

Review Article

The hidden integration: J-sign patella as a predicting indicator for knee osteoarthritis and its therapeutic implications

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ABSTRACT

The J-sign patella is an erroneous movement or tracking of the patella during knee movement, particularly when moving laterally during knee flexion, which can be symptomatic of patellar malalignment or instability, essential in developing and progressing knee osteoarthritis (KOA). The study aimed to determine the clinical significance of the J-sign patella as a diagnostic and prognostic tool in patients with KOA. The objective of this study was to comprehensively evaluate the clinical and pathophysiological importance of the J-sign patella in the onset, progression, and management of KOA, with a particular emphasis on its diagnostic, prognostic, and therapeutic implications. A systematic search was conducted to discover all relevant studies on the J-sign patella and its relation to the OA knee. Databases such as PubMed, Cochrane Library, and Scopus were used. A few research studies show the clinical significance of addressing J-sign patella in treating KOA.

Keywords: J-sign patella, Knee osteoarthritis, Patellar malalignment, Patellar instability, Biomechanical dysfunction

INTRODUCTION

KOA is a common and devastating disorder that causes considerable functional impairment and disability around the world. Mechanical strain, joint instability, and structural anomalies all contribute to the development of knee osteoarthritis. Abnormal patellar tracking, in particular, has been identified as a significant mechanical contributor to knee osteoarthritis, resulting in unequal stress distribution throughout the joint. A specific clinical sign known as the J has emerged as a substantial diagnostic of patellar instability and abnormal patellar tracking. The J sign is defined by a lateral displacement of the patella during knee extension, which resembles the letter "J."¹

The J sign indicates a disturbance in standard patellar tracking. It is commonly associated with anatomical abnormalities such as an elevated Q angle, trochlear dysplasia, or patellar alta, as well as muscle imbalances, particularly weakening of the vastus medialis obliquus

(VMO). This abnormal tracking causes higher mechanical stress on the lateral compartment of the knee, accelerating cartilage wear and promoting the inflammatory processes that contribute to OA. Notably, the J sign has been associated with recurrent patellar dislocations, chronic discomfort, and impaired knee function, all known risk factors for the development of OA.²

Pathophysiology of the J sign

The J sign, which resembles the letter "J" in motion, describes the lateral displacement of the patella as the knee moves from flexion to extension. There are several leading causes for this aberrant patellar tracking. A significant factor is a muscular imbalance, especially the vastus medialis obliquus (VMO) weakness concerning the lateral quadriceps, preventing the patella from sufficiently stabilizing. Structural abnormalities, including trochlear dysplasia, patellar alta, or an elevated Q angle, can also cause alterations in patellar mobility and location. Patellar

instability is further aggravated by ligamentous laxity, namely insufficiency of the medial patellofemoral ligament (MPFL).³

Clinical implications of the J sign on knee joint

During a clinical examination, the J sign is diagnosed when the patient extends their knee from a flexed position. The J sign is indicated by a sudden lateral shift of the patella during this motion. Imaging techniques like dynamic MRI can visualize aberrant patellar tracking and validate patellar instability, further corroborating the clinical findings.

The J sign is linked to persistent discomfort, changed joint loading, and repeated patellar dislocations regarding prognostic significance. Continuous instability increases the articular cartilage's wear and tear, hastening joint deterioration and increasing the knee's vulnerability to OA.^{3,4}

Contributors to the development of osteoarthritis

Contributors from biomechanics

Increased stress on the lateral compartment results from abnormal patellar tracking, which modifies the load distribution across the knee joint. This eventually leads to joint space constriction, subchondral bone remodeling, and cartilage degradation.

Inflammatory pathway

Recurrent instability can exacerbate cartilage deterioration by causing localized synovitis and inflammatory cascades. This low-grade inflammation further accelerates the progression of OA.³

The J sign's significance in osteoarthritis

Considering the J sign has been associated with lateral patellar instability, it is an essential clinical indicator for determining whether patients are at risk for the advancement of OA.

Its existence draws attention to underlying biomechanical abnormalities that worsen joint deterioration. By enabling prompt action, early diagnosis of the J sign lowers the inflammatory and mechanical stresses that lead to OA. This emphasizes how crucial it is to address risk factors that can be changed to prevent OA-related impairment and identify patellar instability.^{3,4}

Furthermore, the significance of the J signs as a prognostic indicator in OA helps direct individualized therapy regimens. By providing targeted therapy for patients with patellar maltracking and instability, incorporating the examination of this sign into routine clinical evaluations may improve outcomes.

Purpose of the study

The study aimed to evaluate the clinical importance of the J sign in KOA and patellar instability. The project also intends to determine how early intervention efforts to prevent or reduce the progression of OA can be guided by the detection of the J sign. This study highlights the significance of early diagnosis and focused treatment in treating patients at risk of developing OA by understanding the underlying pathophysiology and the influence of the J sign on joint biomechanics.

REVIEW

The database searches were PubMed, Google Scholar, and Research Gate. Terms used during the search were J-sign Patella, osteoarthritis, knee pain, and the following algorithm. To analyze the research J-sign patella, a contributor to developing KOA. A total of 20 relevant articles were found through a search in PubMed, Google Scholar, and Research Gate.

