby diminish the implant bone interface stresses. This should extrapolate to less dislocation as well as less cup loosening (Teissier et al., 2021).

Outcomes

Medium term survival rates are between 90% and 95% for the 5- to 10-year follow-up studies of most devices (Huang et al., 2015a). On the metacarpal side, complications are few. Fracture at the time of implantation and incorrect positioning can be avoided by meticulous surgical technique and the use of fluoroscopy. Most complications result from loosening of the trapezium cup, fracture of the trapezium and dislocation of the coupling device. Quoted figures for dislocation and cup loosening range from 4% to 7%. It is hoped that with third generation technology – modularity, dual articulation and better cup design – the complications can be mitigated. A 5-year follow-up study by Martins et al. (2020) showed 0% revision and high patient satisfaction. The authors' recommendations for CMC I joint arthroplasty are shown in Table 2.

DRUJ arthroplasty

Indication

The DRUJ presents particular challenges due to the need for stable pro-supination under load. The extent

Table 2. Authors' recommendations for thumb carpometacarpal joint arthroplasty.

Indication	Resection arthroplasty is the gold standard for peri-trapezial osteoarthritis. In cases of isolated thumb carpometacarpal (CMC) osteoarthritis without of the involvement of the scaphotrapeziotrapezoid (STT) joint, implant arthroplasty can be offered. Excluded are patients with fixed adduction contracture of the thumb CMC joint, especially with compensatory metacarpophalangeal (MCP) joint hyperextension. Excision arthroplasty as well as replacement arthroplasty have high success rates. Replacement arthroplasty offers the potential of quicker rehabilitation and a better outcome in terms of strength and in fine motor skills. Implant arthroplasty does have inherent risk of later implant complications, especially loosening, while failed resection arthroplasty can be very difficult to salvage. In younger, high-demand patients, a thumb CMC joint fusion is an established alternative to implant and resection arthroplasty.
Implant	A third-generation dual mobility uncemented thumb CMC joint replacement is recommended.
Surgical details	A dorsal or dorsoradial approach is used and care has to be taken to protect the superficial radial sensory nerve branches and dorsal radial artery. In cases of a ball-and-socket design, the joint capsule can either be repaired or resected according to the preference of the surgeon. With hemiarthroplasty and/or less constrained implants, a more meticulous capsular repair is necessary.
Special considerations	In cases of secondary or persistent STT joint pain, resection of the STT joint, with or without interposition, has been successfully utilized to avoid a more complex salvage procedure with removal of the implant.

to which this influences management decisions is modified by the patient's functional demands. There has been increasing concern about ablative procedures (Darrach Sauve–Kapandji and hemiresection) in even moderate-demand patients with issues related to multiplanar instability of the proximal ulna, particularly radioulnar convergence under load. Early DRUJ arthritis often responds well to non-operative treatment (Faucher et al., 2016). Arthroscopy and ulnar shortening may offer solutions in early-to-moderate cases refractory to non-operative management.

The indications for arthroplasty may be in a primary setting for degenerative, inflammatory or post-traumatic arthritis, or for revision of a previous ablative procedure. In both settings, the key additional consideration is the presence of marked preoperative instability of the proximal ulnar stump. This is more common in revision of previous ablative surgery.

There are two major groups of implant arthroplasty – unconstrained and semiconstrained. Unconstrained arthroplasty can be divided into partial (hemiarthroplasty) and total replacement (including sigmoid notch replacement).

Surgical technique

Unconstrained DRUJ arthroplasty is performed with a dorsal/ulnar incision centred over the distal ulna, commonly through the floor of the 5th extensor compartment. The triangular fibrocartilage complex (TFCC) is released from the ulnar fovea, or the styloid is cut with the TFCC and extensor carpi ulnaris (ECU) subsheath left attached (Berger and Cooney, 2005). The goal is to facilitate stability through optimal preservation of stabilizing structures, including the TFCC and ECU subsheath.

Total DRUJ arthroplasty begins with a hockey stick-shaped longitudinal incision along the ulnar border of the forearm. The specific surgical approach is well described and has been modified to decrease the risk of extensor tendon irritation with the creation of a large ulnar-based reticular flap (Scheker, 2008).

