# ACL cross-sectional area can be predicted by the measurement of distal femoral intercondylar notch area

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INTRODUCTION: In recent decades anterior cruciate ligament (ACL) reconstruction has been performed as an "anatomical" procedure. Since ACL reconstruction has the characteristics of graft transplantation, knowing the native ACL size is essential for accurate anatomical ACL reconstruction. However, since the native ACL is torn in ACL injured knees, and as the ligament consists of soft tissue, calculating native ACL size before surgery is often difficult. If the native ACL size can be predicted by measuring knee bony morphology, surgeons will be able to perform more accurate anatomical ACL reconstruction. The purpose of this study was to reveal the size correlation between the ACL mid-substance cross sectional area and the femoral intercondylar notch area, and to calculate the size proportion when correlation was found. The hypothesis of this study was that some size correlation would be found between the ACL mid-substance cross sectional area and knee bony morphology. Establishing such a correlation would enable surgeons to predict the native ACL size and better assess graft size and variation in the surgery.

METHODS: Sixty-three subjects (33 female and 30 male) less than 50 years old (average age 37±11.4) were included in this study. Informed consent was obtained from all subjects before data collection. MRI was performed for all subjects. Although all subjects complained of knee pain, MRI showed no structural damage of the knee. The main diagnoses were knee arthritis, synovitis, and tendinitis. The exclusion criteria were history of knee trauma, history of knee surgery, knee osteoarthritis more severe than Kellgren-Lawrence grade I, and knees with bony spur formation. Using the T2 axial slice perpendicular to the femoral bone shaft, the ACL cross-sectional area and the femoral intercondylar notch area were measured using a PACS system. In each slice, the ACL cross-sectional area was outlined. The femoral intercondylar notch area was outlined following van Eck's method [1]. Area measurement was performed automatically. Measurements were made at the most proximal (S1), 1/3 (S2), 2/3 (S3), and the most distal (S4) Blumensaat's line levels (Figure 1). The correlation between the ACL cross-sectional area and the femoral intercondylar notch area of each slice was calculated using a Pearson's coefficient correlation test. Statistical analysis was performed using SPSS 19.0 software (SPSS Inc., Chicago, IL). When significant correlation was observed between the ACL cross-sectional area and the femoral intercondylar notch area, the size proportion was calculated as: average ACL cross-sectional area/femoral intercondylar notch area×100 (%).

RESULTS SECTION: The measured ACL cross-sectional area was: S1: 35.9±10mm$^2$, S2: 59.9±14mm$^2$, S3: 67.2±19.5mm$^2$, S4: 70.7±20.3mm$^2$. The measured femoral intercondylar notch area was: S1: 215.5±43mm$^2$, S2: 311.8±65mm$^2$, S3: 453.8±86mm$^2$, S4: 503.7±99.8mm$^2$. The ACL cross sectional area and the femoral intercondylar notch area were found to be significantly correlated at the S3 (Pearson's coefficient correlation: 0.510, p=0.000), and S4 (Pearson's coefficient correlation: 0.529, p=0.000) levels (Figure 2, Table 1). The proportion of the ACL cross-sectional area to the notch area was 15% in S3 and 14% in S4.

DISCUSSION: The most important finding of this study was that a significant correlation was observed between the ACL cross-sectional area and the axial femoral intercondylar notch area at the distal part of the Blumensaat's line. The proportion of the ACL cross-sectional area to the femoral intercondylar notch area was approximately 15%. This suggests that the ACL cross-section area can be predicted by measuring the axial femoral intercondylar notch area at the distal part of the Blumensaat's line.

SIGNIFICANCE/CLINICAL RELEVANCE: For clinical relevance, the ACL cross-sectional area can be predicted by pre-operative measurement of the femoral intercondylar notch area at the distal part of the Blumensaat's line. The proportion of the ACL cross-sectional area to the femoral intercondylar notch area was approximately 15%. These data can be useful for achieving greater accuracy in anatomical ACL reconstruction.

REFERENCES: [1] Van Eck C et al. Knee Surg Sports Traumatol Arthrosc 2010.

Figure 1.

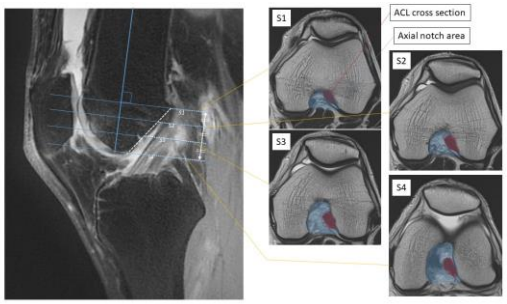


Figure 2.

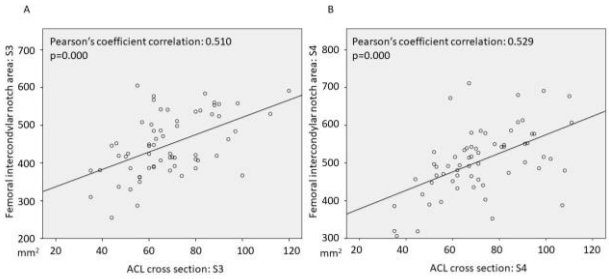


Table 1. ACL cross sectional size and femoral intercondylar notch area

| | ACL cross sectional size | Femoral intercondylar notch area | Pearson's coefficient correlation | P-value |
|---|---|---|---|---|
| S1 | 35.9±10mm$^2$ | 215.5±43mm$^2$ | | N.S. |
| S2 | 59.9±14mm$^2$ | 311.8±65mm$^2$ | | N.S. |
| S3* | 67.2±19.5mm$^2$ | 453.8±86mm$^2$ | 0.510 | 0.000 |
| S4* | 70.7±20.3mm$^2$ | 503.7±99.8mm$^2$ | 0.529 | 0.000 |

*p<0.05