AADO-HKSSH Nursing Symposium
Arthroplasty of Ulna head

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Invited Speakers:
Prof. Brian D. Adams (USA)
Prof. Yoshitaka Minamikawa (Japan)
Dr. Jo Adams (UK)

Arthroplasty in Hand, Wrist and Elbow

17-18th March, 2012

Venue:
Lecture Theatre, 7/F, Block H,
Princess Margaret Hospital, Hong Kong SAR

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Please visit our website for latest information.
Website: www.hkssh.org
M/40 manual worker, fall on level ground
Close reduction and short arm POP
Ulnar plus with subluxed DRUJ

* Persistent ulnar wrist pain
* Decrease supination
* TFCC intact

4 month
Ulna wrist pain is the most common residual symptom after Distal radius fracture
Causes of Ulnar wrist pain

- Bone: ulna styloid nonunion
- Soft tissue: TFCC injury, tendinitis
- Joint: Distal Radio-Ulna joint Problems
DRUJ (Distal Radio-Ulnar Joint):

- A space separate and distinct from Radio-carpal joint
- Articulation: sigmoid notch of radius and ulnar head
- Volar and dorsal capsule
- Separate from RCJ by TFCC
- For forearm rotation
Importance: distinctive!

- Complete separation of DRUJ from carpal joint by fibrous articular disc

- Distinguish man from other hominoid primates
DRUJ

**Bones**
- Radius
- Ulnar
- Articulations

**Soft tissue Components**
- TFCC
- ECU and DRUJ capsule
- Pronator quadratus
- Interosseous membrane
Cartilage articulation:

- Ulna head: 90 to 135 degree
- Sigmoid notch: 47 to 80 degree
- Mid range: 60-80 degree contact
- Extreme range: ~10 degree
- Translation: 2.8mm dorsal, 5.4mm palmar

Pirela-Cruz MA, 1991, J Hand Surg 16A
Movement of DRUJ

• Forearm Pronation

• Forearm supination

• Volar – dorsal translation
So unstable!

- Importance of Soft tissue stability

- Especially at extremes of forearm rotation
**Soft tissue components**

1. **TFCC**
2. *ECU sheath and DRUJ capsule*
3. Pronator quadratus
4. Interosseous membrane
TFCC
Triangular FibroCartilage Complex”

- Extensive fibrous system
- Arise from carpal margin of sigmoid notch
- Cups the lunate and triquetral
- Ulnar attachment with base of ulnar styloid
TFCC : components

a. TFC :
   1. Articular disc,
   2. Dorsal and volar radio-ulnar ligaments
b. Ulnotriquetral and Ulnolunate ligaments
c. ECU sheath
d. meniscus

• Palmer AK, Werner, J Hand Surg (Am)1988
Knowledge about TFCC


- Isometric Fibre:
  - Fovea
  
  T Nakamura, A Makita
  T Nakamura, S Takayama
• TFCC play a major role in stabilizing DRUJ
  • 1981 Palmer & Werner

• Dorsal and palmar RadioUlnar ligaments as major components of TFCC
  • 1989 Mikic 1989
Stability of DRUJ

- **Primary:**
  - TFCC

- **Secondary:**
  - Conformation of sigmoid notch
  - Distal interosseous membrane
  - DRUJ capsule

- **Dynamic:**
  - ECU subsheath
  - Pronator quadratus
What happen to DRUJ after distal radius fracture?
Radial shortening after DR fracture

Normal

Ulna plus after healed but shortened distal radius fracture

Lax TFCC fovea anchor results in DRUJ instability

Ulna shortening tension up TFCC

Thus increase DRUJ stability
Articular incongruity after DR fracture
TFCC disruption after DR fracture

- “Styloid affection ……a *better predictor of poor outcome* than intra-articularity” Oskarsson et al Arch Orthop Trauma Surg 1997

- “Ulnar styloid avulsions contribute to a *poorer result* because of their effect on **DRUJ function**” Stoffelen et al J. Hand Surgery 1998
DRUJ problems after distal radius fracture

- Pain
- Stiffness
- Instability
- ? Congruous Articular surface
- ? Structural integrity of ligamentous stabilizer and its bony attachments
Comprehensive Evaluation

