Evaluation of the Angle Between Femoral ACL Footprint’s Long Axis and Knee Bony Morphology

Makoto Suruga¹, Takanori Iriuchishima², Yoshiyuki Yahagi¹, Takashi Horaguchi¹, Yasuaki Tokuhashi³, Shin Aizawa³

¹ Nihon University Hospital
² Kamimoku Hot Spring Hospital
³ Nihon University School of Medicine
COI Disclosure Information

Presenter: Makoto Suruga

I have no financial relationships to disclose.
Introduction

Although, numerous studies about ACL anatomy have been published, not many studies have been approached to the angle of the long axis of the femoral ACL footprint.

Considering the twisted structure of the ACL, the angle between ACL footprint’s long axis and knee bony morphology may be important.

The purpose of this study was to evaluate the angle between femoral ACL footprint’s long axis and knee bony morphology.
Materials and Method

✓ Thirty non-paired formalin fixed Japanese cadaveric knees were used.
  16 Males, 14 Females median age 78.9 (range: 53-94)

✓ Knees with severe osteoarthritic changes were not included in this study.

✓ All surrounding muscles, and other soft tissues around the knee were resected before ACL dissection.
Materials and Method

✓ AM and PL bundles were identified according to the difference in tension patterns during complete knee range of motion.

✓ As reported by Mochizuki et al., there existed a fold between the mid-substance insertion site and the fan-like extension fibers, and the fold could be detected macroscopically.

[Images of mid-substance of ACL and fan-like extension fibers]
Methods

Following the identification of the AM and PL bundles of mid-substance fibers, the mid-substance and the fan-like extension were divided in the AM and PL bundles and marked.
Methods

The center point of each of four areas (mid-substance insertion of AM and PL, fan-like extension fibers of AM and PL) and the angle between ACL’s long axis and knee bony morphology were calculated using Image J software (National Institute of Health).
Results

✓ The mean angle between axis of shaft and the long axis of mid-substance: $28.8 \pm 12.2^\circ$ (range 7.8-64.6)
   → whole ACL: $29.4 \pm 12.0^\circ$ (range 8.4-64.6)

✓ The mean angle between Blumensaat’s line and the long axis of mid-substance: $54.2 \pm 13.5^\circ$ (range 30.1-80.6)
   → whole ACL: $54.6 \pm 12.2^\circ$ (range 32.4-80.6)

There exist wide variations on the long axis of the ACL.
Discussion

✓ Odensten et al
   The angle between the long diameter of the oval area and the coronal plane through the long axis of the femoral shaft was $26 \pm 7^\circ$.
   
   Odensten et al. JBJS Am, 1985

✓ Siebold et al
   The angle between ACL footprint’s long axis and axis of shaft was $12 \pm 12^\circ$ (range 0-12)

→ This study approximately $29^\circ$

Siebold et al. Arthroscopy, 2008
Using a leg holder, the femoral shaft was lifted at the angle between axis of shaft and long axis of ACL from the horizontal plane, it is possible to make bone tunnel at an anatomical angle by making them horizontally.

Siebold et al. Arthroscopy, 2008

If anatomical angle can be predicted before surgery, it is possible to make bone tunnel at an anatomical angle.
Which landmarks should we use to make bone tunnel??

✓ Intercondylar ridge (Resident’s ridge)
✓ Remnant
✓ Quadrant method
✓ Posterior cartilage

Investigation of most useful landmarks to create bone tunnel with reproducing the anatomical ACL footprint long axis is needed.

Ferretti et al. Arthroscopy, 2007
Limitation

✓ Our sample size was not large (n=30).
✓ The ACL dissection was performed only by macroscopic evaluation.
✓ There are no biomechanical consideration in this study.
Conclusion

✓ The mean angle between axis of shaft and the long axis of ACL are approximately 29 degrees.

✓ It is important to consider the morphological variations, when we perform anatomical ACL reconstruction.