

Development of Patella Alta

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INTRODUCTION: Patella alta is an anatomic risk factor for patellar instability in adolescents that is also linked to the risk factor of trochlear dysplasia. There is some evidence that trochlear morphology does not change significantly after age 11, supporting the theory that trochlear dysplasia is a genetic predisposition rather than a developmental dysmorphology. This study aims to determine the age of onset and age-related incidence of patella alta in a pediatric population of patients with patellar instability. We hypothesized that the patellar height ratios would not increase with increasing age, suggesting a genetic rather than developmental origin of patella alta.

METHODS:

A retrospective cross-sectional cohort of patients was collected from a convenience sample with the following inclusion criteria: patients aged 5-18 who had knee magnetic resonance imaging (MRI) performed from 2000-2022 with current procedural terminology code listed for patellar dislocation. Demographic information and details of the patellar instability episode(s) were collected with chart review. Sagittal MRI was used to measure Caton-Deschamps Index (CDI) and the Insall-Salvati Ratio (ISR) by 2 observers. Patella alta was defined as CDI \geq 1.2 or ISR \geq 1.3. Multiple linear regression was used to assess associations between patellar height ratios and age of first dislocation while adjusting for sex and body mass index (BMI). The Cochran-Armitage trend test was used to assess if the proportion of patients categorized as having patella alta changed with age.

RESULTS: The 149 knees included in the cohort had an average age of 14 years (SD = 2.36; range: 8 – 18) and were 57% female. Patella alta was present in 82 knees (55%) using CDI \geq 1.2 and in 52 knees (35%) using ISR \geq 1.3. For the 82 knees with patella alta (CDI \geq 1.2), the mean CDI was 1.36 (SD = 0.13; range: 1.20 – 1.79). The earliest age patella alta was observed was at age 8 using CDI \geq 1.2 and age 10 using ISR \geq 1.3. There were no statistically significant associations between CDI and age without adjustment (P=0.179) nor after adjustment for sex and BMI (P=0.301). The proportion of knees above the CDI threshold for patella alta to the knees below the cutoff did not show a significant change with age (P = 0.0945).

DISCUSSION AND CONCLUSION: Patella alta, as defined by CDI, is seen in patients as young as 8 years old. Patellar height ratios do not show an increase with age in patients with patellar dislocation, suggesting that patella alta is established at a young age rather than developing during the pre-adolescent and adolescent years.

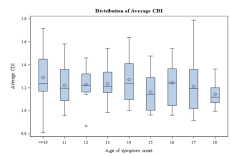


Figure 1: The distribution of calculated Caton-Deschamps index for all subjects with patellar instability in each age group.

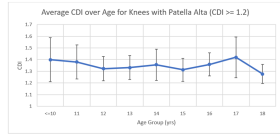


Figure 2: The mean Caton-Deschamps index calculation for knees classified as having Patella Alta (CDI \geq 1.2) for each age group showed no significant increase or decrease over age.

Table 4 – Proportion of patients categorized as patella alta across different ages

CDI	Age								Total	
	≤ 10	11	12	13	14	15	16	17		18
Count	4	7	4	11	9	9	7	9	7	67
Cal Pct	33.33	53.85	40.00	44.00	31.03	60.00	36.94	56.25	70.00	44.97
< 1.2	8	6	6	14	20	6	12	7	3	82
	3	1	1	1	1	1	1	1	1	14
≥ 1.2	66.67	46.15	60.00	56.00	48.97	48.00	43.16	43.75	30.00	55.03
Total	12	13	10	25	29	15	19	16	10	149
	8.00	17.72	6.73	16.78	19.66	10.07	12.75	10.74	6.71	100.00

Table 5: Average CDI and ISR across age groups (Patella Alta defined as CDI \geq 1.2)

Age Group	≤ 10	11	12	13	14	15	16	17	18	Overall
Average CDI	1.29	1.22	1.32	1.34	1.27	1.16	1.24	1.21	1.14	1.29
Average CDI (Patella Alta)	1.42	1.38	1.32	1.33	1.30	1.31	1.30	1.42	1.28	1.36
Average ISR (Patella Alta)	1.40	1.38	1.31	1.30	1.34	1.23	1.30	1.35	1.33	1.33