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Shoulder Instability in the Athlete

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Disclosures

- Consultant and Speakers Bureau: Arthrex
- Consultant: Zimmer Biomet
- Consultant: Trice Medical

No Conflict of Interest Regarding This Talk

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Case

- ASU Senior FB Defensive Back
- NFL Prospect, Currently a mid round pick
- Fall Camp prior to senior year
- R Ant shoulder dislocation, first time
- Repeat subluxation event in same practice
- MRI showed a minimal sliver of a bony Bankart with an anterior inferior labral tear from 2:30-6 and minimal Hill Sachs lesion

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Questions

- Initial management?
- Do you let him play this season? If so, when and how do you prepare him. What are the risks?
- If surgery, what surgery and rehab?
- What does he need to know about his future?

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Incidence of Glenohumeral Instability in Collegiate Athletics

Brett D. Owens,[*†] MD, Julie Agel,[‡] MS, Sally B. Mountcastle,[§] PhD, Kenneth L. Cameron,[‖] PhD, ATC, and Bradley J. Nelson,[‡] MD
From the [†]Division of Orthopaedic Surgery, William Beaumont Army Medical Center, El Paso, Texas, the [‡]Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, Minnesota, the [§]University of Texas, El Paso, El Paso, Texas, and the [‖]Department of Orthopaedic Surgery, Keller Army Hospital, West Point, New York

- Incidence of GH instability is 0.12 injuries per 1000 athletic exposures
- Male collision athletes
- 45% of instability events result in >10 days lost

Owens et al. AJSM 2009

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Prevalence of Musculoskeletal Disorders at the NFL Combine—Trends from 1987 to 2000

ROBERT H. BROPHY[1], RONNIE BARNES[2], SCOTT A. RODEO[1], and RUSSELL F. WARREN[1]

[1]Shoulder and Sports Medicine, Hospital for Special Surgery, New York, NY; and [2]New York Giants, New York, NY

- 10% of athletes invited to the NFL Combine have history of shoulder instability
- 4.7% of incoming NFL players reported prior shoulder stabilization surgery

Med Sci Spots Exerc 2007

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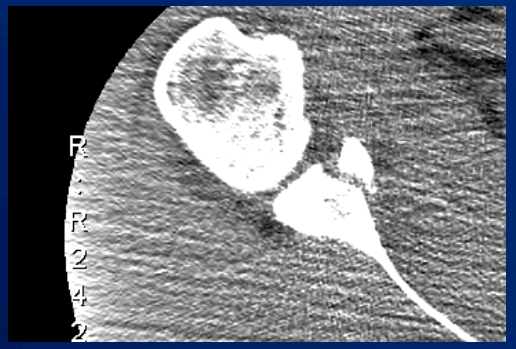
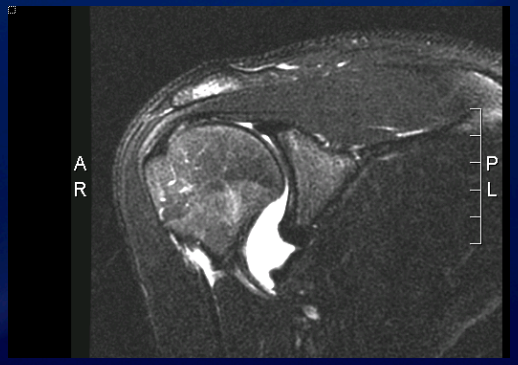
Background

- ½ anterior shoulder dislocations = age 15-29
- Male : Female = 3:1
- Typically begins as a discrete traumatic event
- Many shapes and sizes!





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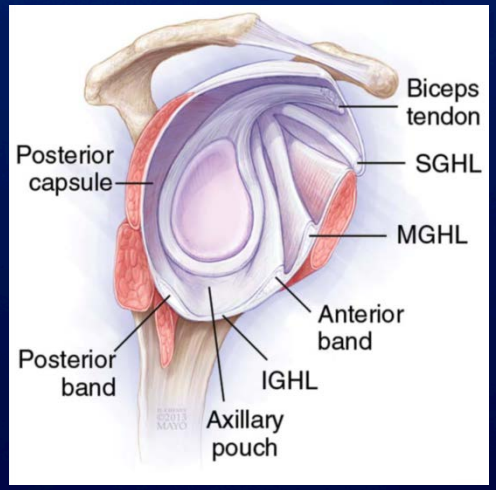
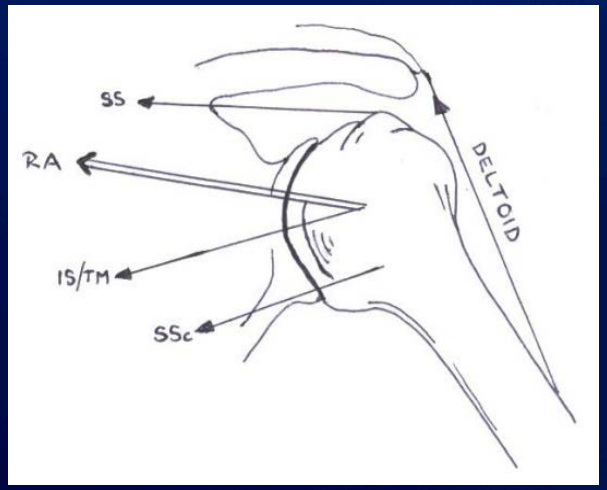
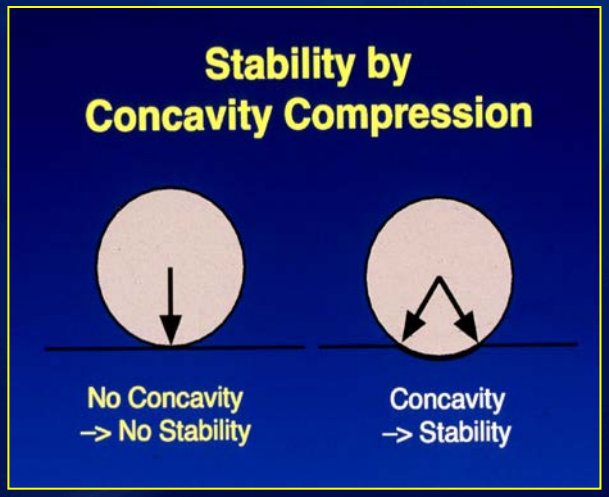
Anatomy

- Stability - product of static and dynamic restraints
- RTC – net force vector compresses HH into glenoid
- Periscapular muscles – position the glenoid
- Glenoid Bony Anatomy - Very limited constraint!







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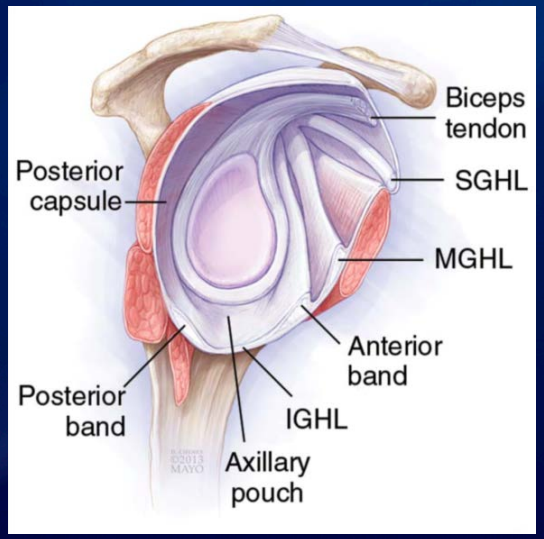
Capsulolabral complex

- Labrum
  - increases depth by 2.5 to 5mm
  - provides articulation for negative hydrostatic intra-articular pressure
- Capsule
- 3 GH ligaments
  - SGHL, MGHL, IGHL



