



PRISM Presents: Management of Adolescent Shoulder Instability

7 February 2017
VuMedi Webinar

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- Board Certified Sports Clinical Specialist
- American Physical Therapy Association
- Soccer player, coach, mom



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- Director of Pediatric Sports Medicine, UCSF Benioff Children's Hospitals
- Undergrad: Univ of Chicago
- Med School: Univ of Chicago
- Residency: Penn
- Fellowship: Rady Children's San Diego



Brett Burton – Bio



- Education:
 - University of Nebraska-Lincoln (Athletic Training)
 - University of Nebraska Medical Center (Physical Therapy)
 - St. Luke's Sports Medicine (Physical Therapy Residency)
- Experience:
 - Worked closely with the University of Nebraska Baseball Team
 - Trained at the Andrews Institute, Athletes' Performance (currently EXOS), and the Mayo Clinic
 - Currently serves as physical therapist at Northwest Nazarene University and treats several adolescent patients in outpatient clinical setting at St. Luke's Rehab in Idaho



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Adolescent Shoulder Instability: Patient Presentation

Carlin Senter, MD
Associate Professor
Primary Care Sports Medicine
UCSF Medicine and Orthopaedics

February 7, 2017



Epidemiology

- Shoulder is most commonly dislocated joint in the body
 - 1-2% of the population
- 90-95% of shoulder dislocations are anterior
- 20% of shoulder dislocations occur in patients under 20 years of age.
- Mechanism = fall on outstretched arm or collision, especially when arm is abducted and externally rotated



Shoulder anatomy: Bony stability





Injured structures

- Anterior dislocation
 - Failure of anterior inferior glenohumeral ligaments
 - +/- axillary nerve injury

<https://posna.org/Physician-Education/Study-Guide/Shoulder-Dislocation-Instability>
 Accessed January 29, 2017.



Traumatic Instability

- T – Traumatic
- U – Unidirectional
- B – Bankart Lesion
- S – Surgical



Multidirectional Instability

- A – Atraumatic
- M – Multidirectional
- B – Bilateral
- R - Rehab, rehab, rehab
- I – Inferior Capsular Shift





Shoulder dislocation: History

- Trauma vs atraumatic
- Past history of dislocation or subluxation
- Age at time of first dislocation



Anterior shoulder dislocation: Acute exam

- Athlete will use other arm to hold affected arm
- Flat appearance of deltoid
- Humeral head palpable anteriorly, below coracoid
- Neurovascular status
 - Axillary nerve in particular
 - Sensation lateral shoulder
 - Contraction deltoid muscle





Anterior shoulder dislocation: Full exam

- Inspection
- Palpation
- Range of Motion
- Neurovascular





Anterior shoulder dislocation: Special tests

- Load and shift
 - Patient supine
 - Shoulder abducted 45 degrees in plane of scapula, 30 degrees of flexion, neutral rotation
 - Axial force with examining hand centering humeral head in glenoid fossa
 - Other hand applies anterior force to check translation





Anterior shoulder dislocation: Special tests

- Apprehension test
 - Patient is supine
 - Affected arm in abduction, extension and external rotation
 - Apply gentle anterior translation on proximal humerus → apprehension
- Relocation test
 - Apply posteriorly directed force → instability is relieved





Instability: Sulcus Sign

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





Anterior shoulder dislocation, recurrent

- Beighton score for joint hypermobility
 - Passively dorsiflex 5th MCP joint by at least 90°
 - Oppose thumb to the volar aspect of the ipsilateral forearm
 - Hyperextend elbow by at least 10°
 - Hyperextend knee by at least 10°
 - Place hands flat on floor without bending knees
- 1 point for each maneuver (R and L side)
- 4 or more points → generalized joint hypermobility



Thank you!

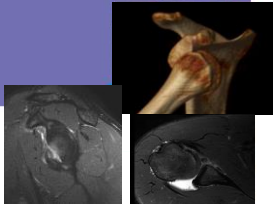
Imaging of Glenohumeral Instability in the Adolescent Patient

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Department of Diagnostic Imaging

2/7/17




Disclosure

Advisory Board on Hypophosphatasia
Alexion Pharmaceuticals, Inc.

