Chronological changes in anterior knee stability after anatomical anterior cruciate ligament reconstruction using bone-patellar tendon-bone graft and hamstrings graft

Kohei Kawaguchi, Shuji Taketomi, Hiroshi Inui, Ryota Yamagami, Kenichi Kono, Keiu Nakazato, Kentaro Takagi, Manabu Kawata, Sakae Tanaka

The University of Tokyo Hospital
Department of Orthopaedic Surgery
I have no conflicts of interest.

Kohei Kawaguchi  M.D.
Introduction

The bone-patellar tendon-bone (BTB) and the hamstring tendon (HT) are commonly utilized autografts for Anterior Cruciate Ligament Reconstruction (ACLR) in Japan.

**BTB VS HT**

- **BTB = HT** Stability: *Dai et al. KSSTA 2016*³  Clinical scores: *Samuelson et al. CORR 2017*⁴
- **BTB < HT** Less anterior knee pain: *Kautzer et al. SICOT 2015*⁶

✓ These studies evaluated anterior knee stability at only final follow-up.
✓ Chronological changes and differences between BTB and HT were unknown.

*References:
1. Amano et al. KSSTA 2018
2. Taketomi et al. J knee Surg 2018
4. Samuelson et al. CORR 2017
5. Cristiani et al. KSSTA 2018
6. Kautzer et al. SICOT 2015*
Objectives

1) To characterize the chronological changes in anterior knee stability after anatomical ACLR with BTB and HT.
2) To evaluate the anterior knee stability achieved with BTB with that of HT.

Materials and Methods

123 consecutive patients received anatomical ACLR at our institute between April 2013 and August 2016. Of these, 82 were included in our study.

Inclusion criteria

✓ a rectangular tunnel ACLR using a BTB or a double-bundle ACLR using HT
✓ no previous knee ligament injury or osteotomy around the knee
✓ no re-injury of ipsilateral ACL or no injury of contralateral ACL during the postoperative period
✓ clinical assessments performed at 6 months, 1 year and 2 years
Surgical Technique

**BTB**

- Anatomical rectangular tunnel BTB
  - Shino et al. Arthroscopy 2005
- Femoral tunnel was placed using a 3D fluoroscopy-based navigation system.
  - Taketomi et al. Arthroscopy 2014
- Grafts were fixed at 0° knee flexion with 80N tension using Endobutton® and DSP small® (Smith & Nephew).

**HT**

- Anatomical double-bundle
  - Taketomi et al. J knee Surg 2018
- Femoral tunnels were placed using a 3D fluoroscopy-based navigation system.
  - Taketomi et al. Arthroscopy 2014
- AM and PL were fixed at 0° knee flexion with 40N tension using Endobutton® and DSP small®.
Anterior knee stability

Anterior knee stability was evaluated at 6 months, 1 year and 2 years after ACLR

✓ KneeLax3 arthrometer (Monitored Rehab Systems, Haarlem, the Netherlands)

✓ Showed side-to-side differences (mm) between the ipsilateral knee and the contralateral knee

Subjective outcomes

Clinical subjective assessment was performed 1 year and 2 years postoperatively.

✓ Lysholm score

✓ Knee Injury and Osteoarthritis Outcome Score (KOOS)
## Results: Patient demographics

<table>
<thead>
<tr>
<th></th>
<th>BTB</th>
<th>HT</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>59</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Gender (female/male)</td>
<td>16/43</td>
<td>18/5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Age (years)</td>
<td>31.3 ± 11.3</td>
<td>34.7 ± 11.6</td>
<td>0.23</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>24.5 ± 4.3</td>
<td>21.9 ± 2.7</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Tegner activity scale</td>
<td>8 (3-10)</td>
<td>7 (3-9)</td>
<td>0.01</td>
</tr>
<tr>
<td>Lysholm score</td>
<td>76.3 ± 13.7</td>
<td>75.6 ± 13.1</td>
<td>0.82</td>
</tr>
<tr>
<td>Time between injury and surgery (mo)</td>
<td>5 (1-252)</td>
<td>5 (1-348)</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Data are given as mean ± standard deviations or medians (range)
P<0.05: significant difference
Results: Anterior knee stability in BTB and HT

BTB: No significant differences during studied postoperative period.