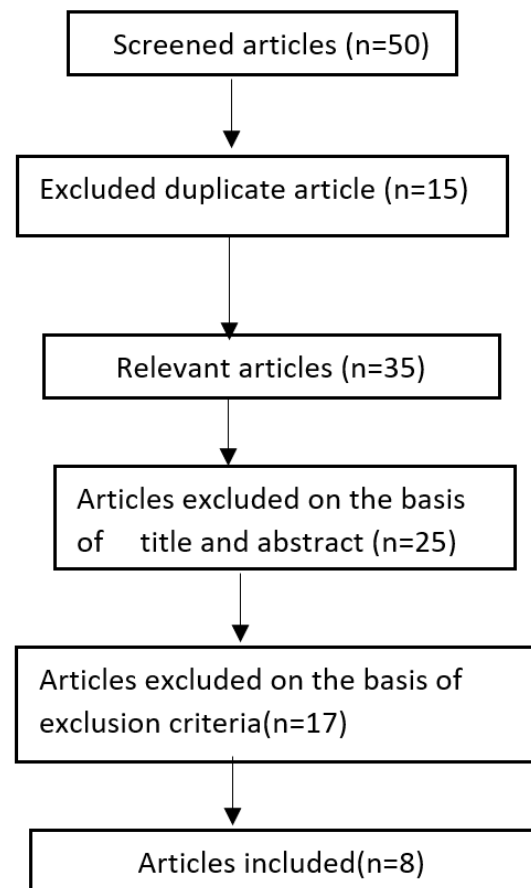


Figure 1: Flow chart of screening of articles for review.

Nine articles were relevant and found through searches in PubMed, Google Scholar, and Research Gate, in which a cohort study, two cross-sectional studies, three observational studies, and two literature reviews were included.

For the adult population, the impact of J-sign patella on KOA was examined and published from 2001 to the present. Studies were published in English, and recent research was the inclusion criteria. Research conducted on adults and research published before 2000 was the exclusion criteria.

RESULT

A total of nine articles were taken and studied. The review study was tabulated about the author, year of publication, the title of the study, study design, and conclusion of the study are described below in Table 1.⁵⁻¹²

Table 1: List of articles including author, year of publication, title, type of study design and conclusion.

Year of publication	Author	Title	Study design	Conclusion
2007	Kalichman et al ⁵	The association between patella alignment and knee pain and function: an MRI study in persons with symptomatic knee osteoarthritis	Observational	Observed that J-sign affects the knee joint's biomechanics, increasing the development of OA.
2007	Hunter et al ⁶	Patella malalignment, pain, and patellofemoral progression: the Health ABC Study	Cohort study	Observed that patellar malalignment influenced the degree of knee discomfort and the development of patellofemoral OA.
2010	Sheehan et al ⁷	Q-angle and J-sign: Indicative of Maltracking Subgroups in Patellofemoral Pain	Cross-sectional study	Investigates the correlation between knee pain and patellar maltracking, Q-angle, and J-sign.
2011	Hunter et al ⁸	The patellofemoral joint: the forgotten joint in knee osteoarthritis	Review	Highlights the physiological causes and treatment of knee OA while highlighting the significance of the patellofemoral joint.
2016	Buchanan et al ⁹	Current Concepts in the Treatment of Gross Patellofemoral Instability	Review article	Reviews J-sign-related treatment options for patellofemoral instability.
2018	Zhang et al ¹⁰	Association of malalignment, muscular dysfunction, proprioception deficits, and laxity with knee osteoarthritis	Observational	Analyses the role that proprioception deficiencies, muscle dysfunction, and misalignment play in knee OA.
2022	Zhang et al ¹¹	Patellar malalignment is associated with increased pain and increased risk of patellofemoral osteoarthritis.	Observational	It was discovered that the chances of developing patellofemoral OA and more significant pain are correlated with patellar malalignment.
2024	MünHermann et al ¹²	Clinical findings in patellofemoral osteoarthritis compared to tibiofemoral osteoarthritis.	Cross-sectional study	It emphasizes functional performance and contrasts the clinical features of tibiofemoral and patellofemoral OA.

DISCUSSION

This study highlights the connection between KOA and the J sign's function in patellar instability. Atypical load distribution across the joint, particularly on the lateral femoral condyle, is caused by the J sign, defined by lateral patellar deviation during knee extension. This elevated stress causes cartilage deterioration more quickly, which

complicates OA.¹³⁻¹⁵ The study's dynamic MRI results supported the clinical diagnosis and demonstrated the usefulness of imaging in identifying anomalies in patellar tracking. According to the study, OA is linked to both chronic pain and recurrent patellar dislocations. Stabilizing the patella and halting the course of OA need conservative measures like physical therapy and bracing in addition to surgical procedures, including MPFL

restoration and, in extreme situations, tibial tubercle transfer.¹⁶

CONCLUSION

The patella's J sign is a significant marker of lateral patellar instability and a possible risk factor for KOA. Early detection is crucial because it can result in focused therapies to stop joint deterioration. Longitudinal studies should be the main focus of future research to determine causal linkages and improve treatment algorithms. Clinicians can help individuals at risk of OA by treating the underlying biomechanical and inflammatory factors linked to the J sign.

Future studies could provide unique insights into the significance of patellar malalignment in KOA therapy. They could also identify more effective therapeutic strategies by performing large-scale randomized controlled trials focused on the J-sign patella and its impact on OA progression.

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