

Adapting the Dejour MRI-Based Classification System of Trochlear Dysplasia: A Pediatric-Specific Modification Yields Excellent Diagnostic Accuracy

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INTRODUCTION: Trochlear dysplasia is the primary anatomical risk factor for patellofemoral instability (PFI) and is most commonly interpreted by the H. Dejour and D. Dejour classifications (Dejour v1.0 and v2.0). However, these current systems rely on qualitative observations, and are thereby limited in their reproducibility. The recent quantitative Dejour classification (v3.0) greatly improves reproducibility and sensitivity by relying solely on MRI-based measurements. However, as the Dejour v3.0 classification was established using adult measurements, its validity in the pediatric population has yet to be evaluated. This study aimed to (1) assess the diagnostic accuracy of the Dejour MRI-based classification of trochlear dysplasia in children and adolescents and (2) determine MRI-based measurement cutoffs for predicting PFI in the pediatric population.

METHODS: 144 patients with objective PFI were age and sex matched to 144 control patients. Four raters performed 7 measures of patellofemoral morphology: cartilaginous sulcus angle, lateral trochlear inclination (LTI), patellar tilt, lateral patellofemoral angle (LPFA), tibial tubercle to trochlear groove (TT-TG) distance, sagittal central bump size, and Caton-Deschamps Index (CDI). Rater agreement was excellent for all measures. The adult cutoff combinations (Dejour v3.0) were assessed for their sensitivity, specificity, and their diagnostic accuracy, as defined by the area under the curve (AUC) for the respective receiver operating characteristic (ROC) curves, within our pediatric sample. Regression tree analysis with recursive partitioning was utilized to identify clinically relevant threshold values for MRI-based measurements specific to our pediatric sample, and these combinations were assessed for their sensitivity, specificity, and diagnostic accuracy. The AUC for the ROCs for the two measurement combination options with highest sensitivity were compared to a random-forest (RF) model, which serves as a benchmark for comparison to evaluate optimal diagnostic accuracy. A P-value > 0.05 between the AUC(RF) and AUC(option) suggests non-inferior diagnostic performance of the option.

RESULTS: Application of the four adult cutoff combinations resulted in low to moderate sensitivity and fair to good diagnostic accuracy (range of AUCs: 0.79 to 0.87) in our pediatric cohort. Regression tree analysis yielded 5 cutoff combinations, of which two achieved sensitivity above 90%. The first cutoff was a singular cartilaginous sulcus angle measurement $\geq 151^\circ$ (sensitivity: 93%, specificity: 87%); the second cutoff combination incorporated an LPFA cutoff $< 0.45^\circ$ if the sulcus angle was $< 151^\circ$ (sensitivity: 98%, specificity: 85%). The AUC for ROC curves were 0.94 and 0.97, respectively. The AUC for the second cutoff combination was non-inferior to the AUC(RF) (P = 0.33).

DISCUSSION AND CONCLUSION: We present an objective MRI-based classification system for PFI specific to the pediatric population. The need for a pediatric-specific, MRI-based evaluation of PFI – rather than applying adult thresholds from the Dejour v3.0 classification – is supported by well-established changes in trochlear morphology throughout skeletal maturation. Two measurement combinations had high sensitivity and excellent diagnostic accuracy, relying only on one or two measurement cutoffs. The two-measurement based rule was non-inferior in diagnostic accuracy to the complex RF model, suggesting its practicality in the clinical setting.