Choice of implant

Unconstrained hemiarthroplasty may have a bearing surface of ceramic (Herbert Ulnar Head prosthesis – UHP – KLS Martin, Tuttlingen, Germany) or cobalt chrome, and one implant provides for reattachment of ulnar-sided soft tissues (uHead – Stryker Corporation, Kalamazoo, MI, USA). Unconstrained hemiarthroplasty requires reasonable preservation of soft tissue stabilizers and reasonable sigmoid notch anatomy (Yeo et al., 2016). There is an option for sigmoid notch resurfacing if it is deficient. The only regularly utilized semiconstrained replacement is the Aptis-Scheker prosthesis (APTIS Medical, Glenview, KY, USA), which achieves excellent primary stability through a semiconstrained articulation that allows proximal/distal sliding to decrease forces at the prosthesis bone interface (Douglas et al., 2014; Scheker, 2008).

In primary cases without instability, it remains the surgeon's choice whether to use an unconstrained implant or a semiconstrained implant. Where instability is not a problem, a hemiarthroplasty may be a less invasive procedure. In cases with instability (primary or revision), although there are options for augmenting stability with soft tissues, the semiconstrained implant would appear to offer a more predictable outcome. There is an increasing number of implants, which are no longer available, especially on the European market, due to the new medical device regulations.

Outcomes

There is conflicting evidence about functional outcomes. Some studies report considerable residual disability, and others cite symmetrical grip strength and improved range of motion at approximately 7 years (Axelsson et al., 2015; Faucher et al., 2016). There is insufficient evidence to identify an optimal bearing surface material or a clear benefit for the prosthesis that includes soft tissue reattachment.

There is a risk of ulnar head dislocation in hemiarthroplasty, which is almost zero in semiconstrained implants (Bellevue et al., 2018; Galvis et al., 2014). Erosion of the unconstrained head into the radius is a frequent and concerning radiographic finding, but as yet it has not been linked to an increased revision incidence or decreased outcome (Axelsson et al., 2015).

There is insufficient published evidence to draw any conclusions on the use of unconstrained total replacement versus semiconstrained replacement. There is a trend toward higher survivorship in the semiconstrained prosthesis versus unconstrained (98% versus 95%) (Faucher et al., 2016; Scheker, 2008). However, a significant percentage of patients undergoing semiconstrained arthroplasty have required further surgery for extensor tendon irritation and superficial radial nerve irritation (Bellevue et al., 2018). These risks can be mitigated by careful adherence to detailed surgical technique, including avoidance of long screws protruding from the radius and the aforementioned retinacular flap. Many of these reported complications predate the revised technique. The authors' recommendations for DRUJ arthroplasty are shown in Table 3.

Table 3. Authors' recommendations for distal radioulnar joint arthroplasty.

Indication	Hemiarthroplasty (ulnar head replacement only) is a reasonable choice for primary surgery in patients with arthritis in the absence of instability when sufficient soft tissue stabilizers and bone stock is present. Total joint replacement, including a sigmoid notch component, is rarely performed and often not even available. A semiconstrained total replacement (Aptis-Scheker prosthesis) is indicated for treatment of post-traumatic, degenerative, or inflammatory arthritis, and is preferred in salvage situations, revisions and in the presence of instability.
Implant	See indication
Surgical details	The most important factor in implant arthroplasty of the distal radioulnar joint (DRUJ) is the soft tissue stabilization. The goal is to facilitate stability through optimal preservation of stabilizing structures, including the retinaculum, the triangular fibrocartilage complex (TFCC) and extensor carpi ulnaris (ECU) subsheath.
Special considerations	Unstable DRU joints cannot be stabilized with an unconstrained hemiarthroplasty. In these cases, either a semi-constrained replacement or a non-arthroplasty alternative like resection/hemi-resection of the ulnar head or a DRUJ arthrodesis (Sauvé–Kapandji) procedure needs to be considered.

MCP joint arthroplasty

Indication

Arthroplasty of the MCP joint is most often performed for patients with RA when the joint deterioration has progressed to Larsen Grade $\geq$3 with the joint in ulno–palmar subluxation or dislocation often leading to secondary swan neck deformity. Other rarer indications are chondrocalcinosis, hemochromatosis, other monoarthritic destruction of the MCP joints or post-traumatic joint destruction. In patients with RA, in addition to pain relief, arthroplasty can provide for aesthetic and functional improvements.

