Shoulder Arthritis in the "Lifelong" Athlete: Management Strategies from Biologics to Arthroscopy to Arthroplasty

Lauren Zurek, MD
Allina Health Orthopedics

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Objectives:

1. Describe treatment options for shoulder arthritis in an active population
2. Identify patient factors that may affect treatment options and outcome
3. Compare risks and benefits of treatment options for glenohumeral osteoarthritis

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Why do we care?

- Glenohumeral osteoarthritis is a common cause of shoulder pain in clinical practice
- Estimated 16.1-20.1% of adults over the age of 65 have evidence of glenohumeral osteoarthritis on x-ray[1]
- 18% of patients with single and 39% of patients with recurrent shoulder dislocation develop arthritis 25 years later[16]
- As the most mobile joint in the body, the shoulder is critical to many sporting activities (swimming, tennis, golf, etc)[2]

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- Activity modification
- Medication
- Physical Therapy
- Corticosteroid injections
- Biologics
- Non-arthroplasty surgery
- Arthroplasty

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Activity Modification

- Excessive strengthening should be avoided[3]
  - Repetitive overhead lifting
  - Heavy overhead lifting
- Immobilization should be avoided
- Move commonly sought objects to more accessible height
- Reconsider occupation or chores
- Realistic expectations for sporting activities

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Medication

- NSAIDs
  - Improvement in symptoms in up to 67% of patients with glenohumeral OA[4]
  - Improved pain reduction as compared to acetaminophen for patients with OA[5]
  - First line of conservative care[6]
  - Side effect profile and contraindications
- Acetaminophen
- Topical medications
- Oral steroids
- What about glucosamine and chondroitin?

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Physical Therapy

- Range of motion exercises[3]
  - Focus on AROM/AAROM
  - PROM if pain remains mild, but should avoid forceful ROM exercises and avoid extremes of ROM
  - Forward flexion / abduction -> pectoralis major and latissimus dorsi
  - Extension -> anterior deltoid, supraspinatus
  - External rotation -> coracohumeral ligament, subscapularis
  - Internal rotation -> posterior capsule, infraspinatus and teres minor

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Physical Therapy

- Strengthening should focus on deltoid and scapular girdle[3]
- Structured exercise program with joint mobilization -> decrease pain and improve function[7]
- "In the absence of reliable evidence, it is the opinion of the work group that physical therapy may benefit select patients with glenohumeral joint osteoarthritis."[11]
  - Patients with minor radiographic changes and with limitations in ROM and strength

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Corticosteroid Injection

- Intra-articular administration of anti-inflammatory medication
- Corticosteroid can negatively affect cartilage and hasten progression of OA[8]
- Increased risk of infection with repeated CSIs[9]
- Shanthanna et al. demonstrated that CSIs showed no increased benefit as compared to local anesthetic injections[10]

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Viscosupplementation

- Hyaluronic acid is a component of synovial fluid and contributes to viscoelasticity of the fluid
- Limited studies on its role in the glenohumeral joint
- Randomized controlled trial did not demonstrate significant benefit in glenohumeral OA[12]
- AAOS: "Strong evidence supports that there is no benefit… in the treatment of glenohumeral OA."[11]

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Non-operative management of shoulder osteoarthritis: Current concepts

Nobuyuki Yamamoto [a], Dominik Szymski [b,c], Andreas Voss [b,c], Hiroaki Ishikawa [d], Takayuki Muraki [d], Ronaldo A. Cunha [e], Benno Ejnisman [e], Joseph Noack [f], Eric McCarty [f], Mary K. Mulcahey [g], Eiji Itoi [h,*]

Table 3
Biologic therapies available for management of glenohumeral osteoarthritis.

Biologic Therapy	Mechanism	Preparation time	Data in shoulder OA
Platelet-rich plasma	Growth factors reduce pro-inflammatory cytokines and slow catabolic pathways	~30 min	Limited, small studies and case reports
Bone marrow aspirate concentrate	Recruit local progenitor cells and antagonize local inflammatory mediators	~1 h	Limited, small studies
Mesenchymal stem cells	Anti-inflammatory and anti-catabolic effects through secretory process	~24 h	Limited, small studies

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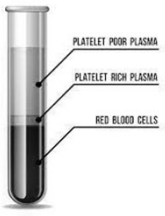
Biologics

- Platelet Rich Plasma[13]
  - Initiates body's repair processes
  - Modulates inflammation
  - Delivers growth factors
  - Promotes healing environment
- Scarce research for glenohumeral OA application[14]
- "In the absence of reliable evidence, it is the opinion of the work group that injectable biologics, such as stem cells or platelet-rich plasma, cannot be recommended in the treatment of glenohumeral osteoarthritis."[11]



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Biologics

- Bone marrow aspirate injections
  - Secretion of cytokines and growth factors -> stimulates angiogenesis and anti-inflammatory properties[3]
  - Growing evidence for knee OA
  - Centeno et al. observed preliminary encouraging results for shoulder OA[15]
- Adipose-derived stem cell injections
  - Secretion of growth factors and cytokines[3]
  - Few reports investigating ASCs for glenohumeral OA

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Why not arthroplasty for everyone?

