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LITERATURE REVIEW

Management of Habitual Patellar Dislocation in Pediatrics

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ABSTRACT

Habitual patellar dislocation occurs when the knee is bent and returns to its usual position when straightened. Habitual patella dislocation is 13.5 per 100,000 in children under 13 and 147.7 per 100,000 in children 14–18. This review aims to present a comprehensive and complete literature on the management of habitual dislocation of the patella so that appropriate therapy can be obtained. A complete literature review was used in this investigation. Source search databases are PubMed, Science Direct, and Google Scholar. The literature study shows that habitual patellar dislocation in children is infrequent. Stability requires bone and connective tissue that match the patellofemoral joint. Patella alta, torsional, angular, trochlear dysplasia, muscular anomalies, ligamentous laxity, or ligament damage can produce lateral patellar habitual instability. The quadriceps muscle drags laterally to the limb's mechanical axis. Clinical children with recurrent patellar dislocation may experience a sudden dislocation that "disappeared somewhere." If this condition returns, patients frequently develop unusual knee edema and inflammation. MRI, CT, and plain radiography can diagnose this condition. A CT scan can detect trochlear dysplasia. Joint effusion, osteochondral lesions, medial retinaculum tears, and medial patella and lateral femoral condyle cartilaginous discolorations can be seen by MRI. Conservative or surgical treatment of habitual patellar dislocation depends on the deformity and its effects.

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INTRODUCTION

Habitual dislocation of the patella, also known as obligatory patellar dislocation, refers to a condition where the patella dislocates during knee flexion and naturally relocates upon knee extension. This disease can cause patellofemoral and degenerative arthritis (Li *et al.,* 2022). This condition often appears in children who are learning to walk. In children, this condition does not cause pain, so it does not cause any complaints (Mittal *et al.,* 2021; Schlichte *et al.*, 2019). This disorder causes the knee to bend and straighten over and over again. The main problems it causes are in the lateral soft tissues of the knee joint, the underdevelopment of the femoral trochlea, an increased Q angle, a longer distance between the tibial tubercle and the trochlea groove (TT-TG), and a patella that sits high on the thigh. Experts emphasize that the broadus medialis obliquus plays a crucial role in preserving the integrity of the medial patella (Mulliez *et al.,* 2017).

In most cases, it is only noticed when the child starts walking and is often well tolerated in children if it is painless. This is a complex pathological condition (Hauser, 2006). Several studies estimate that the incidence of habitual dislocation of the patella is at least 13.5 per 100,000 in the population of children under 13 years and 147.7 cases per 100,000 in children 14-18 years. Some literature states that women aged 10-17 years have the highest risk of experiencing habitual dislocation of the patella. One study found that patients with immature skeletons were twice as likely to experience habitual dislocation of the patella (Mittal *et al.,* 2021; Schlichte *et al.*, 2019).

Many therapeutic methods can be used to manage cases like this in children. Although many techniques have been described in the literature for the treatment of habitual patellar dislocation, there still needs to be a single procedure that is completely effective in the surgical treatment of common patellar dislocation (Park *et al.,* 2007). There are two treatments for this condition, namely conservative and operative management. Conservative management and operative management have their respective indications. Treatment that is fast and precise and, according to the symptoms, reduces the risk of morbidity in children with such conditions (Mittal *et al.,* 2021).

So far, there are few more comprehensive and focused literature reviews on managing habitual patellar dislocation. This literature review will provide a complete presentation of the current management of patellar dislocation, incorporate new changes since its previous assessment, and give a brief overview of the findings that have accumulated over the years. With the right treatment, patients can recover quickly and avoid complications.

METHODS

The research approach employed in this study is a comprehensive examination of existing literature. The databases used for the source search include PubMed, Science Direct, and Google Scholar. The keywords used in the investigation were “habitual patellar dislocation,” “diagnosis,” and “management.” The search results from the three databases were 1,837 articles. Next, the articles were filtered, and there were 1,625 excluded because they only contained abstract articles, not full-text articles, articles in the form of literature reviews and case reports, duplicate articles, and no articles explaining details about habitual patellar dislocation. There were 212 full-text articles, but only 25 were read in detail. The results were the ten articles that matched the author’s criteria and the topic as a whole. There are inclusion criteria included in the article search, namely articles in English, research showing the diagnosis and discussing habitual

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patellar dislocation in pediatrics, and the complete report that can be accessed.

