Arthroscopic Capsular Release, Plication and Thermal Capsulorrhaphy

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Hip Anatomy

- Synovial Fluid
- Ligament and Joint Capsule
- Synovial Membrane
- Articular Cartilage
- Femoral Head
- Femur
- Ligament and Joint Capsule
Anatomy & Ligaments Hip Capsule

- Ischiofemoral ligament
- Iliofemoral ligament
- Pubofemoral ligament

POSTERIOR

ANTERIOR
Capsular Ligaments

ANTERIOR

POSTERIOR
Role of the Capsule

- **Proprioception**
- **Structural support**
  - Iliofemoral (resists extension and ER)
  - Ischiofemoral (constriction in flexion)
  - Pubofemoral (resists extension and ABD)
Capsular Release

- Facilitate instrument movement
- OA related capsular contractures
- Flexion contractures
- Previous surgery related adhesions
Capsular Releases
Capsular release
Hip Instability
Traumatic

• **Dislocations**
  – Posterior (90%)
  – Axial force applied to flexed knee

• **Subluxations**
  – Pro football players

• **Complications:**
  – AVN, sciatic injury, hip instability, DJD

Moorman et al. JBJS 2003
Subluxation
Combined instability (Capsular tear)
Hip Instability

- **Traumatic**
  - Dislocation
  - Subluxation

- **Atraumatic**
  - Global ligamentous laxity (Ehlers-Danlos, Marfans, Downs)
  - DDH
  - Idiopathic
  - Focal rotational-type (athletes)
### Classification of Hip Laxity

<table>
<thead>
<tr>
<th>Grade</th>
<th>Vacuum Sign and/or Laxity on Axial Distraction</th>
<th>Clinical Feel</th>
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</thead>
<tbody>
<tr>
<td>1 (mild)</td>
<td>No (negative pain on axial distraction test)</td>
<td>Soft end point</td>
</tr>
<tr>
<td>2 (moderate)</td>
<td>Yes (positive pain)</td>
<td>Laxity at 45°</td>
</tr>
<tr>
<td>3 (severe)</td>
<td>Yes (pistoning and pain)</td>
<td>Patient can demonstrate subluxation/dislocation (history of previous dislocation. No end point at 45°)</td>
</tr>
<tr>
<td>4 (collagen disease)</td>
<td>Ehlers-Danlos syndrome, Down syndrome, Marfan syndrome</td>
<td>Upper extremities and lower extremity joint laxity</td>
</tr>
</tbody>
</table>

*Acetabular and femoral neck version must be taken into account.

Philippon (AAOS ICL 2006)
When the capsule fails...

- Recent prospective study noted patients with iliofemoral, ischiofemoral, or global laxity diagnosed by arthroscopic probing
  - Patients reported feelings of hip instability or giving way (p=0.013)
  - Patients reported significant difficulty with prolonged standing (p=0.037)

Philippon et al. ESSKA, 2006
Atraumatic Instability
Mechanism of Injury

- Labral deficiency has been shown to decrease the suction seal on the femoral head and increase lateral movement of the femoral head

Ferguson et al. 2000
Atraumatic Injury Mechanism

The pelvis usually rotates over a fixed femur creating anterior and medial forces with rotary moments.
Hip Instability
Focal & Atraumatic

- Common in high-level athletes involved in sports with repetitive hip rotation and axial loading
- Rotational, NOT translational type instability
- Associated with labral tears and elongation of the iliofemoral ligament
IFL Insufficiency

Professional Golfer
IFL Insufficiency
MLB Player

Baseball Left Hip Anterior-posterior Force

Baseball Left Hip Internal-external Moment
IFL Insufficiency

NFL Quarterback

Quarterback Left Hip Anterior-posterior Force

% Body Weight | Time (sec)
---|---
-60 | 0.00
-30 | 0.10
0 | 0.20
0 | 0.30
0 | 0.40
10 | 0.50
10 | 0.60
10 | 0.70
10 | 0.80
10 | 0.90
10 | 1.00