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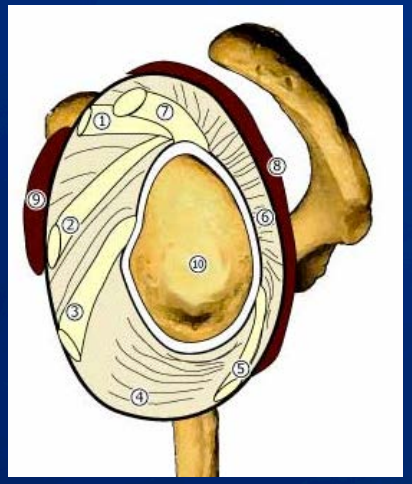
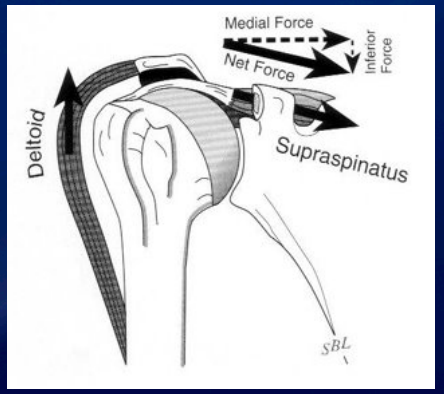
Competing forces

- IGHL
  - Even 10º of scapular protraction significantly increases the strain on the anterior band of the IGHL *(Weiser, AJSM 1999)*
- Subscapularis
  - Passive restraint to anterior translation
- Deltoid
  - Acts as an anterior stabilizer in the abducted, ER arm *(Kido, AJSM 2003)*
- Pec major
  - Increases anterior directed forces in the apprehension position *(Labriola, JSES 2005)*





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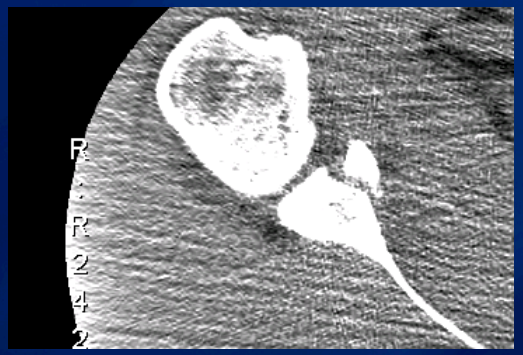
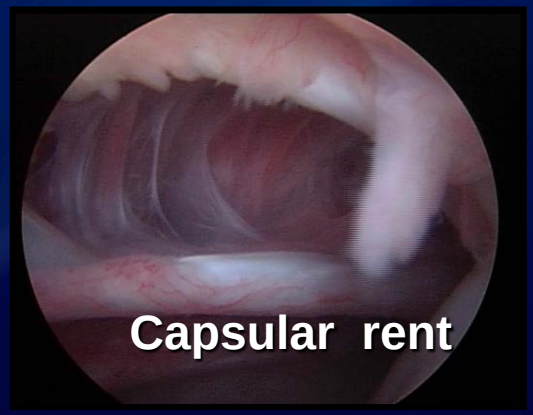
GH Instability Pathology

1. Bankart and Bony Bankart Lesion
2. Capsular Injury
   - Capsular Tears
   - Capsular Deformation
   - Capsular Elongation
3. Hill-Sachs
4. ALPSA and HAGHL
5. SLAP Tears
6. Rotator Interval Lesions
7. Ligamentous laxity
8. Scapulothorasic dyskinesia





GH Instability Pathology

- Subluxation
  - Most common
  - Translation beyond physiologic limits
  - US Military Academy
    - 85% of new traumatic shoulder instability was subluxation

    Owens et al. AJSM 2007
- Dislocation
  - Complete dissociation of humeral head from glenoid requiring reduction

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Hill-Sachs Lesion

- Less common with subluxation than dislocation
- 7% after subluxation
- 90% after dislocation

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Classification

- Laxity
  - Asymptomatic translations
  - Spectrum wide among individuals
- Instability
  - Symptoms elicited with translations

Treat instability not laxity!!!

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Types of Shoulder Instability

- Direction
  - Unidirectional (UDI)
    - Anterior
      - ER & horizontal abduction while abducted
        - Anterior apprehension position
    - Posterior
      - Posterior directed force while adducted
  - Multidirectional (MDI)
    - Defined as combined anterior and posterior

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History

- Anterior Instability
  - Specific sport (gymnast vs hockey)
  - Position within sport (linebacker vs receiver)
  - Subluxations
  - Dislocations
  - Bone loss Glenoid/ significant articular cartilage loss Glenoid (ie GLAT lesion)
  - Throwing arm
  - Time of season
  - Time of career

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History

- Posterior Instability
  - Specific Sport
  - Specific position
  - Dislocation vs subluxation
  - Pain rather than instability
  - Mechanism of Injury
    - Landing on adducted arm cross body vs landing on outstretched arm

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Physical Exam

- **Beighton Scale** – (generalized laxity): out of potential 9 points
  - Hyperextension elbows
  - hyperextension knees
  - 90 degree dorsiflexion pinky
  - positive thumb to forearm
  - Standing - knees straight can bend and touch palms to floor.
- **Eyeball test**
  - Muscular development
  - Skeletal maturity - facial hair, developmental changes

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Sulcus Sign

- Inferior instability
- Arm relaxed in neutral position
- Arm pulled downward at wrist
- Positive test is a visible sulcus at infra-acromial area
  - Compare to contralateral side

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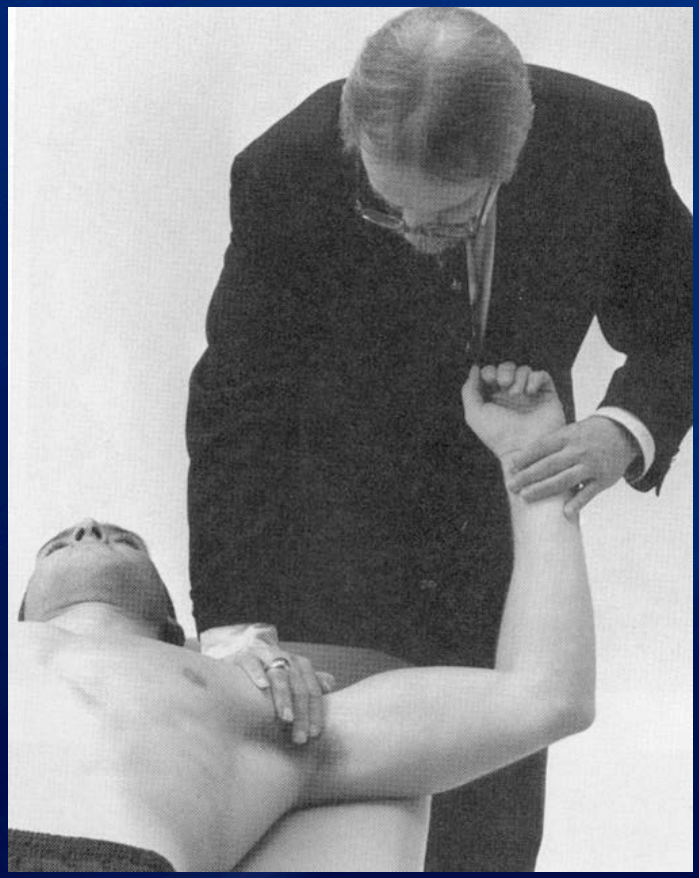
Apprehension Test

- Anterior instability
- Shoulder abducted to 90°
- Slight stress to humeral head directed in anterior direction
- While externally rotating shoulder
- Positive test is apprehension due to feeling of instability or impending dislocation
  - -Beware of false positives

Relocation Test

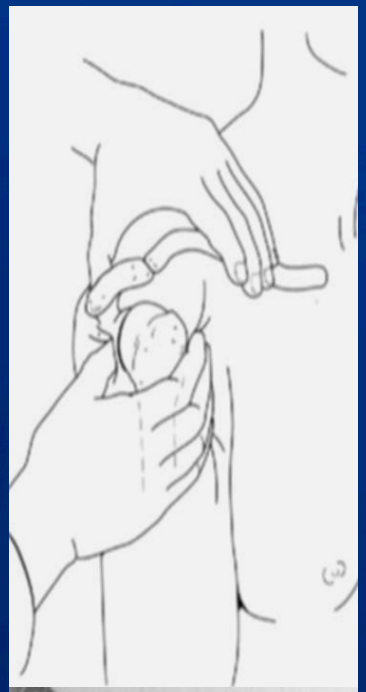
- Anterior instability
- After a positive apprehension
- Apply posteriorly directed force over externally rotated humeral head
- Positive test is relief of apprehension
- Anterior release test

