

ARTICULAR CARTILAGE THICKNESS OF THE PEDIATRIC KNEE: IMPLICATIONS FOR CARTILAGE IMPLANTATIONS

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INTRODUCTION

While access to pediatric tissue for cartilage conditions is limited, recent research on the use of pediatric cartilage tissue for implantation has shown promising results. These pediatric grafts may include bulk osteochondral allografts, morselized cartilage, or cellular manipulation products.

The purpose of this study was to evaluate the parameters of cartilage thickness in different regions of the pediatric knee from a larger pediatric knee specimen research database.

MATERIALS AND METHODS

- CT Scans of 12 skeletally immature knees ranging from ages 7 to 11 years were evaluated
- Cartilage thickness measurements were taken in the following regions:
 - Femoral Condyles at Cahill Zones 1, 2, 4, and 5 (Fig 1) via the region of greatest thickness on the coronal plane
 - Femoral Condyles at Cahill Zones A, B, and C (Fig. 2) via the region of greatest thickness on the sagittal plane
 - Tibial Plateau at the region of greatest cartilage thickness, medial and lateral, via coronal plane (Fig. 1)
 - Patella at the region of greatest cartilage thickness, axial and sagittal (Fig. 3 and 4)

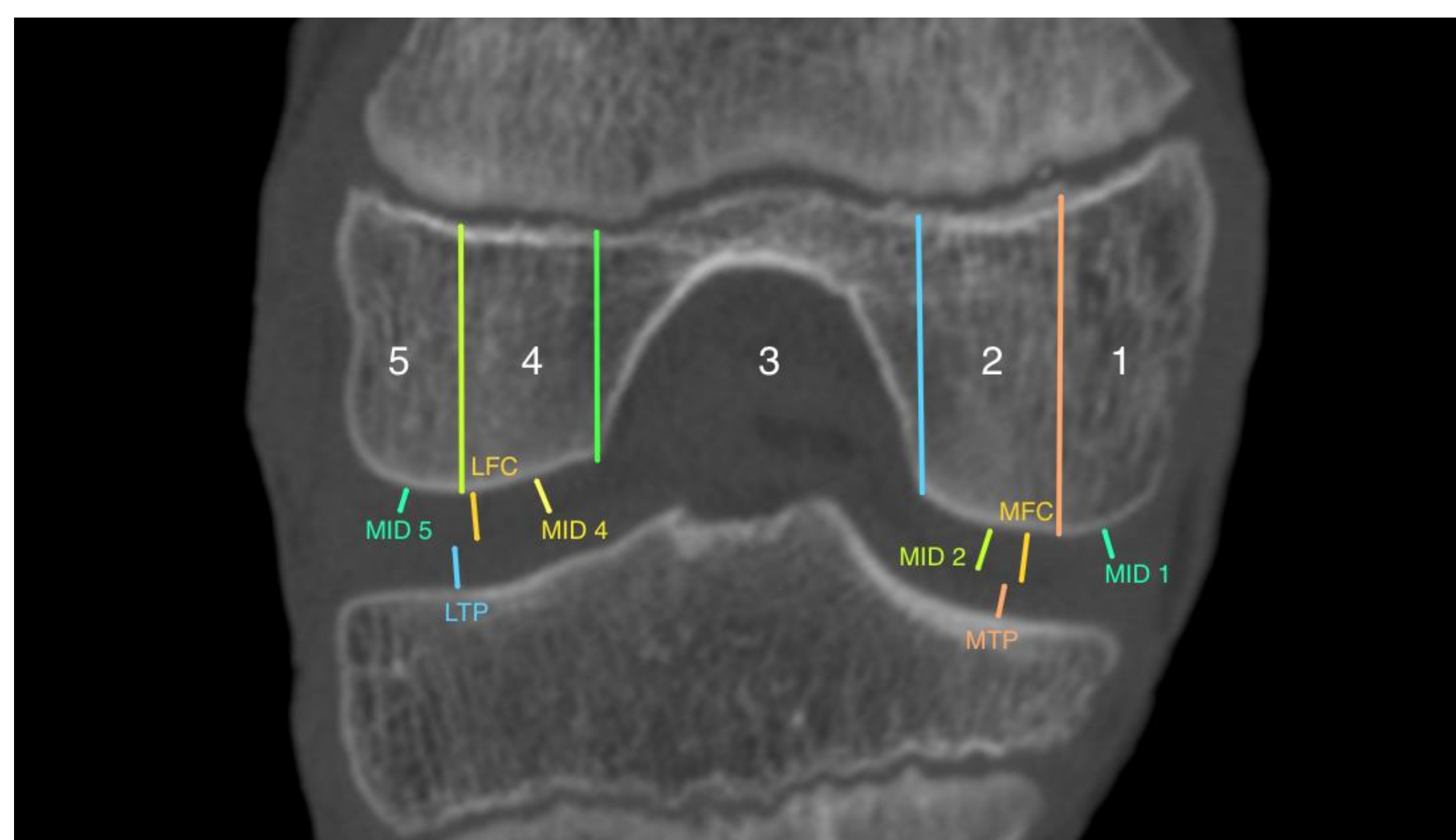


Figure 1. Method for measuring Cahill Midpoints 1,2,4,5, MFC, LFC, MTP, and LTP

Five anatomic regions (Cahill Zones 1,2,3,4, and 5, with Zone 1 being the most medial) were created by bisecting the condyles and identifying the ends of the intercondylar notch. The width of the articular cartilage was then measured using the midpoints of Cahill Zones 1,2,4, and 5. The greatest cartilage thickness for the medial femoral condyle (MFC), lateral femoral condyle (LFC), medial tibial plateau (MTP), and lateral tibial plateau (LTP) were also measured.

