Humeral Bone Loss with Instability: Ignore, Remplissage, Implant?
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Disclosures:
- Consultant: DJO Global, Inc.
- Institutional Support:
  - DJO Global, Arthrex, DePuy-Mitek

Objectives:
- Define Hill-Sachs Lesion
  - Engaging and non-engaging
- Discuss Imaging
- Discuss Treatment options and considerations:
  - Ignore
  - Remplissage
  - Implant (replace)
  - Metal or Allograft bone
  - Glenoid augmentation
Hill-Sachs Lesion - Definition

- Humeral Head Bone Defect
- Occurs during Anterior Glenohumeral Dislocation

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
**Radiographs**

*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

**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

X/Y x 100 = 34%

Reverse Hill-Sachs
Percentage of articular injury
Hall et al 1994

Advanced Imaging

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

CT Scan
- Near 100% accuracy
- Study of choice

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

(Provencher et al., JAAOS, 2012)
**Hill-Sachs Lesions - Features**

- Size
- Depth
- Location
- Orientation
- Glenoid bone loss
- Engaging or not

(Provencher et al, JAAOS, 2012)

**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”
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 (or a larger lesion), the humeral head can engage

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

Yamamoto et al., JSES, 2007

Engaging Hill-Sachs Defects

A. Illustration of an engaging Hill-Sachs lesion: dark gray arrow. B. With the shoulder in a position of flexion or adduction and internal rotation, the lesion is not engaged with the anterior glenoid and thus engages C. Illustration of a non-engaging lesion: dark gray arrow, which is oriented in a perpendicular position. D. When the shoulder is abducted and externally rotated, the lesion is not engaged with the glenoid and thus does not engage. (Reprinted with permission from Provencher SP, O'Brien SJ. The role of the humeral head defects and their relationship to failure of arthroscopic Bankart repair: Significance of the non-rotated glenoid and the humeral engaging Hill-Sachs lesion. Arthroscopy 2006;22:537-544)
**Glenoid Track**

Humeral head contact with glenoid changes with arm elevation/abduction

- 45°
- 90°
- 135°

**Combined Glenoid and Humeral Bone Defect**

Figure 1: Width of glenoid track. The posterior view of the humeral head and the glenoid is shown. (A) In cases without a glenoid defect, the glenoid track width was defined as 85% of the glenoid width (a). (B) In cases with a glenoid defect, the glenoid track width (b) was defined as the length obtained by subtracting the glenoid bone defect width (c) from 85% of the unaffected glenoid width.

**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**
  - Bone loss = 4.5 mm
B. Glenoid Track

Glenoid Track

= 22.5 mm

22.5 mm > 17.3 mm (Glenoid track) → ENGAGES Since Outside Glenoid Track

Preoperative Planning in the Future...

- CT derived 3D Printing
- Sheth et al., Arthr. Tech, 2015
- Cine-imaging
- Preoperative planning

The prevalence of a large Hill-Sachs lesion that needs to be treated

Daisuke Kurokawa, MD, Nobuyosi Yamamoto, MD, PhD, Hidesaki Nagamoto, MD, Yasushi Omori, MD, PhD, Hiroyuki Tanaka, MD, PhD, Hirotsugu Sano, MD, PhD*, Eiji Itou, MD, PhD++

JSES, 2013

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 3 types of Hill-Sachs lesion: a wide and large Hill-Sachs lesion, a narrow but medially located lesion.
Treatment of Bone Loss

- Glenoid Based
- Humeral Based
- Severe Combined Bone Loss

Strategies for Treating a Hill-Sachs Lesion

- Non-engaging lesions:
  - Can be ignored
- Engaging lesions:
  - Filling the defect
  - Limiting rotation
  - Smoothing the defect
  - Rotating the defect
  - Extending glenoid arc

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
Treating the Engaging Hill Sachs Lesion

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Hill Sachs Defect

Fresh Osteochondral Graft
Systematic Review

Humeral Head Reconstruction With Osteochondral Allograft Transplantation
Bryan M. Saltzman, M.D., Jonathan C. Riboh, M.D., Brian J. Cole, M.D., M.B.A., and Adam B. Yanke, M.D.