Clinical test: Instability vs Impingement

X-Ray (Neutral Rotation PA/Lat)

Fluoroscopic Examination

Wrist Arthroscopy
Major Causes of Chronic DRUJ Symptoms

Incongruency

Impaction

Inselation
Impaction

• Ulna plus

• Symptomatic ulnar styloid non union
Impaction

- Pain on ulna deviation

- Positive ulnecaral grinding
Impaction

- Wafer procedure
Impaction:
ulna shortening

• Prerequisites:

  – Well oriented sigmoid notch in frontal and sagittal planes

  – No intraarticular step-off or degeneration
Impaction

• Advantages of ulna shortening:
  – Decompress ulnar compartment of wrist
  – Reestablish DRUJ congruity
  – Tighten Ulnar carpal ligaments and TFCC

The ulnar impaction syndrome: follow-up of ulnar shortening osteotomy.

Chun S, Palmer AK.
Ulnar Shortening

Stepcut Osteotomy
Figure 1. Schematic presentation of the plate and wires during the operation.
Symptomatic Ulna styloid nonunion

- F/37
- Initial Frykman Type 2
- Persistent pain 19 months
- **No Instability**/Arthrosis
- Excision of bone fragment
- **Function Score:** 25 → 39/40
- **Pain Score:** 12 → 1/20

23-11-98
Instability

- Malunited distal radius — sigmoid notch malposition

- TFCC tear/attenuation/bony avulsion
Instability

- Increased AP translation of ulna on radius during passive manipulation

- Done in neutral, pronation, supination

- Compare opposite wrist
Instability

- X ray:
  - standard AP and lateral (SPC) views
  - Semi-pronated / semi-supinated views
  - Stress views

- CT: standard
Instability: treatment

- Radial malalignment:
  - Radial osteotomy
  - +/- partial ulna head resection

- Ulna styloid non union, TFCC intact
  - ORIF with bone graft
  - Palmaris longus sling augmentation

- TFCC disruption (RU ligament disruption)
  - TFCC augmentation / reconstruction (Arthroscopic assisted)

- Ulna plus
  - Ulna shortening
ORIF of ulnar styloid

- M/25
- Motor bike victim
- Persistent ulnar wrist pain

- DRUJ instability
- TFCC intact
- No joint Arthrosis
- ORIF + BG Stable

- Function score 40/40
- Pain Score 0/20
Case 3: TFCC Reconstruction for Failed Repair

Function score  26  →  37/40
Pain Score  12  →  3/20
Incongruency
Incongruency: may progress to DRUJ arthritis

- Extra-articular
- Intra-articular
Extra-articular incongruity

• Etiology:
  – Radial shortening
  – Malaligned Sigmoid notch – ulna head articulation

• Changing the tilt to 40 degree dorsal increases ulna loading by 21 –65%
Incongrunity

• Pain and restricted forearm rotation

• Painful DRUJ loading /stress

• Wrist radial deviated deformity
Extra-articular incongruity

- Compare opposite wrist

- Goal:
  - Achieve STABLE DRUJ with Free Pronataion/supination
Radius corrective osteotomy
Intra-articular incongruity

• Choices:
  - Resection arthroplasty
  - Sauve-Kapandji procedure
  - Prosthetic replacement

• Age, hand dominance, occupation
DARRACH’S PROCEDURE

- Indications:
  - For pain relief following DRU disruption and/or RU arthritis
  - For symptomatic radius nonunion in elderly patients
  - Procedure is generally performed on elderly patients of low functional demands
Complications

Procedure does not produce uniformly good results, especially in younger patients

- Instability of the distal ulnar shaft
- Radio-ulnar impingement (convergence)
- Palmar subluxation or ulnar translation of the carpus
- Painful subluxation of the ECU over transected end of the ulna
- **Problems:**
  - Instability of ulnar stump
  - Loss of carpal support
  - Decreased torque strength
  - Radio-ulnar impingement
    - Pain, clicking, catching, locking
Watson 1986
Contour ulnar to:
1) decrease contact pressure
2) decrease pain
3) prevent catching, clicking, locking
Sauve-Kapandji Procedure

- Described in 1936
  - A) Druj Arthrodesis (treat arthritis pain)
  - B) Pseudarthrosis at ulnar head (Permit rotation)

