Current Concepts in Rehabilitation of Orthopedic Shoulder Conditions

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Background

• Supervisor - Raleigh Orthopaedic Performance Center
• Practiced since 1996 in outpatient sports/ortho clinics
• S & C coach for MLS - Columbus Crew 2002-2006
• Owned my own training facility 2000-2010
• FMS certified, board certified orthopaedic clinical specialist (OCS), credentialed in dry needling
• Write for PFP Magazine
• PT consultant for Carolina Hurricanes
Objectives

• Understand how static and dynamic restraints contribute to optimal shoulder function
• Recognize signs and symptoms of common shoulder disorders
• Perform a thorough shoulder exam to rule out differential diagnoses
• Use a multi-modal approach to treatment for various shoulder conditions to maximize outcomes
• Understand key concepts of post-operative care for shoulder stabilization, labral repair, rotator cuff repair, SAD, and total shoulder arthroplasty

Common Conditions

• Rotator cuff pathology
• Labral tears
• Subluxation/dislocation
• Bicipital tendinopathy
• Adhesive capsulitis
• Overuse
• Fracture
• Arthritis
Stability vs. Mobility

Delicate balance needed to allow for repetitive movement and significant amounts of load or torque at any given moment.

Injury Risk Factors

- GHJ Laxity
- Scapular dyskinesia
- Postural dysfunction
- Muscular imbalances
- Bony morphology
- Overuse

Pertinent Anatomy

- Scapula
- Humerus
- Ligaments
- Labrum
- Dynamic stabilizers
The Scapula

- Resting alignment
- Dynamic mechanics
- SICK scapula

1. Inferior border prominence
2. Medial border prominence
3. Superior border prominence

Acromial Type

Static Restraints
Key Scapular Stabilizers

- Trapezius
  - Elevation (U)
  - Depression (L)
  - Retraction (M)
  - Upward rotation (U, L)
- Rhomboids: retraction, downward rotation
- Levator scapulae: downward rotation
- Serratus anterior: retraction, upward rotation
- Pectoralis minor: depression
Weight Training Considerations

- Age
- Acromial type
- Prior injury
- Instability
- Scapular dyskinesia
- Clavicular osteolysis and bone spurs

Instability & Exercise

- Acquired laxity > anterior micro instability
- MDI
- Secondary RC, bicipital and labral stress
- Caution with loading (snatch, jerks, flies, pressing, dips, etc)
Threatening Exercises

- Full range chest press, flies and dips
- Long lever side raises
- Wide grip pull-ups
- Heavy overhead press, hand stand push-ups
- Burpees, bear crawls, undulating ropes
- Overhead lifts (e.g. snatch) with improper form and certain squat variations

Distal Clavicle Osteolysis

Crossfit Injury rates

- 486 CrossFit participants completed the survey
- The overall injury rate was determined to be 19.4% (75/386)
- Males (52/231) were injured more frequently than females (21/150; P = .03)
- Across all exercises, injury rates were significantly different (P < .001), with shoulder (21/84), low back (12/84), and knee (11/84) being the most commonly injured overall
- The shoulder was most commonly injured in gymnastic movements, and the low back was most commonly injured in power lifting movements

Rotator Cuff Pathology

- Tendinitis and tears can present the same
- Pain with reaching
- Nocturnal pain
- Loss of strength
- Common problem is subacromial impingement

Differential Diagnosis

- Labral tears
- AC joint pathology
- Bicipital tendinopathy
- Brachial plexus
- Radicular pain
- Myofascial pain

Key Special Tests

- Hawkins, Neer impingement signs
- AC joint provocation
- O’Brien’s and Speed test
- Sulcus sign, Apprehension, Jobe relocation, supine drawer
- C-spine clearing tests
Shoulder Imaging

Common X-rays
1. AP (external rotation)
2. Axillary
3. Lateral (Y View)
Lateral View

Rotator Cuff Tears

- Partial vs. full thickness
- Articular vs. bursal sided
- Pain level varies
- Size of tear does not always predict amount of dysfunction

Classification

Small = < 1 cm
Medium = 1 - 3 cm
Large = 3-5 cm
Massive = > 5 cm
Partial Thickness Tears