Surgical technique

A dorsal transverse approach is usually used (Ishikawa et al., 2002; Swanson et al., 1997). While preserving the subcutaneous veins and nerves, the ulnar intrinsic muscles are released in all fingers. The extensor hood and the sagittal band are incised either on the radial or ulnar side of the ulnarly displaced extensor tendons, depending on the degree of the possibility to relocate the tendon. In the index and small fingers with no or little tendon dislocation, the interval between the two extensor tendons can be used. After longitudinally opening the joint capsule and synovectomy, the metacarpal head and proximal phalangeal base are resected using the trial implant as a template. If needed, the volar capsule is incised transversely, and after pulling out the flexor tendon, flexor tenosynovectomy is performed. It is important to have a supple joint to host the implant, so ligament release and if needed, further bone resection is applied. The medullary space is prepared according to the implant requirements, and the definitive implant is inserted. To avoid index finger pronation and recurrent ulnar deviation, it is possible to reattach a radial slip of the capsule or the sagittal band to the bone. Any remaining capsule is closed over the implant, and the extensor tendon is centralized if needed. Crossed-intrinsic transfer can be added in cases of severe joint deviation. The ulnar-sided released intrinsic tendon is transferred to the radial side of the adjacent finger and fixed dorsoradially in the extensor hood (Ishikawa et al., 2002; Swanson et al., 1997).

Choice of implant

Flexible silicone implants are the standard implants for MCP joints with moderate-to-severe deformities and fragile soft tissue (Beevers and Seedhom, 1995). The encapsulation process around the joint creates stability, and the elastic implant has a role as an internal splint. Non-constrained or semiconstrained implants (e.g. pyrocarbon) are reserved for patients with a stable MCP joint and little/no subluxation.

Outcomes

Flexible silicone implants provide pain relief, correction of deformity and functional range of motion in the mid-term; however, a significant increase in the grip and pinch strength cannot be expected. The average range of motion is 40°–50°. Patients are satisfied with the aesthetics and function of the hand (Chung et al., 2017). In the long-term, deformity may recur, the range of flexion decreases and the incidence of implant fracture increases (Boe et al., 2018; Cook et al., 1999; Goldfarb and Stern, 2003; Trail et al., 2004). Even if the implant is broken, it often does not require revision unless it causes

severe bone resorption and deformity due to silicone particulate-induced synovitis.

Non-constrained or semiconstrained implants provide pain relief and a slightly better range of motion than silicone implants (Iwamoto et al., 2021; Linscheid, 2000). However, they are associated with the risk of radiographic evidence of loosening, recurrent deformity and dislocation, if the soft tissue surrounding the MCP joint is weak. The authors' recommendations for MCP arthroplasty are shown in Table 4.

Wrist arthroplasty

Indication

Total wrist arthroplasty (TWA) is an established motion-preserving alternative to arthrodesis in the management of recalcitrant arthritis. Indications include pan-carpal arthritis in lower-demand individuals, failed limited (or complete) wrist arthrodesis, inflammatory arthritis/deformity, scapholunate advanced collapse/scaphoid nonunion advanced collapse in older and lower-demand patients, and avascular necrosis of the carpus.

Surgical technique

A dorsal surgical approach to the wrist is performed for all types of arthroplasty designs and implant-types. The retinaculum is elevated from either a 4th compartment Z-plasty or radially from the first compartment. A dorsally based u-shaped flap helps facilitate exposure of the wrist. Adequate exposure is necessary to ensure appropriate technique.

Choice of implant

All types of implants follow the premise of proximal carpal row excision and maintenance of the capitate as the centre of rotation. Silicone implants are no longer available. The more common arthroplasty choices nowadays are modular metal–plastic ellipsoid articulations that rely on osseointegration of the components. These designs are similar and have radial intramedullary stems proximally and carpal plate with screw–peg fixation distally that maintains polyethylene articulation. Metal-on-metal ball-in-socket articulated implants, with single intramedullary stems in the radius and 3rd metacarpal, are available in Europe and Asia. A pyrocarbon interposition implant is also available in Europe and Asia that functions as a 'spacer' without formal fixation in/on bone. The use of cement has been largely abandoned.