Retrospective series of 41 Sauve-Kapandji
for post-traumatic disorders of the distal radio-ulnar joint

- Pain improved in 25 of the 37 patients, and unchanged in 10
- Rotation of forearm returned to within 7° of uninjured side
- Sauve-Kapandji procedure

(PB Carter, P. R. Stuart. JBJS(Br) 2000;82-B:1013-18)
Disadvantages:

- Distal ulnar instability/ Radio-ulnar impingement
  - If excessive bone is resected, distal portion of proximal ulna may be unstable
  - This complication is more likely to occur if instability existed preoperatively
  - A non-painful clunk will be present in more than 50% of patients

- Reactive bone formation
  - Limiting motion

- Nonunion DRUJ

- Hardware impingement

- Limited forearm rotation
Ulnar Head Arthroplasty

- Swanson 1973
- Silicone ulnar head replacement

Ulnar Head Arthroplasty

4 yrs FU, 20 wrists

- Fracture 15%
- Angulation 40%
- Bony resorption 100%

45 wrists

- Migration or breakage
- Silicone synovitis

Stanley JHS 1992

Sagerman JHS 1992
Current implants

- Non-constrained ulnar head replacement
- Semi-constrained total DRUJ replacement
ULNAR HEAD ARTHROPLASTY

- Advantages:
  - Treat pain
  - Improve stability
  - Prevent impingement
Ulnar Head Arthroplasty

- **uHead™** (SBI, Avanta)
- Modular
- Morris Taper
- Cobalt Chrome
- Plasma spray on stem
Surgical technique of Ulna head replacement
Ulnar Head Arthroplasty

- No long term data

- 19 wrists with failed Darrach (Willis JHS 2007)
- 2 years FU
- Pain scores decreased 50%
- Grip strength improved 4kg (16%)
- 100% “improved”, would have surgery again
Ulnar Head Arthroplasty

- Complications
  - Ulnar fracture (1)
  - Neuroma (1)
  - Instability (1)
  - Progressive degeneration of sigmoid notch (1)
  - Stem loosening (2)
Ulnar Head Arthroplasty

- 22 wrists failed resection arthroplasty (Shipley N Tech Hand Surg 2009)
- 4.5 yrs FU
- VAS (3.4 to 1.7)
- Mayo wrist scores 73 (good)
- Complications of recurrent instability
Comparison of native ulnar head and partial ulnar head resurfacing implant  (Adams, JHS Am, 2009)

Partial ulnar head implant, without an extensive dissection, the clinical results are expected to at least match the functional results of total head replacement, reduce the rehabilitation, and possibly reduce the risk of joint instability.

Partial Ulnar Head Replacement Arthroplasty

by Brian Adams, M.D.

The Distal Radioulnar Joint (DRUJ) is the distal link between the radius and the ulna and a pivot for pronation and supination. Its articulation is incongruent and therefore, the soft tissues play a substantial role in guiding and restraining the joint. Not only is the DRUJ susceptible to arthritis, any injury or deformity involving the radius or ulna can alter the function of the joint.

Complete implant replacement of the distal ulna has become a popular and accepted procedure to alleviate pain and restore function to the joint. However, in many cases complete replacement sacrifices normal portions of the distal ulna along with important soft tissue attachments. Consequences of resecting unaffected portions of the distal ulna include a higher risk of distal radioulnar joint instability, implant prominence, soft tissue irritation, and ulnocarpal instability. A partial ulnar head replacement was designed to minimize the resection and to optimize the functional results of implant arthroplasty for the treatment of distal radioulnar arthritis.

The Ascension Partial Ulnar Head Replacement implant allows retention of the ulnar neck, ulnar styloid, extensor carpi ulnaris groove, ulnocarpal ligament attachments, extensor carpi ulnaris sheath, and the triangular fibrocartilage complex attachments to the ulnar styloid. Thus, while all articular surfaces of the ulnar head are replaced, the ligaments and other bony anatomy responsible for DRUJ stability are maintained. Because the DRUJ anatomy is preserved, the joint mechanics are
TOTAL DRUJ REPLACEMENT ARTHROPLASTY