• Articular surface partial tear
• Bursal surface partial tear
• Grade 1 (<3 mm deep)
• Grade 2 (3-6 mm deep, or approximately 50% of the thickness of tendon)
• Grade 3 (> 6 mm deep, or more than 50% of the thickness of the tendon)

Prevalence of PTRCT

• MRI of asymptomatic shoulders
• Overall prevalence of PTRCTs was 20%
• In patients under the age of 40, the prevalence was approximately 4%
• In patients over the age of 60, the prevalence was 26%

Risk factors - PTRCTs

Intrinsic
• Age (risk increases over time)
• Decreased vascularity

Extrinsic
• Subacromial impingement
• GH instability
• Internal impingement
In 2003, Connor et al. performed MRIs in the shoulders of asymptomatic elite overhead athletes.

In 20 athletes, the overall prevalence of rotator cuff tears (i.e., partial or full thickness) was 40% in the dominant throwing shoulder.

Importantly, at a 5-year follow-up, none of the athletes developed shoulder symptoms requiring treatment, and none of them had appreciable decreases in their level of play.

While MRI has limits in its ability to accurately detect PTRCTs, MR arthrography remains the imaging modality of choice. Its high mean sensitivity (85.9%) and specificity (96.0%) place it superior to other imaging modalities.
• Despite advances in imaging technologies, arthroscopy remains the gold standard for diagnosing PTRCTs.
• Arthroscopy allows direct visualization of the bursal and articular surfaces of the rotator cuff as well as the anatomic footprint.
• Arthroscopy provides the ability to probe the soft tissues to identify areas of tearing that would otherwise be undetectable.

Debride vs. Repair

• Percentage of tendon torn
• Age
• Tear configuration
• Concomitant pathologies (i.e., labral tear and impingement)
• Work or sport-related factors
• Disease process/projection
Rehab - SAD & DCE

- Initial 4 weeks focus on pain reduction, P/AAROM progressing to AROM
- Weeks 4-8 push for full ROM, isometrics, scapular activation and gradually light PREs
- Weeks 8-12 move to full strengthening with transition to overhead and functional exercise with goal of full return to activity around 3 months

Arthroscopic RC Repair

- Weeks 0-4 focus on pain reduction, gentle PROM, scapular isometrics, no pulley and no cane exercises
- D/C sling b/w weeks 4 and 6
- Weeks 4-8 weeks continue with PROM -> AAROM, add cane exercises, submit isometrics b/w 4 and 6 weeks
- Scapular strengthening and AROM b/w weeks 6 and 8

Rehab - Arthroscopic Repair

Phase IV - Months 3-6

- ROM - Goal is full pain free motion
- Advance RC and scapular strengthening with light weights (typically no > 4% bodyweight)
- Progress to overhead exercises as indicated
- Initiate functional and/or sport specific between 14 and 16 weeks post-op once cleared by MD
- Return to sports at 6 months if approved, but may be longer based on age, degree of injury and demand of sport (may be longer for throwers)
PRP During Surgery

- At 3 months of follow-up, there were initially significantly better pain scores and improved forward elevation in patients treated with PRP. However, by 6 months there was no significant difference between PRP treated patients and control patients.
- Prospective randomized trial of 80 patients undergoing rotator cuff repair by Castricini et al., there was no significant difference in Constant score between patients treated with a platelet rich fibrin matrix and controls at a minimum of 16-month follow-up.

Castricini et al. AJSM 2011

Double-Row vs. Single-row

- Systematic review of 8 meta-analyses comparing SR and DR RCR to elucidate the cause of discordance and determine which meta-analysis provides the current best available evidence.
- Six meta-analyses found no differences between SR and DR RCR for patient outcomes, whereas 2 favored DR RCR for tears greater than 3 cm. Two meta-analyses found no structural healing differences between SR and DR RCR, whereas 3 found DR repair to be superior for tears greater than 3 cm and 2 found DR repair to be superior for all tears.
- Current highest level of evidence suggests that DR RCR provides superior structural healing to SR RCR.

