



## REVIEW

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# Primary traumatic patellar dislocation

Chun-Hao Tsai<sup>1</sup>, Chin-Jung Hsu<sup>1</sup>, Chih-Hung Hung<sup>1</sup> and Horng-Chaung Hsu<sup>1,2\*</sup>

## Abstract

Acute traumatic patellar dislocation is a common injury in the active and young adult populations. MRI of the knee is recommended in all patients who present with acute patellar dislocation. Numerous operative and non-operative methods have been described to treat the injuries; however, the ideal management of the acute traumatic patellar dislocation in young adults is still in debate. This article is intended to review the studies to the subjects of epidemiology, initial examination and management.

**Keywords:** Patella, Trauma, Dislocation, Medial patellofemoral ligament

## Introduction

Acute traumatic patellar dislocation is the second most common cause of traumatic hemarthrosis of the knee and it accounts for approximately 3% of all knee injuries [1,2].

It is typically resulted from a sports injury and occurs about 2/3 of the time in young, active patients under the age of 20. Most patellar dislocations are associated with participation in sports and physical activity [3-5]. The long-term impact of patellar dislocation and the resulting patellar instability can lead to considerable pain, recurrence, and even patellofemoral osteoarthritis [6].

## Definition

The differentiation of acute primary patellar dislocation from habitual dislocation is important because the recommendations with varying treatment approaches were framed in the literatures. Primary (first-time) patellar dislocation is defined as a clinical entity that usually causes a traumatic disruption of the previously uninjured medial peripatellar structures [3,7,8].

One of the common findings related to acute, primary, traumatic patellar dislocations is hemarthrosis of the knee, caused by rupture of the medial restraints of the patella.

## Incidence and risk factors

The incidence rates of primary patellar dislocation in a population-based setting among adults were revealed in

some reports [3-5,9]. The average annual incidence for patellar dislocation injuries ranged between 5.8 and 7.0 per 100,000 person-years in the civilian population, and up to 29 per 100,000 person-years in the 10–17 year age group. However, the incidence was increased to 69 per 100,000 person-years in the military population who needed to pass physical fitness tests and training requirements of military service [9]. Women were more likely to sustain a patellar dislocation injury than men. The trend of the highest rates for patellar dislocation injuries in the youngest age group, and rates declined with increasing age were observed not only in military but also in the civilian population-based studies [3-5,9]. Those previous findings may be associated with increased activity levels in younger individuals and predisposed to anatomic features rendering some youth more vulnerable.

## Injury mechanism

Knee flexion and valgus have been noted as the leading mechanism of injury associated with patellar dislocation, accounting for as many as 93% of all cases [5]. Sillanpaa and colleagues reported that hemarthrosis, medial patellofemoral ligament injury, and medial retinacular disruption were presented in nearly all patients with acute traumatic primary patellar dislocation. Osteochondral fractures have been noted in nearly 25% of acute patellar dislocations [5].

Results obtained after patellar dislocation were reported from studies evaluating treatment approaches [10-14], but often no distinction was made between acute traumatic and recurrent instability. The risk

\* Correspondence: d4749@mail.cmu.h.org.tw

<sup>1</sup>Department of Orthopaedic Surgery, China Medical University Hospital, School of Medicine, China Medical University, Taichung, Taiwan

<sup>2</sup>Department of Orthopaedic Surgery, China Medical University Hospital, No. 2, Yuh-Der Road, Taichung 404, Taiwan, Republic of China

factors could not be adequately determined due to lack of consistent and qualified reports in many articles. The trend of dislocation and recurrent instability was up to 80% of cases and attributable to predisposing factors of vastus medialis muscle hypoplasia, hyperlaxity of the ligaments [15,16], increased femoral anteversion with compensatory external tibial torsion[17], trochlear dysplasia [18,19], patella alta [20,21], dysplastic patella, and increased Q-angle with lateralized tibial tuberosity and genu valgum [22,23].

