Clinical Comparisons of Double-Bundle Versus Single-Bundle Posterior Cruciate Ligament Reconstruction Procedures using Hamstring Tendon Hybrid Autografts

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Introduction

- Several studies have reported favorable results of PCL-R using SB techniques. 
  Sekiya JK et al Arthroscopy 2005
  Jackson WF et al JBJS(Br) 2008

  ✓ However, the clinical results of this surgery have shown that mild residual laxity is common after surgery.

- Biomechanical studies demonstrated that DB PCL-R provides better stability than SB PCL-R. 
  Kennedy NI et al AJSM 2013

- We have studied the utility of the hamstring tendon-‘hybrid’ autograft, which is composed of the multistrand tendon and polyester tapes.

  ✓ Based on these studies, we have developed a DB PCL-R procedure with hamstring tendon ‘hybrid’ autografts. 
  Yasuda K et al KSSTA 2009

  • However, the superiority of SB or DB PCL-R remains uncertain.
Objective

- We hypothesized that the DB procedure may be significantly better concerning the posterior laxity than the SB procedure, while there may be no significant differences in the Lysholm knee score, and the International Knee Documentation Committee (IKDC) evaluation between the 2 procedures.
- The purpose of this study was to test this hypothesis.
Methods

● A retrospective, comparative study (2003-2016)
  ✓ 35 patients (35 knees): PCL-R using hamstring tendon-hybrid autografts
    • 34 men and 1 woman w/ a mean age of 32 (14–56) yrs
      □ 10 knees: isolated PCL-R
      □ 25 knees: Multiple ligament-R w/ PCL-R
  ▪ All patients were divided into the 2 groups
    ✓ Group S: SB PCL-R (10 knees)
    ✓ Group D: DB PCL-R (25 knees)

● Evaluation
  ✓ Patient demographics
  ✓ Clinical outcome @ 2yrs
  ✓ Statistical analysis
    • Mann-Whitney’s U test, Chi-square test
    • Significance level: p=0.05
Anatomic double-bundle PCL-R procedure

- **Graft**
  - ✓ Hamstring tendon–hybrid autografts

- **Tibial tunnels**
  - ✓ Center of the normal attachment of ALB & PMB

- **Femoral tunnels**
  - ✓ Outside-in technique

- **Fixation**
  - ✓ Fixed onto the femoral cortex w/ staples
  - ✓ Sagging reduction @ 90°
  - ✓ The grafts were fixed @ 10° w/ staples
## Results

### Patient demographics

<table>
<thead>
<tr>
<th></th>
<th>Group S (n=10)</th>
<th>Group D (n=25)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>36.6 (15.0)</td>
<td>32.5 (11.2)</td>
<td>N.S.</td>
</tr>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>25.5 (6.6)</td>
<td>25.0 (3.8)</td>
<td>N.S.</td>
</tr>
<tr>
<td>Combined injury</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>Isolated PCL-R</td>
<td>3 knees</td>
<td>7 knees</td>
<td></td>
</tr>
<tr>
<td>Multiple-R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACL-R</td>
<td>6 knees</td>
<td>14 knees</td>
<td></td>
</tr>
<tr>
<td>MCL-R</td>
<td>4 knees</td>
<td>6 knees</td>
<td></td>
</tr>
<tr>
<td>PLC-R</td>
<td>0 knees</td>
<td>6 knees</td>
<td></td>
</tr>
<tr>
<td>Ope. time (min)</td>
<td>188.2 (54.0)</td>
<td>202.7 (48.6)</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

### Clinical outcome

<table>
<thead>
<tr>
<th></th>
<th>Group S (n=10)</th>
<th>Group D (n=25)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysholm score (pts)</td>
<td>87.0 (21.3)</td>
<td>90.4 (10.3)</td>
<td>N.S.</td>
</tr>
<tr>
<td>IKDC evaluation</td>
<td></td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>A・B</td>
<td>6 knees (60%)</td>
<td>16 knees (64%)</td>
<td></td>
</tr>
<tr>
<td>C・D</td>
<td>4 knees (40%)</td>
<td>9 knees (36%)</td>
<td></td>
</tr>
</tbody>
</table>
## Results

- **Posterior laxity**

<table>
<thead>
<tr>
<th></th>
<th>Group S (n=10)</th>
<th>Group D (n=25)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The side-to-side differences in AP translation @ 70°</td>
<td>2.7 (1.6) mm</td>
<td>2.0 (2.7) mm</td>
<td>N.S.</td>
</tr>
<tr>
<td>Stress radiograph @ 90°</td>
<td>45.3 (5.1) %</td>
<td>53.7 (5.4) %</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Mean (SD)

Midpoint measurement method

\[
\text{Mean (SD)} = \frac{b}{a} \times 100
\]
• Comparison of SB and DB PCL-Rs
  ✓ Both bundle assume a significant role in resisting posterior tibial translation, at all flexion angles, suggesting a codominant relationship.  
    \[\text{Kennedy NI et al AJSM 2013}\]
  ✓ DB PCL-R can restore the biomechanics of the intact knee than SB PCL-R throughout the range of knee motion.
    \[\text{Harner CD et al AJSM 2000}\]

\[\text{Graph showing comparison of SB and DB PCL-Rs in posterior tibial translation.}\]
• Chala et al. Arthroscopy 2017 (Meta-Analysis)
  ✓ DB PCL-R provided significantly improved objective posterior tibial stability and objective IKDC scores when compared with SB PCL-R.

• Lee et al. KSSR 2017 (Meta-Analysis)
  ✓ Both SB & DB techniques are comparable in terms of restoration of knee stability and improvement of knee function.

• Present study
  ✓ Stress radiograph @ 90° showed that the postoperative posterior stability was significantly better in DB PCL-R than in SB-R.
Discussion

- Limitations
  - A retrospective study
  - 2 years follow-up
  - High rate of multiple knee ligament injuries
    - Group S 70%, Group D 72%

- Further long-term studies are needed to assess the subjective and objective patient outcomes of DB procedure in patients with the PCL-deficient knee.
Conclusions

- We compared clinical outcomes after DB and SB PCL-Rs.
- There were no significant differences in the clinical outcome between the 2 procedures.
- Stress radiograph @ 90° showed that DB PCL-R was significantly better in the posterior translation than SB PCL-R.
References

7. Lee DY, Park YJ. Knee Surg Relat Res. 2017