LITERATURE REVIEW

Definition And Epidemiology

Habitual patellar dislocation is a condition of more than one episodic dislocation of the patella, which can be assessed by examination and occurs when the patient experiences a flexion-extension movement. The dislocation almost always occurs on the lateral side of the femur. Dislocation will occur spontaneously when the patient flexes, and it will occur spontaneously when the patient extends without any intervention (Schlichte *et al.,* 2019; Ms *et al.,* 2014).

Habitual dislocation of the patella is at least 13.5 per 100,000 in the population of children under 13 years and 147.7 cases per 100,000 in children 14–18 years. Some other literature states that patellar dislocation occurs in as many as 43 out of 100,000 children under the age of 16 years and is more common in women, with a percentage of 70%. Children under 14 experience this condition more often than older children (Schlichte *et al.,* 2019; Hasler, 2016). Moreover, there is a considerably elevated rate of re-dislocation after an initial dislocation in children and adolescents compared to adults especially in patients under the age of 15 compared to those aged 15–18 years (Buchner *et al.*, 2005). As a result, probably, children and adolescents will frequently encounter instability, with a prevalence ranging from 38.4% to 91% (Lewallen & McIntosh, 2013).

Patellar dislocation is thought to occur due to an aberrant interaction between the alignment of the lower limb, the shape of the trochlea and patella bones, the passive constraints provided by ligaments and retinaculum, and the activity of the quadriceps muscle. Anatomical characteristics that may increase the probability of patellofemoral joint (PFJ) instability in adults have been found through medical imaging investigations (Stefancin, 2007). However, the complex relationship between risk variables that make people more likely to experience repeated patellar dislocation has yet to be well known, as the parameters have only been reported separately or in limited combinations and with different levels of significance (Barzan *et al.,* 2018).

Mechanism Of Injury

The stability of the patellofemoral joint depends on the correlation of the bone and connective tissue to its structure. Patella alta, torsional, angular deformity, trochlear dysplasia, muscle abnormalities, ligamentous laxity, or ligament damage can play a role in lateral patellar habitual instability (Schlichte *et al.*, 2019; Ms *et al.,* 2014). One reason for this is that the quadriceps muscle drags slightly laterally to the mechanical axis of the limb. This means that patellar dislocations often happen laterally. Medial instability is an uncommon occurrence, with congenital anomalies, quadriceps atrophy, or iatrogenically caused causes being more probable. Although intra-articular dislocation is rare, it can occur after a trauma in which the patella is separated from the quadriceps tendon and subsequently rotated (Hayat & Bitar, 2023).

a. Patella alta

It is often correlated with patellar dislocation habitual. The superior trochlear anatomical position will result in a bony restraint on the distal femur at the end of patellar flexion and dislocation of the patella (Ms *et al.*, 2014; Schlichte *et al.*, 2019). The instability of the patella was exacerbated by several risk factors, such as trochlear dysplasia, insufficiency of the MPFL, patella alta, aberrant Q angle, and genu valgum (Ms *et al.,* 2014).

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b. Torsional and angular deformity

Torsional or angular deformities in the femur and tibia or valgus in the patella will cause changes in the vector to become more lateral to the patella. The combination of femoral anteversion, genu valgum, and external tibial tubercles that are more reflected by the Q angle increases the risk of patellar dislocation (Ms *et al.,* 2014; Schlichte *et al.*, 2019).

Figure 1. Q angle in torsional and angular deformity (Ms *et al.,* 2014).

c. Trochlear dysplasia

A shallow femoral sulcus results in a decreased bony constraint on lateral translation. Several studies have found a 70% decrease in the stability of the lateral aspect of the femur in patients with this condition (Ms *et al.,* 2014; Schlichte *et al.,* 2019). Trochlea dysplasia was examined in five investigations involving individuals with repeated dislocations

d. Muscular imbalance

The role of the quadriceps and extensor muscles in habitual patellar dislocation is currently under further research. However, several studies have found that laterally moving the quadriceps muscle (J sign) can cause the patella to move out of the femoral sulcus with both extension and flexion (Ms *et al.,* 2014; Schlichte *et al.*, 2019).