- 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%
- Re-operation 25%

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, 2009) / Tibone (AJSM, 2015) 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

**Arthroscopic Remplissage**

- **Remplissage**
  - French "to fill in"
  - Connolly (1972) described open transfer of IS and portion of GT into defect to fill 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, Hobgood, Pollock, Smalley, Arthroscopy 2008
- All-arthroscopic
- Prior to Bankart repair
- Capsulotenodesis
  - Posterior Capsule
  - Infraspinatus
**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 attorney with recurrent instability
  - Bankart tear and large Hill-Sachs
  - Lower demand

**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
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:
Larger Humeral Head Defect with Minimal Glenoid Bone Loss

Anatomical and Functional Results After Arthroscopic Hill-Sachs 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 (74%) 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
Humeral Head Replacement

- **Combined Large Humeral Head and Glenoid Defects:**
  - Marked glenoid bone loss:
  - Large Hill-Sachs lesion (30% HH volume)
  - Chronic anterior dislocation
  - Static anterior instability

Humeral Head Replacement

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**Humeral Head Replacement**

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 M. Glines, BDS, DLA; Dil Ekroos, BM; MBBS; MSc.
Louis A. Terebesi, MD; MD; Andrew J. Feller, MD; MPH; FACR; FRCSC; Huseyin Ozen, MD; Barry J. Mair, MD; PhD; FRCSC; James A. Johnson, PhD; MD; FRCSC.

- Remplissage
- Humeral head allograft
- Partial resurfacing
- Eight specimens – 30% defect model
- Stability
  - Remplissage and humeral head allograft prevented engagement
  - Partial surfacing didn’t fill the edges
- ROM
  - Remplissage had less ROM

**Conclusions: Glenohumeral Instability with Humeral Bone Loss**

- Most Hill-Sachs lesions are small and can be ignored
- If there is substantial glenoid bone loss then extending glenoid arc is usually effective
- Engaging Hills-Sachs lesions need to be identified and treated
- Humeral based options:
  - >20% articular surface
  - Medial to glenoid track
  - Certain revision cases
**Conclusions: Glenohumeral Instability with Humeral Bone Loss**

- Osteochondral allograft and partial prosthetic resurfacing work for large defects
- Arthroscopic remplissage can be considered if glenoid bone loss is modest, but postoperative stiffness is a concern
- Massive humeral AND glenoid bone loss may required combined treatment, including prosthetic hemiarthroplasty and glenoid reconstruction

**Clinical Algorithm**

**Boileau et al. JBJS 2012**

<table>
<thead>
<tr>
<th>Prognostic factors</th>
<th>Points</th>
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<tbody>
<tr>
<td>Instability Severity Index Score - ISIS</td>
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<tr>
<td>ISIS score of 3 or higher associated with recurrent instability &gt; 10%</td>
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<tr>
<td>Bankart repair + remplissage offered only to patients with large and engaging HSD</td>
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<tr>
<th>Pre-op sports participation</th>
<th>Points</th>
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<td>Competitive</td>
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<td>Recreational or none</td>
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<th>Type of Sport</th>
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<td>Other</td>
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<td>Hyperlaxity (ant/inf)</td>
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<tr>
<td>Normal</td>
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<th>Hill-Sachs on AP radiograph</th>
<th>Points</th>
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<tr>
<td>Visible on ext. rotation</td>
<td>2</td>
</tr>
<tr>
<td>Not visible ext. rotation</td>
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<table>
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<tr>
<th>Glenoid appearance on AP</th>
<th>Points</th>
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<tbody>
<tr>
<td>Loss of contour</td>
<td>2</td>
</tr>
<tr>
<td>No lesion</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total                        | 0-10   |
Clinical Algorithm

- 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

Boileau et al. JBJS 2012

A Prospective, Comparative, Radiological, and Clinical Study of the Influence of the “Remplissage” Procedure on Shoulder Range of Motion After Stabilization by Arthroscopic Bankart Repair

Level of Evidence: II (Prospective Double Cohort)

Bankart repair alone (n=17) vs. Bankart repair/Remplissage (n=15)
- ISIS score < 4
- 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 arm at side: 4°, ER in abduction: 3°
  - IR: 2 vertebral levels, FF: 5°
- Excellent results in both groups approximately 80%