- Younger patients tend to have higher functional expectations that may not be met by arthroplasty
- Recommended lifting restriction
- Concerns surrounding durability and need for revision surgery -> high rate of revision in young population

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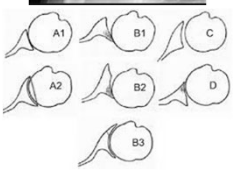
What should we consider?[17]

- Patient age
- Occupation
- Activity level
- Sports participation
- Focality of disease (unipolar versus bipolar)
- Disease level (Walch classification)
- Patient expectations



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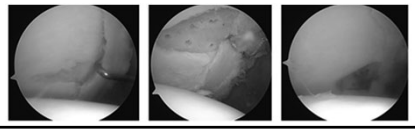
Arthroscopic Debridement and Associated Procedures

- +/- Biceps tenodesis or tenotomy, distal clavicle excision, subacromial decompression, capsular release, microfracture, loose body removal, synovectomy, osteophytectomy
- Most benefit seen in patients with minimal osteophyte formation and subchondral sclerosis or cysts[17]
- Outcomes worse in patients with bipolar disease[17]
- Arthroscopic lavage alone may be helpful in removing proinflammatory enzymes and proteins from the synovial fluid[17]



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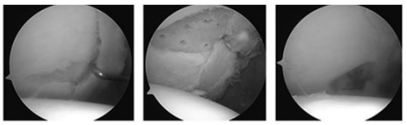
Arthroscopic Debridement and Associated Procedures

- Capsule release -> prevent altered joint contact forces[26]
- Remove loose chondral fragments -> less mechanical irritation and inflammation[26]
- Osteophytes can limit abduction and tension the axillary pouch[26]
- Crucial to counsel patients on expectations with such a procedure -> does not prevent osteoarthritis progression, but is a temporizing option
  - Improved pain scores at mid and long term f/up, but 24% of patients converted to arthroplasty at average of 1.75 years, in case series of 1 surgeons' patient population[18]
  - Short term relief with lower risk of complication as compared to arthroplasty



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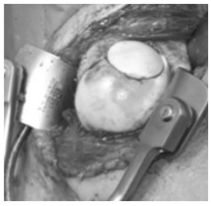
Biologic Replacement

- Indicated for contained chondral lesions with an intact subchondral plate, <2 cm^2 in size[19]
- Goal is to re-establish hyaline or hyaline-like cartilage at the articular surface[19]
- Ranges from microfracture, osteochondral allograft, and autologous chondrocyte implantation (ACI)
- Procedure has shown more success in the knee, rather than the shoulder -> theorized to be related to the thicker articular cartilage in the knee[19]



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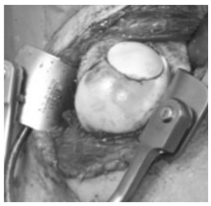
Biologic Replacement

- Again, there is limited data in the shoulder…
  - Millett et al. reviewed 31 shoulders in 30 patients[20]
    - <60 years of age (mean age, 43 yo; range 19-59 yo)
    - Microfracture for full thickness chondral lesions
    - Mean follow-up of 47 months
      - 19% (6 shoulders) had progressed to another surgery
      - Remaining shoulders had decreased pain scores and reported improvement in ADLs, sports activity and ability to work
    - Isolated humeral lesions had better outcomes



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Humeral Arthroplasty w/o Glenoid Treatment

- Avoids complications related to prosthetic loosening of the TSA glenoid component
- Optimal candidate is a young patient with preserved glenoid articular surface, or at least not unevenly worn[21]
- Resurfacing (full vs partial) versus replacement
- Balance the shoulder to re-create anatomic glenohumeral motion and avoid uneven glenoid wear
- Re-surfacing replaces the humerus with a metallic cap -> less bone loss, but replication of the native humeral head can be challenging
- Iagulii et al. reviewed 48 patients (avg age, 48 years)[24]
  - Evaluated ability to return to high demand activities
  - Acceptable results at mid-term follow-up
- Partial humeral head re-surfacing used to treat focal cartilage defects
  - Core a circular trough around a focal defect and replace with metallic implant of equal specifications
  - Unacceptable failure rate in the literature[25]

