Steeper Posterior Tibial Slope Correlates with Greater Tibial Tunnel Widening Following Anterior Cruciate Ligament Reconstruction

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Introduction

Background

- Tunnel widening after anterior cruciate ligament reconstruction (ACL-R) is a potential problem should a revision procedure be required.
- Tunnel widening is also considered to be an indication of poor graft/tunnel healing and a proxy for graft/tunnel interface [1].
- Steeper posterior tibial slope (PTS) has been shown to be associated with ACL injury [2-5], graft failure [6], and high-grade rotatory instability [7,8].
- However, the effect of PTS on the tibial tunnel remodeling after ACL-R has not been fully investigated.

Aim

- To investigate the correlation between PTS and tibial tunnel widening after ACL-R using high-resolution 3D computed tomography (CT).

Hypothesis

- Steeper medial/lateral PTS would correlate with greater tibial tunnel widening after ACL-R.

Methods

Subjects

- **25 unilateral ACL injured patients underwent single-bundle ACL-R using autologous quadriceps tendon graft** (19 male/ 6 female, age: 21±4 y.o.)
- The study was approved by an institutional review board and all patients provided informed consent.
- Tibial tunnel was drilled with a rigid drill and then a dilator was used. The graft was fixed with an interference screw on the tibial side. At 6 months after surgery, each patient underwent a high-resolution CT scan (0.31 x 0.31 x 0.6 mm voxels).

PTS measurement

- Medial/lateral PTS was measured based on the method described by Hudek et al [9].
- The PTS (°) was determined by the angle between the axis perpendicular to tibial shaft axis and the line connecting the most proximal anterior and posterior subchondral bone points in the center of the medial and lateral joint compartment (Figure 1).

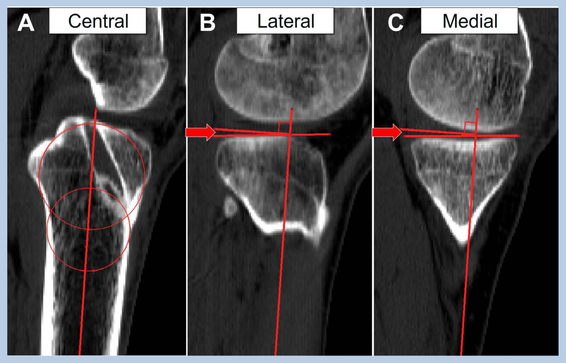

***Figure 1**. Posterior tibial slope (PTS) measurement*

Tibial tunnel widening measurement

- Cross-sectional area (CSA) of the tibial tunnel beneath the aperture was measured using the most axial slice where a complete ellipse could be drawn around the aperture (Figure 2A).
- The nominal elliptical area was calculated according to the diameter of the tibial tunnel dilator and the angle between the axial slice and the tunnel axis (Figure 2B). The percentage of tunnel widening (%) was determined by dividing the CSA by the nominal area (Figure 2B). 100% means that the CSA is the same as the nominal area.

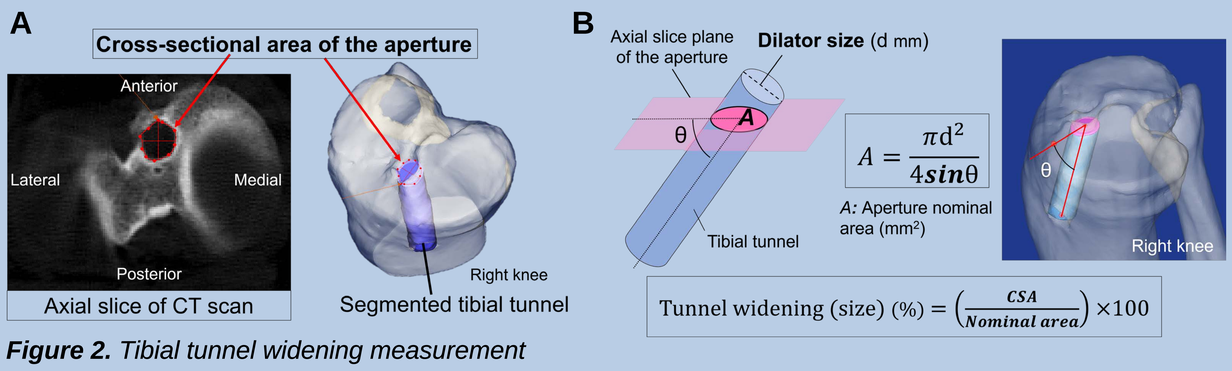

***Figure 2.** Tibial tunnel widening measurement*

Statistical analysis

- Pearson's correlation coefficient was used to explore the correlation between medial/lateral PTS and tibial tunnel widening. Significance level was set as $P < 0.05$.

Results

***Table 1.** Results of medial and lateral posterior tibial slope (PTS)*

	Medial (°)	Lateral (°)
Posterior tibial slope	3.7±2.5	4.9±2.4

***Table 2.** Results of tibial tunnel widening*

Nominal area (mm²)	CSA (mm²)	Tunnel widening (%)
94.3±11.7	90.7±21.8	97.2±20.3

- Tibial tunnel widening was positively correlated with medial PTS (Corr = 0.558, $P = 0.004$) and lateral PTS (Corr = 0.431, $P = 0.031$) (Figure 3).

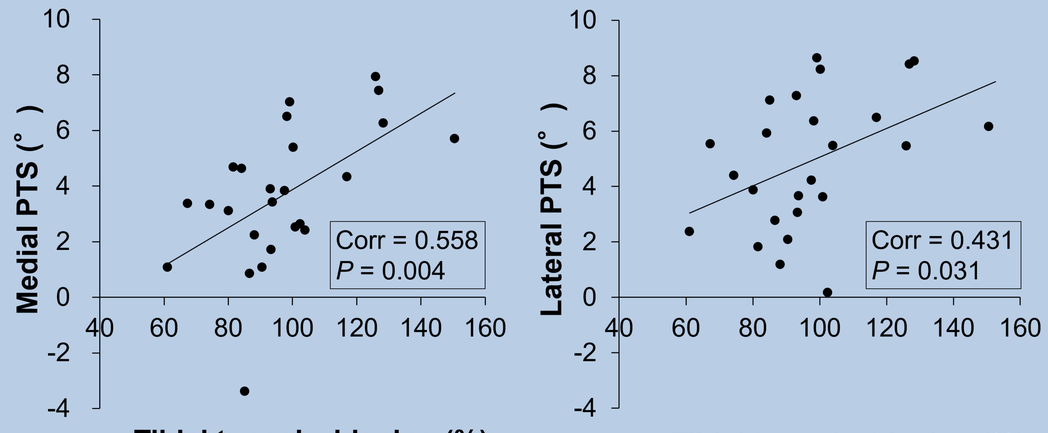

***Figure 3.** Correlation between tibial tunnel widening and medial/lateral PTS*

Discussion

- Steeper medial/lateral PTS correlated with greater tibial tunnel widening, supporting the hypothesis.
- This correlation could be due to larger anterior tibial translation force and increased ACL force in the knee with the steeper PTS as previously described [7,10,11,12].
- The strength of the present study is that precise CSA and PTS measurements were made using high-resolution CT.
- It is the first study to investigate the correlation between tibial tunnel aperture remodeling and PTS.
- Although literature demonstrated that tunnel widening is multifactorial, the current study demonstrates that PTS is an additional factor that may affect the tibial tunnel widening after surgery.

Clinical Significance

- Surgeons should be aware that PTS may affect tibial tunnel widening after ACL-R.

References and Acknowledgement

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