Revision ACL Surgery: Considerations in Treatment
2016 Update

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• None specific to this presentation
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Outcome of Revision Anterior Cruciate Ligament Reconstruction: A Systematic Review
Rick W. Wright, MD; Corey S. Gill, MD; Lung Chen, PhD; Robert H. Brummett, MD; Matthew J. Matava, MD; Matthew V. Smith, MD; Nathan A. Mall, MD

http://dx.doi.org/10.2106/JBJS.K.00733

• 21 Studies met inclusion criteria (n=1004 patients)
  – Mixed model meta analysis
• Failure defined as 2+/3+ pivot
• PRO worse than Primary ACL R
• Results worse than Primary ACL R
• Primary Graft: autograft (86%)
• Technical error 45% / “retear” 49%
• Graft choice for Revision ACL: 89% Autograft
  – BTB (48%), HS (40%), QT (12%)
Revision Anterior Cruciate Ligament Reconstruction: Results of a Single-stage Approach Using Allograft Dowel Bone Grafting for Femoral Defects

Werner, Brian C. MD; Gilmore, Carl J. MD; Hamann, Joshua C. MD; Gaskin, Cree M. MD; Carroll, John J. MD; Hart, Joseph M. PhD; Miller, Mark D. MD

• CT documentation of allograft bone dowel for single stage expanded femoral tunnels (12/16 patients completed study). All 12 dowels had excellent incorporation

• “A single-stage approach for revision ACL reconstruction using allograft dowels for isolated femoral bony deficiency yields objective and subjective outcomes comparable to those reported in the literature for two-stage and single-stage techniques, with good incorporation of the dowels.”

• Mean IKDC 70, Mean Tegner 4.8, 58% (7) demonstrated 1+ pivot, and grade 1-2+ Lachman

Effect of Graft Choice on the Outcome of Revision Anterior Cruciate Ligament Reconstruction in the Multicenter ACL Revision Study (MARS) Cohort

The MARS Group*,†
doi: 10.1177/0363546514549005
Am J Sports Med October 2014 vol. 42 no. 10 2301-2310+

• 1205 patients within MARS study group
• 88% first revision, 28% revised by same surgeon
• 48% autograft, 49% allograft, 3% combined for ACL R
• 3.3% rerupture rate at 2.2 yr fu (n=37)
• Allograft 2.78 x more likely to fail
• Sports function and PRO better with autograft
• No differences among BTB auto and HS auto

Knee-Store Sports Trauma Rd. Anthony: 2016 Jun 27 (first draft of article)
Anterior Cruciate Ligament reconstruction with bone-patellar tendon-bone autograft versus allobone in multivariate analysis with 2 year follow up.

Kane PW1,2, Wascher J3, Dodson CC3, Hammoud S3, Cohen SB3, Ciccotti MG3.
PMID: 27349433 DOI: 10.1007/s00167-016-4213-z

• 224 patients (101 BTB auto, 124 BTB NI Allo)
• Minimum 2 yr follow up study
• Mean Lysholm and IKDC scores equal
• 13 patients required rev ACLR (12 allo, 1 auto/ p<.005)
Anterior Cruciate Ligament Revision Surgery: Ipsilateral Quadriceps Versus Contralateral Semitendinosus-Gracilis Autografts. Häner M1, Bierke S2, Petersen W2.

