

# The femoral intercondylar notch volume is correlated with femoral ACL tunnel placement

Takanori Iriuchishima<sup>1,3</sup>, Bunsei Goto<sup>2</sup>

<sup>1</sup>Department of Orthopedic Surgery, Shiroyama Hospital, Ota, Japan

<sup>2</sup>Department of Orthopedic Surgery, Kamimoku Spa Hospital, Minakami, Japan

<sup>3</sup>Department of Functional Morphology, Nihon University School of Medicine, Tokyo, Japan

Email of Presenting Author: sekaiwoseisu@yahoo.co.jp

**Disclosures:** Takanori Iriuchishima (N), Bunsei Goto (N)

**INTRODUCTION:** Anatomical anterior cruciate ligament (ACL) reconstruction is now widely performed as gold standard technique. Anatomical femoral ACL footprint is attached to the relatively low (distal) in the femoral intercondylar notch, and to create anatomical femoral ACL tunnel, the usefulness of trans-portal technique has been reported when compared with trans-tibial technique. There are several benefits to the trans-portal technique. However, this technique requires surgeons to create the femoral tunnel from the antero-medial portal to the femoral intercondylar notch, presenting the likelihood that the resulting femoral tunnel characteristics will be influenced by femoral intercondylar notch morphology, which can be a problematic factor especially when the femoral intercondylar notch size is small. The present study endeavors to investigate the influence femoral intercondylar notch volume on the femoral tunnel characteristics in anatomical single bundle ACL reconstruction. Our hypothesis was that significant correlation would be found between notch volume and various characteristics of the created femoral ACL tunnel. Especially, in the small femoral intercondylar notch, creating low (distal) and deep (posterior) femoral tunnel would be difficult, and resulting tunnel length would be short. Revealing this issue might be used by ACL surgeons as a guide for their selection of surgical technique, particularly regarding the method of approach.

**METHODS:** Fifty-one (51) subjects (24 male and 27 female: median age 27; range 15-49), were included in this study. Anatomical single bundle ACL reconstruction was performed in all subjects using a trans-portal technique. The femoral tunnel was created using the antero-medial (AM) bundle footprint center on the femoral side as a target. Femoral tunnel length was measured intra-operatively using a depth gauge. Three-dimensional computed tomography (3D-CT) was taken at pre and post-surgery. The intercondylar notch volume was calculated with a previously reported truncated-pyramid shape simulation [1] using the pre-operative 3D-CT image. Using the axial slice of the knee, this method defines the most proximal slice of the femoral intercondylar notch area as the apex, (S1) and the most distal plane of the femoral intercondylar notch area as the base (S2). The height of the femoral intercondylar notch (h) was calculated as the length between S1 and S2. The formula used for the truncated-pyramid shape simulation was: Volume (mm<sup>3</sup>) =  $h(S1+S2+\sqrt{S1S2})/3$  (Figure 1A). Normalization was performed by dividing notch volume by body height in order to account for the correlation between knee size and body size. In the post-operative 3D-CT of complete sagittal image of the knee, the modified quadrant method (Figure 1B) was used to measure femoral ACL tunnel placement. Statistical analysis was performed with Pearson's coefficient correlation test to evaluate the correlation between characteristics of the femoral tunnel (length and placement) and femoral intercondylar notch volume, notch volume/body height, and other measured parameters (S1, S2, and h).

**RESULTS SECTION:** Femoral tunnel placement was  $47.6 \pm 10.5\%$  in the high-low (proximal-distal) direction, and  $22.6 \pm 5.4\%$  in the shallow-deep (anterior-posterior) direction. Femoral tunnel length was  $35.3 \pm 4.4\text{cm}$ . Femoral intercondylar notch volume was  $8.6 \pm 2.1\text{cm}^3$ . A significant correlation was found between high-low (proximal-distal) femoral tunnel placement and femoral intercondylar notch volume, or notch volume normalized by body height (Figure 2). S2 and high-low femoral tunnel placement exhibited a significant correlation. Femoral tunnel length and h were also seen to be significantly correlated (Table 1).

**DISCUSSION:** Femoral ACL tunnel placement at a significantly lower level was found in knees with large femoral intercondylar notch volume in the trans-portal technique. For the clinical relevance, surgeons can create femoral ACL tunnel low (distal) in the notch where close to the anatomical ACL footprint in the knees with large femoral intercondylar notch volume.

**SIGNIFICANCE/CLINICAL RELEVANCE:** For clinical relevance, determining femoral intercondylar notch volume before ACL reconstruction using the truncated-pyramid shape simulation would be useful for the selection of femoral tunnel creating method. In the small volume of the knee, creating the tunnels low (distal) in the notch is difficult with trans-portal technique, and then, out-side in technique or other technique should be selected.

**REFERENCES:** [1] Iriuchishima et al. Knee Surg Sports Traumatol Arthrosc 2021.

Figure 1.



Figure 2.

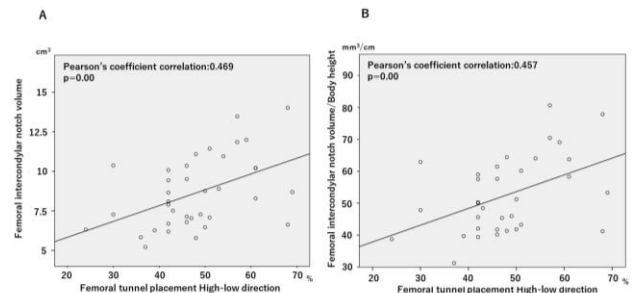


Table 1.

	Tunnel length	Tunnel placement	
		Shallow-deep	High-low
S1	n.s.	n.s.	n.s.
S2	n.s.	n.s.	* 0.462/p=0.00
h	0.455/p=0.00	n.s.	n.s.
Notch volume	n.s.	n.s.	0.469/p=0.00
Notch volume/Body height	n.s.	n.s.	0.457/p=0.00

\* Pearson's coefficient correlation/p-value