DIFFERENCES IN INTERCONDYLAR NOTCH GEOMETRY BETWEEN MALES AND FEMALES

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INTRODUCTION

The geometry of the intercondylar notch has been implicated as a possible risk factor related to ACL injury. ACL injuries are a common source of disability in the United States and often lead to instability, further ligamentous injury, meniscal injury, and arthritis. Females are substantially more susceptible than males to suffer acute noncontact injury of the ACL. Although the cause of disparity in injury rate is not fully understood, numerous extrinsic and intrinsic factors are believed to be associated with ACL injury. Intercondylar notch geometry is one of the intrinsic factors suspected of predisposing individuals to ACL injury. Some data indicate that females have a more narrow intercondylar notch than males, while other data show that no difference exists between females and males. Orthopedic surgeons have also observed that the shape of the intercondylar notch varies between females and males. However, their subjective commentary has not been confirmed. The purpose of this study was to compare intercondylar notch geometry between males and females.

PROCEDURES

One hundred male skeletons (age at death 33.0±10.3) and one hundred female skeletons (age at death 36.7±11.8) from the Terry Collection (a 20th century autopsy store) housed at the National Museum of Natural History, Smithsonian Institution in Washington, D.C., were evaluated relative to intercondylar notch geometry. The individuals were free from any orthopedic disorder as listed in medical records or observed upon inspection.

Digital photographs were taken of the distal end of the left femur of each individual. Three indices related to intercondylar notch geometry were calculated using MATLAB: notch width index (NWI), notch area index (NAI), and notch shape index (NSI). NWI was calculated by dividing the width of the intercondylar notch by the width of the femoral condyles. NAI was computed by creating a ratio of the area encompassed by the intercondylar notch to the area of the femoral condyles. NSI was determined by dividing the width of the intercondylar notch by the height of the notch.

Descriptive statistics (means and standard deviations) were calculated for each of the three dependent variables. Independent t-tests were used to detect any differences between males and females across the dependent variables. The Bonferroni adjustment for multiple comparisons was used to decrease the likelihood of making a Type I error.

RESULTS AND DISCUSSION

Previous data are somewhat inconclusive concerning differences in notch width
between injured and healthy individuals, as well as, males and females. In this study, no differences were detected between males and females for NWI and NAI. NSI for males exceeded NSI for females (p=0.003). See Table 1.

Narrow notches have been subjectively identified as being shaped like a cresting wave and wider notches appear as an inverted U. No attempts have been made to objectively quantify the shape of the intercondylar notch. Our data indicate that no differences exist between males and females concerning notch width or the two dimensional area that the cruciate ligaments pass through. However, males and females do differ when compared with a general measure of intercondylar notch shape. The results demonstrate that males may have a proportionately wider intercondylar notch when normalized by the anterior/posterior height of the notch.

**SUMMARY**

This study is a unique evaluation of cadaveric skeletal geometry. Previous research has yielded inconclusive results regarding intercondylar notch width and little or no information regarding the area and shape of the notch. The shape of the intercondylar notch may play an important role in causing ACL injuries and apparently varies between males and females.

The present work is a part of a larger project designed to evaluate skeletal alignment and its affect on knee mechanics. The larger NSI present in males may partially explain the discrepancy in ACL injury rates between males and females. Further quantification of the shape of the notch is recommended.

**ACKNOWLEDGEMENTS**

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**REFERENCES**


**Table 1:** Intercondylar notch geometry indices (mean ± SD).

<table>
<thead>
<tr>
<th>Index</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>NWI</td>
<td>0.255±0.03</td>
<td>0.249±0.03</td>
</tr>
<tr>
<td>NAI</td>
<td>0.173±0.02</td>
<td>0.170±0.02</td>
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<tr>
<td>NSI*</td>
<td>0.638±0.09</td>
<td>0.599±0.09</td>
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