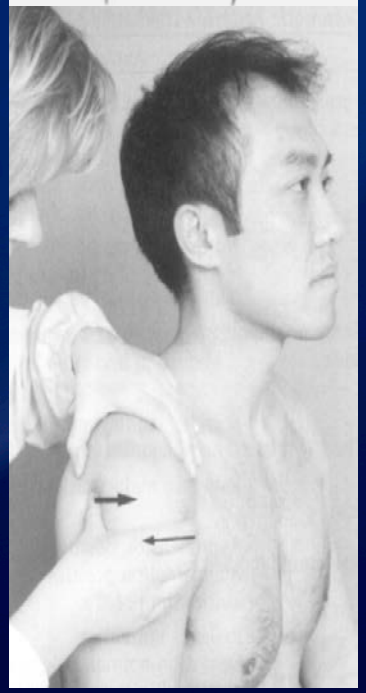


Load & Shift Test

- Multidirectional instability
- Stabilize and secure scapula & clavicle with one hand
- Grasp humeral head with other hand
- Slide humeral head anteriorly and posteriorly
- Grading
  - Grade 0: Little / no movement (0-25%)
  - Grade 1: Shifts to edge of glenoid (25-50%)
  - Grade 2: Shifts over edge of glenoid (> 50 %), Spontaneously reduces
  - Grade 3: Shifts over edge of glenoid (> 50 %), Does not spontaneously reduce

Positive test if > 50% displacement





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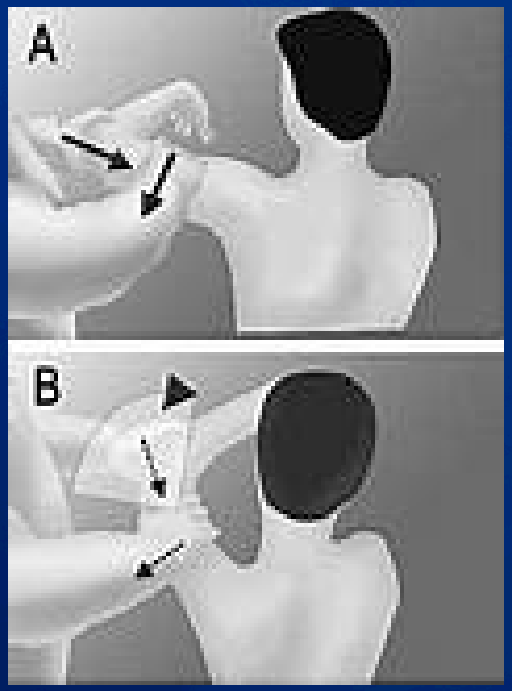
Posterior Instability

- Kim test
  - PI Load and Shift
- Jerk test
  - 90 deg FF with elbow flexed to 90
  - Post directed force onto elbow
- Circumduction Test
  - Pain post with circumduction



Presentation

- Age
- Prior instability
- Mechanism
- Direction
- Shoulder weakness/numbness
- Ligamentous laxity

- Prominent, palpable humeral head
- Loss of normal shoulder contour
- Arm adducted and internally rotated
- Positive apprehension

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Initial Management

- Determine Anterior vs Posterior
- Reduce player on field or locker room as quickly as possible
- Place player in sling
- Imaging: Xrays / MRI

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Reduction with different sports

- Football
  - Pads on vs off
    - If can’t get initially, take pads off. Sometimes shoulder reduces getting pads off
  - Getting pads off AFTER reduction is hard, usually have to cut jersey
- Hockey
  - Pads thin/loose enough to try in pads
  - Easier to take sweater and pads off than football

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Reduction Techniques: Anterior

- Scapular manipulation
- External Rotation Techniques: arm adducted (folded towel in axilla; arm forward flexed (Spaso)
- Stinson
- Faries – oscillations while abducting up to 90 degrees
- Traction / counter traction Davos
- SELF REDUCTION:
  - Boss-Holzach-Matter
  - Davos

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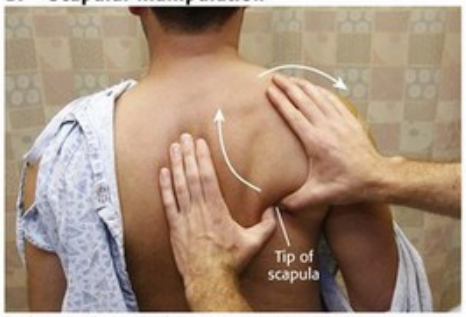
ANTERIOR SHOULDER DISLOCATION REDUCTION

A. Stimson Maneuver

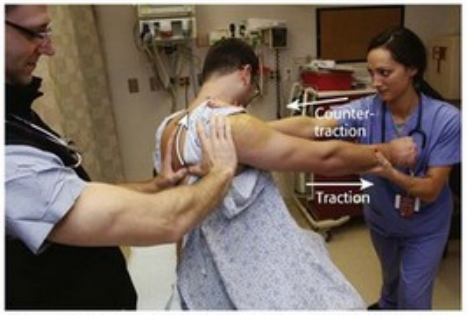
Place the patient prone on the edge of the stretcher. Be careful that a sedated or intoxicated patient does not fall off the table. Belts or sheets can be used to secure the patient to the stretcher, 5-kg weights are attached to the arm, and the patient maintains this position for 20 to 30 minutes, if necessary.

The addition of scapular manipulation and/or gentle external and internal rotation of the shoulder with manual traction may aid in reduction.

B. Scapular Manipulation



Rotate the inferior tip of the scapula medially and dorsally toward the spine with the tips of your thumbs.



The procedure can take place with the patient prone (as in the Stimson technique) or with the patient seated. For the latter, have an assistant apply traction on the arm while applying countertraction on the ipsilateral clavicle.

C. Best-of-Both Technique

Position the patient seated sideways with the unaffected shoulder and hip against the upright head of the stretcher. Apply downward force on the patient's flexed forearm, and gently rotate the arm internally or externally as needed.

Once downward force is applied, instruct an assistant to perform scapular manipulation as described above.

Scapular Manipulation

- Needs two people – player seated or standing
- LIGHT downward traction on arm by assistant
- For RIGHT shoulder:
  - LEFT THUMB on inferior lateral border scapula
  - RIGHT FINGERS on anterior humeral head
  - With LEFT thumb push inferior scapular MEDIAL AND SUPERIOR
  - With RIGHT fingers PULL HEAD POSTERIORLY

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Reduction Techniques: Posterior

- Best with two people - player can be seated or standing
- Players elbow at 90 degrees (arm will be internally rotated to chest)
- Stand behind player
- For RIGHT shoulder:
  - Assistant grasps humerus with LEFT hand and wrist with RIGHT hand
  - LIGHT downward traction, LIGHT distraction, and LIGHT/GRADUAL progressive external rotation
  - Reducer- Left hand over top shoulder – fingers on coracoid
  - With right hand grasping humeral head, lever head forward with right thumb

Post Reduction

- Sling
- ACE wrap arm to side if no sling
- Imaging
  - Xrays immediately
  - MRI ASAP
- Recommend for dislocations seeing an orthopedic surgeon before beginning any PT or exercises
- Subluxation can be confused with stinger/burner. If suspect multiple subluxations refer to orthopedic surgeon

