2 Patellofemoral Anatomy, Mechanics, and Evaluation: Patient and Family History in the Evaluation of Patellofemoral Patients

John Fritch, Jason L. Koh, and Shital N. Parikh

2.1 Event History

A patient's first patellar dislocation is a memorable and often traumatic event. Despite this, often the patient's description of the event will not clearly lend itself to a patellar dislocation. Usually patients will not present with a frank dislocation as they often spontaneously reduce. Patients often describe a painful, swollen, and guarded knee after an acute event [1, 2]. The clinician should ask if the kneecap appeared out of place or if it required a reduction maneuver. Particular attention should be paid to pain location and provocation. Pain at the medial epicondyle, medial patellar facet, and lateral femoral condyle should provide clues to a dislocation event. Similarly, an effusion and locking of the knee should raise suspicion for a possible associated osteochondral injury. Careful questioning should help discern between sensations of patellar subluxation, dislocation, and the knee giving way. The clinician must also obtain a thorough history about the exact activity the patient was performing at the time of injury, such as cutting, pivoting, and twisting.

2.2 Previous Instability

The biggest predictor of recurrent instability is any previous dislocation or subluxation. Several recent studies estimate the rate of recurrent instability is between 17 and 30% [3, 4]. This rate varies widely across studies most likely due to the multifactorial nature of patellar instability and design flaws within some of the historical studies. Despite this, it is widely accepted that those patients sustaining more than one prior dislocation are at much higher risk for subsequent dislocation events. In a large epidemiological study, Fithian et al. found that 49% of patients with two prior dislocations sustained another in the same knee [4].

Not surprisingly, patients with a history of patellar instability were at higher risk for instability in the contralateral knee. In one study, risk of contralateral instability was six times higher for patients with recurrent instability in the index knee [4]. Conversely, the odds of recurrent insta-

J. Fritch
Department of Orthopaedic Surgery, Pritzker School of Medicine, University of Chicago, Chicago, IL, USA

J. L. Koh
Orthopaedic and Spine Institute, NorthShore University HealthSystem, Skokie, IL, USA

Pritzker School of Medicine, University of Chicago, Chicago, IL, USA

Northwestern University McCormick School of Engineering, Evanston, IL, USA

S. N. Parikh (✉)
Orthopaedic Sports Medicine, Cincinnati Children's Hospital, Cincinnati, OH, USA

University of Cincinnati School of Medicine, Cincinnati, OH, USA
e-mail: Shital.Parikh@cchmc.org

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bility was about three times higher in patients with a history of a contralateral dislocation [5]. Clearly, those patients with bilateral instability are at higher risk for recurrence in either knee.

2.3 Age

Young age has been consistently identified as a risk factor for recurrent patellar instability. The association is not completely understood, but is most likely due to high risk individuals sustaining injury early and frequently in life. Peak incidence of patellar instability is the second decade of life. Median age for first-time dislocation is 16 years and recurrent dislocation is 21 years [4]. One study found when instability started before age 16, the odds ratio of recurrence was 11.2 [6]. Recurrent instability rates of 52–60% have been reported in patients under the age of 15 compared to 26–33% in patients 15–18 years old [7, 8]. When considering bone age or maturity, skeletally immature patients have more than twice the risk of recurrent instability than skeletally mature patients, 43.3% and 21.6%, respectively [5, 9]. Although young age is a risk factor for repeat dislocation, increasing age is protective. In one study, for each year increase in age after first dislocation the risk of recurrence decreased by 8% with no recurrence past age 40 [9].

2.4 Gender

Historically, it has been accepted that females between 10 and 17 years old are at highest risk for first time and recurrent patellar instability [4]. The same study reports that the risk of recurrent instability is three times greater in females than males [4]. This gender discrepancy was thought to be due to increased incidence of malalignment and joint laxity in females. More recent studies suggest no difference in patellar instability between males and females [5, 6, 10]. A systematic review by Stefancin et al. reports that the overall incidence of patellar dislocation between males and females is nearly equal: 47% versus 53% [3]. It is possible that previous studies captured a disproportionate patient population; however, this has not been proven.

2.5 Activity

A critical aspect of the patient's history is the activity they were engaged in at the time of patellar dislocation. Injuries can occur from either direct or indirect trauma to the knee; however, non-contact injuries occur more commonly [11]. Multiple studies have cited 50–60% of patellar dislocations occur during sports activities [4, 12, 13]. This is most likely due to sports activities placing the knee in a vulnerable position for patellar instability. Specifically, a position of knee valgus and internal rotation on a planted foot produces a lateral vector on the patella which may result in injury [2]. Sports that have been implicated as higher risk in patellar instability include gymnastics, football, wrestling, basketball, and dancing [4, 12, 14].

Additionally, patients that initially dislocated during a sport activity were at higher risk for recurrence (HR 1.97) presumably due to return to high risk activity [9].

Importantly, there appears to be two subsets of activities associated with patellar instability. Patellar dislocations in the setting of significant trauma such as during contact sports or a direct blow to the knee usually demonstrate normal patellofemoral anatomy and have a lower risk of recurrent instability. Conversely, patellar instability after low risk activities are likely due to the presence of underlying anatomical risk factors or joint hyperlaxity and are at a higher risk for recurrence [15, 16].