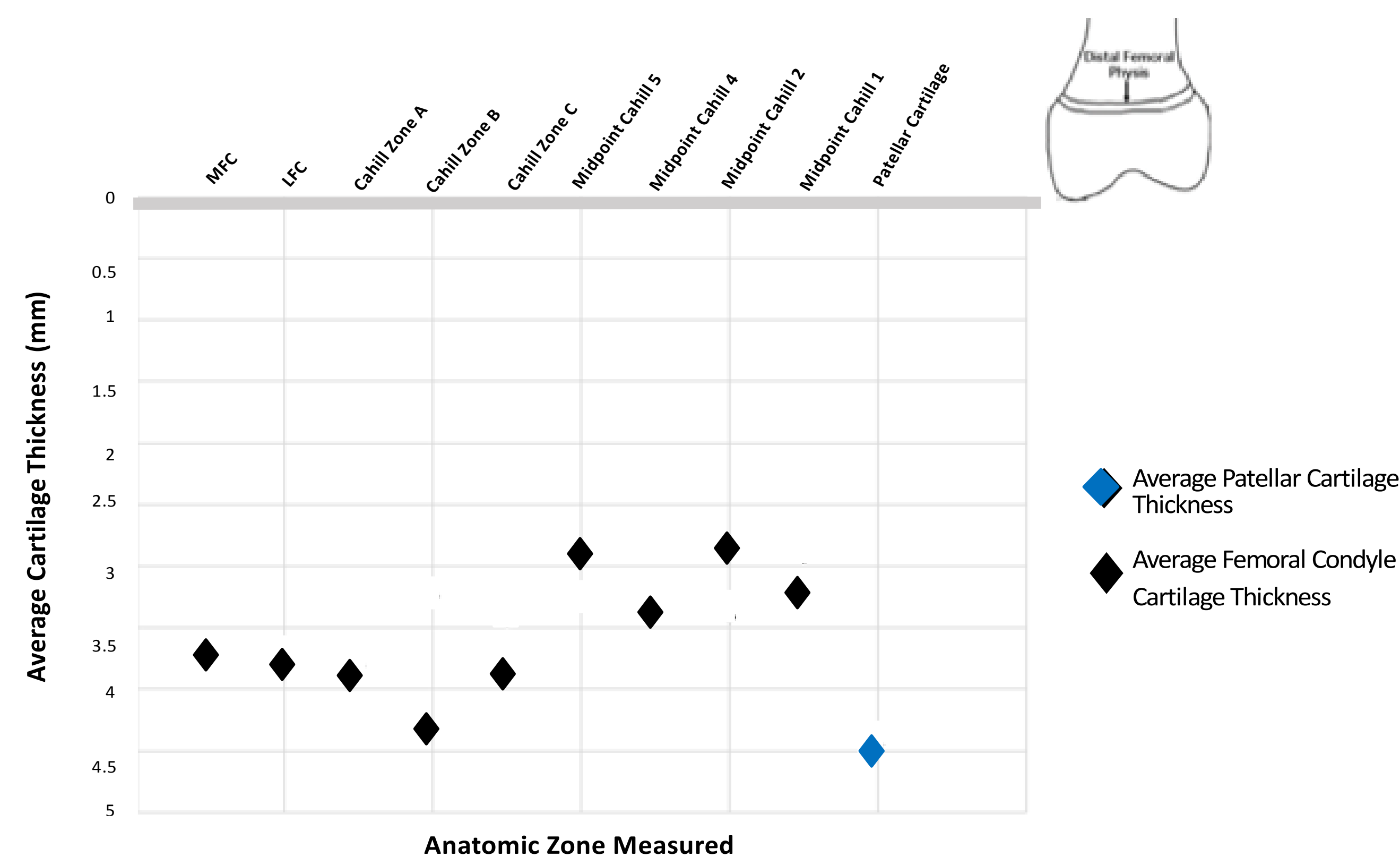


Figure 5. Average cartilage thickness for patella and femoral condyles.

