3-D Modeling of Humeral Head Defects: Clinical Implications of the Glenoid Track

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My Disclosures

1. Financial
   - None
2. Scientific
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“Engaging” Hill-Sachs
Non “Engaging” Hill-Sachs

Burkhart & DeBeer Arthroscopy 2000

Traumatic Glenohumeral Bone Defects and Their Relationship to Failure of Arthroscopic Bankart Repairs: Significance of the Inverted-Pear Glenoid and the Humeral Engaging Hill-Sachs Lesion

Stephen S. Burkhart, M.D., and Jose F. De Beer, M.D.
3-D Modeling of HH Defects: What is the critical size of bony defects?

- No Bone Defect
  → 4% recurrence
- “Inverted Pear Glenoid” & “Engaging Hill-Sachs”
  → 67% recurrence
Bony deficiency increases surgical failure risk if not addressed

Burkhart, DeBeer Arthroscopy '01

3-D Modeling of HH Defects: What is the critical size of bony defects?

Dynamic spatial interaction of the glenoid and the humeral head bony lesions
Shape, location and orientation

Yamamoto at al. JSES 2007
- Mapped track of glenoid on humeral head through simulated motion
- Started in Max ER
- Varied Abduction from 0° to 60°
3-D Modeling of HH Defects: Implications of the Glenoid Track

No Engagement | Engagement

Dynamic model that took into account glenoid bone loss and humeral lesion location and orientation

Assumed a stereotyped pattern of shoulder motion

Does not account for soft tissue

Clinical Implications of Lesion Morphology and the Glenoid Track Concept

Study objective

- Does engagement as defined by the glenoid track concept correspond to failure of primary arthroscopic capsulolabral stabilization?
- Was there a difference in glenoid track engagement between patients who underwent arthroscopic capsulolabral repair versus coracoid transfer procedures?
Clinical Implications of the Glenoid Track

Methods

Patient inclusion
• Retrospective review
• 40 consecutive pts with shoulder instability
• 33 had pre-operative CT scans, complete pre- and post- surgical clinical data

At presentation
• 14 failed prior scope stabilization
• 19 no prior surgery

Surgical Simulation

New Research Initiative

Pre-op CT converted to 3D models
• Materialise’s Interactive Medical Image Control System (Mimics)

Table: Mean 2D Humeral Head Lesion Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Our study</th>
<th>Saito et al.</th>
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</thead>
<tbody>
<tr>
<td>Width</td>
<td>20.4 mm</td>
<td>22 mm</td>
</tr>
<tr>
<td>Depth</td>
<td>5.3 mm</td>
<td>5 mm</td>
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</table>

Clinical Implications of the Glenoid Track

Methods

H-S Lesion Volume (Best-Fit Sphere Model)

Clinical Implications of the Glenoid Track

Results

Glenoid track model

• 12 of 33 (36.3%) were Engaging lesions

Engaging lesion comparison

• Failed scope stabilization 5/14 (35.7%)
• No prior surgery 7/19 (36.8%)

No difference
### Clinical Implications of the Glenoid Track

#### Results

Type of procedure selected by surgeon

- **Glenoid track engagement**
  - Coracoid transfer: 5/14 (35.7%)
  - Scope stabilization: 6/15 (40.0%)
  - No difference

- **Humeral head volume**
  - Coracoid transfer: 1924 mm$^3$
  - Scope stabilization: 988 mm$^3$
  - Significant ($p = 0.0385$)

#### Discussion

Glenoid track engagement **not associated** with stabilization treatment outcomes or clinical indications.

Humeral head lesion volume was **significantly associated** with selection of a coracoid-transfer procedure.

#### Limitations

- Small numbers
- Retrospective Study Design
- Lack of control of instability factors
  - Age, activity level, surgical indications, surgical technique

#### Future Directions

- Apply 3D imaging tools prospectively
- Better control of variables
- Evolution of the glenoid track concept
THANK YOU

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Inman-Abbott Society