Mascarenhas et al. Arthroscopy 2014

Bicipital Tendinopathy

- Rarely in isolation.
- As secondary humeral head depressor, often see associated rotator cuff pathology, concomitant labral tears and/or shoulder instability.
- May progress to tendinosis and eventual “popeye” deformity with rupture.
- If conservative care fails, may treat with tenodesis or tenotomy.
Labral Pathology

- Most common tear is a type 2 SLAP tear
- May occur in isolation related to dislocation event (bony Bankart lesion) or in combination with rotator cuff pathology
- Often seen in overhead athletes or with some type of trauma
- Stability is paramount as the labrum serves to deepen the glenoid fossa by 50%

Signs & Symptoms

- Pain along the anterior, superior or posterior shoulder
- Increased pain with throwing or repetitive overhead activity
- Instability and/or weakness
- Clicking/popping/snapping in the shoulder
- Soreness along the biceps

Classifying SLAP Tears

- Type I - associated cuff pathology
- Type II - older patients had rotator cuff pathology & younger patients had anterior instability
- Type III & IV - associated w/traumatic instability

Specific Labral Tests

- Active compression test (O'Brien)
- Compression rotation test or Grind test
- Speed's test
- Resisted supination external rotation test
- Pronated load test (Wilk)

Specificity of Tests

- Sensitive: O'Brien, Hawkins, Speed, Neer, Jobe
- Specific: None
- “There is no single maneuver that can accurately diagnosis SLAP lesions”

Type II SLAP Tear is Most Common Injury

- Involves disruption of the proximal biceps anchor
- First reported by Andrews and seen in overhead athletes (“peel back” injury)
- Late cocking (max ABD & HER) is an at-risk position
Type II Tear Subclassification


- Anterior, Posterior and Combined Lesions
- Prevailing thought is the tear causes microinstability which may lead to articular sided lesions, specifically partial thickness rotator cuff tears
- Anterior SLAP tears = anterior cuff tears
- Posterior SLAP tears = posterior cuff tears

Imaging

- Plain films include - A-P, axillary and scapular Y and Stryker notch views
- X-rays are usually benign but may reveal bony abnormality (e.g. Hill-Sachs lesion)
- MRI is gold standard but MRA (using intra-articular gadolinium) has become the preferred choice for many
- Noncontrast MRI in ABER position works well according to Altchek
Operative Treatment

- Debride type 1 and 3 tears
- Repair type 2 and 4 tears
- Biceps tenodesis is generally recommended for active patients over 40 = more predictable pain relief
- Debride concomitant rotator cuff tears in overhead athletes

Post-op Treatment

- 0-4 weeks consisted of sling immobilization with gentle PROM, shoulder isometrics (ABD, IR/ER) but no resisted FF or elbow flexion
- Discontinue sling at 4 weeks and begin AAROM -> AROM with light scapular exercises
- Weeks 6-12 push for full AROM and begin scapular and rotator cuff PREs (no resistive biceps exercise if tenodesis until 8 weeks post-op
- Begin throwing at 4.5 months post-op with goal of return to full sports at 6 months pending MD approval

Overhead Athletes & Overuse Injury Patterns

- Overuse related to too much stress and inadequate recovery (baseball, swimming, tennis, volleyball, weight training)
- Tendinitis, labral tears, apophyseal injury and internal impingement are common
- Inadequate mobility and poor scapular stability often contribute to pathology
- Micro-instability along with poor deceleration mechanics leads to suboptimal throwing mechanics
Youth Baseball

- **Biomechanics** - improper form leads to increased varus elbow torque. Common flaws include: hand under ball during stride phase, late arm rotation, excessive external rotation, excessive elbow flexion and improper abduction and trunk tilt.

- **Pitch type** - concern about curveballs revolves around the thought that the elbow must be placed in a position of stress to create spin. Dun et al. studied 11-14 y/o who threw fastballs, change-ups and curves. There was greater supination with a curve, but more varus torque with a fastball. UNC and ASMI studies found no correlation w/curves before age 13 and an elbow injury.

Injury Risk

- Fleisig et al. showed that pitching more than 100 competition innings per year more than tripled the risk for serious shoulder or elbow injury.

- Playing catcher as well as pitcher increased the odds ratio of injury 2.7 times.