Signs And Symptoms

Manifestation clinical children with recurrent patellar dislocation may experience a sudden onset of dislocation in the patella that feels like it has “disappeared somewhere”. They will come back when the child’s knee is straightened. If this condition recurs, the patient typically complains of inflammatory disease and edema in the abnormal knee. In this condition that occurs repeatedly, it can also make it difficult to return the patella to its original position, so sometimes it requires the help of other people to produce the patella to its original work. An abnormal knee can be unilateral or bilateral, but most often it is bilateral (Hasler, 2016; Ms *et al.,* 2014). It typically manifests itself after the initiation of locomotion and is frequently tolerable during early childhood. It is usually asymptomatic and is commonly identified on routine examinations or by parents as an unusual-appearing knee in several children. Nevertheless, the condition may manifest during childhood as dysfunctional symptoms and an inability to run due to instability (Park *et al.,* 2007).

A physical examination can provide suggestive results for diagnosing this condition. Usually, the patient does not find signs of acute abnormalities. Two checks can be done, namely:

1. Tracking the patella: the patient is asked to sit on the edge of the table with the legs extended and asked to flex slowly while the examiner watches the movement of the patella.
2. Fairbank sign: knee flexed 30 degrees; examiner manually dislocates the patella laterally (Ms *et al.,* 2014; Schlichte *et al.*, 2019).

Imaging

A standing radiographic examination of the lower extremities can show genu valgum, a risk

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factor for habitual patella dislocation (Ms *et al.,* 2014; Schlichte *et al.,* 2019). The condition of the patella alta can also be seen on a lateral genu X-ray examination. One method for determining patella alta is installing and Salvati techniques. On analysis of the lateral genus, the patella (LP) and the patellar tendon (LT) length should be approximately the same. If the patella tendon is 20% longer than the patella (LT/LP > 1.2), the patient has a patella alta.

Figure 2. X-ray examination *standing* (Ms *et al.,* 2014)

A CT scan examination of this patient can be done if the patient is suspected of having trochlear dysplasia (Herring, 2014; Ms *et al.,* 2014). CT scans measure the TT-TG distance, which is critical for patellar dislocation evaluation and treatment (Hayat & Bitar, 2023).

Finding diagnostic clues for patellar dislocation using MRI is very helpful. These clues include cartilaginous contusions of the medial patella and lateral femoral condyle, joint effusion, osteochondral lesions, and the medial retinaculum tears that are usually present. Moreover, it facilitates the monitoring of concurrent knee pathology. While the decision ultimately depends on the specific patient, the presence of osteochondral injury and certain risk factors for recurrent dislocation, such as an elevated sulcus angle, trochlear dysplasia, increased tibial tuberosity-trochlear groove distance, and a high Insall-Salvati Index (an indicator of patella alta), can be accurately assessed using MRI. These findings may indicate that surgical intervention is required. The instability of the patella was exacerbated by various risk factors, such as trochlear dysplasia, insufficiency of the MPFL, patella alta, aberrant Q angle, and genu valgum (Tsai *et al.*, 2012).

DISCUSSION

The management of patients with habitual patellar dislocation can be classified into two categories, which can be conservative or operative depending on the type of deformity and possible complications (Li *et al.,* 2022; Ms *et al.,* 2014).

Conservative

Nonoperative care has historically been the most popular first treatment for first-time dislocations without osteochondral fragments, bone MPFL avulsions, or meniscal tears (Popkin *et al.,* 2018; Vellios *et al.,* 2020). The non-operative treatment protocol consists of the following stages: (1) reduction of pain and swelling; (2) regaining joint flexibility and mobility; (3) strengthening of muscles; (4) regaining motor patterns and coordination; and (5) going back to sports (Rund *et al.,* 2021). Patients who experience dislocation for the first time should be immobilized at the knee. The majority of medical facilities begin with an immobilization phase, the length of which varies greatly. In the first few days, the patient should start straight-leg exercises to strengthen the quadriceps muscles. After the pain disappeared, another physical activity was created on the vastus medialis (Li *et al.,* 2022; Ms *et al.,* 2014).

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Isometric quadriceps strengthening is a component of physical therapy, with an emphasis on vastus medialis obliquus (VMO) exercises. Later, gluteal and core exercises are included (Hasler & Studer, 2017). These individuals may have ligamentous laxity; in these situations, balancing exercises should be used to effectively regulate the condition and prevent repeated dislocation. As a protective strategy against pain and panic, gait disruption may also arise following dislocation; gait training should be done (Rund *et al.,* 2021). After participating in a supervised physical rehabilitation program, returning to athletics often takes at least three months.