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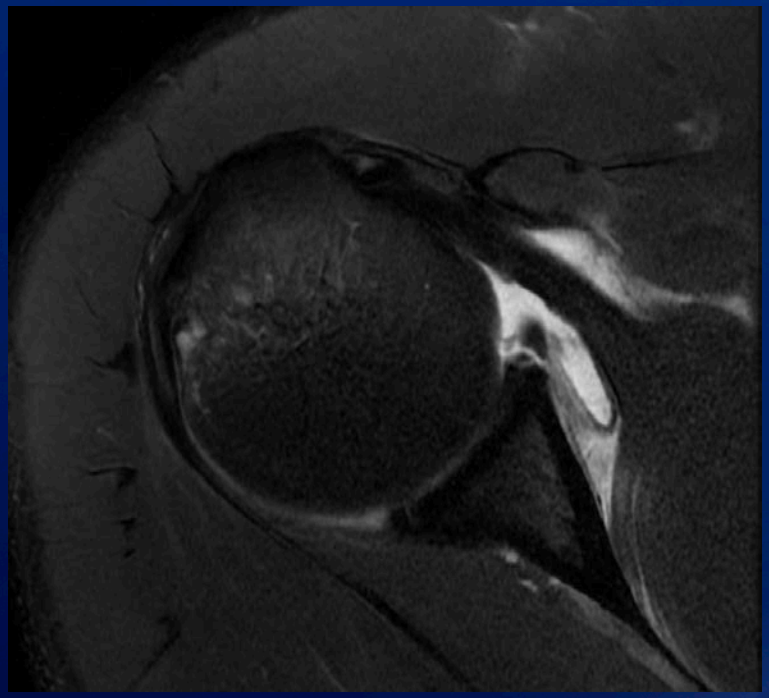
Imaging

- True AP
- Axillary view
- MRI
- CT scan
- Ultrasound



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Initial Management: Can you return this season?

- Must balance athlete's desire to return to play vs. risk of recurrence and further damage
- Non-op treatment
  - PT
  - Bracing
- Op treatment

How do you decide?

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Risk Factors for Recurrence

- Age is single most important risk factor for predicting recurrence
  - <20 yo =51%
  - 21-40 yo = 36%
  - >40 yo = 11%

Olds et al. Br J Sports Med 2015

- Sex
  - Men 3X more likely to have recurrent dislocation

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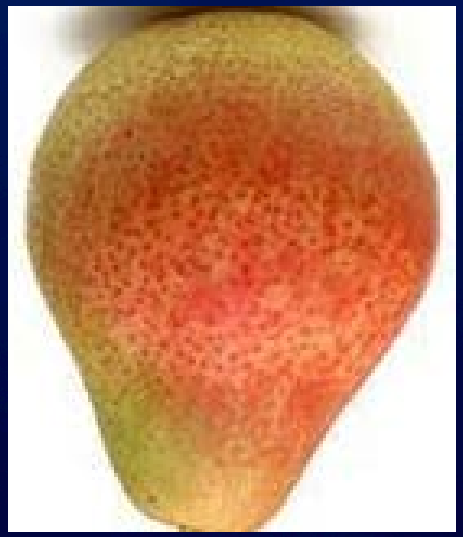
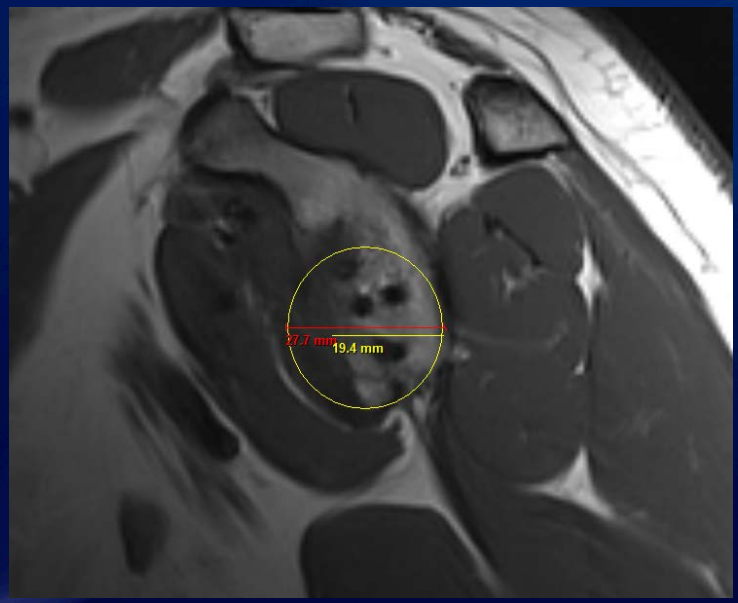
Imaging: Measuring Glenoid Bone Loss

- Perfect Circle Technique
- 100 – (Residual diameter of bone/normal diameter)
- Example: 100 – (19.4mm/27.7mm) = 30% bone loss





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Imaging: How About the Hill-Sachs? Glenoid Track

- Evolution of Concept of Engaging Hill Sachs Lesion

- Glenoid Track
  - Normal = 83% of Glenoid Width
    - In this case 22.4 mm
  - Track = nl track – lost bone
    - e.g. bone loss of 7 mm gives a track of 15 mm in this case

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On or Off Track?

- How Large is the Hill-Sachs lesion?
- The size of the Hill-Sachs lesion is measured from the rotator cuff attachment posteriorly

  - On–Track: The Hill Sachs lesion is contained within the Glenoid Track **GOOD**
  - Off-Track: The Hill Sachs lesion extends further medially than the Glenoid Track distance **BAD**

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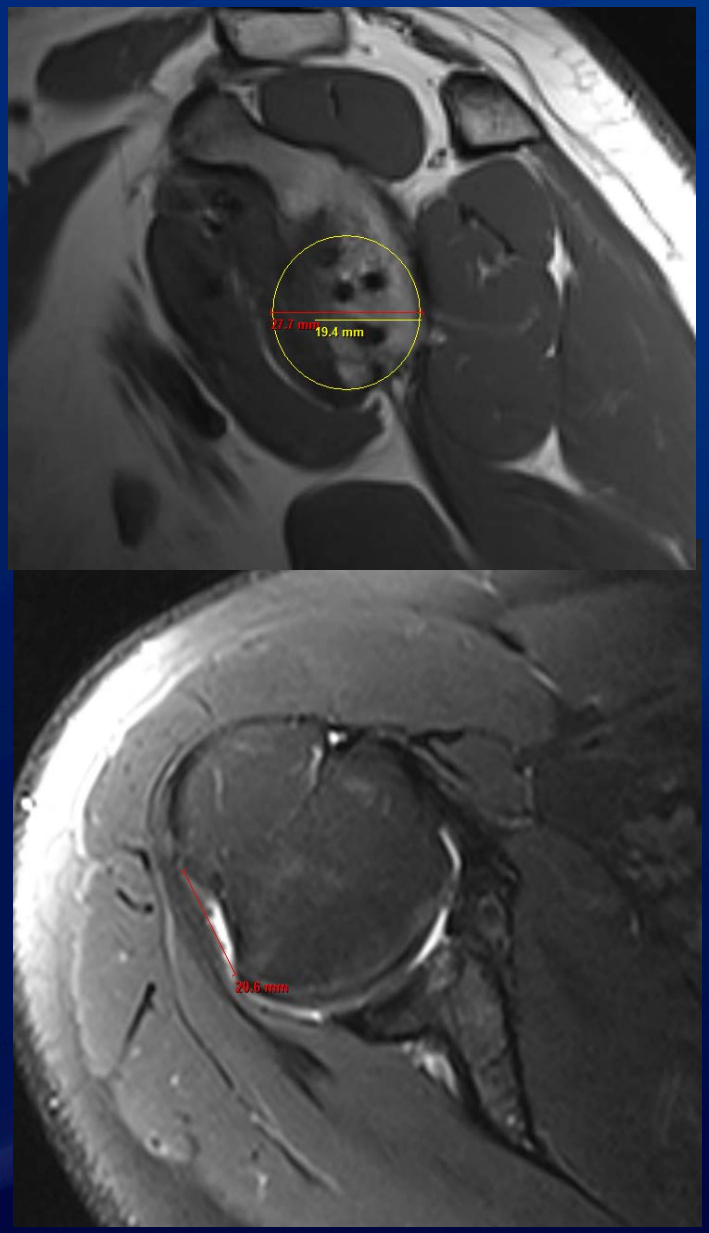
On or Off Track?

