Humeral Hill Sachs Lesions: Neglect or Address
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Disclosures:
• Consultant: DJO Global, Inc.
• Institutional Support:
  - DJO Global, Arthrex, DePuy-Mitek

Disclosures:
• Some of these slides borrowed and adapted from Dr. Romeo, and in turn from colleagues including Drs. Cole and Provencher
• Reflects their great contribution to understanding how to manage Hill-Sachs lesions
Objectives:
- Define Hill-Sachs Lesion
  - Engaging and non-engaging
- Discuss Imaging
- Discuss Treatment options and considerations:
  - Neglect
  - Soft tissue procedures (Remplissage)
  - Bone reconstruction
    - Bone vs. metal
  - Glenoid augmentation

Hill-Sachs Lesion - Definition
- Humeral Head Bone Defect
- Occurs during Anterior Glenohumeral Dislocation
- Not the Bare Area of the humerus

Hill-Sachs Lesion – Definition:
- Harold Arthur Hill (1901-73)
- Maurice David Sachs (1909-87)
- The grooved defect of the humeral head: a frequently unrecognized complication of dislocations of the shoulder joint. (119 cases)
  *Radiology* 1940
- Key features
  - Posterior-lateral humeral head
  - Superior to bare area of humerus
  - Impaction of dense glenoid
  - Line of condensation
Hill-Sachs Lesion: Incidence

- 35-73% with initial anterior dislocation
- 95% or more with recurrent dislocations
- ↑ Instability events:
  - Increased incidence
  - Increased size
  - Increased relevance

Exam under Anesthesia

Mechanism: How a Hill-Sachs Lesion Occurs

- Humeral head impacts hard glenoid during an anterior glenohumeral dislocation
- Location:
  - Abduction
  - Amount of ER
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Hill-Sachs Lesion: Location

Saito et al. 2009
Arch Orthop Trauma Surg

From Superior → Inferior
- Hill Sachs 0-24 mm
- Bare area >19 mm

Hill-Sachs Lesion

Spectrum of pathology:

Posterolateral humeral osteoedema → Massive impaction fractures
Imaging Studies

Radiographs

- Evaluate for:
  - Dislocation
  - Bony Bankart
    - Glenoid rim fracture
  - Hill-Sachs
    - Humeral head impaction

- Radiographs:
  - True AP, Axillary-lateral
  - Hill-Sachs lesion may be difficult to evaluate by plain radiographs

Rockwood, 1998
Best radiographs for evaluating Hill-Sachs lesion:
- Stryker notch view
- Apical-Oblique or Garth view:
  - Arm IR
  - Beam 45° superior and 45° internal
  - JBJS 1984

Radiographs

Apical Oblique          Stryker Notch

Radiographs

Apical Oblique          West Point Axillary
Fluoroscopy
At the time of closed reduction in OR
- Hill-Sachs
- Bony Bankart

Radiographic Classification
Related to percentage of joint surface involved
- < 20%: Insignificant
- 20-40%: Variable
- > 40%: Significant

Clinically Significant Lesion
- Sanghavi, Gaudin, Hardy SECEC 2009
  - 45° IR View
  - Measure depth of Hill Sachs lesion
  - Measure humeral head radius of curvature
  - Depth / Diameter > 15% had higher recurrence

Hall et al 1994
X/Y x 100 = 34%
Magnetic Resonance Imaging (MRI)

- Gold Standard for soft tissue imaging
- Labrum tear
- Rotator cuff tear
- HAGL
- Hill-Sachs Lesion
  - Axial, sagittal, coronal cuts

Advanced Imaging

Ultrasound
- les accurate than MRI

MRI
- Ability to see both soft tissue and bone injury
- 91-97% accuracy

CT Scan
- Near 100% accuracy
- Study of choice

Same patient
CT Scan

- Axial Cuts
  - Thin slices (1-2 mm)
- Reformats
- 3D reconstructions
- Glenoid and humeral subtraction

Hill-Sachs Lesions - Features

- Size
- Depth
- Location
- Orientation
- Engaging or not

Engaging Hill-Sachs Lesion

- Refers to the defect engaging the anterior glenoid during humeral rotation
- Any shoulder that has dislocated with resultant Hill-Sachs defect and Bankart tear may engage
- Engaging Hill-Sachs defects refers to specific lesions that are at risk of causing mechanical symptoms... in functional positions
Classification: “Engaging Hill-Sachs”

Burkhart & De Beer

Arthroscopy 2000

- Inverted pear 18/194 shoulders
- Hill-Sachs engaged 3 shoulders
- 90° abduction + ≥ 30° ER
- Symptoms ± "instability"

Engaging Hill-Sachs Defects

Contact between the Glenoid and the humeral head in abduction, external rotation, and horizontal extension: A new concept of Glenoid Track