Patients who have a low-risk profile can receive advantages from conservative treatment because of their minimal risk of redislocation (Frings *et al.*, 2020). Based on existing literature, conservative therapy is linked to relatively high rates of redislocation, reaching up to 66% (Hussein *et al.*, 2017; Smith *et al.*, 2015). In cases of first-time patellar dislocation, conservative treatment is often first favored due to outmoded beliefs or a lack of evidence-based options (Frings *et al.,* 2020).

Rood *et al.* (2012), a comparative analysis of function was conducted using the Lysholm knee score and the dislocation rate by implementing two conservative interventions: tape and immobilization. The outcomes of this regimen were assessed after 6 and 12 weeks, one year, and five years. Taping yielded superior results in knee function compared to plaster immobilization in both the short- and medium-term, without any variation in the rate of re-dislocation. Furthermore, the act of taping resulted in a reduced degree of muscle hypotrophy. During the post-injury phase, it is advisable to carry out controlled mobilizations to prevent a decrease in mobility and potential muscle wasting in the future. Most surgeons advise patients to have weight-bearing tolerance and wear a knee brace for the initial four weeks following surgery. During the first 15 days, the recommended range of motion is from full extension to 30° of flexion, and for the next 15 days, it is advised to increase the flexion to 60° (Flores *et al.,* 2023).

Operative

It was only recently that the conventional method of conservative therapy for dislocations came under scrutiny. According to a study by Magnussen *et al.,* (2017), even though 73.1% of patients did not experience further dislocation, only 26.4% of patients who did not undergo surgery were able to resume their desired sporting activities without any restrictions within an average of 3.4 years after primary dislocation. Certain research has moreover revealed a noteworthy re-dislocation rate of up to 71% (Rund *et al.* 2021). According to Longo *et al.,* (2017), individuals receiving surgical treatment had a considerably lower recurrence rate (25%) than those receiving conservative treatment (36.4%).

If the patient has been treated conservatively but continues to experience dislocations, the patient will likely require operative management. Intervention should not be carried out in children with an open physical growth period because it can disrupt the child's bone growth, so some literature mentions that it is better if the operative procedure is safer to do when they are adults. A tibial tubercle osteotomy was performed to correct angular and torsional conditions. A trochlear osteotomy is performed if the patient has trochlear dysplasia (Li *et al.,* 2022; Ms *et al.,* 2014).

a. Patellofemoral joint stabilization

The bony structures that make up the patellofemoral joint naturally stabilize the patella; as a result, any impairment or flaw in the bony surface will cause instability. Where

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the patella articulates predominantly, which is between the lateral trochlear fissure and the lateral facet, The substantial profundity and acute angle of the typical trochlear fissure afford intrinsic stability to the patellofemoral joint (Wolfe *et al.*, 2023). The flattening of this fissure causes trochlear dysplasia and patellar instability. The undersurface cartilage of the patella is the thickest in the body, measuring 6 to 7 mm. The patella is composed of sesamoid bone, which is encased within the quadriceps tendon. Patellar function principally enhances the muscle's mechanical advantage during knee extension (Rhee *et al.*, 2012).

Operative management of pediatric patients focuses on soft tissue restraint in lateral translation and extensor mechanisms. Redirection of the quadriceps muscle can be achieved by changing the strength itself by changing the muscle's insertion on the patella or changing the attachment of the patella on the tibia. The Dewar-Galeazzi procedure consists of several components, including lateral retinal release, medial advancement of the vastus medialis, and semitendinosus patella transfer (Li *et al.,* 2022; Ms *et al.,* 2014).

b. Lateral release

The lateral release procedure can be performed openly or by arthroscopy. Although lateral release is often performed in patients with isolated patellar tilt or subluxation, this procedure often fails in patients with habitual patellar dislocation (Wolfe *et al.*, 2023). Research has demonstrated that the lateral release procedure is not beneficial for treating patellar instability. This treatment is intended for cases of lateral compression syndrome, where there is a combination or isolation of patellar tilt or excessive tightness following a medialization operation. Typically, this is performed in conjunction with a medialization operation rather than separately (Goyal, 2013).