Little League Shoulder
GIRD

- Acquired focal thickening and contracture of posterior inferior capsule in the zone of the poster band of the inferior glenohumeral joint complex
- Occurs due to repetitive throwing, muscular fatigue in rotator cuff and scapular stabilizers
- Deceleration overloads the muscle and the capsule responds with thickening

ERD and GIRD

- ERD (ext. rot. deficiency) - 5 deg or less w/PROM increases injury risk in throwers 2.3x (unpublished data)
- Anatomical GIRD - normal loss of IR (18-20 deg), with adequate ER gain and TROM within 5 deg of the uninvolved side
- Pathologic GIRD - A shoulder that has GIRD more than 18-20 deg and a concomitant loss of TROM > 5 deg (= 2.5x injury risk)
Internal Impingement

- Cocking phase
- Pathomechanics:
  - humeral ER
  - horizontal extension
  - anterior translation
- Pinches undersurface RC & labrum between GT and glenoid

GHJ PROM DeficitsIncrease Risk of Elbow Injury in Prof. Baseball Players

- Prospective study 2005 - 2012
- 505 exams on 296 pitchers
- Assess PROM for HER, HIR & shoulder flexion for throwing & non-throwing side
- Bilateral differences greater than or equal to 5 deg in total shoulder rotation and flexion increase risk for elbow injuries 2.6 and 2.8x respectively

Wilk et al AJSM 2014

Rx Algorithm

- Resolve GIRD and soft tissue tightness
- Improve scapular stabilization
- Strengthen the rotator cuff, especially posterior shoulder
- Educate parents and coaches about appropriate rest intervals
Stretches

Shoulder Instability
- Acute versus chronic
- Traumatic versus atraumatic
- Unidirectional versus multi-directional (MDI)
- Younger (<35) versus older
- Athlete versus non-athlete
- AMBRI versus TUBS

TUBS
- Traumatic
- Unidirectional
- Bankart lesion
- Surgery
AMBRI

- Atraumatic
- Multi-directional instability
- Bilateral
- Rehabilitation
- Inferior capsular shift

Testing

- Apprehension
- Sulcus
- Load and shift
- Jerk (posterior)
- Kim (inferior)
- Gage - hyperabduction (> 105° = abnormal laxity of IGHL)

Imaging Results

- Bony Bankart
- Hill-Sachs and reverse Hill-Sachs
- Labral tears
- Capsular tears
- Bennet’s lesion (mineralization of posterior band of IGHL due to posterior capsular avulsion injury)
**Bankart Repair**

- Sling immobilization for 4 weeks with PROM -> AAROM -> AROM with FF to 90, ABD to 45 and ER to 30 and gentle isometrics at side
- D/C sling in weeks 4-6, ROM as tolerated, and begin prone scapular exercises
- Weeks 6-12 focus on rotator cuff, deltoid and scapular strengthening
- Functional rehab in months 3-6 (closed chain, plyometrics and overhead activity)

**Proximal Humerus Fx**

- Low energy fall - elderly
- High energy trauma - youth
- 2:1 female to male ratio
- Third most common fracture in elderly population
- Concern for axillary nerve palsy and AVN if blood supply is affected to humeral head

**Proximal Humerus Fractures**

- Neer classification based on greater tuberosity, lesser tuberosity, shaft and articular surface
- Displaced versus non-displaced (need to identify presence of dislocation)
- Roughly 85% of fractures are minimally displaced and can be treated with sling immobilization and rehab (ROM w/in 14 days)
- Operative solutions include closed reduction percutaneous pinning, ORIF, intramedullary rodding, hemiarthroplasty, total shoulder arthroplasty and reverse shoulder arthroplasty (non-reconstructible tuberosities)
GHJ Arthritis

- Conservative RX includes lifestyle modification, therapy, meds and injections

- Surgical intervention:
  1. Primary total shoulder replacement
  2. Reverse total shoulder replacement
  3. Humeral Head resurfacing

Shoulder Joint Replacement Prevalence

Top 5 Associated Diagnoses for Shoulder Arthroplasty

- Osteoarthritis (Primary or Secondary in Shoulder Region)
- Osteoarthritis (Primary) in Shoulder Region
- Rheumatoid Arthritis
- Diabetes Mellitus

