Clinical Outcome of Anatomic Double-Bundle Anterior Cruciate Ligament Reconstruction with Remnant Tissue Preservation: Comparison with Conventional Double-Bundle Procedure Using 272 patients

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Double-bundle ACL reconstruction (DB ACL-R) with remnant tissue preservation

- We reported that remnant preservation in anatomic DB ACL-R significantly improved postoperative knee stability \(^1,2\).
  - However, the number of patients was insufficient to compare the clinical results of the 2 procedures with or without remnant tissue.

- The purpose of this study was to compare the functional clinical results between the 2 procedures using a large number of patients.
Study design

- A total of 272 patients underwent anatomic DB ACL-R with 2 hamstring tendon autografts in the unilateral knee (2009-2016).
  - 162 male, 110 female
  - Age; 29 (13–71) years

- Patients were divided into the 2 groups
  - RT group (n=133): Crain’s group 1-3
    - ACL-R w/ remnant tissue preservation
  - DB group (n=139) Crain’s group 4
    - ACL-R w/o remnant tissue preservation

- Clinical outcomes @ one year after surgery
- Statistics: Mann-Whitney test, Chi-square test, p=0.05
Surgical procedure

- Anatomic DB ACL-R with ligament remnant tissue preservation
  - Trans-tibial tunnel technique
  - 30N of initial tension for each bundle
Postoperative knee stability (KT-2000)

- **Side to side anterior laxity (mm)**
- **RT group**
- **DB group**

\[ P = 0.03 \]
## Results

### Postoperative Pivot-shift test

<table>
<thead>
<tr>
<th></th>
<th>RT group</th>
<th>DB group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>91%</td>
<td>77%</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>9%</td>
<td>23%</td>
<td>0.007</td>
</tr>
<tr>
<td>2+</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>
## Clinical Outcome

<table>
<thead>
<tr>
<th></th>
<th>RT group</th>
<th>DB group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of extension (&gt;5°)</td>
<td>2 pts</td>
<td>2 pts</td>
<td>N.S.</td>
</tr>
<tr>
<td>Loss of flexion (&gt;15°)</td>
<td>0 pts</td>
<td>0 pts</td>
<td></td>
</tr>
<tr>
<td>Lysholm knee score (points)</td>
<td>96.8 ± 6.8</td>
<td>96.0 ± 4.6</td>
<td>N.S.</td>
</tr>
<tr>
<td>IKDC score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (normal)</td>
<td>76.4%</td>
<td>66.7%</td>
<td></td>
</tr>
<tr>
<td>B (near normal)</td>
<td>17.9%</td>
<td>16.7%</td>
<td>N.S.</td>
</tr>
<tr>
<td>C (nearly abnormal)</td>
<td>2.4%</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>D (abnormal)</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Isokinetic peak torque*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadriceps muscle</td>
<td>86.5%</td>
<td>86.8%</td>
<td>N.S.</td>
</tr>
<tr>
<td>Hamstring muscles</td>
<td>86.4%</td>
<td>90.8%</td>
<td>N.S.</td>
</tr>
<tr>
<td>ACL retear</td>
<td>3 pts (2.4%)</td>
<td>2 pts (1.7%)</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

*% to the uninjured knee
2nd look arthroscopy

Graft thickness (Laceration or tear)

- Grade I: 2 points
- Grade II: 1 point
- Grade III: 0 point

Synovial coverage

- Grade I: 2 points
- Grade II: 1 point
- Grade III: 0 point

- RT group was significantly better (p=0.0428) than DB group
The subjective and functional clinical results were comparable between the RT and DB groups using 272 patients.

The anterior laxity values and the results of the pivot-shift test were significantly better in the RT group than in the DB group.

The arthroscopic evaluation showed that the RT group was significantly better than the DB group.
The preservation of the remnant tissue significantly accelerated revascularization, and significantly increased the number of mechanoreceptors in the reconstructed ACL\(^5,6\).  

- Remnant tissue coverage significantly improved AP translation after ACL-R using a sheep model\(^6\).
- The sufficient remnant tissue coverage enhances healing of the graft after ACL-R.

![Graph showing AP translation comparison between non-remnant and remnant groups with *P<0.05](image.png)

![Immunohistochemical staining images of αSMA blood vessels, Ruffini corpuscle, Pacini corpuscle, and Golgi tendon organ](images.png)
Anatomic DB ACL-R with remnant tissue preservation was significantly improved postoperative knee stability and the 2nd-look arthroscopic evaluation at 1 year after surgery.

![Chart showing side-to-side anterior laxity comparison between RT group and DB group with a P value of 0.03]
References

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