- Normal glenoid diameter = 27.7mm
- Glenoid Bone loss = 8.3 mm
- Glenoid Track = .84 x 27.7 = 23.3 mm – 8.3 mm (bone loss) = 15.0mm
- Hill-Sachs defect = 20.6mm
- Therefore Off-track
- Solutions:
  - Increase Glenoid Track *or*
  - Decrease Hill-Sachs defect *or*
  - Both



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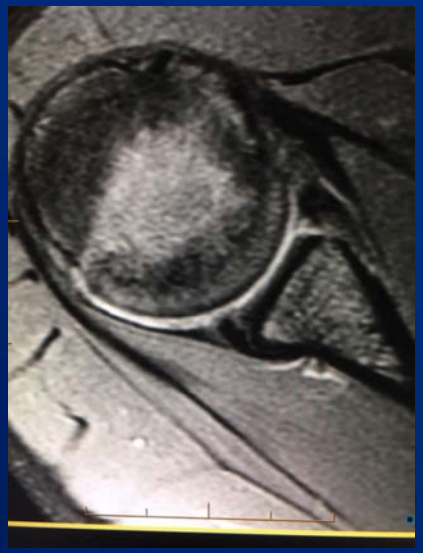
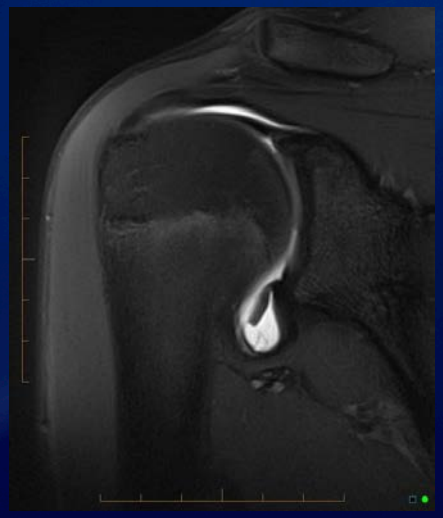
With this Info, Op vs Non op treatment?

- **High risk imaging findings / often season-ending findings**
  - Bony Bankart lesion
  - Large Hill Sachs lesion
  - Capsular tear – inferior or posterior
  - **GLAT** lesion - **G**lenoid articular cartilage **L**abral **A**rticular **T**eardrop





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With this Info, Op vs Non op treatment?

The Nonoperative Instability Severity Index Score (NISIS): A Simple Tool to Guide Operative Versus Nonoperative Treatment of the Unstable Shoulder

John M. Tokish, MD,* Charles A. Thigpen, PhD, Michael J. Kissenberth, MD, Stefan J. Tolan, MD, Keith T. Lonergan, MD, John M. Tokish Jr, Jonathan F. Dickens, MD, and Ellen Shanley, PhD

- 57 high school athletes treated non-op
- 79% RTS
  - 97% low risk (NISIS <7)
  - 59% high risk (NISIS >7)
    - Unipolar lesion 100% RTP
    - Bipolar 67% RTP

Factor	Cutoff	Score Assigned	Individual Odds Ratio when added to NISIS
Type of Sport	Collision vs. Not	3 pts	23.4
Age	>15	2 pts	6.0
Bone Loss	Detectable on XR	2 pts	4.5
Type of Instability	Dislocation vs. Subluxation	1 pt	3.6
Arm Dominance	Dominant Arm involved	1 pt	2.8
Sex	Female vs. Male	1 pt	1.5

Tokish et al Sports Health 2020

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What is the risk?

Abstract

Prospective Evaluation of Glenoid Bone Loss After First-time and Recurrent Anterior Glenohumeral Instability Events

Jonathan F. Dickens,*†‡§ MD, Sean E. Slaven,‡§ MD, Kenneth L. Cameron,† PhD, MPH, ATC, Adam M. Pickett,†§ MD, Matthew Posner,†§ MD, Scot E. Campbell,‖ MD, and Brett D. Owens,§¶ MD

Investigation performed at Keller Army Hospital, United States Military Academy, West Point, New York, USA

- 23 first-time instability events
- After 1st time event, mean glenoid bone loss was 6.8%
- Increased to 22.8% glenoid bone loss with single subsequent event

So we decide to do Non-op treatment

- **Sling for 2 weeks**
- Immediate grip exercises
- NSAID if tolerated – decreases pain inhibition for PT
- Initiate PT at 3-4 days working initially in plane of scapula (15 degrees off direct forward flexion)
- **Don’t worry about range of motion !**

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Rehab Protocol

- 1) regain Rotator Cuff control- this includes O'Briens position
- 2) immediately begin working on trunk rotation/mobilization and hip mobility
- 3) generalized shoulder strength in weight room (80lb dumbbell press from floor – males)
- 4) dynamic stabilization
- 5) Proceed to sport specific movements: catching a pass, hitting off tee/soft toss
- 6) ALL CONTACT ATHLETES RETURN IN BRACE (SULLY, SAWA)

Time Variable!

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Brace

Sully

Sawa

How do the do with Non-Op Treatment?

Return to Play and Recurrent Instability After In-Season Anterior Shoulder Instability

A Prospective Multicenter Study

MAJ Jonathan F. Dickens,*†‡ MD, LTC Brett D. Owens,†‡ MD,
Kenneth L. Cameron,‡ PhD, MPH, ATC, MAJ Kelly Kilcoyne,†§ MD,
LTC C. Dain Allred,‖ MD, COL Steven J. Svoboda,†‡ MD, LTC Robert Sullivan,‖ MD,
Col (Ret) John M. Tokish,†¶ MD, Karen Y. Peck,‡ MEd, ATC, and CDR John-Paul Rue,# MD
Investigation performed at the United States Naval Academy, Annapolis, Maryland, USA;
the United States Military Academy, West Point, New York, USA;
and the United States Air Force Academy, Colorado Springs, Colorado, USA

- 45 NCAA athletes treated non-op
- 73% returned for all or part of season
- 27% without recurrence
- Subluxation leads to 5.3x more likely to return to sport

AJSM 2014

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Operative Treatment

- **Absolute Indications**
  - >50% rotator cuff tear
  - Glenoid bone loss >25%
  - Bipolar off-track Hill-Sachs lesions
  - Proximal humeral fracture
  - Irreducible dislocation
  - Failed trial of rehabilitation
  - Inability to tolerate shoulder restrictions
  - Inability to perform sport-specific drills without instability
- **Relative Indications**
  - >2 recurrent dislocations in same season
  - Overhead or throwing athletes
  - Contact sport
  - End-of-Season injury
  - <20 years of age
  - Subcritical glenoid bone loss >13.5%

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Surgical Options

- Modern Arthroscopic Anterior Stabilization Technique (Soft Tissue Bankart Repair)
- Open Bankart Repair
- +/- Remplisage
- Bony Bankart Procedure (Laterjet vs Allograft

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What is a Modern Arthroscopic Anterior Stabilization?

1. Multiple Suture Anchors (>3)
2. Creating Bumper with Capsulolabral Shift onto the face of the glenoid
3. Proximal shift of ant. capsule and capsular plication
4. Address associated pathology
   - Rotator interval lesions
   - Capsular rents / laxity

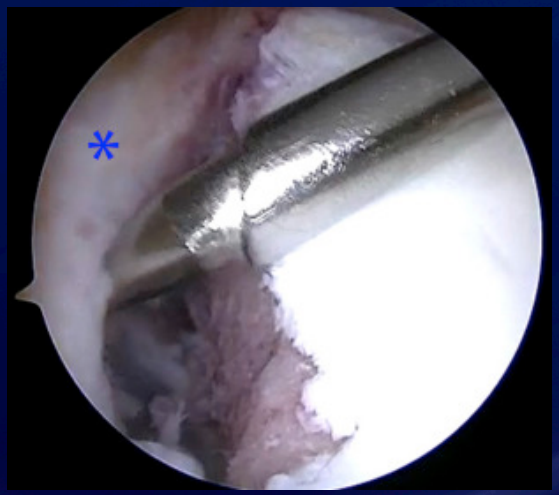
Modern Arthroscopic Anterior Stabilization Technique *(Hendawi et al Arth Tech 2017)*

