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ACL size of skeletally immature subjects can be predicted by the measurement of femoral intercondylar notch size

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Introduction

In recent decades, anterior cruciate ligament (ACL) reconstruction has been performed as an “anatomical” procedure [1][2].

Since ACL reconstruction has the characteristics of graft transplantation, knowing the native ACL dimensions is crucial for accurate anatomical ACL reconstruction.

While the native ACL dimensions in adults have been well documented[3] corresponding measurements in skeletally immature subjects remain unreported.

Although the anterior cruciate ligament (ACL) injury in skeletally immature subjects are becoming a significant clinical concern [4][5], accurate morphological characterization in this population has not been thoroughly investigated.

Introduction

If native ACL dimensions can be predicted by measurements of knee bony morphology, more accurate anatomical ACL reconstruction can be performed in skeletally immature subjects.

The purpose of this study was to reveal the correlation and proportion between the ACL cross-sectional area and the femoral intercondylar notch area in skeletally immature patients.

The hypothesis of this study was that a significant correlation exists between the ACL mid-substance cross-sectional area and specific parameters of knee bony morphology.

Materials and methods

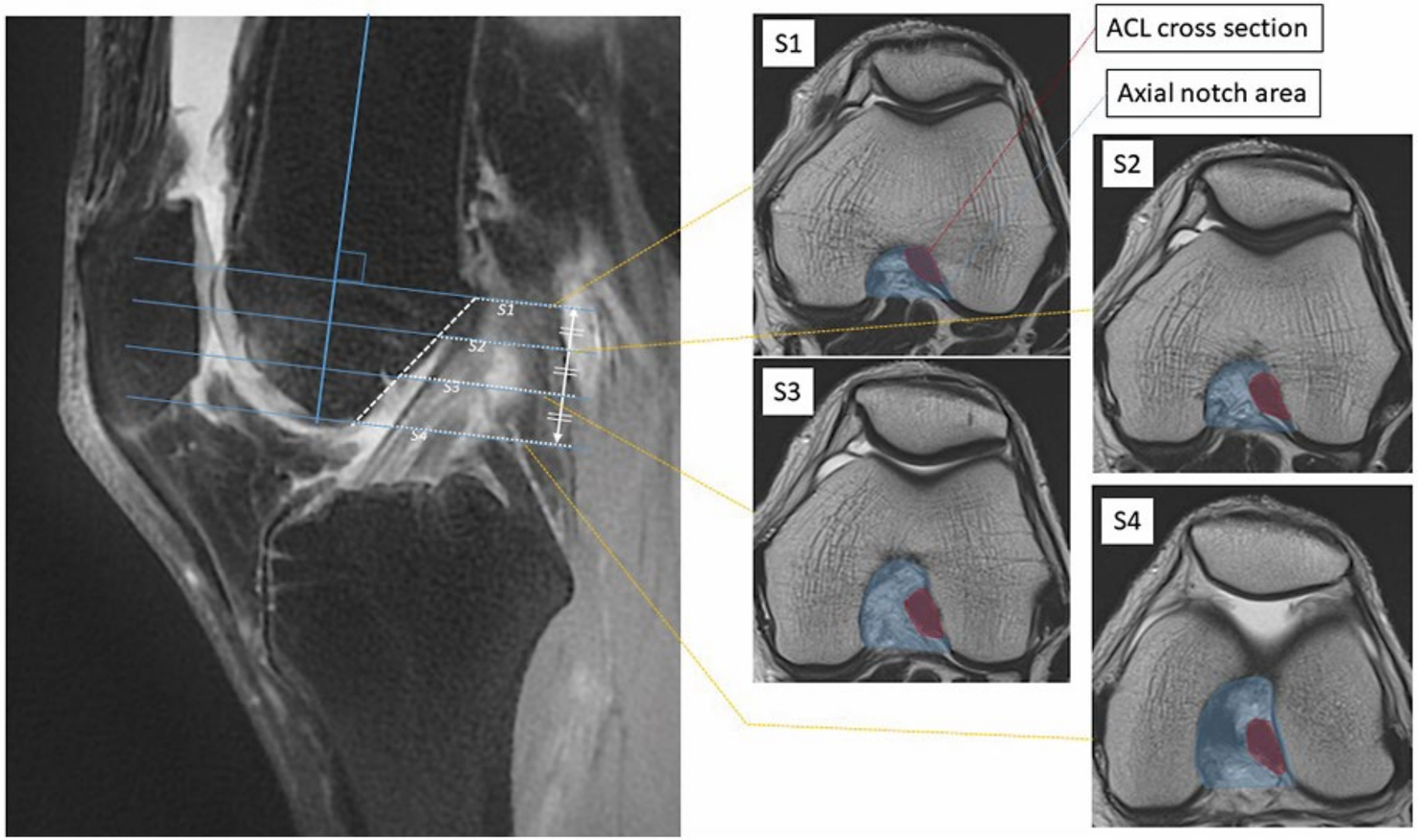
Thirty-five adolescents(20 female and 15male) with open growth plates on knee radiographs between 2016 and 2024. The exclusion criteria is age under seven and history of knee surgery.

average age: 13.5±2.3

The ACL cross-sectional area and the femoral intercondylar notch area were measured using T2 axial MRI slice perpendicular to the bone shaft.

Measurements were made at the most proximal(S1), ⅓(S2), ⅔ (S3), and the most distal (S4) Blumensaat's line levels. The correlation and the proportion between the ACL cross-sectional area and the notch area were calculated.

Materials and methods



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Results

The ACL cross sectional area

	S1	S2	S3	S4
The ACL cross sectional area (mm^2)	24.7±6.9	36.0±8.9	48.5±11.7	57.5±13.6

The Axial notch area

	S1	S2	S3	S4
The Axial notch area (mm^2)	205.9±53.2	288.8±72.9	384.0±82.6	437.3±82.9

Results

The proportion of the ACL cross-sectional area to the notch area

S1	S2	S3	S4
12.0%	12.5%	12.6%	13.2%

The ACL cross-sectional area was found to be significantly correlated with the femoral intercondylar notch area.

	S1	S2	S3	S4
Pearson's correlation coefficient	0.757 (p=0.000)	0.637 (p=0.000)	0.734 (p=0.000)	0.758 (p=0.000)

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 in skeletally immature patients.

In previous studies, the proportion of the ACL cross-sectional area to the notch area was about 15% in normal knees of adults[3], and tended to be slightly smaller in knees of skeletally immature patients.

Discussion

Autografts 8 mm in diameter or less in patients is associated with higher revision rates[6].

Larger ACL graft dimensions may lead to increased contact area and impingement forces. Impingement on the intercondylar wall is considered a major factor contributing to ACL injury[7].

Understanding native ACL dimensions prior to surgery is important for reducing the risk of revision.

Limitation

(1) The sample size was relatively small (n=35). Studies with larger sample sizes should be conducted in future investigations.

(2) All subjects were drawn from an Asian population. The data and results may vary according to ethnicity.

(3) Height and weight variables were not considered in this study.

(4) The axial MRI images were not perpendicular to the ACL long axis. For reproducible axial images, this study utilized images perpendicular to the femoral shaft.

Conclusions

The ACL cross-sectional area can be predicted by measuring the femoral intercondylar notch area in skeletally immature patients.

This finding may contribute to achieving greater precision in anatomical ACL reconstruction for skeletally immature subjects.

References

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(7)Alexander D Orsi et al. The Knee 2017