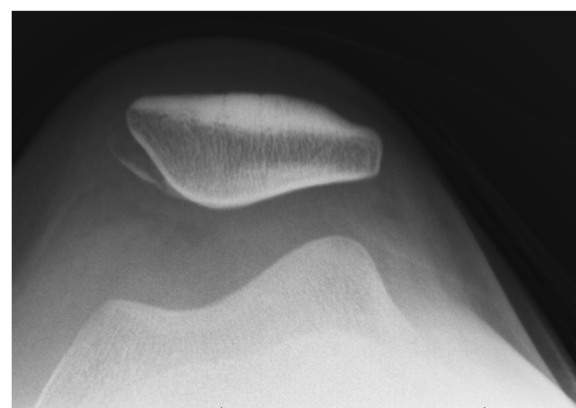
### Examination and diagnostic study

The initial evaluation of a first-time traumatic patellar dislocation should include an appropriate patient history, family history of patellar dislocation and hyperlaxity, physical examination, and diagnostic studies. Sports (61%) and dances (9%) injuries are two common mechanisms of patellar dislocation. The risk of recurrence increased to 6-fold for patients with a history of contralateral patellar dislocation, which was as much as a previous dislocation event on the index knee [4].

Diagnostic and therapeutic aspiration of the knee joint should be performed in patients with moderate to severe effusions. Joint aspiration performed with/without a local anesthetic can relieve joint depression to achieve patient comfort and improve clinical examination and radiographic assessment (such as 45° flexion Merchant view, 45° flexion weight-bearing view, and 30° lateral view, which are difficult to obtain in patients with an acute hemarthrosis). In addition, the presence of fatty globules may be indicative of an osteochondral fracture. In the acute setting, physical examination is important in making the diagnosis of acute lateral patellar dislocation and for noting any concurrent knee or lower extremity injury [24]. Assessment for malalignment of lower extremities and hypermobility of the contralateral knee are also suggested to be included [25].

Patellar apprehension and mobility should be assessed by medial and lateral patellar translation. Palpation is important in detecting areas of retinacular tenderness and soft tissue injury. Palpable defects in the vastus medialis obliquus (VMO), adductor mechanism, medial patellofemoral ligament (MPFL), and a grossly dislocatable patella are prognostic factors that may predict poor nonoperative outcomes [24].

Radiographic examination should include an AP extended knee weight-bearing view, a Mercer-Merchant view (45° flexion weight-bearing view), and a 30° flexion lateral view. A Merchant view in a “first-time” traumatic patellar dislocator shows an osteochondral fracture of the medial facet of the patella in a well-aligned patellofemoral joint with no lateral subluxation of the patella (Figure 1). Osteochondral fractures at the medial inferior edge of the patella are highly suggestive of injury



**Figure 1** The plain Merchant axial radiograph demonstrates an osteochondral fracture of the medial facet of the patella in a first-time traumatic patellar dislocation, a secondary sign of an injury to the medial patellofemoral ligament, at the patellar attachment.

pattern. However, it has been reported to be missed in 30% to 40% of initial radiographs in both surgical and MRI studies [26,27].

CT scan could be used to evaluate the bony predisposing risk factors for dislocation, including patellofemoral alignment, the presence of osteochondral defects, patellar tilt, translation, tibial tuberosity trochlear groove distance, and trochlear dysplasia [28]. It is also helpful in evaluating long bone torsional deformities and determining the rotational relationship between the tibial tuberosity and femoral sulcus in varying degrees of knee flexion [24]. The cartilaginous femoral sulcus contour is shallower than the underlying bony sulcus in patients younger than 18 years old. Therefore, measurement of the bony femoral sulcus angle on radiograph or CT scan is less important than that of the cartilaginous femoral sulcus angle using ultrasound or MRI [29]. CT scan is also limited in looking at the location and extent of soft tissue defects of the medial patellar stabilizers.

Characteristic MRI findings of patellar dislocation include joint effusion, bruising of the medial patellar facet and lateral femoral condyle, osteochondral injury to the medial patella and anterolateral portion of the lateral femoral condyle. A concave impaction deformity of the inferomedial patella is a specific sign of lateral patellar dislocation [7,30]. But there is no correlation can be defined between initial size and size reduction in bone bruise volumetric and the presence/absence or type of associated injuries [31,32].

With the information available on utilizing newer types of magnetic resonance sequencing, MRI is becoming more specific in assisting the surgeon in deciding on nonoperative versus operative management to define the specific injured structure for surgical repair. MRI

assessment is important to evaluate not only the chondral surfaces of the patellofemoral joint but also at the location an extent of soft tissue damage to the medial patellar stabilizers (including medial retinaculum, medial patellofemoral ligament and the vastus medialis obliquus) [33-35]. MRI with the most specificity in visualizing the medial patellofemoral ligament is the primary restraint to lateral subluxation of the patella in early flexion (Figure 2) [29,31].