Outcomes

While earlier systemic reviews of TWA condemned its use when compared with arthrodesis (Yeoh and Tourret, 2015), more recent meta-analyses examining the newer generation designs have been encouraging (Berber et al., 2018). Both agree that TWA is a higher risk procedure with more complications and failures. TWA also affords generally very effective pain relief, grip strength averaging 50–75% of contralateral side and functional arc of motion improvement with flexion/extension averaging 33°/30° (Berber et al., 2018). A significant improvement in patient-related outcomes can be expected (Sagerfors et al., 2015). Newer 4th generation designs have lower complication incidences than 2nd–3rd generation implants – 17% versus 48%,

Table 4. Authors' recommendations for metacarpophalangeal arthroplasty.

Indication	Destroyed or deformed metacarpophalangeal (MCP) joints with functional impairment. Caution is needed in joints with severe joint contracture. There is an increasing number of single joint involvement due to osteoarthritis, hemochromatosis or chondrocalcinosis.
Implant	Any flexible silicone implants according to the surgeon's experience and availability is the gold standard, especially in inflammatory disease. Two component arthroplasty can be considered in single joint involvement and minimal joint deformity or defects. There are only few two component implants available, of which the pyrocarbon has the best tract record.
Surgical details	Transverse dorsal approach in multiple fingers, longitudinal dorsal in single or dual finger involvement. When swan neck deformity remains after implant insertion at the MCP joint, tenodesis or fusion at the proximal interphalangeal joint is added. The role of crossed intrinsic transfer is debated with limited evidence.
Special considerations	To prevent early implant fracture, the range of MCP joint flexion should be restricted to $<60°$ in postoperative rehabilitation. The control of disease activity in rheumatoid arthritis affects the surgical outcome. Revision option is change of the implant or in rare cases resection–interposition arthroplasty (volar plate, dorsal capsule, artificial interposition material).

Table 5. Authors' recommendations for wrist arthroplasty.

Indication	Pan-carpal arthritis with no motion-preserving alternative, such as partial wrist arthrodesis or proximal row carpectomy. Prerequisite are decent bone stock and functional tendons. Wrists with a significant dislocation and/or fixed deformity are a contraindication for wrist arthroplasty. In rheumatoid arthritis, stable inflammatory control of the disease is mandatory. Young manually active patients are a relative contraindication. Bilateral involvement also favours a motion-preserving procedure at least on one side.
Implant	Metal-on-plastic designs or metal-on-metal implants with carpal peg/screw fixation with a ball-and-socket design or ellipsoid articulations are the current standards of care. Pyrocarbon capitate resurfacing implants or the Amandys (Stryker Corporation, USA) are viable alternatives.
Surgical details	Dorsal through a fourth compartment z-plasty or oblique retinacular exposure and u-shaped dorsally based capsular flap. If there is a need for tendon rebalancing, the indication might have been wrong. Be very generous with your exposure to minimize risk of implant malposition.
Special considerations	Patient selection and setting expectations is most important. Many implants have failed the proof of time and there are no reliable long-term results on any of the prostheses. Since revision surgery is difficult and paved with complications, surgical indications should be applied carefully and critically. Postoperative rehabilitation should be individualized, and motions begin typically at 2–4 weeks following surgery. However, if there are any concerns with respect to stability or stiffness postoperatively, longer immobilization or more aggressive mobilization might be needed.

respectively (Berber et al., 2018). The expected survivorship at 5 years is greater than 90% (Berber et al., 2018), at 10 years is closer to 85% (Reigstad et al., 2017) and at 15 years is closer to 80% (Gil et al., 2017). Longer-term data for the pyrocarbon implant are lacking, but excellent survivorship was noted at mid-term follow-up (Bellemère et al., 2012; Marie et al., 2021).

The most common mode of failure is distal component loosening, which unfortunately results in loss of the precious carpal bone stock. Thus, while revision TWA is feasible (Fischer et al., 2018), most surgeons rely on arthrodesis for salvage (Rizzo et al., 2011). The outcomes for arthrodesis in the management of failed arthroplasty carry high failure and nonunion rates (Berber et al., 2020); but with structural bone grafting and improved fixation techniques/technology, predictable fusion has been demonstrated (Adams et al., 2016). The authors' recommendations for wrist arthroplasty are shown in Table 5.