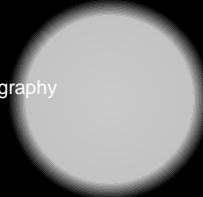
Goals


- Imaging acute traumatic shoulder dislocation
- Imaging chronic instability with repeated dislocation
- Diagnostic Imaging
 - Characterize extent of structural damage
 - Show osseous and soft tissue abnormalities
 - Guide surgical planning
 - Choice of stabilization procedure



Imaging Modalities

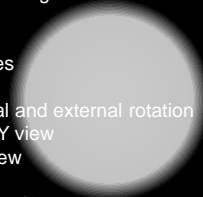

- Radiographs
- MRI
- MR arthrography
 - Direct
 - Indirect
- CT






Radiographs




- Obtained following acute dislocation
- Routine series
 - AP internal and external rotation
 - Scapular Y view
 - Axillary view
- Post-reduction films
 - Evaluate for fractures
 - Residual malalignment





Radiographs

Patient 1

Hills-Sachs

Patient 2

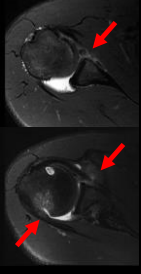



Bankart

MRI

Conventional MRI
Axial T2 FS

- Acute setting
 - Joint effusion or hemarthrosis
 - MR arthrogram not necessary
 - Mechanism evident by edema pattern



Standard MRI Technique

3T

Axial	T2 FS	PD
Sagittal	T2 FS	T2
Coronal	T2 FS	T1

TE/TR
T2 60/3000
PD 30/3000
T1 15/600

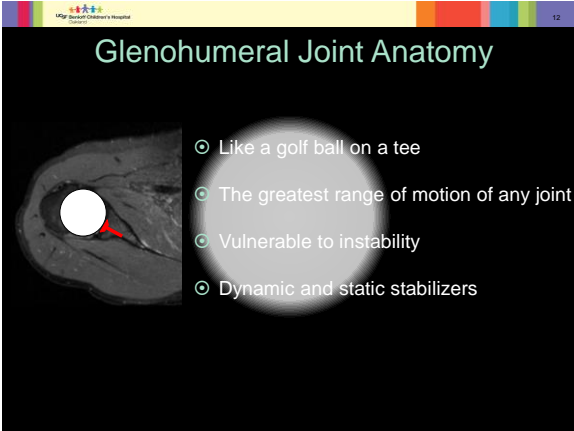
14 year old football player with 5 repeated traumatic dislocations