- 30 consecutive patient ipsi BQT vs contralateral HS (51 evaluated)
- Minimum 2 yr fu
- IKDC
- Lysholm: Mean 82% BQT vs 73% HS
- KT STSD QT: 2.0 mm +/- 1.2 vs HS 3.0 mm +/- 2.9 mm
- No reruptures
- No difference in KOOS subscores or anterior knee pain

30 Year Practice Overview

- Total ACL-R: 2450
  - 214 two-incision, 2236 arthroscopic
    - 1420 ♂ (55%), 1030 ♂ (42%)
- Primary ACL-R: 2225
  - 1296 ♂ (58%), 929 ♂ (42%)
  - Mean Age: 28.9y
- Revision ACL-R: 225
  - 124 ♂ (55%), 101 ♂ (45%)
  - Mean Age: 29.3y
  - Personal revisions: 40 (16 ♂, 24 ♂)
  - Gender difference for PR 101/124 (79%) vs. 2.5%
  - "Inherited" Revisions: 180 (108M, 77F)
- Revision ACL-R: N=23
  - 9 ♂, 14 ♂
  - Personal re-revisions: 7/225 (3 ♂, 4 ♂) of 225 revisions I have performed 7 repeat revisions

30 Year Practice Profile

- Practice since 1986 (20-25% knee ligament surgery)
- To date > 2225 primary ACL-R
  - 1986-2016: Personal revision rate 1.7%
  - 2016: 40/2225; 1510 Auto BTB, 674 Allo BTB
  - 2016: Contralateral ACL R (110 6%)
- To date 225 revision ACL R (23 repeat revision)
  - 2016: 40 + 185 referred/transfered Rev ACL R
  - Repeat Revision ACL R: 3.5%
  - 76% Revisions performed w low dose irradiated BTB
  - 97% single stage, almost all transtibial
  - No double bundle revision ACL R performed
  - No ALL reconstructions
### Graft Utilization for Primary ACL-R

<table>
<thead>
<tr>
<th>Graft Choice</th>
<th>Number</th>
<th>Age</th>
<th>♂:♀</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTB Auto</td>
<td>10/0</td>
<td>21.7</td>
<td>933:577</td>
</tr>
<tr>
<td>BTB Allo</td>
<td>0/4</td>
<td>37.3</td>
<td>347:327</td>
</tr>
<tr>
<td>HS Auto</td>
<td>25/5</td>
<td>20.7</td>
<td>7/18</td>
</tr>
<tr>
<td>HS Allo</td>
<td>16/6</td>
<td>13.3</td>
<td>10.6</td>
</tr>
</tbody>
</table>

### Personal Revision Experience

#### Duration between Index and Revision (Months) & Mean Age at Primary (Years)

<table>
<thead>
<tr>
<th>Graft Used for Primary</th>
<th>Revisions</th>
<th>Duration</th>
<th>Mean Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>54.3</td>
<td>24.3</td>
<td></td>
</tr>
<tr>
<td>BTB Auto</td>
<td>56.1</td>
<td>17.9</td>
<td></td>
</tr>
<tr>
<td>BTB Allo</td>
<td>52.2</td>
<td>32.0</td>
<td></td>
</tr>
<tr>
<td>NPTA</td>
<td>94.0</td>
<td>52.2</td>
<td>32.0</td>
</tr>
<tr>
<td>IPTA</td>
<td>36.2</td>
<td></td>
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</tr>
</tbody>
</table>

### Graft Utilization for Revision ACL-R

<table>
<thead>
<tr>
<th>Graft Choice</th>
<th>Number</th>
<th>Age</th>
<th>♂:♀</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTB Allo</td>
<td>17/0</td>
<td>36.6</td>
<td>81.89</td>
</tr>
<tr>
<td>Achilles Allo</td>
<td>3/3</td>
<td>32/2</td>
<td>1/1</td>
</tr>
<tr>
<td>BTB Auto</td>
<td>48/8</td>
<td>20.8</td>
<td>19.29</td>
</tr>
<tr>
<td>Contralateral</td>
<td>2/2</td>
<td>21.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Quad Tendon</td>
<td>1/1</td>
<td>34/1</td>
<td>1/1</td>
</tr>
<tr>
<td>HS Auto</td>
<td>1/1</td>
<td>44/1</td>
<td>1/1</td>
</tr>
</tbody>
</table>
Allograft Utilization over 30 Years