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References

Adams BD, Kleinhenz BP, Guan JJ. Wrist arthrodesis for failed total wrist arthroplasty. J Hand Surg Am. 2016, 41: 673–9.

Axelsson P, Sollerman C, Kärrholm J. Ulnar head replacement: 21 cases; mean follow-up, 7.5 years. J Hand Surg Am. 2015, 40: 1731–8.

Barrera-Ochoa S, Vidal-Tarrason N, Correa-Vazquez E, Reverte-Vinaixa MM, Font-Segura J, Mir-Bullo X. Pyrocarbon interposition (PyroDisk) implant for trapeziometacarpal osteoarthritis: minimum 5-year follow-up. J Hand Surg Am. 2014, 39: 2150–60.

Beevers DJ, Seedhom BB. Metacarpophalangeal joint prostheses. A review of the clinical results of past and current designs. J Hand Surg Br. 1995, 20: 125–36.

Bellemère P, Maes-Clavier C, Loubersac T, Gaisne E, Kerjean Y. Amandys([R]) implant: novel pyrocarbon arthroplasty for the wrist. Chir Main. 2012, 31: 176–87.

Bellevue KD, Thayer MK, Pouliot M, Huang JI, Hanel DP. Complications of semiconstrained distal radioulnar joint arthroplasty. J Hand Surg Am. 2018, 43: 566 e1–e9.

Berber O, Garagnani L, Gidwani S. Systematic review of total wrist arthroplasty and arthrodesis in wrist arthritis. J Wrist Surg. 2018, 7: 424–40.

Berber O, Gidwani S, Garagnani L et al. Salvage of the failed total wrist arthroplasty: a systematic review. J Wrist Surg. 2020, 9: 446–56.

Berger RA, Cooney WP 3rd. Use of an ulnar head endoprosthesis for treatment of an unstable distal ulnar resection: review of mechanics, indications, and surgical technique. Hand Clin. 2005, 21: 603–20, vii.

Bezwada HP, Sauer ST, Hankins ST, Webber JB. Long-term results of trapeziometacarpal silicone arthroplasty. J Hand Surg Am. 2002, 27: 409–17.

Bodmer E, Marks M, Hensler S, Schindele S, Herren DB. Comparison of outcomes of three surgical approaches for proximal interphalangeal joint arthroplasty using a surface-replacing implant. J Hand Surg Eur. 2020, 45: 608–14.

Boe C, Wagner E, Rizzo M. Long-term outcomes of silicone metacarpophalangeal arthroplasty: a longitudinal analysis of 325 cases. J Hand Surg Eur. 2018, 43: 1076–82.

Cheah AE, Yao J. Surgical approaches to the proximal interphalangeal joint. J Hand Surg Am. 2016, 41: 294–305.

Chung KC, Kotsis SV, Burns PB et al. Seven-year outcomes of the silicone arthroplasty in rheumatoid arthritis prospective cohort study. Arthritis Care Res (Hoboken). 2017, 69: 973–81.

Cook SD, Beckenbaugh RD, Redondo J, Popich LS, Klawitter JJ, Linscheid RL. Long-term follow-up of pyrolytic carbon metacarpophalangeal implants. J Bone Joint Surg Am. 1999, 81: 635–48.

Craik JD, Glasgow S, Andren J et al. Early results of the ARPE arthroplasty versus trapeziectomy for the treatment of thumb carpometacarpal joint osteoarthritis. J Hand Surg Asian Pac Vol. 2017, 22: 472–8.

Douglas KC, Parks BG, Tsai MA, Meals CG, Means KR Jr. The biomechanical stability of salvage procedures for distal radioulnar joint arthritis. J Hand Surg Am. 2014, 39: 1274–9.

Faucher GK, Zimmerman RM, Zimmerman NB. Instability and arthritis of the distal radioulnar joint: a critical analysis review. JBJS Rev. 2016, 4: 1.

Fischer P, Sagerfors M, Brus O, Pettersson K. Revision arthroplasty of the wrist in patients with rheumatoid arthritis, mean follow-up 6.6 years. J Hand Surg Am. 2018, 43: 489 e1–e7.