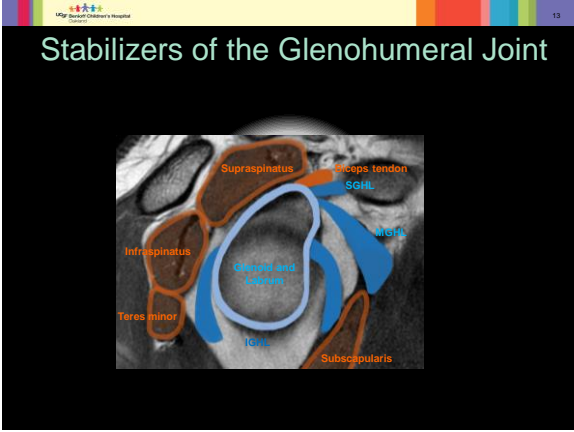
Axial T2 FS Axial PD

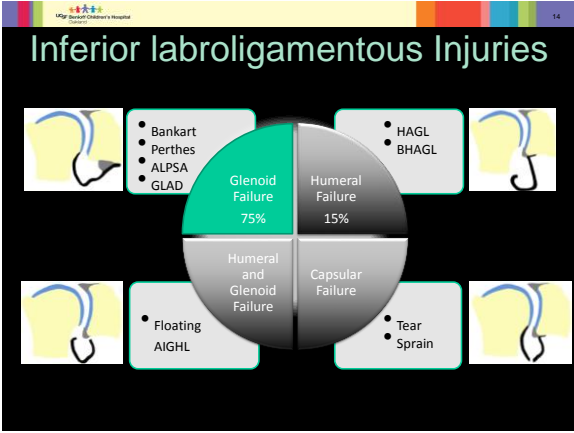














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Capsulo-Labral Lesions

Lesion	Normal	Soft Tissue Bankart	Osseous Bankart	Perthes	anterior labroligamentous peristeeal sleeve avulsion (ALPSA)	Glenohumeral ligament disruption
Periosteum	Normal	Stripped and Torn	Torn	Stripped	Stripped	Mildly Stripped
Labrum	Normal	Displaced	Displaced	Nondisplaced	Medially Displaced	Nondisplaced

17

17 year old female with 5 episodes of anterior shoulder dislocation

- Axial T2 FS
- Axial T2

18

17 year old female with 5 episodes of anterior shoulder dislocation

- Axial T2 FS
- Axial T2

Anterior Labroligamentous Peristeeal Sleeve Avulsion ALPSA







MR Arthrogram

Direct	Indirect
Arthrogram with dilute gadolinium solution	IV injection of gadolinium
Joint Distension	Does not distend joint

Provocative positioning maneuvers

ABduction External Rotation (ABER)

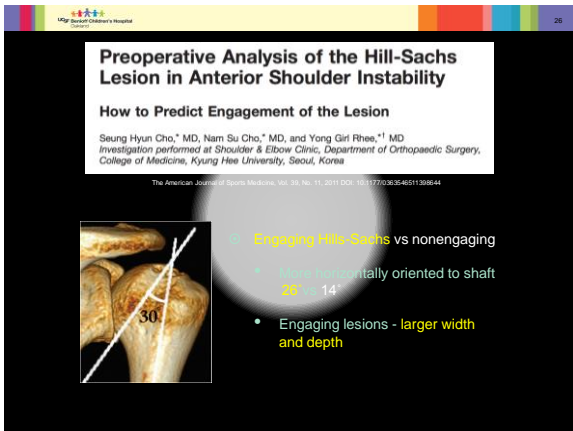
Abduction External Rotation (ABER)

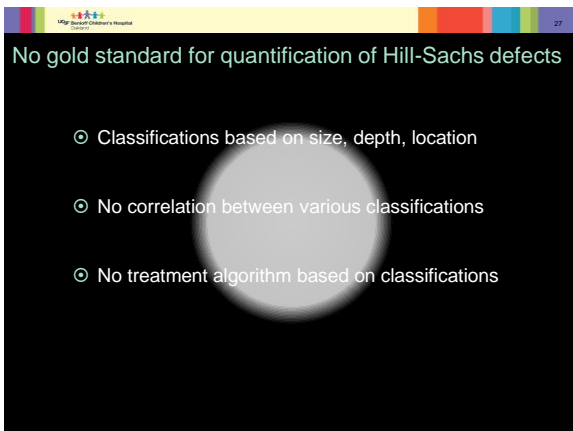
- Place anterior band of IGHL under tension
- Labral tear at attachment site of IGHL
- Outlines undersurface of Infraspinatus tendon

Pre-operative Planning


- MDCT or MRI with volume rendering
 - Quantify Glenoid deficiency
 - Measure Hills-Sachs








16 year old who experienced his first shoulder dislocation 1 year prior while playing football and has had multiple dislocations since.