Source: PearlDiver Patient Records Database, 2004-2006

Shoulder Replacement Devices

- Bone Preserving Primary Total Shoulder
- Reverse Total Shoulder Stem and Head
- Bone Preserving Humeral Resurfacing
- Primary for Fracture
- Reverse for Fracture
Total Shoulder Arthroplasty

(“Primary” shoulder arthroplasty)

- Gold standard in shoulder replacement
- Alleviates pain and improves function
- Replacement consists of humeral stem, humeral head (ball), and glenoid (socket)
- Usually performed after conservative treatments have failed (physical therapy, medications)
- Option for patients with rotator cuff function

Total Shoulder Rehab

- Sling immobilization for 4-6 weeks, PROM/AAROM/AROM with no active IR or extension beyond midline (protect subscapularis repair)
- Weeks 6-12 continue ROM, begin light strengthening (isometrics and concentric bands but no resisted IR, extension or retractions)
- Months 3-12 advance to resisted IR, extension and retractions with traditional scapular and cuff strengthening as well as eccentric exercise and functional rehab as indicated

Total Shoulder Arthroplasty Outcomes

Study results demonstrated:

- 93% survivorship of prosthesis at 10 years, and 87% at 15 years (1)
- 83% of patients reported relief from moderate or severe pain at 12 years (1)
- Active abduction (raising arm to the side) improved by an average of 40-117 degrees (1)
- 73% of patients at 10-20 years reported “excellent results,” and 20% reported “satisfactory results” (2)

Reverse Shoulder Arthroplasty

- Used for patients with arthritis and/or irreparable rotator cuff tear
- Designed to be ‘self stable’ and function only using the deltoid
- Also used for patients with complex shoulder issues and previously failed surgical treatments

Reverse Shoulder Rehab

- Sling immobilization for initial 6 weeks with pendulums and elbow/wrist/hand exercises
- D/C sling at 6 weeks post-op and begin ROM recovery with active IR and extension as tolerated along with light isometrics (FF, ABD and ER) and concentric only
- No resisted IR, extension or retraction until 12 weeks post-op
- Months 3-12 advance to resisted IR, extension and retractions with traditional scapular and cuff strengthening as well as eccentric exercise and functional rehab as indicated

Standard vs. Reverse

One Patient, Two Procedures = Different Results
Fig a: Xray of right shoulder (standard hemiarthroplasty)
Fig b: Function of right and left shoulders
Fig c: Left shoulder treated with reversed prosthesis
Humeral Resurfacing Head

- Conservative option to restore normal joint mechanics with minimal bone resection
- Replaces diseased humeral head surface for patients with early stage avascular necrosis or glenohumeral joint disease
- Cementless fixation allows for future revision to primary or reversed shoulder arthroplasty

Adhesive Capsulitis

Risk Factors
- More common in females ages 40-65
- Thyroid dysfunction
- Diabetes
- Prior hx in the contralateral arm
- Trauma
- Myocardial infarction
- Auto-immune disorder

Stages of Adhesive Capsulitis

- **Stage 1** - sharp pain at end range, aches at rest, nocturnal disturbance (lasts up to 3 months)
- **Stage 2** - “freezing” stage marked with global loss of motion due to pain (3-9 months)
- **Stage 3** - “frozen” stage with continued pain and loss of motion (9-15 months)
- **Stage 4** - “thawing” stage with resolving pain and persistent stiffness (15-24 months)
Diagnosing Adhesive Capsulitis

- A/PROM restrictions
- Assess irritability and end feel
- R/O bursitis, tendinitis, AC joint pathology, arthritis, arthrosis, cervical and labral injury
- Consider medical history and any existing surgery

Treatment for Adhesive Capsulitis

- NSAIDs
- Corticosteroids
- Brisement
- Manipulation
- Arthroscopic release
- Therapy

Arthroscopic Capsular Release

- Sling immobilization for 1 week with immediate goal of full PROM
- Weeks 0-4 focus on pendulum, pulley, cane and stretching as tolerated
- Weeks 4-8 begin light isometrics at side and slowly advance to light theraband along with passive stretching
- Weeks 8-12 advance strengthening as tolerated and begin eccentriccs, closed chain exercise and plyometrics
PT Evaluation