1. Pre-op Planning
2. Anesthesia and Positioning (Beach chair vs lateral)
   - Lateral traction with shoulder in IR and adduction → anteroinferior labrum
3. Establish posterior portal
4. Diagnostic GH arthroscopy
   - Articular cartilage
   - Superior and anteroinferior labrum
   - Cuff
5. Anterosuperior portal and Anteroinferior portal

MAYO CLINIC **Portal Placement is key to optimal visualization!**

Modern Arthroscopic Anterior Stabilization Technique *(Hendawi et al Arth Tech 2017)*

6. Capsulolabral mobilization
   - Camera – anterosuperior portal
   - Instruments – anteroinferior portal
     - Traction suture through capsulolabral junction may help visualization
7. Glenoid preparation with rasp / burr



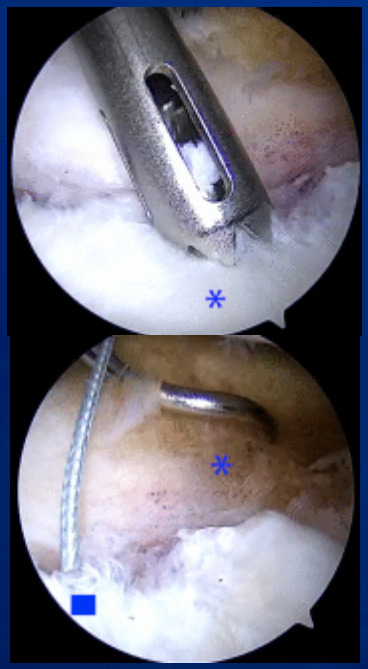
Modern Arthroscopic Anterior Stabilization Technique *(Hendawi et al Arth Tech 2017)*

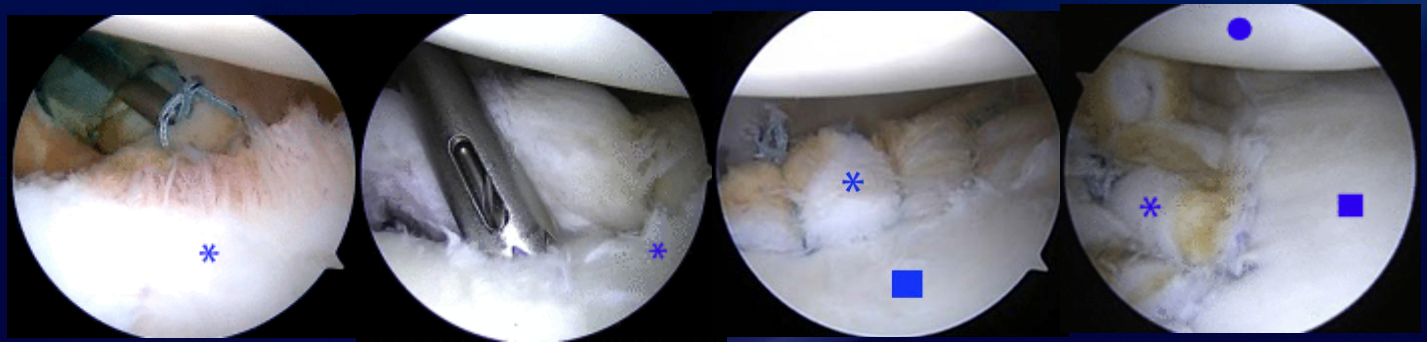
8. Anchors
- Glenoid margin
  - Do not medialize → labral height not restored
- How many anchors? How far apart?

9. Reduction of Labrum (Bony Bankart Must be reduced)

10. Capsular plication with superior shift

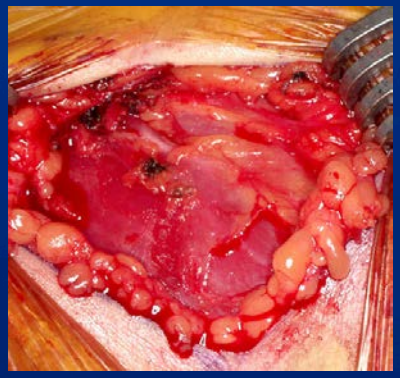
11. Knot tying / tensioning



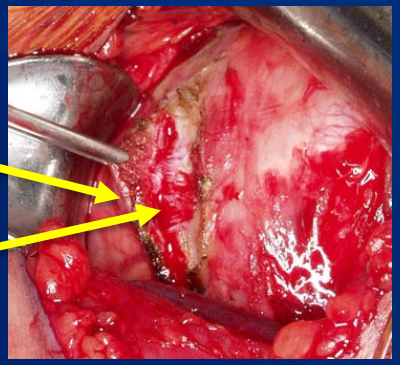


Open Bankart

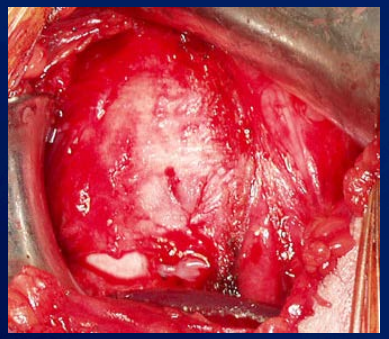
- Deltopectoral approach



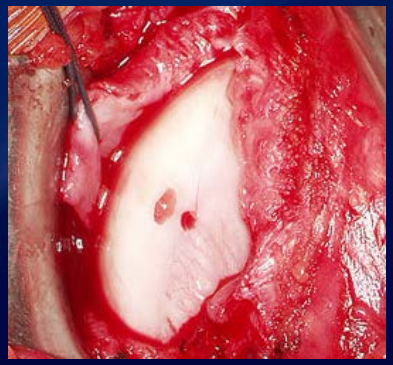
- Sharp peel of subscapularis off the anterior capsule



- Anterior capsular exposure



- Laterally based capsular arthrotomy
  - Allows secure repair of capsular redundacy
  - Postero-inferior extension for capsular shift



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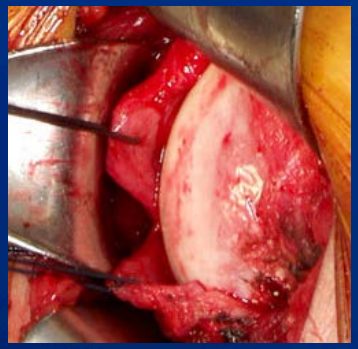
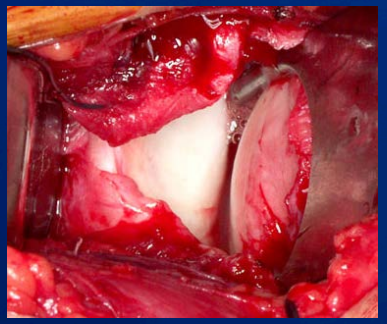
Open Bankart

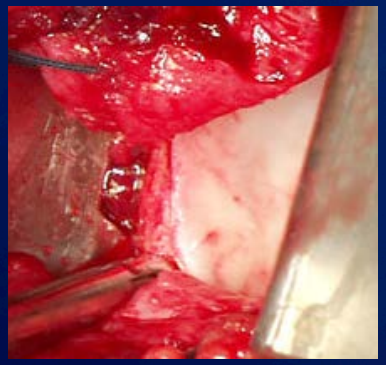
- Capsule “T’d” down to labral tear



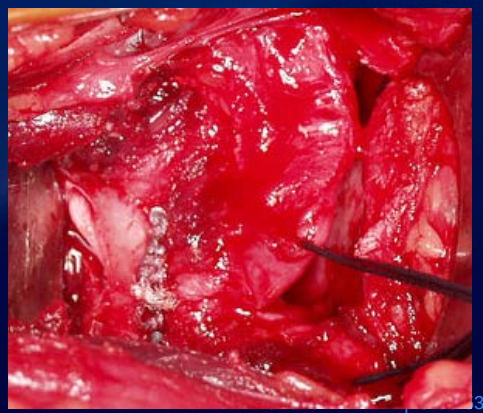
- Humeral retractor inserted to allow exposure of labrum