2.6 Personal History

Obtaining a complete history is important as 9–15% of patients with a patellar dislocation will have a positive family history [11, 17]. Additionally, patients with factors associated with developmental dysplasia of the hip at the time of birth or delivery by cesarean section had higher odds of contralateral instability [4].

Connective tissue disorders such as Ehlers-Danlos Syndrome or generalized ligamentous hyperlaxity are important to identify as those patients are at higher risk of recurrent instability. Any underlying disorders such as cerebral palsy and Down syndrome should be identified as they may have chronic patellar dislocations and require different treatment algorithms.

2.7 Previous Treatment History

2.7.1 Conservative Management

Although most first-time patellar dislocations are treated conservatively, it is important to understand the natural history of non-operative management and recurrence of instability. Out of patients treated conservatively for a first-time dislocation, one third return to activity without consequences, one third have another dislocation requiring surgical stabilization, and one third do not have another dislocation but continue to have symptoms and are unable to return to previous level of activity [18]. Most conservative treatment involves physical therapy and varying degrees of immobilization or bracing. In a long term study of patients with a primary patellar dislocation, those treated in a patellar brace had greater than three times the risk of repeat dislocation compared to those treated in a posterior splint, however those treated in a splint or cast had the highest rate of stiffness [19]. In general, rehabilitation protocols now focus on early protected mobilization to minimize stiffness while preventing repeat instability.

When examining the outcomes of first-time patellar dislocations treated conservatively versus operatively, it is still unclear which treatment is superior. A prospective randomized study compared 62 patients treated either operatively or conservatively and found no difference in outcome, function, instability, or activity [20]. Similarly, Buchner et al. showed no difference between patients treated with early operative stabilization and those treated conservatively for a first-time dislocation with respect to repeat dislocation, activity level, functional and subjective outcomes [7]. Multiple randomized control trials of operatively treated primary dislocations failed to improve recurrent dislocation rate compared to conservative management [21–25]. A study by Arnbjornsson et al. followed patients with bilateral patellar dislocations for 14 years. One side was treated operatively and the other conservatively. They found that at long term follow-up the operative extremity had worse arthritis and instability than the nonoperatively treated side [26]. It appears that operative treatment of first-time dislocations carries a more substantial complication profile while offering only similar protection from repeat dislocation as non-operative treatment.

2.7.2 Surgical Treatment

Similar to conservative treatment, it is important to know any operative treatment a patellar instability patient had undergone to better understand their risk for recurrence. Although more recent research has led to treatment algorithms resulting in better stability, historically there has been increased risk of recurrent instability and other complications with certain procedures. One such procedure is an arthroscopic lateral retinacular release, which can lead to lateral patellar mobility and medial instability and is no longer supported as treatment for patellar instability [27, 28]. Similarly, MPFL repair or refixation after primary dislocation does not prevent further instability [20–24].

Over time, the success of various surgical techniques has been tested by other patient factors. For example, results of medial plication techniques had satisfactory results at short-term follow-up, however, in the presence of trochlear dysplasia, early redislocation occurred commonly [25, 29].

More recently it has been widely accepted that MPFL reconstruction is a reliable procedure for patellar instability. Redislocation rates after MPFL reconstruction are low; several different studies have published rates of 0–5% [30–33]. However, MPFL reconstruction should not be considered a universal treatment as other patient

factors can affect its success. For example, Hopper et al. reported a 100% rate of redislocation in patients with an isolated MPFL reconstruction in the setting of severe trochlear dysplasia [34]. In cases of rotational malalignment, recent literature suggests the addition of tibial tubercle transfer can help decrease recurrent instability. Allen et al. report combined MPFL reconstruction with tibial tubercle anteromedialization has promising results in patients with recurrent patellar instability, citing a redislocation rate of 3% [35]. Tibial tubercle transfer has its own complication profile including overmedialization which can result in increased medial patellofemoral pressure and pain. One author suggests this can be avoided by reserving medialization for cases of lateral patellofemoral chondrosis only and intraoperatively correcting the tubercle sulcus angle to zero [36].

2.8 Importance and Implications

The accurate identification of demographics and risk factors associated with patellar instability are becoming increasingly important in determining treatment algorithms to improve patient outcomes and reduce disability. There is still much unknown about patellar instability. Meetings of experts in the field such as the AOSSM/PFF and International Patellofemoral Study Group (IPSG) help by publishing consensus statements providing useful insight into the evaluation and treatment of patellar instability [37, 38]. Additionally, multicenter trials such as JUPITER (Justifying Patellar Instability Treatment by Early Results) will be critical to learning more about treatment and prognosis of patellar instability across an increasingly diverse patient population [39].

Take Home Message

- Patellar instability is multifactorial in nature.
- Careful history taking can help identify risk factors for recurrence.
- Patient history including age, gender, family history, and ligamentous laxity plays a role.
- Pay attention to mechanism, history of ipsilateral or contralateral instability, and previous treatments.
- Future multicenter research will help define demographics, prognostic factors, and treatment algorithms.

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