L Hip F ANT/POS. Gait Joint Force

Quarterback Left Hip Internal-external Moment

% Body Weight | Height
---|---
-2.0 | 0.00
-1.5 | 0.20
-1.0 | 0.40
-0.5 | 0.60
0 | 0.80
0.5 | 1.00
1.0 | 1.20
1.5 | 1.40
2.0 | 1.60

L Hip M INT/EXT. Gait Joint Moment
IFL Insufficiency
Tae Kwon Do
Hip Moments in Various Sports

Hip Internal-external Rotation Moments

% Body Weight * Height

- Walking
- Taekwondo
- NFL Quarterback
- MLB batter
- PGA Golfer
Hip Forces in Various Sports

Maximal Hip Medial-lateral Forces

- Walking
- Taekwondo
- NFL Quarterback
- MLB batter
- PGA Golfer

% Body Weight
Hip Forces in Various Sports

Maximal Hip Anterior-posterior Forces

- Walking
- Taekwondo
- NFL Quarterback
- MLB batter
- PGA Golfer
Role of the Labrum in Hip Stability

• Hip was tested with labrum intact and torn in 8 hips
• 8 fixed pelvic and femoral points along the iliofemoral ligament
• Microscribe was used to register points in space and measure distance between points
Role of the Labrum in Hip Stability

- Hip motion during the golf swing was recreated
- Changes in the length of different portions of iliofemoral ligament were assessed
Significant increases in the length of the iliofemoral ligament were seen after the labrum was cut.

![Graph showing the comparison of normal and cut conditions]
Hip Angles During the Golf Swing

Top of the Swing ...

Injured
Healthy

Acceleration ...

Injured
Healthy

and Impact

Injured
Healthy

The hip is more flexed, more adducted, and less internally rotated
Global Ligamentous Laxity

- Passive thumb apposition to forearm
- Passive finger hyperextension (finger parallel to forearm)
- Elbow hyperextension > 10 degrees
- Knee hyperextension > 10 degrees
- Excessive ankle dorsiflexion and foot eversion

Carter et al. JBJS Br 1964
The Log Roll Test

- Designed to assess normal and pathologic iliofemoral ligament stiffness
- Patient is supine and the examiner notes the degree of resting external rotation
- The knee is then captured and an external rotation torque is applied
Log Roll Test

Positive exam = increased resting ER without endpoint to ER torque beyond 45 degrees
The Log Roll Test

- Prospective Data on 349 hip arthroscopy patients (no OA or retroversion)
- Log Roll Exam PreOp and Capsular Laxity Assessment IntraOp
- Conclusion:
  - *Positive Log Roll Test was significantly (p<0.001) correlated with Anterior capsular laxity*
  - *Negative Log Roll Test (NPV 0.90) could help rule out Anterior capsular laxity*

Philippon et al. ESSKA, 2006
Radiographic Considerations

- Higher Sharp’s angle
- Lower center-edge angle
- Positive vacuum sign on gentle distraction
- Large intra-articular volume of contrast on arthrogram
Hip Instability

DDH

Recent prospective study evaluated radiographs of 163 consecutive patients for the center-edge (CE) angle and Sharp’s angle

- Patients with CE angles < 20 degrees more often reported activity-limiting feelings of instability or “giving way” (p=0.036)
- Patients with Sharps’ angles > 45 degrees more often had surgical findings of iliofemoral or ischiofemoral ligament redundancy (p=0.006)
Plain Radiographs

Sharp’s Angle: 33° to 38°
 (>42° abnl)
Plain Radiographs

Center Edge Angle (superior coverage): 20° to 35° (<20° abnormal)
Axial Distraction Test

- Hip in abduction and ER
- Axial distracting load is applied under fluoroscopy
Axial Distraction Test