Courtesy of Dr. Mimi Lin, Washington Radiologist Medical Group

Critical Area for Glenoid Deficiency is 25%

⊙ Defect greater than 25% glenoid width would need bone grafting (Bankart, the Beer)



Normal Glenoid Significant Bone Loss

Burkhart SS, DeBeer JT, Feinberg AM, et al (2002) Quantifying glenoid bone loss arthroscopically in shoulder instability. Arthroscopy 18:448-453

Journal of Shoulder and Elbow Surgery
Volume 16, Issue 5, September 2007, Pages 649-656

Original article
Contact between the glenoid and the humeral head in abduction, external rotation, and horizontal extension: A new concept of glenoid track

Nobuyuki Yamamoto, MD*, Eiji Itoi, MD*, Hirotaka Aiba, MD*, Hiroshi Minagawa, MD*, Nobuhiko Seki, MD*, Yoshio Shimada, MD*, Kyoji Okada, MD*

* Division of Orthopaedic Surgery, Department of Neuro and Locomotor Science, Aita University School of Medicine, Aita, Japan
** Department of Orthopaedic Surgery, Tohoku University School of Medicine, Sendai, Japan

- ⊙ Contact area of humerus on glenoid = glenoid track for critical ROM
- ⊙ Width of track is 84% glenoid width
- ⊙ Bankart lesions decreases width of tract
- ⊙ If medial margin of Hills-Sachs defect is more medial than glenoid track, standard stabilization are unlikely to stabilize the shoulder

UCSF Benioff Children's Hospital

Journal of Shoulder and Elbow Surgery
Available online 15 December 2016
In Press, Corrected Proof—Note to users

774781
Original Article

Interobserver and intraobserver variability of glenoid track measurements

Adrian K. Schneider, FMH(Orth), MD^{a,*}, Gregory A. Hoy, MBBS, Dip Anat., FRACS(Orth)^{b,c}, Eugene T. Ek, MBBS(Hons), PhD, FRACS(Orth)^{b,c}, Andrew H. Rotstein, MBBS, FRANZCR^d, Julie Tate, BSc(Hons), PgCert(CT)^e, David McD Taylor, MBBS, MD, MPH, BRCCOG, FACEM^f, Matthew C. Evans, MBBS, FRACS(Orth)^{b,c,*}

Goal
Assess reproducibility of characterizing bipolar bone loss and treatment

Method
71 patients with anterior inferior shoulder instability
4 Reviewers

- Good agreement between 4 observers about % glenoid bone loss
- Poor agreement assessing Hills-Sachs defect
- Poor reliability of the glenoid track classification

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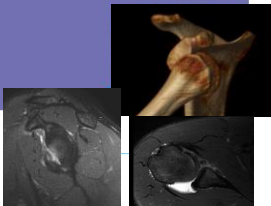
Summary

- In the acute setting radiographs
- MRI and MR arthrography
 - Osseous and soft tissue abnormalities
- CT and MRI with 3D reformations
 - Characterize and measure glenoid deficiency and Hill-Sachs lesions for preoperative planning

UCSF Benioff Children's Hospital

Imaging of Glenohumeral Instability in the Adolescent Patient

THANK YOU!!!



UCSF Benioff Children's Hospital
Oakland



Traumatic Anterior Shoulder Instability: Rehabilitation Through Return to Play

Michelle Cappello, PT, MSPT, SCS
USCF Benioff Children’s Hospitals
Sports Medicine Center for Young Athletes
February 7th, 2017



Objectives

- Review conservative management for primary TASI
- Review evidence based return to sport criteria for traumatic anterior shoulder instability (TASI)



Traumatic Anterior Shoulder Instability (TASI)

- Treatment of first time traumatic GH dislocators will be different from that of a patient with atraumatic instability. Micro vs. Macro
- A gradual graded advancement of ROM and exercise progression will be required, based on the degree of the acute injury
- Goals remain the same; dynamically stabilize the inherently unstable glenohumeral joint.
- Master the “Thrower’s Paradox”; Shoulder loose enough to throw yet stable enough to prevent injury (*Wilk AJSM 2002*)



Rehabilitation Overview

- Reduce acute pain & inflammation
- Restore motion and soft tissue mobility
- Emphasize strength balance
- Enhance dynamic humeral head control
- Integrate kinetic chain
- Return to Sports Specific Activity/PLF