- Observe posture
- A/PROM
- MMT
- Joint mobility
- Palpation (TrP’s)
- Special tests

Kinetic Assessment

- Thoracic spine mobility
- Core stability
- Hip mobility
- Hip stability
- SL stance
- Ankle mobility
- Integrated movement (FMS)

T-spine Rotation
Rehab Pearls

- Listen to the patient and respect pain
- Respect healing tissue and avoid loads to failure early on
- Approach must be progressive and functional based on capacity/goals
- Pain threshold used to assess efficacy and progression of intra and inter session Rx
Pain Threshold

- Journal pain before, during and after activity
- 24 hour rule = elevated soreness after a workout or training session must return to baseline level or less in 24 hours (or less)
- Rehab/training progression is based 100% on pain response

Rehab Fundamentals

- Control pain
- Resolve joint restriction & soft tissue tightness
- Resolve unwanted GIRD
- Strengthen cuff and scapular stabilizers
- Emphasize stability and incorporate entire kinetic chain

Rehab Phases

1. Relative Rest, Mobility & Stabilization
2. Activation & Strengthening
3. Integrated CKC Strengthening & Power
4. Return to Activity
Manual Therapy

- GH joint mobilization
- Scapular mobilization
- PROM
- IASTM
- Dry needling

Dry Needling Efficacy

- A total of 56 subjects with neck or shoulder girdle pain > 3 months duration and active MTrPs were recruited from a campus-wide volunteer sample. 52 completed the study (23 male and 33 female) and mean age was 35.8 years.
- 3 weekly dry needling treatments of a single active MTrP.
- A total of 41 subjects had a change in trigger point status from active to latent or resolved, and 11 subjects had no change (P < .001). Reduction in all pain scores was significant (P < .001).

Gerber et al. PM&R. 2015

Videos

1. Manual techniques video
2. ROM exercises video
Doorway Stretches

Towel Stretch for IR

Mobility Exercises

- Soft tissue priorities are pecs, lats, upper/lower trapezius and posterior rotator cuff
- Thoracic spine (extension and rotation)
- Posterior capsule (need adequate horizontal adduction for proper mechanics)
Videos

1. Soft tissue mobilization
2. Shoulder mobility
3. Posterior shoulder stretches
Early Post-op Strengthening Video

Full Can vs. Empty Can

- Dominant shoulder MVIC tested w/EMG for 3 exercises: full can standing, empty can standing and prone hor. ABD at 100 with full can.
- While all 3 exercises produced similar amounts of supraspinatus activity, the full can exercise produced significantly less activity of the deltoid muscles and may be the optimal position to recruit the supraspinatus muscle for rehabilitation and testing.
- The empty can exercise may be a good exercise to recruit the middle deltoid muscle and prone full can exercise may be a good exercise to recruit the posterior deltoid muscle.

External Rotation

- Often the weak link
- DB vs. theraband - consider the force generation mismatch and phase of rehab
- Consider hand held dynamometer to assess strength ratio
EMG Activity

- Side lying ER produced the greatest amount of EMG activity for the infraspinatus (62% MVIC) and teres minor (67% MVIC).
- The greatest amount of activity of the supraspinatus (82% MVIC), middle deltoid (87% MVIC), and posterior deltoid (88% MVIC) was observed during prone horizontal abduction at 100 degrees with full ER.

Reinold et al. JOSPT 2004

Videos

- Shoulder Stabilization
- Shoulder Strengthening
- OH Athlete Exercises

Return to Activity

- Assess ER/IR strength ratio, general MMT, movement quality, FMS and UQYBT (if indicated)
- Maintain daily mobility work and essential scapular and RG exercises 2-3x/week
- Interval hitting and throwing programs commence between 4 and 6 months
- Timeline varies depending on patient, procedure (s), MD and activity level
Summary

• Nonoperative care is line of first defense in many cases
• Communicate closely with MD regarding post-op care and guidelines
• Respect healing tissue and maintain patient specific approach to rehab
• Seek appropriate balance between mobility and stability while strengthening the posterior rotator cuff in OH athletes
• Utilize a multi-modal approach to maximize outcomes

Thank You

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