Forster N, Schindele S, Audigé L, Marks M. Complications, reoperations and revisions after proximal interphalangeal joint arthroplasty: a systematic review and meta-analysis. J Hand Surg Eur. 2018, 43: 1066–75.

Galvis EJ, Pessa J, Scheker LR. Total joint arthroplasty of the distal radioulnar joint for rheumatoid arthritis. J Hand Surg Am. 2014, 39: 1699–704.

Ganhewa AD, Wu R, Chae MP et al. Failure rates of base of thumb arthritis surgery: a systematic review. J Hand Surg Am. 2019, 44: 728–41 e10.

Gil JA, Kamal RN, Cone E, Weiss AC. High survivorship and few complications with cementless total wrist arthroplasty at a mean followup of 9 years. Clin Orthop Relat Res. 2017, 475: 3082–7.

Goldfarb CA, Stern PJ. Metacarpophalangeal joint arthroplasty in rheumatoid arthritis. A long-term assessment. J Bone Joint Surg Am. 2003, 85-A: 1869–78.

Herren D. The proximal interphalangeal joint: arthritis and deformity. EFORT Open Rev. 2019, 4: 254–62.

Herren DB. Current European practice in the treatment of proximal interphalangeal joint arthritis. Hand Clin. 2017, 33: 489–500.

Herren DB, Keuchel T, Marks M, Schindele S. Revision arthroplasty for failed silicone proximal interphalangeal joint arthroplasty: indications and 8-year results. J Hand Surg Am. 2014, 39: 462–6.

Herren DB, Simmen BR. Palmar approach in flexible implant arthroplasty of the proximal interphalangeal joint. Clin Orthop Relat Res. 2000, 371: 131–5.

Huang K, Hollevoet N, Giddins G. Thumb carpometacarpal joint total arthroplasty: a systematic review. J Hand Surg Eur. 2015a, 40: 338–50.

Huang YC, Jazayeri L, Le W, Yao J. Failure of Artelon interposition arthroplasty after partial trapeziectomy: a case report with histologic and immunohistochemical analysis. Am J Orthop (Belle Mead NJ). 2015b, 44: E117–22.

Ishikawa H, Murasawa A, Hanyu T. The effect of activity and type of rheumatoid arthritis on the flexible implant arthroplasty of the metacarpophalangeal joint. J Hand Surg Br. 2002, 27: 180–3.

Iwamoto T, Ishii K, Suzuki T, Kimura H, Matsumura N, Sato K. Risk factors contributing to early implant fracture in silicone metacarpophalangeal joint arthroplasty for patients with rheumatoid arthritis. J Hand Surg Am. 2021, 46: 243 e1–e7.

Lehmann O, Herren DB, Simmen BR. Comparison of tendon suspension-interposition and silicon spacers in the treatment of degenerative osteoarthritis of the base of the thumb. Ann Chir Main Memb Super. 1998, 17: 25–30.

Linscheid RL. Implant arthroplasty of the hand: retrospective and prospective considerations. J Hand Surg Am. 2000, 25: 796–816.

Marie C, Aribert M, Bouyer M, Forli A, Corcella D. Clinical, functional, and radiological results of the Amandys® interposition arthroplasty in 13 cases of wrist osteoarthritis. Hand Surg Rehabil 2021. DOI: 101016/j.hansur.2021.03.001.

Martins A, Charbonnel S, Lecomte F, Athlani L. The Moovis® implant for trapeziometacarpal osteoarthritis: results after 2 to 6 years. J Hand Surg Eur. 2020, 45: 477–82.

Minami A, Iwasaki N, Kutsumi K, Suenaga N, Yasuda K. A long-term follow-up of silicone-rubber interposition arthroplasty for osteoarthritis of the thumb carpometacarpal joint. Hand Surg. 2005, 10: 77–82.

Reigstad O, Holm-Glad T, Bolstad B, Grimsgaard C, Thorkildsen R, Rokkum M. Five- to 10-year prospective follow-up of wrist arthroplasty in 56 nonrheumatoid patients. J Hand Surg Am. 2017, 42: 788–96.

Rizzo M, Ackerman DB, Rodrigues RL, Beckenbaugh RD. Wrist arthrodesis as a salvage procedure for failed implant arthroplasty. J Hand Surg Eur. 2011, 36: 29–33.