(Nagataki, Tumminia, Sisco, Kri, An, Holland, Naka, McNiece, Kurosaka, Kurosaka, Sato, Yamasaki, Hatchi, Huse, Akes, and Sonoda, Japan)
Glenoid Track - Definition

Contact zone of the humeral head on the glenoid during arm elevation in maximum ER and horizontal extension

A) If the glenoid track extends beyond boundaries of the Hill-Sachs lesion, it does not engage
B) With medial extension (larger lesion), the humeral head can engage

(Yamamoto et al., JSES, 2007)

Glenoid Track

Humeral head contact with glenoid changes with arm elevation/abduction

A) 45°  B) 90°  C) 135°

Glenoid Track

Gray area indicates zone of contact between HH & glenoid

A) If the glenoid track extends beyond boundaries of the Hill-Sachs lesion, it does not engage
B) With medial extension (larger lesion), the humeral head can engage

(Yamamoto et al., JSES, 2007)
The glenoid track makes it easier to understand that the most important features of the Hill-Sachs lesion are:

- Location
- Size

- Width of the glenoid track is 84% of the glenoid width with no defect (Yamamoto et al., 2007)
- If + glenoid defect, subtract from 84% to find glenoid track

If the Hill-Sachs defect is contained within the glenoid track then it does not engage. If its medial margin extends beyond the glenoid track, then the Hill-Sachs defect engages.
Combined Glenoid and Humeral Bone Defect

Glenoid Track

Normal Glenoid width = 26 mm, 84% of 26 mm = 21.8 mm
Glenoid width = 21.8 mm - 4.5 mm = 17.3 mm

22.5 mm > 17.3 mm (Glenoid track) ⇒ ENGAGES Since Outside Glenoid Track
The prevalence of a large Hill-Sachs lesion that needs to be treated

Daisuke Kurokawa, MD, Nobuyuki Yamamoto, MD, PhD, Hideaki Kagemoto, M.D., Yasushi Demori, MD, PhD, Minoru Tanaka, M.D., Hirotaka Sano, MD, PhD, Eiji Ito, M.D., PhD.

JSES, 2013

“The purpose of this study was to clarify the prevalence of engaging Hill-Sachs lesions using the concept of the glenoid track.”
Conclusions

The Hill-Sachs lesion that extended medially over the glenoid track was observed in 7% of 100 shoulders with recurrent anterior instability. There were 2 types of Hill-Sachs lesions: a wide and large Hill-Sachs lesion and a narrow but medially located lesion.

Instability Severity Index Score

- Prospective Case-Control Study
- 131 patients
- Dx: Recurrent Anterior Instability
- Rx: Suture Anchor Stabilization
- Follow-up: 31.2 Months (24-52)
- Failures: 14.5%

Risk Factors

- Patient Age < 20 at time of surgery
- Competitive or Contact Sports, or forced overhead activity
- Shoulder Hyperlaxity
- Hill-Sachs lesion on AP Xray in ER
- Loss of Sclerotic Inferior Glenoid Contour

Score of ≥ 6 = Bone Stabilization

Strategies for Treating a Hill-Sachs Lesion

- Non-engaging lesions:
  - Can be ignored
- Engaging lesions:
  - Smoothing the defect
  - Filling the defect
  - Extending glenoid arc
  - Limiting rotation
  - Rotating the defect
  - Traditionally achieved with open reconstruction
Treating the Engaging Hill Sachs Lesion

- **Open Management**
  - Non-anatomic soft tissue repairs to limit ER (historical)
  - Rotational osteotomy (historical)
  - Osteochondral allograft
  - Limited prosthetic resurfacing
  - Prosthetic replacement
  - Glenoid bony procedures

- **Arthroscopic Management**
  - Humeroplasty
  - Bone plugs
  - Remplissage
  - Glenoid bony procedures

**Hill Sachs Defect**
Postoperative Radiographs

Systematic Review

Humerical Head Reconstruction With Osteochondral Allograft Transplantation

- 12 report (8 case reports and 4 case series)
- 33/35 patients with instability, mean age 35
- 23 fem heads, 2 OC plugs, 10 humeral heads
- 3 patients received fresh allografts, 30 frozen allografts
- Mean defect: 40.5% of articular surface
- Substantial improvements in FE/ER at 12 months
- Graft resorption 36%/GH arthritis 36%/graft necrosis 9%
  > None in 3 patients with fresh allografts
- Re-operation 25%
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Resurfacing/Partial resurfacing

Limited Prosthetic Resurfacing

- 33 year old with instability after previous open stabilization
- Limited resurfacing