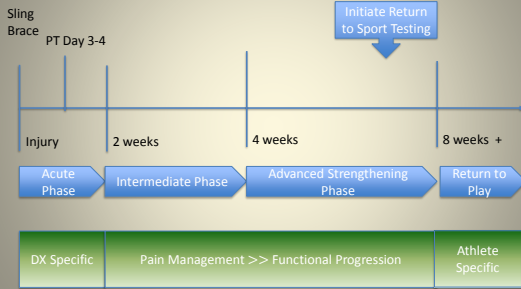
TASI Goals of Rehab

OUTCOME MEASURES

- Patient Reported
- Shoulder ROM
- Movement Segment Strength
- Functional Testing: Ybalance, SL squat, CKCUET, OH Squat, Seated shot put
- Sports Specific training to competition



Rehabilitation Timeline





Acute Phase

Goals: Protect the injured, healing capsular & labral structures

1. Abstain from Sport 2+ weeks (control stresses)
 - Sling for comfort, no evidence on duration, inconclusive ER vs. IR of shoulder position
2. Diminish pain & inflammation
3. Reestablish pain-free ROM, Do not push range
4. Delay muscle atrophy & reestablish voluntary muscle activity



Intermediate Phase

Goals:

1. Improve strength
 1. Rotator cuff anterior and posterior
 2. Scapular "stabilizers" - incl. serratus anterior
 3. Core for energy transfer
2. Normalization of shoulder girdle motion and arthokinematics, manual therapy for tissue mobility
3. Enhancing dynamic stabilization of cuff and scapular muscles & neuromuscular control with upper extremity activities
 - BALANCE net force ant/post/distract of humoral head
 - 3-4% decrease in RTC strength results in loss of dynamic stability (Reinhold, Sports Health 2010)



The Adolescent Shoulder: Linking development into the plan of care

CORE:


- Group of muscles that form a cylinder around your waist
TA, RA, IO, EO
Paraspinals
Diaphragm
Pelvic Floor
Hip Muscles
Thoracolumbar Fascia
- Optimum production, transfer, and control of force delivered to the terminal segment
- Core provides 65% force production, 85% force attenuation
- Glut Max 100% MVIC stride to late cocking phase, Glut Med 40%
- Poor Single leg squat associated with posterior chain weakness which is underdeveloped in pre/adolescents (Wilk PMR 2016)

Oliver JSCR 2010 & 2015

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The Adolescent Shoulder: Linking Core into the plan of care



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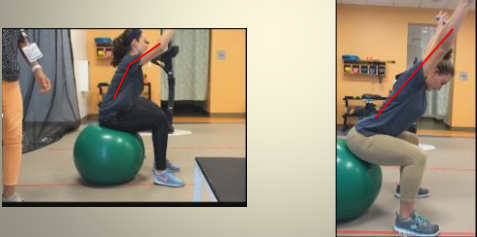
The Adolescent Shoulder: Linking UE & LE



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The Adolescent Shoulder: Exercises Examples

Linking UE & LE





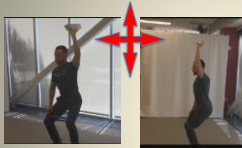
Advanced Strengthening Phase

Goal: improve strength, power, endurance, **MOTOR CONTROL**, enhance dynamic stabilizers of the GH joint and Scapula.





Stabilization



- Rapid torque control progressing into 90/90 shoulder position
- Closed Kinetic chain for proprioception training





Return to Play Phase

Goal: Athletes need to be resilient, strong, technically proficient to robustly maintain proper motor skill competence within the demands of their sport

OUTCOME MEASURES

- Patient Reported
- Shoulder ROM
- Movement Segment Strength
- Functional Testing



Criteria for Return to Play

4. Functional Testing

These are the ones we use regularly.