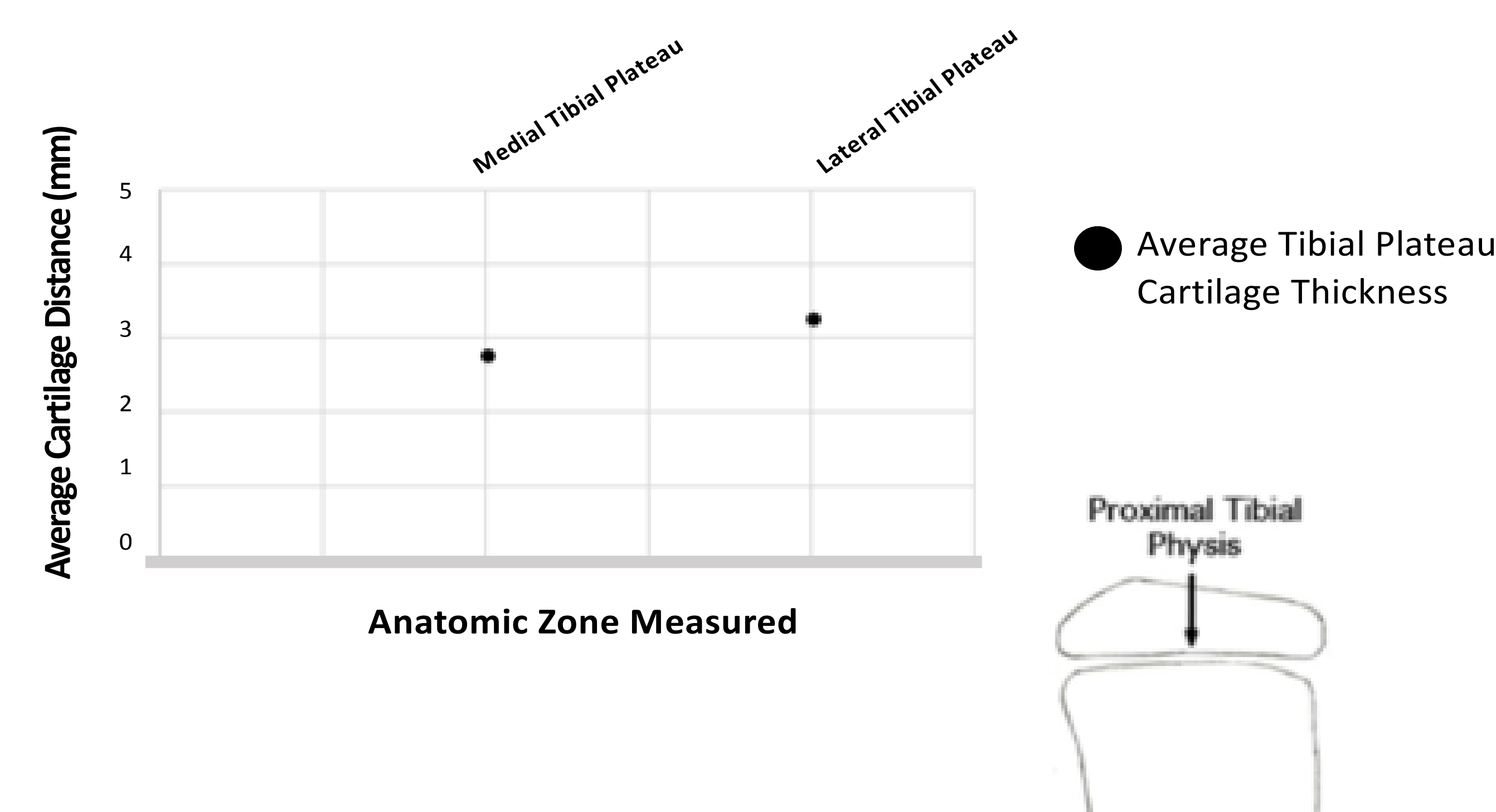


Figure 6. Average cartilage thickness for tibial plateau

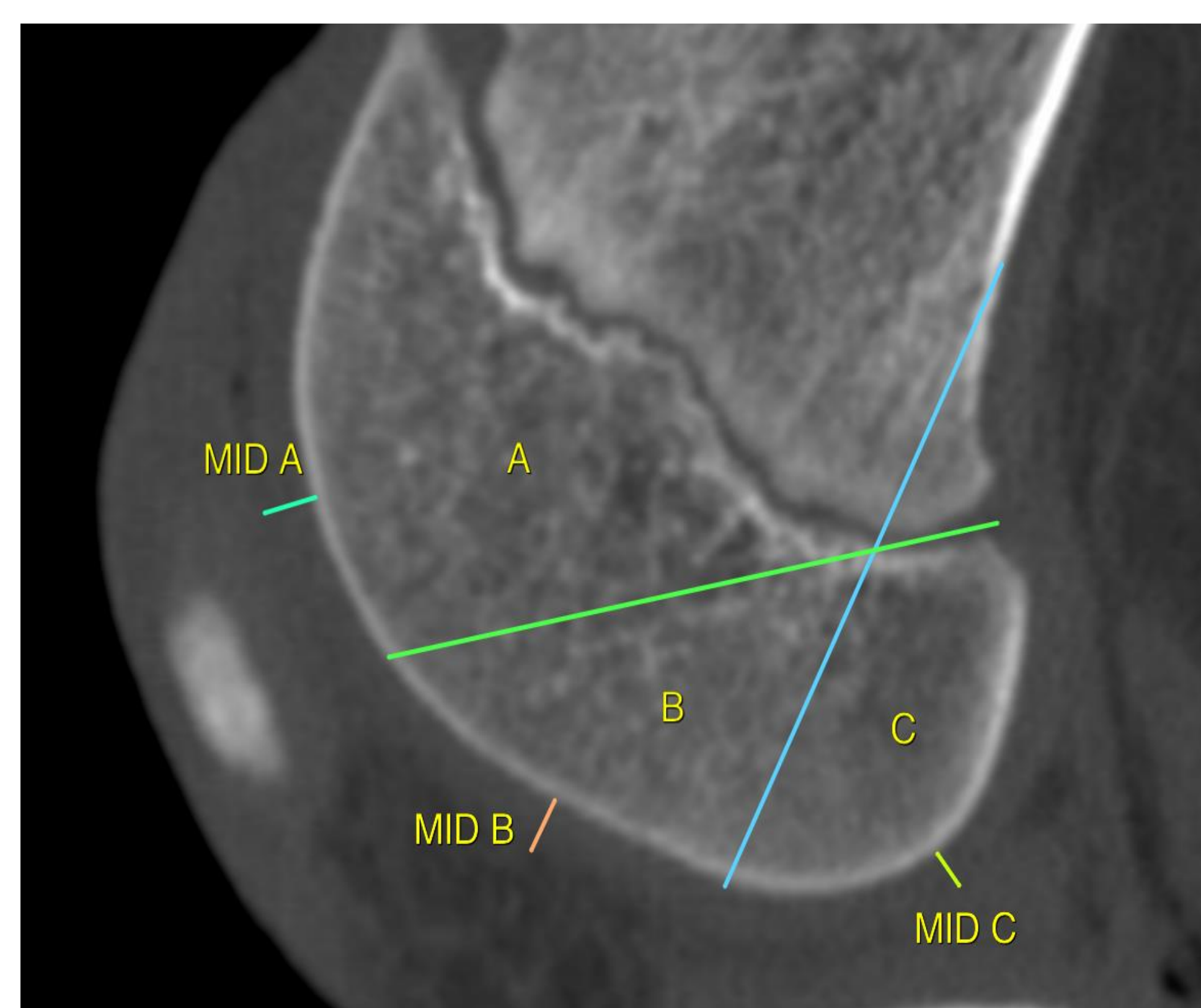


Figure 2. Method For Measuring Cahill Zones A,B,C
A line from the metaphysis to the epiphysis divides zones B and C. Another line from the physis to the anterior portion of the physis divides zones A and B. The cartilage width at the midpoint of each of these zones was then measured