HT: Significant differences between every time points.
Results: Comparison between BTB and HT in Anterior knee stability

HT showed significant laxity than BTB at 2 years.
Results: Lysholm score, KOOS

<table>
<thead>
<tr>
<th></th>
<th>BTB</th>
<th></th>
<th>HT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
<td>2 years</td>
<td>1 year</td>
<td>2 years</td>
</tr>
<tr>
<td>Lysholm score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptom</td>
<td>97.8±3.4</td>
<td>97.6±4.0</td>
<td>97.4±4.4</td>
<td>96.6±4.9</td>
</tr>
<tr>
<td>Pain</td>
<td>92.9±7.7</td>
<td>95.1±6.3</td>
<td>92.4±7.6</td>
<td>92.6±7.0</td>
</tr>
<tr>
<td>ADL</td>
<td>96.9±5.1</td>
<td>97.7±4.8</td>
<td>96.2±5.2</td>
<td>96.2±6.2</td>
</tr>
<tr>
<td>Sports</td>
<td>83.7±14.6</td>
<td>88.3±16.3</td>
<td>81.7±16.8</td>
<td>86.8±14.0</td>
</tr>
<tr>
<td>QOL</td>
<td>80.6±14.7</td>
<td>82.7±16.8</td>
<td>78.7±14.3</td>
<td>82.1±16.7</td>
</tr>
</tbody>
</table>

KOOS

<table>
<thead>
<tr>
<th></th>
<th>BTB</th>
<th></th>
<th>HT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
<td>2 years</td>
<td>1 year</td>
<td>2 years</td>
</tr>
<tr>
<td>Symptom</td>
<td>88.3±9.5</td>
<td>91.6±9.8</td>
<td>89.3±8.9</td>
<td>88.8±13.5</td>
</tr>
<tr>
<td>Pain</td>
<td>92.9±7.7</td>
<td>95.1±6.3</td>
<td>92.4±7.6</td>
<td>92.6±7.0</td>
</tr>
<tr>
<td>ADL</td>
<td>96.9±5.1</td>
<td>97.7±4.8</td>
<td>96.2±5.2</td>
<td>96.2±6.2</td>
</tr>
<tr>
<td>Sports</td>
<td>83.7±14.6</td>
<td>88.3±16.3</td>
<td>81.7±16.8</td>
<td>86.8±14.0</td>
</tr>
<tr>
<td>QOL</td>
<td>80.6±14.7</td>
<td>82.7±16.8</td>
<td>78.7±14.3</td>
<td>82.1±16.7</td>
</tr>
</tbody>
</table>

No significant differences between 1 year and 2 years in either BTB or HT
No significant differences between BTB and HT
Discussion

**Chronological changes** in anterior stability were observed in HT, but not in BTB.

- **Graft maturity or Graft-tunnel integration?**
  
  Histological maturation in HT graft occurred over 18-months.  
  
  \[\text{Sanchez et al. Arthroscopy 2010}\]

- **Graft strength?**
  
  BTB graft was superior to HT graft in biomechanical study.  
  
  \[\text{Her bert et al. Arthroscopy 2013}\]

- **Tunnel widening?**
  
  Femoral tunnel widening in HT was greater than that in BTB.  
  
  \[\text{Taketomi et al. Arthroscopy 2014}\]

Various factors might influence the differences between BTB and HT.

\[\text{ISAKOS 2019}\]
Conclusions

1) No chronological changes in anterior stability were observed from at 6 months to at 2 years after ACLR using BTB, while anterior laxity developed over the same period after ACLR using HT.

2) BTB provided greater anterior stability than HT at 2 years after ACLR.

Limitations

Graft selection depended on patients’ and surgeons’ preferences
Patient backgrounds were different between two groups
Limited follow-up period
Small sample size
Retrospective study
Without evaluation of tunnel position
Without evaluation of concomitant meniscal injury