- **CKQUEST** – Place tape 36" apart with arms in push up position (hands/toes). Tap across each tape alternately many times as they can in 15 sec. Repeat 3 trials and take average them. >23 touches in 15 seconds *BMC musculoskeletal disorders 2014*
- **LEY balance**: Composite score > 92% (*Baseball Players Diagnosed With Ulnar Collateral Ligament Tears Demonstrate Decreased Balance Compared to Healthy Controls, J. Craig Garrison et al, JOSPT, Oct 2013*)





Criteria for Return to Play

4. Functional Testing (cont.)

- Perform maximum effort 2 handed chest passes with 8 lb. medicine ball 2 x 20 *Sportsfisio 2015 Kevin Wilk*
 - Perform maximum effort 1 handed "shot-put" throw with 4 lb. medicine ball 2 x 20 (just need to complete without pain/instability)
 - Prone Y endurance test for scapular stabilizers
 - Tests fatigue in middle and lower traps.
 - Testing performed with 3% of body weight. Metronome set to 60Hz.
 - Task failure was defined as: 1. Unable to keep up with metronome, 2. Demonstration of compensatory strategies, 3. Inability to go above horizontal each time.
 - Only norms available on Football players (26-28 repetitions).
 - For OH athlete I would aim for 10% better on dominant side
- Pantillo, Marisa, Bryan A. Spinelli, and Brian J. Sennett. "Prediction of in-season shoulder injury from preseason testing in division I collegiate football players." *Sports Health: A Multidisciplinary Approach* (2014): 1941738114523239



Criteria for Return to Play

5. Return to Sports

- Begin a specified return to throwing program for throwing athletes
- Work with a sports specific skills coach
- Build intensity and volume, as well as impact
- Single sports specific task, then add complexities and reactive drills
- Start with non-contact practice
- Full practice for 2 full weeks
- Competition



Summary

1. Return to sports after a shoulder dislocation involves many factors
2. There are ideal criteria that give some guidelines for when to return the athlete to play, this will be athlete specific, more research need for proven battery of outcome measures.
3. Timelines for return to play will be athlete specific, and only should occur after attainment of full strength, motion, stability, and confidence.
4. Fatigue is above all the biggest injury risk, train for dynamic stability / postural endurance then power/speed
5. Core/Legs provide >65% of power/torque to the UE – “Train the Chain”



Operative Management of Adolescent Shoulder Instability: Keys for Success

Dr. Nirav K. Pandya

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Director of Pediatric Sports Medicine
University of California San Francisco
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Disclosures

Consultant - Orthopediatrics



Common Scenario

“So I heard you are the person who is going to make my shoulder normal again?”

“Can I go back and play 6 weeks after surgery?”

“I will never dislocate out again right?”

“Are you going to do the surgery with a laser?”





Common Scenario





Key Point



Studies cite up to a 30% re-dislocation rate with arthroscopic treatment in this age group
PREPARE PATIENTS EARLY



Key H and P

- Sport: collision vs. non-collision
- Sport: throwing / swimming
- Hand dominance
- Number of prior dislocations
- Force needed to dislocate and re-locate
- In-season vs. out-of-season
- Ligamentous laxity
- Expectations



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Key H and P



Remember to differentiate atraumatic instability from traumatic instability

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What Can I Do?

Open

vs.

Arthroscopic



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How Do I Decide?

It's not just about throwing some anchors in and fixing the labrum!





How Do I Decide?

- I am searching for evidence that I need to do more than just an arthroscopic labral repair
- History = collision sports, number of dislocations, compliance?
- Imaging!!!





What's In My Tool Box?

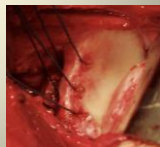
- Arthroscopic labral repair
- Arthroscopic remplissage
- Open labral repair
- Open Latarjet





Pearl #1

Collision athlete /
extreme athlete =
consider open
repair



ORIGINAL ARTICLE

The Open Bankart Repair for Traumatic Anterior Shoulder Instability in Teenage Athletes
Mark D. Harsh, MD and William L. Haworth, MD

Pearl #2

On – Track
vs.
Off – Track

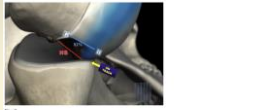


Fig. 3
Anteroposterior joint in abduction and external rotation. If the Hill-Sachs lesion (HS) is within the medial margin of the glenoid track (GT), there is still glenoid track support for bone stability (on-track HS-Sachs lesion). This implies that intrinsic stability can be intact between the Bankart repair and bone support.