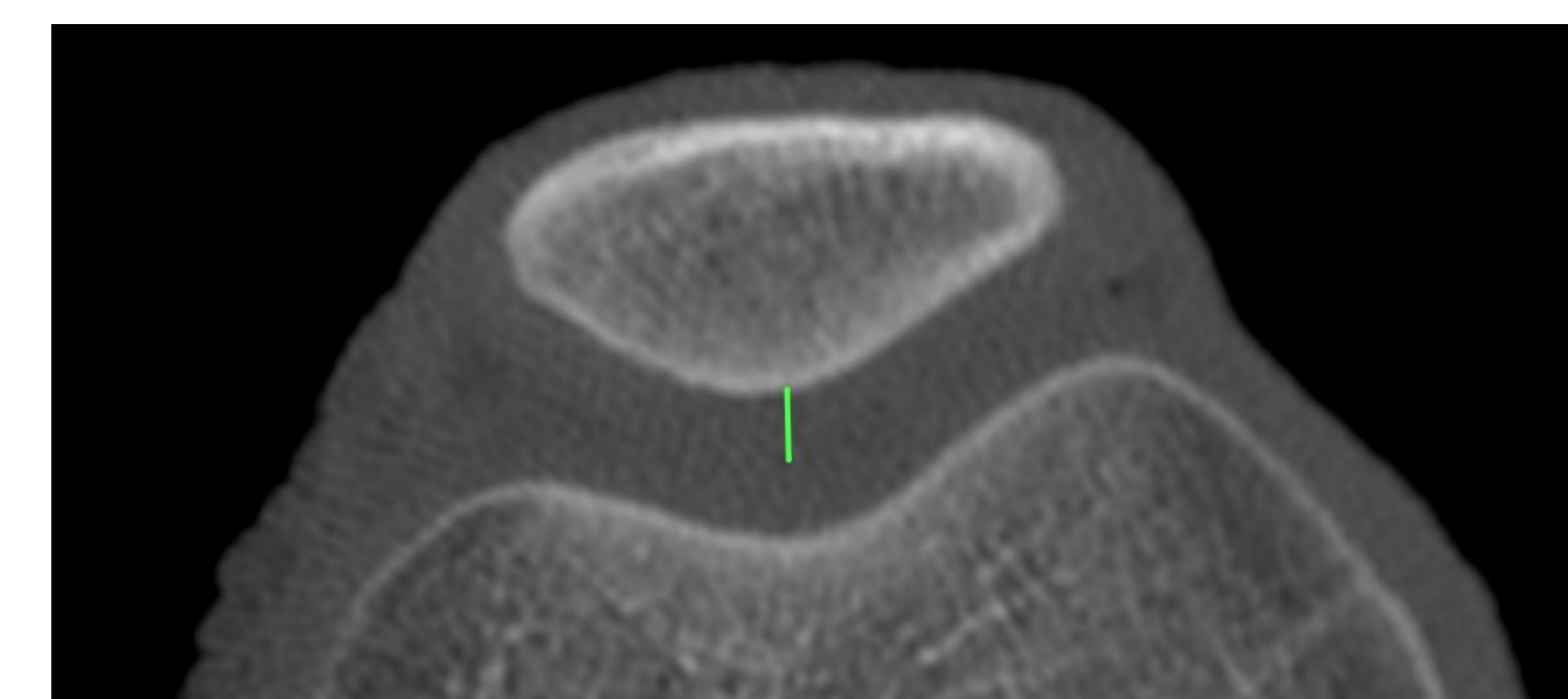


Figure 3. Measuring the greatest cartilage thickness on the patella (axial view).