- Total DRUJ Replacement Arthroplasty
TOTAL DRUJ REPLACEMENT
ARTHROPLASTY

- Luis Scheker
- Aptis Medical
- Semi-constrained
- Modular
- Replaces ulnar head, sigmoid notch, TFCC and joint stabilizers
TOTAL DRUJ REPLACEMENT ARTHROPLASTY

- 31 wrists 3.5-6 years FU (Laurentin-Perez L JHS 2008)

- Pain 4.2 --> 1
- Grip 11 kg --> 22 kg
- Pronation 79
- Supination 72
TOTAL DRUJ REPLACEMENT
ARTHROPLASTY

- Complications
- Wound infection
- CRPS
- Loosening
- Implant failure
- Heterotopic ossification
Bring Home Message

• Beware of DRUJ problems post DR fracture

• 3 “I’s”:
  – Impaction
  – Instability
  – Incongruence

• Prevention by address DRUJ problems and treat accordingly
Thank you
Bring Home Message

• Ulnar wrist pain is most common symptom after distal radius fracture
• Anatomical reduction of fracture and repair of soft tissue stabilizers is important
• Management of DRUJ problem according to pathology
• Ulna head /DRUJ arthroplasties is a salvage option
Intra-articular incongruity —
Resection arthroplasty

• Partial ulna head resection
  – +/- ulna styloid or shaft shortening
  – low demand /non-heavy manual worker
  – Rolloled ECU tendon interposition anchory
Outcome for partial ulna excision

• Good for pain relief

  Distal radioulnar joint arthroplasty: the hemiresection-interposition technique. Bowers WH.

The hemiresection-interposition technique for distal radioulnar joint arthroplasty was developed from anatomic studies that indicated the importance of preserving the functional elements of the ulnocarpal ligament complex. The technique has been previously described. My experience with 38 patients who were followed for an average of 2 1/2 years shows that the procedure is most valuable for patients with rheumatoid arthritis (85% had stable, painless pronation averaging 84 degrees and supination of 77 degrees, while 15% had mild pain and pronation of 70 degrees and supination of 75 degrees). It is also valuable for patients with degenerative or trauma-induced arthritis (100% had painless rotation-pronation averaging 80 degrees and supination of 80 degrees). A modified procedure is useful for patients with ulnocarpal impingement syndrome where the Milch shortening osteotomy may not succeed because of radioulnar incongruity.
Intra-articular incongruity
Resection arthroplasty

- Total ulna head resection
  - Darrach procedure
  - For older, low demand patient
  - Disadvantages:
    - Decreased grip
    - Ulna stump instability
  - Additional ECU / FCU tenodesis
Twenty-nine wrists of 29 patients were treated with three procedures: distal ulnar resection (Darrach's procedure), distal ulnar recession, or hemiresection-interposition arthroplasty. The indications were pain and limitation of motion associated with primary osteoarthritis of the distal radioulnar joint, derangement after distal forearm bone fracture, Madelung's deformity, and distal radioulnar sprain. The age of the patients averaged 48.3 years. Follow-up averaged 1 year and 9 months. Radiographic evaluations were done preoperatively and postoperatively. Relief of pain was good in the wrists treated by Darrach's procedure; however, diminished grip strength and wrist instability occurred. Relief of pain in the wrists treated by distal ulnar recession and hemiresection-interposition arthroplasty was inferior to that of Darrach's procedure; however, postoperative grip strength increased and wrist instability did not occur.
Sixty-two patients underwent resection of the distal ulna because of pain or limited motion after wrist trauma. The median length of resection was 23 mm. Injury to the distal radioulnar joint occurred primarily during fractures of the distal radius. Followup time averaged 87 months. The primary surgical indication was pain, but some procedures were performed in an effort to increase motion. All patients improved after surgery. Three patients had residual pain, 25 had mild pain, and 34 had no pain. Supination was greatly improved, with only modest improvement in other wrist motions. Four patients developed ulnar translation of the carpus (from 1 to 3 mm). Pseudoarticulation and ulnar regrowth of the carpus were noted, but neither pseudoarticulation nor regrowth was clinically symptomatic. Grip strength improved significantly after surgery, the average from 45.3 to 78.9% of the unaffected wrist. The presence or absence of radiocarpal arthritis preoperatively had no significant effect on the patients' estimates of results. Overall, 51 patients (82%) had satisfactory results. The primary gains were pain relief, increased supination, and increased strength.
Intra-articular incongruity — Sauve-Kapandji procedure

• Younger, higher demands
• Pain relief and increase grip
• Complications :
  – Reossification
  – Ulna stump instability
Sauve-Kapandji procedure for disorders of the distal radioulnar joint: a simplified technique.

