TROCHLEAR MORPHOLOGY DEVELOPMENT: STUDY OF NORMAL PEDIATRIC KNEE MRIS

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Introduction:

Trochlear dysplasia is a known risk factor for patellar dislocations yet normal trochlea development is not well described. This study will define the articular cartilage and subchondral trochlear morphology development in pediatric patients using MRI evaluation.

Methods:

Retrospective knee MRI review including patients aged 3-16 years with non-patellofemoral related diagnoses. ICD-9/ICD-10 codes identified eligible study patients. Measurements of the trochlea were made based on previously established methods using the axial MRI image just distal to the physis at the deepest portion of the trochlear groove. Three linear (Lateral Trochlear Height (LTH), Medial Trochlear Height (MTH), Central Trochlear Height (CTH)) and three angular (Sulcus Angle (SA), Lateral Trochlear Slope (LTS), Medial Trochlear Slope (MTS)) were made at the Articular Cartilage (AC) and Subchondral Bone (SCB) (Figure 1). Twelve measurements were made independently by two study authors. Interrater reliability was assessed. Trochlea measurements were summarized across age quartiles: 1st (age 5.1 - 8.3y), 2nd (8.3 - 11.5y), 3rd (11.5 - 14.3y), 4th (14.3 - 16.9y). Associations between age and trochlea measures were assessed using linear regression with Huber-White adjusted standard errors.

Results:

246 knee MRIs from 230 patients were included in this study. 113 patients (51%) were female while 117 (49%) were male. 116 MRIs (47%) were of the Left knee and 130 (53%) were Right knee. Average patient age was 11.4±3.4 years. Interrater agreement was high (ICC values >0.7). Mean values for measurements are presented by age quartiles (Table 1). LTH, MTH, and CTH showed linear increase with age (range 2 to 2.6 mm per year, p<0.001). SA, LTS, MTS measured at the AC showed no change with age (p>0.05) however LTS and MTS measured at SCB showed significant increases with age (0.6 and 0.9 degrees per year, p<0.001) while SA showed a decrease with age (-1.4 degrees per year, p<0.001). There were no significant differences found in the age associations by laterality, left vs right. There were no gender differences in the age associations for SA, LTS, MTS (p>0.05) however for MTH, LTH, and CTH, males were found to have a significantly greater growth rate (p<0.001).

Conclusions:

This study found an increase in articular cartilage and subchondral bone MTH, LTH, and CTH over time as well as an increase in subchondral bone LTS, MTS, and SA. However, no significant change
in articular cartilage LTS, MTS, or SA was found. This normative data indicates that articular cartilage angles determine final trochlear morphology.

| Table 1: Descriptions of Trochlea measures across age quartiles |
|---------------------------------------------------------------|
| **Outcome** | **1st Quartile** (age 5.1 - 8.3) | **2nd Quartile** (age 8.3 - 11.5) | **3rd Quartile** (age 11.5 - 14.3) | **4th Quartile** (age 14.3 - 16.9) |
|              | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** | **Mean ± SD** |
| Lateral Trochlear Height (AC) | (62) 48.5 ± 5.0 | (61) 57.7 ± 5.2 | (62) 65.0 ± 5.4 | (60) 66.9 ± 5.2 |
| Lateral Trochlear Height (SCB) | (62) 42.2 ± 5.2 | (61) 52.6 ± 4.9 | (62) 61.5 ± 5.5 | (60) 63.7 ± 6.2 |
| Medial Trochlear Height (AC) | (62) 46.4 ± 5.1 | (61) 59.1 ± 29.0 | (62) 62.7 ± 5.0 | (61) 64.3 ± 5.2 |
| Medial Trochlear Height (SCB) | (62) 42.0 ± 5.1 | (61) 51.8 ± 4.9 | (62) 59.9 ± 5.0 | (61) 62.2 ± 5.1 |
| Central Trochlear Height (AC) | (62) 43.4 ± 4.7 | (61) 51.8 ± 4.8 | (62) 59.1 ± 5.1 | (61) 60.8 ± 4.9 |
| Central Trochlear Height (SCB) | (62) 39.1 ± 4.6 | (61) 47.2 ± 4.4 | (62) 55.2 ± 5.2 | (61) 57.1 ± 4.5 |
| Sulcus Angle (AC) | (62) 145 ± 7 | (61) 142 ± 7 | (62) 142 ± 10 | (61) 145 ± 7 |
| Sulcus Angle (SCB) | (62) 151 ± 8 | (61) 142 ± 6 | (62) 138 ± 10 | (61) 139 ± 8 |
| Difference in Sulcus Angle (SCB - AC) | (62) 5.63 ± 7.27 | (61) 0.03 ± 5.79 | (62) -4.2 ± 13.1 | (61) -5.83 ± 5.24 |
| Lateral Trochlear Slope (AC) | (62) 19.0 ± 3.9 | (61) 20.0 ± 3.4 | (62) 18.9 ± 4.8 | (61) 18.0 ± 4.6 |
| Lateral Trochlear Slope (SCB) | (62) 14.4 ± 4.3 | (61) 18.6 ± 3.5 | (62) 20.3 ± 5.6 | (61) 19.3 ± 4.5 |
| Medial Trochlear Slope (AC) | (62) 15.9 ± 5.2 | (61) 18.4 ± 5.1 | (62) 17.9 ± 5.3 | (61) 17.8 ± 5.3 |
| Medial Trochlear Slope (SCB) | (62) 15.0 ± 5.2 | (61) 19.8 ± 5.0 | (62) 22.2 ± 5.6 | (61) 22.1 ± 5.9 |
Figure 1: Descriptions of MRI measurements on axial MRI

The Orthopaedic Journal of Sports Medicine, 8(4)(suppl 3)
DOI: 10.1177/2325967120S00164
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