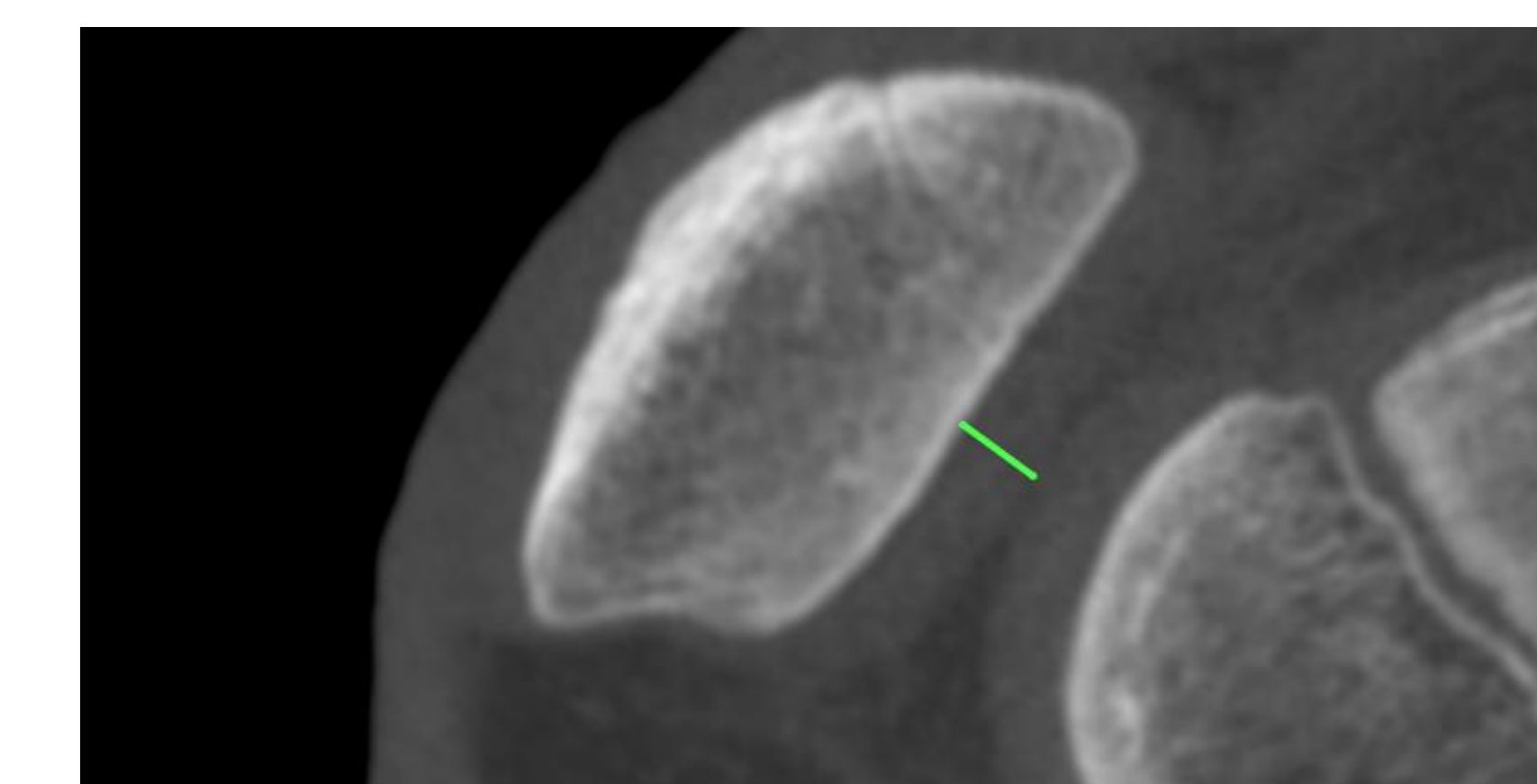


Figure 4. Measuring the greatest cartilage thickness on the patella (sagittal view).

RESULTS

Pediatric knees demonstrate relatively thick cartilage in multiple zone of the knee in comparison with adult specimens.

Zone Measured	Average Cartilage Thickness (mm)
Medial Femoral Condyle	3.68 ± 0.26
Lateral Femoral Condyle	3.71 ± 0.52
Cahill Zone A	3.81 ± 0.68
Cahill Zone B	4.40 ± 0.49
Cahill Zone C	3.82 ± 0.68
Midpoint Cahill Zone 1	2.93 ± 0.62
Midpoint Cahill Zone 2	3.42 ± 0.66
Midpoint Cahill Zone 4	2.81 ± 0.46
Midpoint Cahill Zone 5	3.30 ± 0.73
Patella (axial)	4.53 ± 0.38
Patella (sagittal)	4.40 ± 0.49
Medial Tibial Plateau	2.80 ± 0.26
Lateral Tibial Plateau	3.29 ± 0.45

Table 1. Average Cartilage Thicknesses

DISCUSSION

In another study, adults specimens aged 33-80 years old had a mean articular cartilage thickness of 1.69 to 2.55 mm², which is significantly less than the average thicknesses of any of the zones measured in this study. For example, this study found an average femoral condyle thickness of 3.70 mm and patella thickness of 4.70 mm. This would suggest that age is inversely related to cartilage thickness. However, this conclusion is in contradiction with the Shepherd study's results², which found no correlation between these factors within adults.

Increasing access to and use of this tissue for cartilage grafts, non-manipulated tissue, and manipulated tissue offer significant opportunity to address cartilage loss. Osteochondral allograft procedures may benefit from access to such tissue, with relatively high volume and thickness of normal articular cartilage.

REFERENCES

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