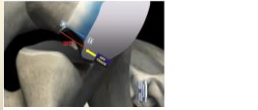


Fig. 4
Anteroposterior joint in abduction and external rotation in a shoulder with glenoid defects and Hill-Sachs lesion (HS) (dipolar bone loss). The Hill-Sachs lesion extends medially to the medial margin of the glenoid track (GT) with loss of bone support at the anterior glenoid rim (off-track HS-Sachs lesion).

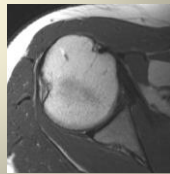
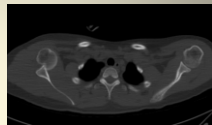


Pearl #2

Engaging Hill
Sach's

= >

Remplissage



Pearl #3

Glenoid Bone
Loss > 25%

=

Open Latarjet





What's In My Tool Box?

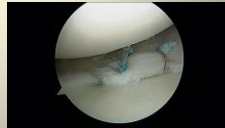
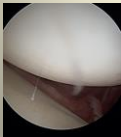
- Arthroscopic labral repair
- Arthroscopic remplissage
 - *Engaging / off-track Hill-Sachs's*
- Open labral repair
 - *Collision / extreme athlete*
- Open Latarjet
 - *> 25% bone loss*





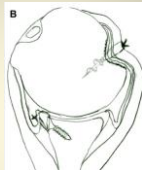
Labral Repair Keys

- Beach chair vs. lateral
- Mobilize labrum!
- Knotless vs. standard (dealer's choice)
- Get down low (5:30 – 6:00 o'clock)
- Grab capsule AND labrum AND advance tissue
- Don't be an anchor animal (space out)

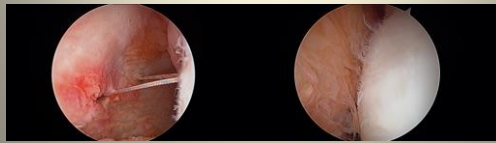




Remplissage Keys



- Engaging / Off-Track
- Prepare bed
- Pass sutures before performing anterior stabilization





Post-Op

- Not worried about stiffness
- Worried about compliance!!





What's The Data??

Downloaded from <http://ajsm.sagepub.com> at February 2, 2017. Published by group 193,000

Recurrence and return to play after shoulder instability events in young and adolescent athletes: a systematic review and meta-analysis

Jason L. Zernicke,¹ Juan Galloza,² Fernando Sepulveda,³ Terrie Vasilopoulos,^{1,4} William Michon,⁵ Daniel C. Hoffman⁶

- 17 studies comprising 654 total shoulder instability events
- Patients grouped non-operative vs operative treatment
- Primary non-operative group was more likely to have recurrence compared to the primary operative group (OR=13.41; 99% CI 3.60 to 49.93, p<0.001)
- The rate of recurrence in patients aged <14 years was high (44.44%)
- For RTP, there is evidence that RTP rates were higher for primary operative patients (95.3%) versus primary non-operative (41.3%, Z=6.12, p<0.001) and secondary operative patients (77.6%, Z=2.66, p=0.008).



What's The Data??

ORIGINAL ARTICLE

Traumatic Anterior Instability of the Pediatric Shoulder: A Comparison of Arthroscopic and Open Bankart Repairs

Stephen J. Shymon, BA,* Joanna Roscraft, MA,† and Eric W. Edmonds, MD*†

- 21% re-dislocation rate

ORIGINAL ARTICLE

Functional Outcomes of Early Arthroscopic Bankart Repair in Adolescents Aged 11 to 18 Years

Kristofer J. Jones, BA,* Brent Wisel, MD,† Theodore J. Ganley, MD,‡ and Lawrence Wells, MD‡

- 18.75% re-dislocation rate

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What's The Data??