Limited prosthetic resurfacing - Results

- Small cases series by Uribe for ON (JSES, 2003) / Tibone (AJSM, 2011) for OA / ON demonstrate good short term results in young patients
- Limited data for Hill-Sachs lesion:
  - J. Leith (Can J Surg, 2009): 2 cases of Latarjet with partial resurfacing
  - C. Ahmad (Orthopedics, 2009): 1 case of Latarjet with partial resurfacing
Humeroplasty
- Percutaneous Balloon Humeroplasty
- Kenter, JSES, 2013
- Cadaver study
- Inflatable balloon tamp used to decrease lesion volume
- Cement used to fill void for measurement
- 1515 mm³ to 31 mm³
- Could be performed arthroscopically

Arthroscopic Remplissage
- Remplissage
  - French "to fill in"
  - Connolly (1972) described open transfer of IS and portion of GT into defect to fill in defect and make it extra-articular
- Popularized by Eugene Wolf
  - Coined the term
- Remplissage involves filling in defect with infraspinatus tendon and capsule
  - Capsulodesis/Tenodesis

Remplissage
- First reported by Purchase, Wolf, Holbrook, Pollock, Smalley, Arthroscopy 2008
- All-arthroscopic
- Prior to Bankart repair
- Capsulotenodesis
  - Posterior Capsule
  - Infraspinatus
Rationale

Loss of Motion? Long term Results?

Boileau et al. JBJS 2012

Remplissage: Pros and Cons

• Advantages
  • Can perform in acute and chronic repairs
  • Can perform arthroscopically without disrupting previous anterior reconstruction

• Disadvantages
  • Non-anatomic?
  • Loss of motion
  • Long term outcomes data lacking
**Arthroscopic Remplissage**

- Case Vignette:
  - 55 year old female lawyer with recurrent instability
  - Bankart tear and large Hill-Sachs
  - Lower demand

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**Arthroscopic Remplissage**

- Prepare Hill-Sachs bed
- Clear out SA bursa
- Place suture anchors
  - 1 or 2, through IS muscle
  - Small non-metal anchors
  - Double loaded

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**Arthroscopic Remplissage**

- Penetrate capsule with suture retriever and retrieve suture
- Repeat as needed
- Tie knots in SA space
- Repair Labrum
  - Harder to Remplissage afterwards
Ideal Patient for Remplissage:

- Humeral Head Defect with Minimal Glenoid Bone lesion

First report of loss of ER following Remplissage

Level of Evidence: IV (retrospective case series)

- N= 47 patients
  - Scope Bankart Repair + Remplissage with anchors
  - 9 patients were revisions (3 Bankart, 6 Latarjet)
  - Age 29 years; F/U 24 months
  - Healing of the capsule/IS (CT Scan)
    - 41/41 cases (100%)
    - 34/41 cases (84%) had a defect fill > 75%
  - Motion
    - Deficit in ER arm at side 8°; 9° in abduction
    - 90% RTS overall; 68% returned to SAME level of sport
    - 98% patients had a stable shoulder
Anatomical and Functional Results After Arthroscopic Hill-Sachs Remplissage

Boileau et al. JBJS 2012

Clinical Algorithm

Boileau et al. JBJS 2012

- Instability Severity Index Score - ISIS
- ISIS score of 3 or higher associated with recurrent instability > 10%
- Bankart repair + remplissage offered only to patients with large and engaging HSD

Prognostic factors | Points
|-------------------|---------|
| Age at Surgery (yrs) | 2
| > 20 | 0 |
| Pre-op sports participation | 2
| Competitive | 0 |
| Recreational or none | 0 |
| Type of Sport | 1
| Contact/forced overhead | 0 |
| Other | 0 |
| Shoulder Hyperlaxity* | 1
| Hyperlaxity (anterior) | 0 |
| Normal | 0 |
| Hill-Sachs on AP radiograph | 2
| Visible on ext. rotation | 0 |
| Not visible ext. rotation | 0 |
| Glenoid appearance on AP | 2
| Loss of contour | 0 |
| No lesion | 0 |
| Total | 0-10 |

Clinical Algorithm

Boileau et al. JBJS 2012

- Instability Severity Index Score - ISIS
- ISIS score of 3 or higher associated with recurrent instability > 10%
- Bankart repair + remplissage offered only to patients with large and engaging HSD
Level of Evidence: II (Prospective Double Cohort)
- Bankart repair alone (n=17) vs. Bankart repair/Remplissage (n=15)
  - ISIS score < 4 (Smaller defects compared with Boileau study?)
  - HSD identified on AP radiograph
- Mean age 24; minimum 2 year follow-up
- Rate of recurrence was 6.25% in both groups
- No significant difference in ROM
  - ER with the arm at side: 4°, ER in abduction: 3°
  - IR: 2 vertebrae levels, FF: 5°
- Excellent results in both groups approximately 80%