Rothwell AG, O'Neill L, Cragg K.

Department of Orthopaedic Surgery and Musculoskeletal Medicine, Christchurch School of Medicine, New Zealand.

A simplified technique of the Sauve-Kapandji (SK) procedure for disorders of the distal radioulnar joint (DRUJ) is described. The DRUJ is transfixed by a screw but is not formally exposed and fused, the periosteum of the distal ulna is not excised, and the pronator quadratus is not advanced into the pseudarthrosis. Stability of the ulna shaft is obtained by suturing the sheath of the extensor carpi ulnaris (ECU) and periosteum as a single layer firmly over the ulnar stump and pseudarthrosis. The operating time averages 20 minutes. Review of 28 wrists demonstrated relief of pain in 27; 80 degrees or greater of pronation and supination in 19 and 20, respectively; fusion of the DRUJ in 18; and ulnar carpal shift in 3. The main complications were related to screw placement and length and prominence of the ECU tendon. The simplified SK procedure **reliably relieves pain and restores movement at the DRUJ.**
Intra-articular incongruity —
Prosthetic replacement

- Restore pain free rotation
- Maintain ulna support to carpus
- Preserve RU convergence
- Indications:
  - Failed partial / total ulna head resection with painful impingement
Intra-articular incongruity — Prosthetic replacement

• Requirement:
  – Well oriented sigmoid notch
  – Adequate soft tissue coverage
intra-articular incongruity — Prosthetic replacement

- Contraindication:
- Grossly unstable distal ulna
- Poor soft tissue coverage

- Un-salvagable: consider RU arthrodesis/One bone forearm
Outcome of prosthesis

- N=23
- Mean FU 15months
- Complete pain relief in all
- Normal rotation
- Average lifting capacity 14lb (2-50lb)
- One removed for suspected infection

Case 4: more complicated....... 

M/34 Van Driver 

Initial Injury appears benign!
Close reduction and short arm POP
Ulnar plus with subluxed DRUJ

*Persistent ulnar wrist pain
*Decrease supination
*TFCC intact
US non-union with DRUJ Instability
US fixation with PL graft augmentation
Recurrent Instability – One stage Ulnar shortening + Arthroscopic TFCC Reconstruction

Function Score 22 → 35/40
Pain Score 14 → 5/20

PO 4 mths
Arthroscopic Anatomical TFCC Reconstruction
Anatomical Reconstruction with Palmaris Longus

Brian D Adams.
Instructional course on anatomical reconstruction of DRU ligaments for DRUJ instability. *ASSH 2000*

Kuzma, 1994
Outcome

• 12/14 restore stability & resume work/sports
• 85% strength recovery
• One palmar instability, one UC instability

Arthroscopic assisted TFCC reconstruction: Surgical Approach

• 3 incisions
  – Dorsal: extend along 4-5
  – Ulnar: S/C border
  – Volar: between ulnar NVB & flexors
Drill Tunnel at Sigmoid Notch

- Image intensifier guide
- 2 mm from articular margin
- Safeguard EDM, ulnar NVB & flexor tendon
- 2.0/3.0/3.5 mm
Drill tunnel at ulnar head

- Aim at fovea
- Arthroscopic monitor & verification
- Protect carpal bone
- 2.0/3.0/3.5 mm
Graft Passing Thru Radial Tunnel

- Dorsal to volar
Tendon Graft Retrieval

- 2.0mm grasper from 4-5 thru volar capsular window
- Avoid catching NVB & flexor tendon
Graft Exteriorization

- Grasper from ulnar tunnel into joint
- Sequential retrieval
Tie around knot over ulnar neck

- Smooth graft passing
- Proper tensioning
- Tie with forearm in neutral
Post op x-ray
### Compared to Open Surgery Series