### Treatment

The squeals of a patient's first patellar dislocation can be harmful and have been well described in the literatures [36,37]. More than 50% of patients have complaints after the first-time dislocation of the patella [13], and will be likely to develop some level of osteoarthritis of the patellofemoral joint after a long-term follow-up [38]. Moreover, recurrence rates after primary dislocation can be relatively high, up to 40% [39].

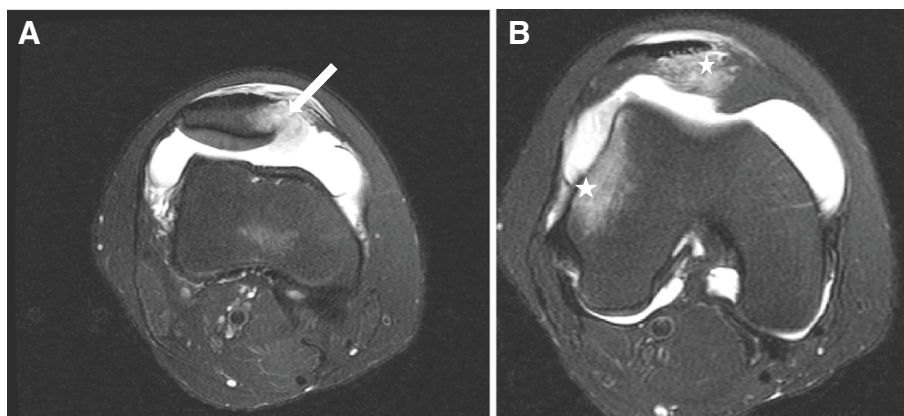
Proper treatment is essential in order to minimize squeals such as recurrent dislocation, painful subluxation, and osteoarthritis. Whether initial stabilizing surgery for treatment of a primary traumatic patellar dislocation decreases the risk of further instability is still in debate. Results and recommendations on treatment of patellar dislocation vary widely and lack higher quality of evidence. The outcomes of conservative and operative management were compared in limited studies [10,40]. To our knowledge, there were only two prospective randomized trials regarding acute patellar dislocations had been published in the English-language literatures [41,42]. The redislocation rates were generally high, varying between 10% and 30% for surgical treatment [1,14,23,40,43] and between 13% and 52% for conservative treatment [10-13,40].

Arthroscopy should be performed if chondral injury or osteochondral fracture is suspected. Whenever the osteochondral fracture is greater than 10% of the patella articular surface or part of the weight-bearing portion of the lateral femoral condyle, it is recommended to perform open repair as long as the fragment is amenable to fixation.

Other than preferences for nonoperative treatment of primary patellar dislocations have been shown in previous studies [41,44,45], patients with habitual dislocations and patellofemoral symptoms seem to be benefited from reconstructive surgery [46,47]. Stefancin and Parker recommended initial nonoperative treatment for first-time traumatic patellar dislocation in their systematic review of 70 articles, unless there are clinical, radiographic, CT, and/or MRI findings of chondral injury, osteochondral fractures, or large medial patellar stabilizer defects [2].

### Non-operative treatment

There were few literatures addressing the nonoperative treatment of the primary patellar dislocation. But it is all agreed that patients should be immobilized initially for comfort (3-4 weeks) to allow immediate weight bearing as tolerated on crutches after close reduction of the lateral dislocated patella. Early mobilization is important in maintaining articular cartilage health [24]. Patella-stabilizing braces were used as soon as comfort permitted, followed by beginning resisted close-chain exercises and passive range of motion in the brace [3]. The efficiency of physical therapy after the first patellar dislocation; either the patellar braces or straps on the outcome, has not been reported in any study. There was still some debate for the best model of knee immobilizers. The effects were compared in patients treated with in a posterior splint, cylinder cast, or patellar bandage/brace



**Figure 2** An axial T2-weighted fast-spin-echo magnetic resonance imaging scan illustrates a eighteen year-old female sustaining a primary traumatic lateral dislocation of the patella while jumping. Complete avulsion of the medial patellofemoral ligament from its femoral insertion can be seen (arrow) (Figure 2A). The bone contusions (stars) (Figure 2B) of the lateral femoral condyle and the medial patellar facet are noted.