- Insertion of suture anchors along articular cartilage margin



- Suture limbs passed though labrum for repair



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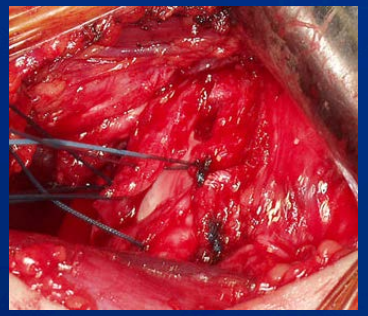
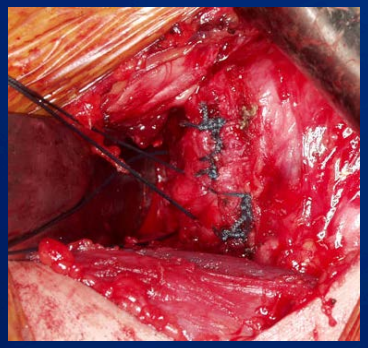
Open Bankart

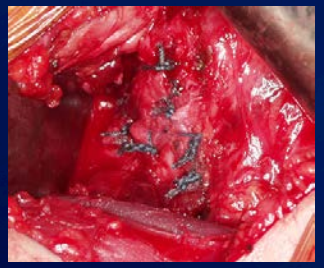
- Inferior capsular flap advanced superiorly and laterally for repair



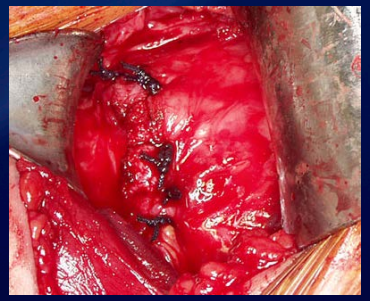
- Superior capsular flap advanced inferiorly and laterally to reinforce repair



- Capsular repair finished



- Subscapularis anatomically repaired



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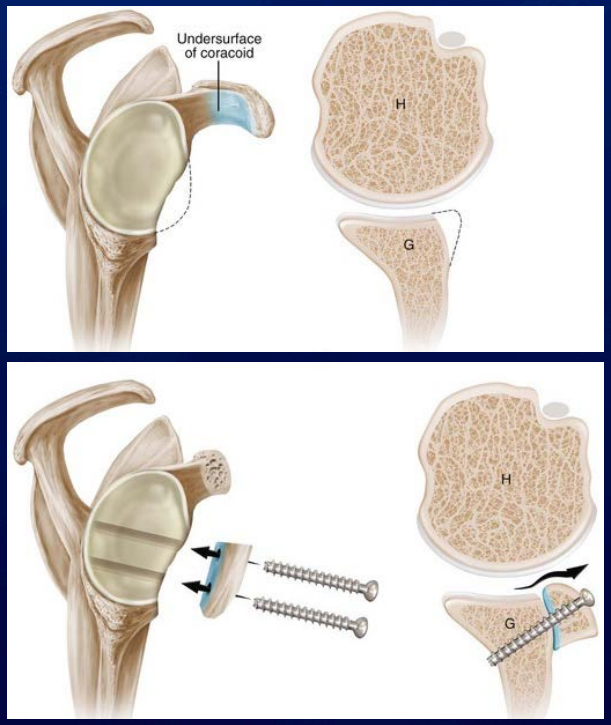
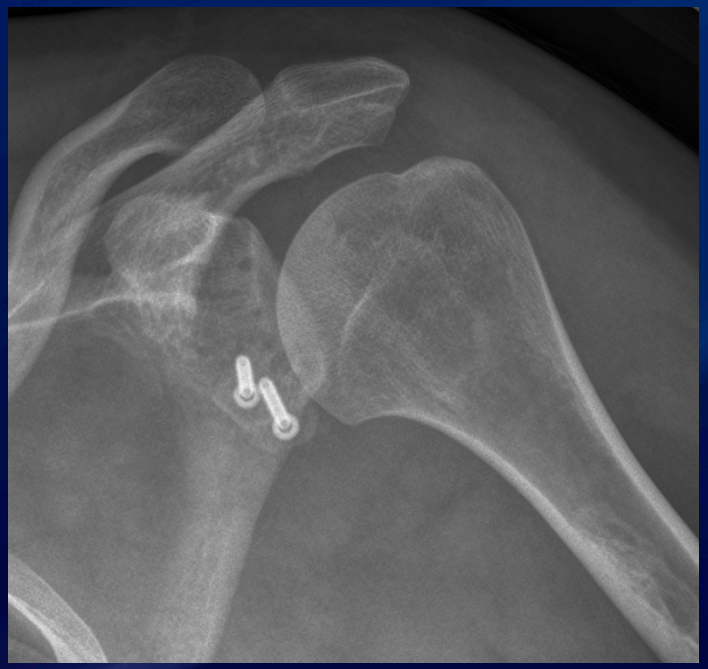
Latarjet

- Bone Block Procedure
  - Rotation of Coracoid and fixation to antero-inferior glenoid
- Alternatives
  - Iliac Crest Autograft
  - Distal Clavicle Autograft
  - Distal Tibial Allograft





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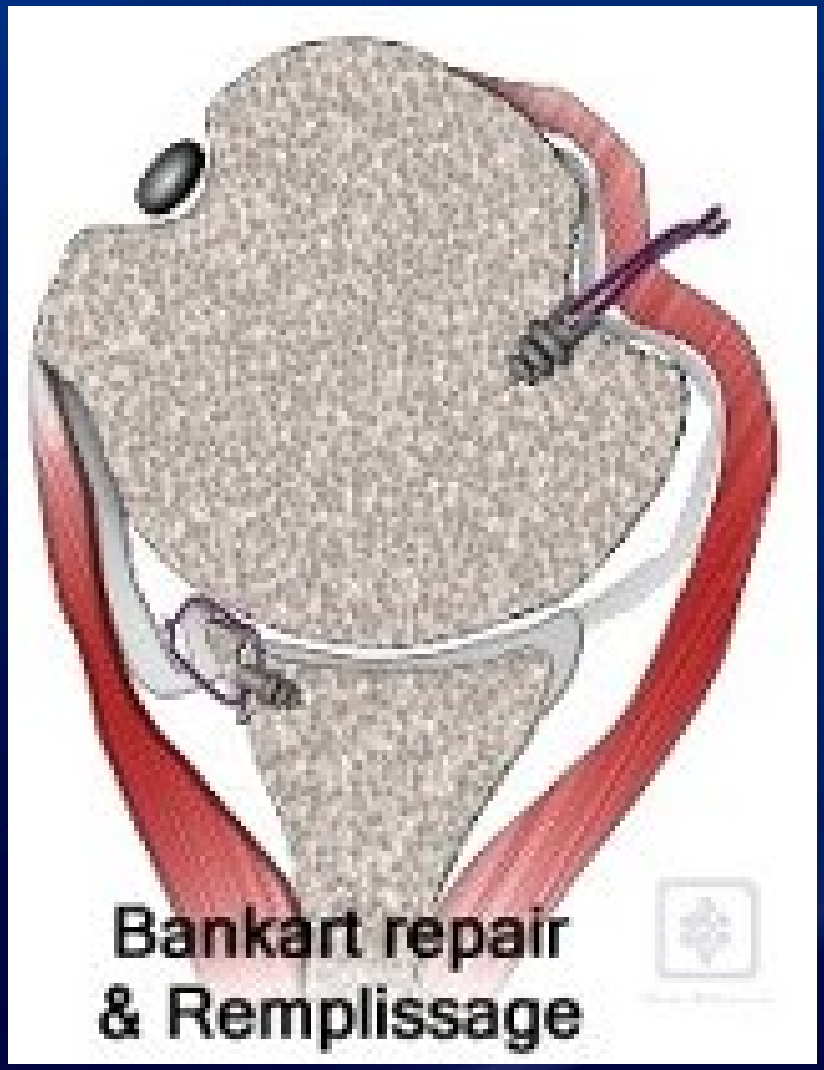
Remplissage



How do you decide what operation to do? Instability Severity Index Score

J Bone Joint Surg Br. 2007 Nov;89(11):1470-7.

The instability severity index score. A simple pre-operative score to select patients for arthroscopic or open shoulder stabilisation.

Balg F[1], Boileau P.