ER, IR and FF was higher in patients with Bankart repair AND Remplissage (not statistically significant)

Arthroscopic Humeral Plugs
- Open Osteochondral Grafting
- Snir et al., Arthoscl. Tech. 2013
- Technique paper
- Fresh-frozen, size, and side-matched graft
- Plugs are press fit into place
- Without internal fixation
- First described by JD Kelly IV in 2005
1. **Combined Large Humeral Head and Glenoid Defects:**
   - Marked glenoid bone loss
   - Large Hill-Sachs lesion (30% HH volume)
   - Chronic anterior dislocation
   - Static anterior instability

2. **Case Vignette**
   - 50 year old female factory worker fell and injured her dominant right arm
   - Pain and difficulty moving arm
   - Presents to ER 3 wks later
   - X-rays show a locked anterior dislocation
   - Ortho on call can't reduce shoulder closed so open reduction performed via mini-arthrotomy
   - Post-op imaging
Humeral Head Replacement

Indications for Open Reconstruction

- 49 year old with comminuted glenoid rim fracture and large Hill-Sachs
- Reduced in OR
- MRI and CT
- Arthroscopic repair of glenoid fracture

Dislocated 1 week later
Findings at arthrotomy
40% Hill-Sachs bone loss
Glenoid rim repair had failed
Rx: Open reconstruction
Autograft glenoid reconstruction
Prosthetic hemi-arthroplasty for humeral bone loss
Chronic Anterior Dislocation

Case Vignette

- 50 y.o female office worker referred to see me after capsular release for frozen shoulder
- Two months physical therapy & repeat surgery had failed to improve shoulder motion
- Repeat radiographs showed dislocation

Chronic Anterior Dislocation

Chronic Anterior Dislocation

Chronic Anterior Dislocation
Chronic Anterior Dislocation

Humeral Head Replacement
For Chronic Anterior Dislocation

3 months later:
• No Immobilization
• Physical therapy well underway
• No Instability Symptoms
• No Pain medicines
• Back to work

Best study to date…

Moderate to large engaging Hill-Sachs defects: an in vitro biomechanical comparison of the remplissage procedure, allograft humeral head reconstruction, and partial resurfacing arthroplasty

Joshua W. Giles, BSC, Ilia Elkinson, BHB, MBChB, FRACS, Louis M. Ferreira, PhD, BSC, MD, FRCE, Kenneth J. Faber, MD, M.PH, FRCE, Harre Bouns, MD, Robert Litchfield, MD, FRCE, James A. Johnson, PhD, George S. Athwal, MD, FRCE*.

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www.elsevier.com/locate/ymse
Eight specimens – 30% defect model

Comparison of remplissage, humeral head allograft, partial resurfacing with respect to stability and ROM

Stability
- Remplissage and humeral head allograft prevented engagement of the Hill-Sachs lesion

ROM
- In adduction, remplissage of a 30% defect reduced internal-external ROM compared with intact
- In extension, remplissage had less ROM than humeral head resurfacing or prosthetic resurfacing

30% Defect Model

- Remplissage
- Osteochondral Allograft
- Partial Resurfacing

Joint Stiffness
**External Rotation**

**Horizontal Extension**

**Remplissage**

- (+) Prevents Hill-Sachs engagement
- (-) Restricts shoulder motion
- (-) Increases joint stiffness

Giles et al. JSES 2102
Moderate to large engaging Hill-Sachs defects: in vitro biomechanical comparison of the remplissage procedure, allograft humeral head reconstruction, and partial resurfacing arthroplasty

> 30% and 45% defects may be too large for remplissage
> Anchors placed at deepest part of defect and not at edge
> Orientation of HSD may be incorrect

Osteochondral Allograft

- (+) Prevents Hill-Sachs engagement
- (+) Restores articular congruity
- (+) Restores biomechanical properties

Giles et al. JSES 2102

Partial Resurfacing

- (+) Prevents Hill-Sachs engagement
- (+) Partially restores articular congruity
- (+) Restores biomechanical properties
- (-) Partial engagement in some specimens due to geometry mismatch

Giles et al. JSES 2102
Summary

Conclusions: Glenohumeral Instability with Humeral Bone Loss

- Most Hill-Sachs lesions are small lesions that can be ignored
- Glenoid is priority – glenoid based treatments are usually effective (extending arc)
- Engaging Hill-Sachs lesions need to be identified and treated
- Humeral based options:
  - >20% articular surface
  - Medial to glenoid track
  - Certain revision cases

- Osteochondral allograft and partial prosthetic resurfacing are open options
- Arthroscopic remplissage can be considered as long as glenoid bone loss is modest, but postoperative stiffness is a concern
- Massive combined humeral and glenoid bone loss may require combined treatment, including prosthetic hemiarthroplasty and glenoid reconstruction