[13]. Results showed that the posterior splint group had the lowest proportion of knee joint restriction and lowest redislocation frequency per follow-up year. In the study using MRI to look at the effect of bracing on patella alignment and patellofemoral joint contact area in skeletally mature women with patellofemoral pain, the On-Track brace and the Patellar Tracking Orthosis (PTO) were shown to increase total patellofemoral joint contact area in comparison to the no-brace control group [48].

### Surgical treatment

Surgical intervention for first-time traumatic patellar dislocation is indicated in the following situations: (1) evidence on imaging or clinical examination of osteochondral fracture or major chondral injury; (2) palpable or MRI findings of substantial disruption of the MPFL-VMO-adductor mechanism; (3) a patella laterally subluxated on the plain Mercer-Merchant view with normal alignment on the contralateral knee; (4) a patient fails to improve with nonoperative management especially in the presence of one or more predisposing factors to patellar dislocation; and 5) subsequent redislocation [2]. Surgical stabilization significantly reduced the redislocation rate of primary traumatic patellar dislocation in a young adult population than those without surgical treatment, which was addressed in a prospective, randomized, controlled study [42].

There is high prevalence of medial patellofemoral ligament injury in association with acute patellar dislocation [42,49,50]. The injuries of the medial patellofemoral ligament and the medial retinaculum as well as hemarthrosis are the definite signs of an acute primary traumatic patellar dislocation[42]. It is reasonable and becomes more accepted to consider that large defects or avulsions are not going to heal or have a good functional outcome with closed treatment especially in individuals with high-level athletic participation and those with evidence of one or more predisposing factors. MPFL injury has been demonstrated as the primary constraint in preventing lateralization of the patella in studies [26,51]. Immediate surgical repair of the injured medial patellar stabilizers, including the vastus medialis obliquus muscle and the medial patellofemoral ligament is advocated in this situation. In our experience, the surgical repair of medial stabilizer with medical plication and arthroscopic removal of osteochondral fragment have satisfactory result and no recurrence of dislocation at least six months follow-up (Table 1).

### Conclusion

Primary traumatic patellar dislocation is a common injury in young active population. The importance of detail initial evaluation with MRI cannot be underestimated. Recent studies have proved that initial surgical stabilization of the medial patellofemoral avulsion is beneficial in acute

**Table 1** The table shows the patient data, image data and surgical detail in our institute within 2 years and no recurrence of dislocation at least six months follow-up

Age	Gender	Injury side	Mechanism	MRI finding		Surgery			Follow-up (months)
				Bone contusion	MPFL tear	Medial plication	Lateral release	Removal of osteochondral fragment	
15	F	Left	Fall	+	Femoral side	+	+	-	20
13	M	Right	Run	+	Both	+	+	+	15
21	M	Right	Non trauma	+	Patella side	+	+	-	13
18	F	Left	Tennis	+	Patella side	+	+	-	12
21	F	Right	Fall	+	Patella side	+	+	-	12
20	F	Left	Direct contusion	+	Patella side	+	+	-	10
31	M	Left	Fall	+	Femoral side	+	+	+	9
23	F	Left	MBC	+	Femoral side	+	+		9
13	F	Left	Dance	+	Femoral side	+	+	+	9
19	M	Left	MBC	+	Both	+	+	-	8
16	M	Right	Basketball	+	Femoral side	+	+	+	8
16	F	Left	Fall	+	Patella side	+	+	-	7
31	F	Left	Fall	+	Patella side	+	+	-	7
16	M	Left	Basketball	+	Both	+	+	+	7
22	M	Right	Sprain	+	Patella side	+	+	+	6



primary traumatic patellar dislocation. Additional prospective randomized comparison studies with longer-term follow-up are needed to identify risk factors like behavioral factors, strength, neuromuscular control, and postural stability in high-risk populations for future research.

#### Competing interests

The authors declare that they have no competing interests.

#### Authors' contributions

HHC designed the main framework and also performed final check for this manuscript. TCH carried out the paper survey and drafted the manuscript and both HCJ and HCH edited the manuscript. All authors read and approved the final manuscript.

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