Short-Term Outcome of Thermal Shrinkage for Anterior Cruciate Ligament Injuries

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ACL Injuries

• 1:3000 Americans ACL tear/year (95,000)
• 50,000 ACL reconstructions/year in U.S.A.
• Unknown number of incomplete tears or stretching injuries
Incomplete ACL Injuries

- Some return to sport/work
- Others continued disability
- Ligament repair & augmentation fail
- Formal reconstruction successful
- Thermal energy employed to address soft tissue laxity
  - ??? Role in ligamentous instability of knee
Materials & Methods

- 35 consecutive patients who underwent ACL thermal shrinkage
- Retrospective chart review
- Subsequent follow-up
Materials & Methods

**Surgical Criteria**

- Exam indicating ACL injury
- Failed non-operative treatment
- Unable to return to desired activity
- Confirmed ACL laxity on arthroscopic exam
- ACL in continuity on MRI/exam
Materials & Methods:

Surgical Technique

- Routine arthroscopic evaluation
- Concomitant meniscal & chondral pathology addressed
- Mitek Vapr wand (Westwood, Massachusetts)
Mitek Vapr wand

- Bipolar radiofrequency unit
- Electrode surface area 3.75 mm$^2$
- Variable output sinusoidal waveform 340-450 kHZ
- 60-75 degree C to denature intramolecular cross-links within tropocollagen molecule
Materials & Methods:

Thermal Shrinkage

- “Paint” entire exposed ACL surface from proximal to distal
- One pass
- Circumferential
Thermal Shrinkage:

**Visualization**

- Visual and tactile cues important for titrating energy doses
- Color change
- Tissue alterations
Thermal Shrinkage:

*Palpation*
Materials & Methods: 

Post-operative Protocol

- WBAT, ROM as tolerated, hamstring & quadriceps isometrics
- Hinged knee brace locked in extension, 0-90 @ 4 wks
- Cycling, treadmill @ 4 wks
- Jogging @ 8-10 wks
- Full activity @ 12 wks
Materials & Methods: Postoperative Information

Physical Exam
• 3, 6, >12 month chart
• Lysholm
• Sports & Occupation levels
• VAS: knee, surgery
• Repeat
• Stability
# Results

<table>
<thead>
<tr>
<th>Follow up data</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 patients</td>
<td></td>
</tr>
<tr>
<td>Range 4-22 months</td>
<td></td>
</tr>
<tr>
<td>Average 13 months</td>
<td></td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td><strong>Failures</strong></td>
</tr>
<tr>
<td>22 male</td>
<td>– Range 15-41 YO</td>
</tr>
<tr>
<td>13 female</td>
<td>– Mean 27 YO</td>
</tr>
<tr>
<td></td>
<td><strong>Successes</strong></td>
</tr>
<tr>
<td></td>
<td>– Range 18-58 YO</td>
</tr>
<tr>
<td></td>
<td>– Mean 39 YO</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Mechanism of Injury</th>
<th>Shrinkage type</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 slip/twist/jump</td>
<td>Primary Shrinkage 26</td>
</tr>
<tr>
<td>5 basketball</td>
<td>– 6 failures</td>
</tr>
<tr>
<td>4 running</td>
<td>Graft Shrinkage 9</td>
</tr>
<tr>
<td>6 other sports</td>
<td>– NO failures</td>
</tr>
<tr>
<td>1 MVA</td>
<td></td>
</tr>
<tr>
<td>7 unknown</td>
<td></td>
</tr>
</tbody>
</table>
Results

**Concomitant procedures**
- 18 medial or lateral meniscectomies
- 14 medial & lateral meniscectomies
- 9 chondroplasties
- 3 notchplasties

*NOT predictive of outcomes*
Results: Exam

**Effusion**

- Preop
  - 7 minimal
  - 28 moderate
- Postop
  - 11 minimal
  - 1 moderate

**ROM**

- No significant change
Results: *Exam*

**Pivot Shift**
- 32 preop (91%)
- 2 postop (6%)

**Anterior Drawer**
- 27 (6: 2+) preop (77%)
- 6 postop (17%)

**Lachman**
- 34 (6: 2+) preop (97%)
- 9 postop (26%)
Results: Exam

Follow-up > 6mo

- 3/12 pivot shift
- 6/12 anterior drawer
- 6/12 Lachman
- Trend to clinically loosen with time but remained subjectively stable
Results: *Lysholm Scores*

- Range 46-100 points
- Average **93** points
- Median **99** points
- 29 patients > 90 points
- 3 patients < 60 points
## Results: *Sports*

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Level 1: 10-&gt;7</th>
<th>Level 2: 9-&gt;6</th>
<th>Level 3: 16-&gt;22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collegiate, High School</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Organized team/League</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pick-up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10 changed activity secondary to knee
Results: Occupation

Level 1: 0
Level 2: 3->3
Level 3: 24->22
Level 4: 8->10

4 changed activity secondary to knee
## Results: VAS scale

<table>
<thead>
<tr>
<th>Knee satisfaction</th>
<th>Surgery satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range 2-10</td>
<td>Range 3-10</td>
</tr>
<tr>
<td>Average 8.1</td>
<td>Average 9.2</td>
</tr>
<tr>
<td>Median 9</td>
<td>Median 10</td>
</tr>
</tbody>
</table>
Results

Repeat Surgery
• 29 yes (83%)
• 3 uncertain
• 3 no
  – 2 failures

Stability
• 28 more stable (80%)
• 3 no improvement
• 2 no preop symptoms
• 2 uncertain
Results: **Failures**

**Patient 1**
- 20 YO failed @ 5 mo
- College lacrosse
- Lysholm 100
- Decrease sports level
- VAS 9/8
- Repeat
- More stable
Results: *Failures*

**Patient 2**
- 33YO failed @ 18 mo
- Ultimate fighting
- Lysholm 100
- No decrease level
- VAS 9/10
- Repeat
- More stable
Results: *Failures*

**Patient 3**
- 32 YO failed @ 8 mo
- Jump rope
- Lysholm 100
- Increase sports variety
- VAS 10/10
- Repeat
- More stable
Results: *Failures*

**Patient 4**
- Active 30 YO
- Contralateral recon, clinically loosened
- Reconstruction @ 7mo
- Lysholm 100
- Chose decrease sports
- VAS 10/10
- No Repeat
- More stable
Results: *Failures*

**Patient 5**

- 17 YO failed @ 14 mo basketball/contact
- Noncompliant
- Lysholm 94
- No sports level change
- VAS 9/10
- Repeat
- More stable
Results: Failures

**Patient 6**

- Worker’s comp.
- 42 YO never stable
- Recon. @ 10 mo
- Lysholm 58
- Slight decrease sports/occupation
- VAS 5/9
- No Repeat
Discussion

• Increased number and age range for athletic participation
• Corresponding increased in partial ACL injuries – ligament lax but in continuity
• ???What to do
• Reconstruction reliable
  – Identifiable morbidity
  – Lengthy rehab
Discussion: Thermal shrinkage

- Minimally invasive
- Maintains isometric ACL location
- No risk to growth plate
- Not deleterious if formal reconstruction required
- May avoid ACL revision
Discussion

- Clinically tighter postoperatively
- Prevented ACL revision in 9/9 patients
- Failures tended to be younger, more active
- No structural ACL loss on repeat surgery
Discussion

• Maintained a similar activity/occupation level
• Very satisfied with knee function & surgical procedure
• Felt more stable
• Most would repeat
Conclusion

• Thermal Shrinkage may be viable alternative
• May avoid ACL reconstruction or revision
• Need long-term data
• Further research on patient selection
Thank You!