<table>
<thead>
<tr>
<th></th>
<th>BD Adams 2002 n=14</th>
<th>PC Ho 2003 n=5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>16-45</td>
<td>25-46</td>
</tr>
<tr>
<td>Previous surgery</td>
<td>2/14</td>
<td>5/5 (av 2.2)</td>
</tr>
<tr>
<td>Duration of S/S</td>
<td>4m – 30 yrs</td>
<td>15.6 m (8-22m)</td>
</tr>
<tr>
<td>Immobilization</td>
<td>6 weeks</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Grip</td>
<td>85%</td>
<td>76.7%</td>
</tr>
<tr>
<td>RD/UD</td>
<td>N/A</td>
<td>Improved from 64.4% to 94%</td>
</tr>
<tr>
<td>P/S at 6 week</td>
<td>N/A</td>
<td>Av 81.4% in 4 patients</td>
</tr>
<tr>
<td>Final P/S</td>
<td>84% / 80%</td>
<td>95.1%</td>
</tr>
<tr>
<td>Pain relief</td>
<td>12/14</td>
<td>5/5</td>
</tr>
<tr>
<td>Recurrence</td>
<td>2/14</td>
<td>1/5</td>
</tr>
</tbody>
</table>
Prevention is better then cure
Decision making in treating acute distal radius fracture with associated DRUJ disruption

- Fernandez
- Classify DRUJ lesions into 3 types depending on residual stability of DRUJ after the DR fracture has been adequately reduced and stabilized
### Table 12.1. Prognosis- and Treatment-oriented Classification of Radioulnar Injuries Associated with Fractures of the Lower End of the Radius

<table>
<thead>
<tr>
<th>Type I</th>
<th>Pathoanatomy of the Lesion</th>
<th>Joint Surface Involvement</th>
<th>Prognosis</th>
<th>Recommended Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td><strong>A</strong> Fracture tip ulnar styloid</td>
<td><strong>B</strong> Stable fracture ulnar neck</td>
<td>None</td>
<td>Good</td>
</tr>
</tbody>
</table>

- **A+B** Functional aftertreatment
  - Encourage early pronation-supination exercises
  - Note: Extraarticular unstable fractures of the ulna at the metaphyseal level or distal shaft require stable plate fixation

<table>
<thead>
<tr>
<th>Type II</th>
<th>Pathoanatomy of the Lesion</th>
<th>Joint Surface Involvement</th>
<th>Prognosis</th>
<th>Recommended Treatment</th>
</tr>
</thead>
</table>
| Unstable | **A** Tear of triangular fibrocartilage complex and/or palmar and dorsal capsular ligaments | **B** Avulsion fracture base of the ulnar styloid | None | Chronic instability
- Painful limitation of supination if left unreduced
- Possible late arthritic changes |

- **A** Closed treatment
  - Reduce subluxation, sugar tong splint in 45° supination for weeks
- **A+B** Operative treatment
  - Repair triangular fibrocartilage complex or fix ulnar styloid with tension band wiring
  - Immobilize wrist and elbow in supination (cast) or transfixed ulna-radius with K-wire and forearm cast

<table>
<thead>
<tr>
<th>Type III</th>
<th>Pathoanatomy of the Lesion</th>
<th>Joint Surface Involvement</th>
<th>Prognosis</th>
<th>Recommended Treatment</th>
</tr>
</thead>
</table>
| Potentially Unstable | **A** Intraarticular fracture of the sigmoid notch | **B** Intraarticular fracture of the ulnar head | Present | Dorsal subluxation possible together with dorsally displaced die punch or dorsoulnar fragment
- Risk of early degenerative changes and severe limitation of forearm rotation if left unreduced |

- **A** Anatomic reduction of palmar and dorsal sigmoid notch fragments
  - If residual subluxation tendency present immobilize as in Type II injury

- **B** Functional aftertreatment to enhance remodeling of ulnar head.
  - If distal radioulnar joint remains painful: partial ulnar resection, Darrach or Sauvé-Kapandji procedure at a later date
Conclusion

• Beware of DRUJ problems post DR fracture
• 3 “I’s”:
  – Incongruence
  – Imprinagement
  – Instability
• Prevention by address DRUJ problems and treat accordingly
Case 2: Extra-capsular Tendon Graft Augmentation as Primary Treatment

Function Score: 32 → 40/40
Pain Score: 8 → 0/20

TFCC intact
# not reducible
Thank you