Prognostic factors	Points
Age at surgery (yrs)	
≤ 20	2
> 20	0
Degree of sport participation (pre-operative)	
Competitive	2
Recreational or none	0
Type of sport (pre-operative)	
Contact or forced overhead	1
Other	0
Shoulder hyperlaxity	
Shoulder hyperlaxity (anterior or inferior)	1
Normal laxity	0
Hill-Sachs on AP* radiograph	
Visible in external rotation	2
Not visible in external rotation	0
Glenoid loss of contour on AP radiograph	
Loss of contour	2
No lesion	0
Total (points)	10

* AP, anteroposterior

2007

Recurrence rates:

- **<3 = 3%**
- **<6 = 10% → acceptable limit for arthroscopic stabilization**
- **>6 = 70%; high likelihood of recurrence → open repair**

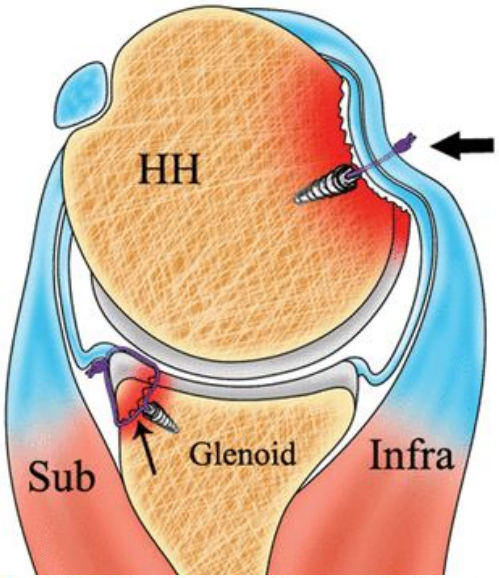
But How About Remplissage?

Arthroscopic Bankart Repair Combined with Remplissage Technique for the Treatment of Anterior Shoulder Instability with Engaging Hill-Sachs Lesion: A Report of 49 Cases With a Minimum 2-Year Follow-up

Yi-Ming Zhu, MD, Yi Lu, MD, Jin Zhang, MD, more... Show all authors

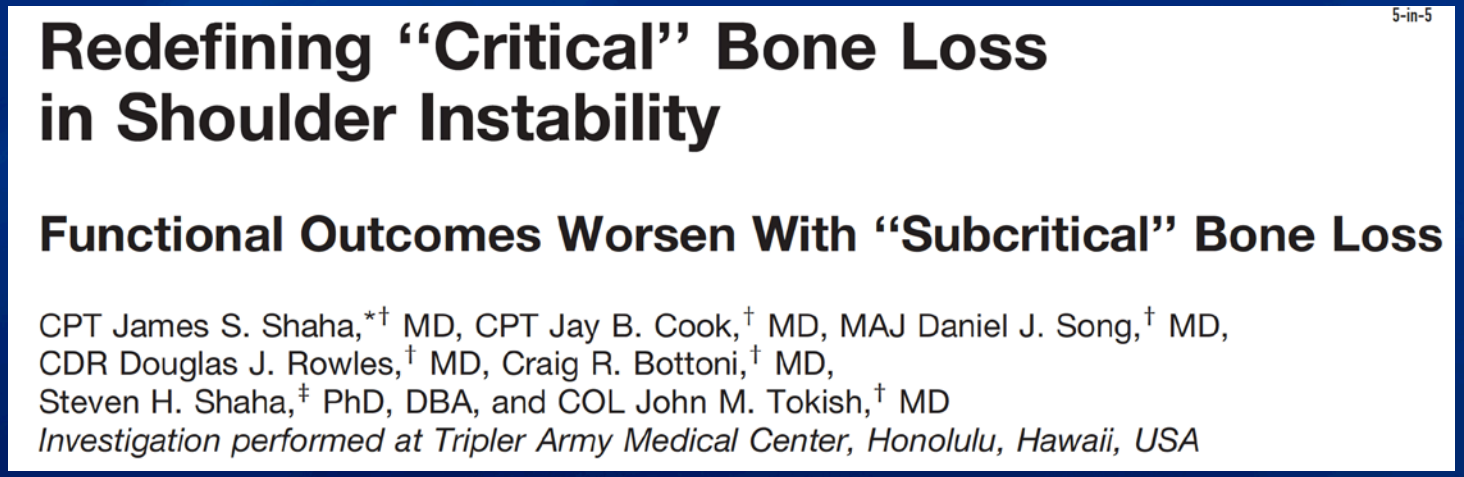
First Published April 19, 2011 | Research Article | Find in PubMed | Check for updates
https://doi.org/10.1177/0363546511400018

- Diagnosed unidirectional anterior instability
- Glenoid bone loss < 25%
- Engaging Hill Sachs "Off Track"



In conclusion, an arthroscopic Bankart repair combined with remplissage is effective in treating anterior shoulder instability with engaging Hill-Sachs lesion. The overall failure rate was 8.2%. A supplementary Hill-Sachs remplissage technique will not cause significant restriction in the range of motion or impairment of the function of the infraspinatus.

What about a bony procedure?



5-in-5

Redefining "Critical" Bone Loss in Shoulder Instability

Functional Outcomes Worsen With "Subcritical" Bone Loss

CPT James S. Shaha,*† MD, CPT Jay B. Cook,† MD, MAJ Daniel J. Song,† MD,
CDR Douglas J. Rowles,† MD, Craig R. Bottoni,† MD,
Steven H. Shaha,‡ PhD, DBA, and COL John M. Tokish,† MD
Investigation performed at Tripler Army Medical Center, Honolulu, Hawaii, USA

- Military population
- Evaluated degree of glenoid bone loss
- All Arthroscopic Bankart repairs
- Overall failure rate 12.3%
- Outcome scores (WOSI/SANE) decreased with increasing bone loss
  - Reached poor functional outcome at 13.5%
- Mean bone loss with failure / recurrence = 24.7%
- Mean bone loss without failure / recurrence = 12.8%

Shaha AJSM 2015

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Surgical Treatment Algorithm

	Glenoid Bone Loss	On or Off Track	Surgery
Group 1	< 25%	On Track	Arthroscopic labral repair
Group 2	< 25%	Off Track	Arthroscopic labral repair with remplissage
Group 3	> 25%	On Track	Latarjet or other bone augment
Group 4	> 25%	Off Track	Latarjet; ? Humeral procedure

Modified from Giacomo, Arthroscopy: 30:90-98, 2014

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Controversies

- Arthroscopic vs Open Bankart
- When to Add Remplisage
- When to do Bony Procedures
- How Contact / Throwing Athletes change the algorithm

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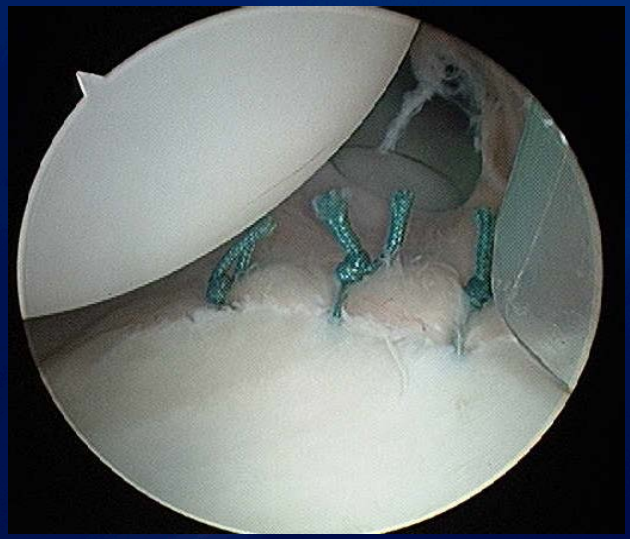
My Protocol: Conclusion

- Non-Op vs. Operative
  - Minimal/no bone loss; non-contact athlete; 1st time dislocation
- Operative
  - Bankart Repair
    - Minimal bone loss
  - Bankart + Remplissage
    - Bone loss 13.5-25%
  - Laterjet / Tibial Allograft
    - Bone loss >25%



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Thank You!

Chhabra.Anikar@mayo.edu