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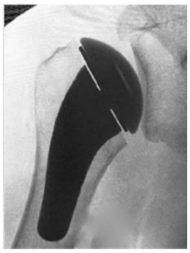
Humeral Arthroplasty w/o Glenoid Treatment

- Levine et al. reviewed 31 patients who underwent hemiarthroplasty
  - Mean age, 56 years
  - 74% with satisfactory results
  - Outcome correlated with status of the glenoid -> specifically posterior glenoid wear[22]
  - Long term follow-up, avg 17.2 years, only 25% of patients were satisfied with their outcome[23]
- Persistent pain from bony erosion and degeneration of the glenoid may require conversion to a total shoulder arthroplasty (TSA)
  - Results after conversion from hemiarthroplasty to TSA are inferior to results after primary TSA[21]



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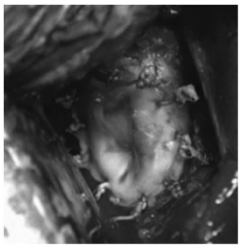
Humeral Arthroplasty with Glenoid Treatment

- Developed due to concern for progressive arthrosis of the glenoid with hemiarthroplasty, but also glenoid component loosening with TSA
- Consider for high demand patients (i.e., manual labor)
- Glenoid biologic interpositional resurfacing
  - Achilles tendon, meniscus, fascia lata, acellular[21]
  - Glenoidplasty to create an even, bleeding bone surface
  - Allograft is passed circumferentially around the glenoid and secured
  - Inconsistent results and high complication rate[27]



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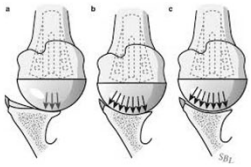
Humeral Arthroplasty with Glenoid Treatment

- "Ream and Run"[28]
  - Restore a concentric glenohumeral articulation
  - Preserve glenoid bone stock
  - Avoid risks associated with polyethylene component wear
  - Avoid complexity of soft tissue interposition
  - Glenoid is superficially reamed to bleeding subchondral bone to re-create articular surface
  - Creates concentric surface with slightly greater radius of curvature
  - Fibrocartilaginous growth covers the glenoid at approx. 24 weeks post-operatively
- Hsu et al. evaluated 201 patients s/p "ream and run"[28]
  - Clinically important improvements in functional outcomes
  - Improvement associated with male sex and lower pre-operative functional scores
  - 11% required revision surgery within 5 year f/up



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Total Shoulder Arthroplasty

- Consistently associated with improved paina nd functional scores, ROM and patient satisfaction
- However, concern remains surrounding survivorship d/t glenoid component loosening and polyethylene wear
- Survivorship 92-95% at 10 years, 81-85% at 20 years[31]
  - Male gender independent risk factor for need for revision surgery
  - Cohort of young patients (<50 yo) with 10 year survival only 62.5%[32]
- Bartelt et al, compared TSA to HA for primary OA[34]
  - Less pain with TSA
  - Greater ROM with TSA
  - Higher satisfaction with TSA

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Total Shoulder Arthroplasty

- 75 patients with mean age of 66 years[29]
  - 53 patients improved their ability to play
  - 50% of pts increased their frequency of participation post-operatively
- 96% of patients returned to recreational golf after TSA and improved their performance by 5 strokes[30]
- Less reliable results in younger populations -> likely related to higher demands

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So, what is pyocarbon?

- New alternative to "hemi-metal" and total shoulder arthroplasty -> avoid complications associated with each
- Pyocarbon theoretically allows for formation of a neo-membrane that would act like cartilage to reduce glenoid wear
- 64 patients, **mean age 53 years** with avg 33 mo f/up[33]
  - Survival at last follow-up was 92%
  - 91% of patients returned to work and 80% returned to sport
  - Non-anatomic reconstruction of the humerus associated with worse outcomes and higher risk of revision
- Early results are promising but longer term follow-up needed

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How do we make TSAs last longer?

- Glenoid component failure is a major cause of poor patient outcomes after total shoulder arthroplasty
- Asymptomatic radiolucent lines 7.3% rate per year
- Symptomatic glenoid loosening 1.2% per year
- Surgical revision 0.8% per year

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How do we make TSAs last longer?

- Younger age associated with lower survivorship
- Male gender
- Rotator cuff pathology
- Glenoid deformity
- Re-creation of humeral anatomy
- Glenoid implant design
- Surgical technique

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Thank you!

Lauren.Zurek@allina.com
Cell: 612-865-1905

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