These distal realignment methods are increasingly being used in conjunction with other operations these days. The outcomes of the 3-in-1 procedure—lateral release, vastus medialis obliquus muscle advancement, and transfer of the medial third of the patellar tendon to the medial collateral ligament—were reported by Oliva *et al.,* (2009). Just one knee out of twenty-five experienced a repeat dislocation at a mean follow-up of 3.8 years, and that one had occurred following a car accident. For the treatment of congenital and habitual dislocations, Danino *et al.,* (2020) recently reported the outcomes of the 4-in-1 procedure (extensive lateral release, Roux-Goldthwait procedure, Galeazzi procedure, and VMO advancement combined): in a total of 46 knees with a mean follow-up of 51.6 months, 18% had recurrent instability.

c.Reconstruction of the medial patellofemoral ligament (MPFL)

Currently, the method most often used for surgically stabilizing pediatric patellar instability is the MPFL reconstruction. This treatment has been documented using a variety of approaches, including different fixation techniques (interference screw, suspensory, suture anchor) and graft types (autografts or allografts) in an anatomic or non-anatomic manner (Popkin *et al.,* 2018). In adults with anatomical predispositions, MPFL restoration is frequently combined with bone surgeries (Longo *et al.,* 2017); however, these combinations are not appropriate for children with open physes.

In their study, Kumar *et al.,* (2018) examined the use of autografts and allografts retrospectively. They included 59 teenagers with a mean age of 15.2 years, and after a mean follow-up of 4.1 years, they observed no differences in the return to sports, pain ratings, or failure occurrences. Lenschow *et al.,* (2013) have also compared fixation techniques: the load to failure of the

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bone bridge technique was significantly lower than that of the other four and also lower than the native MPFL. The comparison included a comparison of medial bone bridges, transpatellar tunnels, transosseous polyester sutures, interference screws, and 3.5-mm titanium anchors.

The MPFL is the primary soft tissue exposed in the lateral translation of the patella, and operative management also focuses on repairing this structure for a good outcome. In habitual patellar dislocation, the MPFL is often weak and defective at several points (Li *et al.,* 2022; Ms *et al.,* 2014). The primary emphasis in treatment during an MPFL reconstruction is determining the precise femoral position that will restore the knee's normal anatomical biomechanics. The width of the femoral attachment of the MPFL ranges from 11 to 20 mm, extending between the medial epicondyle and the insertion point of the adductor magnus (Chahla *et al.*, 2019).

The MPFL procedure is the main procedure in repairing habitual patellar dislocation cases. The knee was examined arthroscopically. The semitendinosus tendon is taken and made into a 4-5 mm graft size graft. A small incision is made at the midpoint of the patella and adductor. A confirmatory radiographic examination 5-7 mm distal to the physis should be performed in patients with immature bones (Ms *et al.,* 2014).

The MPFL provides 50 to 60% of the resistance against sideways movement of the patella. Lateral patellar instability occurs when the MPFL is lacerated, avulsed, or traumatically disrupted. Once the patella starts to move into the trochlea at an angle of 20 to 30 degrees of flexion, the bony structure becomes the primary stabilizer as the patella rests in the trochlear groove. Patella alta is a condition where the patella (kneecap) does not properly fit into the groove until the knee is flexed more than usual. This increases the risk of patella dislocation (Koh, 2015; Wolfe *et al.*, 2023).

Making an informed choice between conservative and surgical treatment options is crucial since there is a growing number of pediatric children being admitted to hospitals due to patellar dislocations (Poorman *et al.,* 2020). Despite a larger likelihood of redislocations, conservative methods offer the benefit of generating higher functional ratings (Askenberger *et al.,* 2018). For most first-time dislocators without substantial osteochondral fragments, non-operative treatments can still be regarded as the preferred treatment option due to the potential for physeal injuries and surgery-related morbidities.

Surgery is typically carried out in cases of recurrent dislocations to prevent additional joint damage, such as patellofemoral osteoarthritis, isolation from peers, and functional deterioration (Familiari *et al.,* 2021; Schneider *et al.,* 2016). Although they are rare, complications can include infections, weakness in the quadriceps, and subsequent dislocations due to the procedure's failure (Popkin *et al.,* 2018).

CONCLUSION

Habitual patellar dislocation is a rare condition affecting children. Patients usually develop inflammatory disease and edema in the atypical knee if this problem returns. MRI, CT, and plain radiographs can be used to diagnose this condition. Conservative or surgical management of habitual patellar dislocation depends on the deformity and its consequences. If it is a first-time habitual patellar dislocation without substantial osteochondral fragments, then non-operative treatment may be considered a better treatment option. Whereas surgery is usually performed in cases of recurrent dislocation to prevent additional joint damage such as patellofemoral osteoarthritis, isolation from peers, and functional deterioration.

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