- **Positive signs:**
  - “Vacuum sign”
  - Increased relative motion: joint laxity
  - Decreased pain: labral tear
    - Relieving the pressure on the labrum
MR Arthrogram
The Role of Arthroscopic Thermal Capsulorrhaphy in the Hip

- Microscopic hip instability
  - Related to subtle capsular laxity with associated labral pathology
  - Characteristic sx occur with combined pelvic rotation and hip external rotation (golf)
- 9 elite athletes (10 hips)
- Tx with labral debridement + thermal capsulorrhaphy
- 82% returned to pre-injury level with no or minimal pain
Indications

- Illiofemoral ligament tear / insufficiency
- Post labral tear capsular redundancy
Thermal Capsulorrhaphy

- Focal targeted area vs Pan Capsule
- Striped Pattern
- Capsular thickening without necrosis (?)
- Central and Peripheral Compartments
Thermal Capsulorrhaphy

- Flexible RF probe set at 75°C and 40 W
- Cornfield-type passes made at the redundant capsule
- Color of tissue closely monitored to prevent excessive heating
Iliofemoral Ligament
(Pre-thermal treatment)
Iliofemoral Ligament
(Post-thermal treatment)
Thermal Capsulorrhaphy

Outcomes

• Philippon (AANA, 2000)
  – N=11
  – Procedures: labral debridement + thermal capsulorrhaphy
  – 83% improvement

• Bharam, Philippon (AAOS, 2003)
  – N=14 (PGA tour golfers)
  – Procedures: labral debridement, thermal capsulorrhaphy, microfracture
  – Improvement in mod. Harris hip score, 100% return to play
Thermal Capsulorrhaphy

Outcomes

• Philippon et al. (AAOS 2006)
  – N=15 (PGA tour golfers)
  – Procedures: labral debridement, thermal capsulorrhaphy, microfracture, rim trimming
  – Average 4.82 year f/u
  – 79% are currently active in professional golf
  – 3 required revision arthroscopy for treatment of impingement or recurrent instability
Capsular Plication

- Suture placed at the interval between the iliofemoral and ischiofemoral ligaments

- Performed to:
  - Close capsulotomy
  - Treat redundancy (along with thermal capsulorrhaphy)
Indications for Capsular Plication of the Hip

- Painful instability
- Gait disturbance
- Post-traumatic capsular redundancy
- Hyperlaxity syndrome
- Poor endpoint with Log Roll test
In Vivo Healing Response After Capsular Plication in an Ovine Shoulder Model. Kelly BT et al, ORS 2004

- No difference in histologic healing response
- Increased evidence of tissue injury in open shift group
Anterior Capsular Plication
Pre-Capsular Plication

Log Roll Test ➔ Positive
Capsular Plication
Post-Capsular Plication

Log Roll Test → Negative
Post-Op Rehab

- 4-8 weeks of 20 lbs foot flat weight-bearing
- Hip brace to limit extension / ER for 10 days
- CPM for 4-8 weeks (0 – 90 degrees)
- Night boots for 4 weeks (limit ER)
- Avoid early SLR to reduce risk of post-operative flexor tendinitis
- Early emphasis on restoring IR
Outcomes

• Philippon et al. (JOSPT 2006, Volume 36) August 2001 to August 2003, N=116
  Average time to f/u = 3 years
  – Capsular modification
    – Self-reported excellent: 84%
    – 92% would have surgery again
  – Thermal capsulorrhaphy (N=70)
    – Self-reported excellent: 86%
    – 95% would have surgery again
  – Capsular plication (N=15)
    – Self-reported excellent: 91%
    – 100% would have surgery again
Summary

• Given the relative thickness of the hip capsule compared to the shoulder capsule, with appropriate application of RF, thermal capsulorrhaphy is a safe and effective treatment option for capsular laxity.

• The combination of sutures and focal application of RF appear to be safe and effective for treatment of hip instability.

• Capsular releases is effective for contractures and portal enlargement.
Thank you!