Sagerfors M, Gupta A, Brus O, Pettersson K. Total wrist arthroplasty: a single-center study of 219 cases with 5-year follow-up. J Hand Surg Am. 2015, 40: 2380–7.

Scheker LR. Implant arthroplasty for the distal radioulnar joint. J Hand Surg Am. 2008, 33: 1639–44.

Srnec JJ, Wagner ER, Rizzo M. Implant arthroplasty for proximal interphalangeal, metacarpophalangeal, and trapeziometacarpal joint degeneration. J Hand Surg Am. 2017, 42: 817–25.

Swanson AB, de Groot Swanson G, Ishikawa H. Use of grommets for flexible implant resection arthroplasty of the metacarpophalangeal joint. Clin Orthop Relat Res. 1997, 342: 22–33.

Takigawa S, Meletiou S, Sauerbier M, Cooney WP. Long-term assessment of Swanson implant arthroplasty in the proximal interphalangeal joint of the hand. J Hand Surg Am. 2004, 29: 785–95.

Teissier J, Teissier P, Toffoli A. Trapeziometacarpal prostheses. Hand Surg Rehabil. Epub ahead of print 2021. DOI: 10.1016/j.hansur.2020.09.013.

Trail IA, Martin JA, Nuttall D, Stanley JK. Seventeen-year survivorship analysis of silastic metacarpophalangeal joint replacement. J Bone Joint Surg Br. 2004, 86: 1002–6.

Yamamoto M, Chung KC. Implant arthroplasty: selection of exposure and implant. Hand Clin. 2018, 34: 195–205.

Yeo CJ, Morse LP, Krishnan J, Bain GI. Salvage procedures for distal radioulnar joint complications. J Hand Surg Asian Pac Vol. 2016, 21: 173–86.

Yeoh D, Tourret L. Total wrist arthroplasty: a systematic review of the evidence from the last 5 years. J Hand Surg Eur. 2015, 40: 458–68.

PRE01: Ulnar-Sided Wrist Pathology: Demystifying The “Black Box” of Wrist Surgery

Achilles Interposition Arthroplasty

Dean G. Sotereanos, MD

● Consultant: Axogen Inc, ConMed

77TH ANNUAL MEETING OF THE ASSH
SEPTEMBER 29 - OCTOBER 1, 2022

Precourse 1:

Achilles InterpositionArthroplasty

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Distal Radio-ulnar interposition arthroplasty using an Achilles tendon allograft

- Is indicated for failed distal ulnar resection due to impingement
- Especially for young, active patients
- Mechanical interposition
- Prevents distal radio-ulnar convergence

Technique Notes

- Previous surgical incisions are incorporated into the approach
- Dorsal approach through the fifth dorsal compartment
- Subperiosteal exposure of distal ulna, 4-6 cm proximal to distal stump
- Exposure of medial cortex of radius
- 3-4 micro suture anchors are placed into the medial cortex of radius (3-4 cm length), proximal to the sigmoid notch, at site of the impingement
- 3-4 drill holes are made in the distal ulna
- The allograft is sutured between the radius and ulna with the sutures from the anchors passed through the graft and drill holes

Pearls & Pitfalls

- For sufficient size of allograft bulk, obtain as much as necessary –increase allograft size if crepitus is palpated
- Use micro suture anchors for graft fixation to avoid radial shaft fracture
- Immobilize in long-arm splint in neutral position for 10 days and convert to cast for 6 weeks
- Physical therapy can be started after 6 weeks to advance motion and strength

REFERENCES

- Sotereanos DG, Papatheodorou LK, Williams BG. Tendon allograft interposition for failed distal ulnar resection: 2-14 year follow-up. J Hand Surg Am. 2014;39(3):443-448.
- Papatheodorou L, Rubright J, Kokkalis Z, Sotereanos D. Resection Interposition Arthroplasty for Failed Distal Ulna Resections. Journal of Wrist Surgery 2013;02(01):13-18.
- Greenberg JA, Sotereanos D. Achilles allograft interposition for failed Darrach distal ulna resections. Tech Hand Up Extrem Surg. 2008;12(2):121-125.
- Sotereanos DG, Gobel F, Vardakas DG, Sarris I. An allograft salvage technique for failure of the Darrach procedure: a report of four cases. J Hand Surg Br. 2002;27(4):317-321.