Orthopaedics & Traumatology: Surgery & Research 101 (2015) 880-883

Available online at **ScienceDirect** www.sciencedirect.com Elsevier Masson France **EM|consulte** www.em-consulte.com/en

Original article

Ten-year follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocation in young patients

V. Chapus^a, G. Rochongar^{a,b}, V. Pineau^a, F. Salle de Chou^a, C. Hulet^{a,c,d}

^a Département d'orthopédie-traumatologie, CHU de Caen, avenue Côte-de-Normandie, 14000 Caen, France
^b Hôpital Pasteur CHU de Caen, avenue Côte-de-Normandie, 14000 Caen, France

- 25% re-dislocation rate

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What's The Data??

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Arthroscopic Hill-Sachs Remplissage

A Systematic Review

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Investigation performed at the Department of Orthopaedic Surgery, New York-Presbyterian Hospital/Columbia University Medical Center, New York, NY

- 6 studies, 167 patients
- 5.4 % re-dislocation rate
- Low complication rate
- No significant loss of shoulder motion

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Key Summary

- High repeat dislocation rate in this population
- Assess activity level and expectations
- Know your tools: arthroscopic, open, remplissage, Latarjet
- Engaging / off-track = remplissage; glenoid loss > 25% = Latarjet
- Start low, shift capsule-labrum arthroscopically
- Be prepared to do a remplissage if necessary
- Post-op = compliance, compliance, compliance





Postoperative Management and Return to Play for Adolescent Shoulder Instability

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Postoperative Management

- Guiding Principles¹
 - Communication with surgeon is imperative
 - Understand the surgery
 - Know all structures involved
 - Understand structures to be protected, how they are stressed, and healing rates
 - Impart appropriate levels of stress to the tissue
 - Absolute ROM, controlled submaximal loading, and dynamic stability
 - Management of initial immobilization and understanding rate of ROM progression





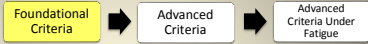
Postoperative Management

- Rehabilitation Overview - approximate timelines²
 - Weeks 0-6: Immobilization in sling
 - Weeks 2-4: PROM at graded intervals; isometric exercise
 - Screen trunk and lower extremity (mobility, stability, and strength) and address limitations³
 - Weeks 4-8: Basic strengthening exercise
 - Weeks 5-6: Begin AROM
 - Weeks 8-12: Advanced strengthening and plyometrics
 - Week 16: Return to play testing performed
 - Week 24: Contact and overhead sports begin





Return to Play

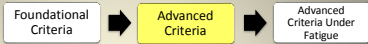


- Pain free movement
- Range of motion established
 - Minimize glenohumeral internal rotational deficit (GIRD) and total range of motion (TROM) deficits^{4,5}
 - Consider specific surgery
 - Loss of motion does increase risk of shoulder or elbow injury^{6,7}
- Strong and pain free manual muscle testing
 - Test throwers in 90/90 position
 - Weakness of supraspinatus is also related to increased risk of injury^{8,9}





Return to Play



Trunk Stability Push Up¹⁰

- Assesses trunk stability in sagittal plane while performing bilateral, closed chained, upper extremity movement
- Desired score: 2/3



Single Arm Seated Shot-Put¹¹

- Utilizes a 6 lb. medicine ball to assess unilateral, open chained, upper extremity power movement
- Desired score: < 10% difference between extremities



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Return to Play

Foundational Criteria

➡


Advanced Criteria

➡

Advanced Criteria Under Fatigue


Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST)^{12,13}

- Assesses power, speed, and stability while performing bilateral, closed chained, upper extremity movement
- Desired score: minimum of 21 touches, see sport specific norms



Upper Quarter Y-Balance Test (UQ-YBT)¹²

- Assesses unilateral stability, proprioception, and mobility of thoracic spine, scapula, and upper extremity
- Desired score: Composite score of > 80% and < 4 cm reach difference between extremities



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Return to Play

Foundational Criteria

➡

Advanced Criteria

➡

Advanced Criteria Under Fatigue

- Why re-test while fatigued?
 - It's a better simulation of upper extremity performance during sport
 - Fatigue impacts joint position and sensorimotor system^{14,15}
 - Fatigue should show symmetrical decrease in performance
 - Asymmetrical decrease may indicate greater compensation and increased injury risk during play

stability
▲
 mobility

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