# The Bump Will Make them Jump: Anatomic Drivers of J Sign Presence, Severity, and Quality

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INTRODUCTION:

The pathophysiology of lateral patellar instability involves a complex interaction between anatomic parameters of the trochlea and patella, such as trochlear dysplasia and patellar height, combined with dynamic elements such as quadriceps activation during knee flexion. Patellar maltracking, measured clinically as a "J-sign," is observed on physical exam at the terminal degrees of active knee extension. The lateral deviation of the patella in active extension often traces an inverted J shape, which is typically graded (Grade 1, 2, or 3), or also qualified by the nature of its transition, such as "gradual" or "jumping." The purpose of this study was to determine the underlying anatomic factors which contribute to the presence, severity, and jumping quality of the J-sign.

METHODS: All patients undergoing evaluation for patellar instability at a single institution between 2013-2023 and healthy controls without patellar instability were included. Patients with a prior history of prior osteotomies were excluded. The presence of a jumping J-sign and its relationship to patellofemoral measures including Caton Deschamps Index (CDI), dysplasia, tibial tubercle to trochlear groove distance (TT-TG), tibial tubercle lateralization, trochlear bump height, and knee rotation (KRA) angle were measured using standardized 1.5T MRIs. Univariate pairwise and multivariate analyses were performed to determine the risk factors associated with J sign presence, severity and quality.

RESULTS:

Of the 135 patellar instability knees, 94 knees (69.6%) demonstrated a J sign on physical examination. Of those with specified quadrants, 44 (32.6%) demonstrated a 1-quadrant J sign, 32 (23.7%) demonstrated a 2-quadrant smooth J sign, and 13 (9.6%) demonstrated a jumping J sign. On multivariate analysis, increasing KRA (OR 1.1 increase per degree, p=0.01) and increasing CDI (OR 2.2 increase per 0.1 increase in CDI, p=0.01) were associated with the presence of any J sign. Compared to patients with a 2-quadrant smooth J sign, more external KRA (OR 1.55 increase per degree increase, p=0.014), large trochlear bump height (OR 9.43 increase per mm, p=0.038) and smaller trochlear width (OR 0.65 decrease per mm, p=0.03) were predictive of the Jumping J sign. A KRA of 10° (AUC=0.70) and a cartilaginous bump height of 6.6 mm (AUC=0.73) were thresholds associated with the presence of a Jumping J sign.

DISCUSSION AND CONCLUSION:

This study sought to identify anatomic factors associated with the presence of a jumping J-sign on physical exam in patients with patellar instability. Overall, a jumping J-sign was observed in 19% of the study population. Increased CDI ratio, increased trochlear bump height, and Dejour A and B trochlear dysplasia were significant risk factors on univariate analysis. On multivariate analysis, trochlear bump height, Dejour A, and Dejour B dysplasia remained the only significant independent predictors for a jumping J-sign. Conversely, CDI was no longer significant on multivariate analysis, suggesting that the presence of a jumping J-sign is primarily driven by anatomic trochlear factors, as opposed to patellar factors (e.g., patellar height) or tibial factors (e.g., TT-TG) associated with patellar instability.

Figure 1. Pairwise comparisons demonstrate significant differences across all measures except patellar length between groups of varying presence and severity of J sign.

Figure 2. Presence of a J sign is associated with external (positive) tibiofemoral rotation and increasing patellar height.

Figure 3. Presence of a Jumping J sign is driven by Bump Height and Knee Rotation Angle. In the setting of a low bump height, a high knee rotation angle is needed to produce the Jump. However, as bump height increases, a lower knee rotation angle is required to produce the Jump. By ROC analysis, a bump height of 6.6 mm and KRA of 10° are associated with the Jumping J Sign.