- 1% 6% 23% 47% 51% 53% 35%
- 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
- 86-91 92-96 97-01 02-06 07-11 12-16 30 year data

Revision Rate During 30 Years in Practice

- Mean interval from reconstruction to revision ACL-R (autograft v allograft): 56mos v 52mos (p=0.8)
- Mean interval from revision to re-revision: 35mos

Interval from Reconstruction to Revision (Autograft v Allograft) [N=40]
Revision Rate as Product of Patient Age and Gender

- A higher personal revision rate was witnessed females vs males: 2.6% v. 1.2% (p=0.019)

Revision Rate as Product of Patient Age for Autograft and Allograft

- Average age of patients undergoing revision ACLR (autograft v. allograft): 30.1y v. 37.0y (p=0.01)
- Revision rate for allograft patients <30y v. 30+: 5.8% v. 1.6% (p=0.003)

The Failed ACL R

- Recurrent instability
  - Missed patholaxity? (MCL / PLC)
  - Malalignment? (Coronal / Sagital)
  - Meniscal deficient knee?
  - Timing of failure? (< 1 yr: technical)
  - Graft initially used? (auto/allo/ soft tissue/ BTB)
  - Technical issues? (vast majority referred in have identifiable technical issues)
  - Bone tunnels? (expanded/non expanded/overlapped/non overlapped)
  - Hardware issues? (Remove/bypass)
  - Is an extraarticular “back up” needed? (ALL vs sling)
  - Is a combined procedure needed (HTO/MT + ACL R)
  - What are patients expectations?
Summary

• Preop planning critical
• Know your limitations, referring patients is not a “sign of weakness”----it is good “doctoring”
• Informed consent critical-understand patient goals/expectations
• Technique can be challenging-intraoperative decisions critical
• Rehab should proceed slower than primary ACL R
• Results are not = to primary ACL R
• Technique critical w primary and revision ACL-R

Revision ACL Surgery

Bone Tunnels
Anatomic
Expanded
Nonexpanded
Nonanatomic
Expanded
Nonexpanded
Overlapped
Nonoverlapped

Nonoverlapped Femoral Tunnel

Non anatomic, non overlapped anteriorized femoral tunnel. Intact anterior wall for revision.
Anteriorized Femoral Tunnels

Non overlapped intact anterior wall

Overlapped tunnels with incompetent anterior wall

Examples of Anteriorized Femoral Tunnels

Expanded Femoral Tunnel

Stacked femoral interference screw

Single staged bone grafting
Posterior Wall blowout

Option: Endobutton + aperture fixation. Game plan dependent upon degree of blowout.

Expanded Tibial Tunnel

Achilles Tendon allograft with marked tibial tunnel expansion

Expanded Tibial Tunnel

Staged bone grafting

Delayed revision
Barium sulfate filled OI vs IO tunnels demonstrating divergent tunnel concept

Revision ACL Surgery

Incompetent Posterior Cortex

Revision ACL Surgery

"Over the Top" Fixation
Revision ACL Surgery

- Prosthetic Ligament Removal
- Goretx
- LAD
- Tunnel expansion issues
- Caveat: OTT femur for Goretx graft
- Adherent residual tissue w/i tunnels

Posteriorized Tibial Tunnel

Posteriorized tibial graft, vertical femoral graft required single staged grafting

Graft Construct Mismatch?

Free bone block modification (pseudo quad tendon graft) for marked graft tunnel mismatch
Hardware Considerations

- Know your hardware
- Does hardware need to be removed?
- Can hardware be removed?
- Can you bypass hardware?
- Strategy for stripped screws?
Summary

- Preop planning critical
- Know your limitations, referring patients is not a “sign of weakness”—it is good “doctoring”
- Informed consent critical—understand patient goals/expectations
- Technique can be challenging— intraoperative decisions critical
- Rehab should proceed slower than primary ACL R
- Results are not = to primary ACL R
- Technique critical with primary and revision ACL-R