Review Article

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Patellar Instability and Recent Trends in its Management

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Abstract

The term "Patellar instability" encompasses not only symptomatic patellar instability but also dislocations as well as subluxations. The management of patellar instability requires a thorough understanding of the factors which are involved in providing patellar stability and the factors which cause instability. For assessing patellar instability various clinical examinations have been advocated. Reduction of patellar dislocation is an easy, safe and simple. Surgery is indicated in the presence of correctable and defined anatomical abnormalities. This is done only after adequate rehabilitation procedures have failed to help the patient regain functional control of their knees. Unfortunately none of these measures is specifically tailor made for patellar instability. The management of patellar instability continues to evolve and improve. Non operative management is still recommended for primary acute patellar dislocation. Once conservative options have failed the surgical management is specifically based on the underlying pathological condition.

Keywords: Patellar Instability; Trochleoplasty; Medial Patellofemoral Ligament.

Introduction

The term "Patellar instability" encompasses not only symptomatic patellar instability but also dislocations as well as subluxations [1]. The etiology is multifactorial [6] making its assessment and management difficult (Table 1). It is hypothesized that an internally rotated femur on a fixed internally rotated tibia is often the causative mechanism.

Epidemiology

The incidence of patellar dislocation is 5.8/ 100000^2. This is even higher in the 10-17 year age group where the incidence peaks to $29/100000^3$. The incidence has been reported to be higher among females [4]. It is estimated that patellar instability constitutes 16% - 25% of injuries among runners. A conservative line of management entails a recurrence rate if 15-44% while any subsequent dislocation increases the chances of recurrence to 50% [2]. It has been reported that 58% continue to have limitations in activity 6 months after initial dislocation while 55% fail to return to sporting activities [5].

Anatomy and Biomechanics

The management of patellar instability requires a thorough understanding of the factors which are involved in providing patellar stability and the factors which cause instability. The stability of the patellofemoral joint depends on the bony architecture, the neighboring soft tissues, including the surrounding muscles.

The Joint

The trochlear groove plays an important role in this regard. As the knee moves from a position of extension to flexion the stability offered by this groove decreases owing to the lateral facet being more prominent anteriorly and decreasing as we move distally and posteriorly. Trochlear dysplasia which includes both decreased trochlear depth as well as a low lateral femoral condyle results in the patella not being able to properly engage in the groove [6].

The patella on the other hand normally engages with the trochlea by 20 degrees of flexion. In patella alta this occurs at a much higher angle resulting in much lesser stability [7,8].

A lateralized tibial tubercle, an increased tibial tuberosity–trochlear groove distance, the tibial tuberosity–posterior cruciate ligament distance,the shape and dimensions of the patella, and the width of the patellar tendon, all have a bearing on lateral patellar dislocation.

Soft Tissues

The Q-angle (which determines the direction and magnitude of force produced by the quadriceps muscle) is largest in extension while the patellar and quadriceps tendon tensions are lowest in in extension, raising the chances of dislocation in this position.

The medial patellofemoral ligament is the primary soft tissue restraint to lateral displacement of the patella and extends from the medial proximal part of the patella to near the medial epicondyle of the femur.

The vastus medialis obliquus (VMO) and vastus lateralis obliquus pull the patella medially and laterally respectively. An imbalance of strength between these two muscles often leads to instability. It has been emphasized that the VMO is the first part of the quadriceps to weaken and the last to strengthen when function is inhibited [9].

Table 1: Risk factors for patellar instability

Trochlear dysplasia
Patella alta
Hypermobility of joints
VMO insufficiency
Tight lateral retinaculum or iliotibial band
Trauma
Previous surgery

Classification of Patellar Instability

Definitions and classifications of patellar instability have always been wanting. In 1994 Dejour et al. provided a classification based on clinical symptoms [10].

Table 2: Classification of patellar instability provided be Dejour et al

Major patellar instability	More than one documented dislocation
Objective patellar instability	One dislocation with associated anatomical abnormality
Potential patellar instability	Patellar pain with associated radiographic abnormalities

Patellar instability has also been classified earlier on the basis of the anatomy of the dislocation.

Table 3: Anatomical classification [11]

Lateral	The most common type of patellar dislocation
Horizontal	A rare occurrence, in which the patella has rotated on its horizontal axis with the articular surfaces facing either proximally or distally
Vertical -	Also a very uncommon event, in which the patella rotates around its vertical axis with impaction of one of the lateral surfaces in the intercondylar notch of the femur
Intercondylar	Any type of dislocation in which the patella remains in its anatomic position and may be rotated around its vertical or horizontal axis

Clinical Tests and Evaluation

A through examination to rule out cruciate and collateral ligament injury is recommended. As cruciate ligament injury often has a similar mechanism of occurrence and is an important differential diagnosis.

For assessing patellar instability various clinical examinations have been advocated. Smith et al reviewed 168 texts from available literature and identified 18 different tests for diagnosing patellar instability [12]. While the patient is flexing the knee

the patella is examined to see whether it engages smoothly on the trochlea proximally or more distally as well as demonstrating whether the lateral structures have any extra tightness. The position of the patella, patellar tilt, any lateralisation, patella baja or alta is also observed. Ligamentous laxity being an important predisposing factor for risk of patellar instability, assessment for Beighton's criteria is critical. The patellar instability apprehension test is carried out with the knees in 30 degrees of flexion while the patient lying supine. A positive sign is supposed to have been elicited when the patient expresses pain or fear of dislocation as soon as the examiner pushes the patella laterally. The patellar grind test is performed by manually trying to displace the patella by applying pressure in the medial, lateral, superior, inferior directions. A pain in the indicates a pathological patellofemoral condition. The patella tilt test on the other hand is done by holding the patella between the thumb and the index finger and attempting to flip its lateral edge upward. Limited upward mobility indicates tight lateral structures.This is done while the patient is lying supine and the knee is in 20 degrees of flexion. Careful palpation of the medial retinaculum for tenderness or a palpable defect, tenderness of the adductor tubercle (termed Basset's sign) indicating disruption of the MPFL is essential.The J sign is the patellar shift laterally in terminal knee extension as it disengages from the femoral intertrochlear groove. This may suggest a tight lateral retinaculum. For medial subluxations particularly after iatrogenic injuries due to lateral release the gravity subluxation test is employed. In this the patient lies in lateral decubitus position with the affected leg superior and knee in full extension. While the examiner abducts the limb the patient relaxes and the patella visibly subluxates medially The patient then isometrically contracts the quadriceps, if the patella remains medially subluxed then this suggests a complete dissociation of the vastus lateralis from the patella. If the patella relocates laterally on contraction, the vastus lateralis is intact.

Sallay et al. reported that the sensitivity of the Bassett's sign was 70%, and that of the apprehension test was only 39% [13]. Nonweiler and DeLee that the gravity subluxation test had a sensitivity of 100% to detect medial patellar subluxation [14].

Imaging

The utility of the anterior-posterior radiograph has always been questioned other than documenting a displaced patella or an osteochondral fractures or loose bodies. On the lateral radiograph, the Insall-Salvati index & the Blackburn-Peel ratio can be estimated. These provide a useful measure of the relationship of the patella to the trochlea.Trochlear dysplasia is represented on a perfect lateral radiograph by the crossing sign, a line represented by the deepest part of the trochlear groove crossing the anterior aspect of the condyles. The supratrochlear spur and a double contour representing a hypoplastic medial are other features indicating a trochlear dysplasia. Patellar tilt, patellar dysplasia and trochlear dysplasia are assessed using the Merchant's view [15]. The sulcus angle is measured by the angle formed between the trochlear ridges and the congruence angle is an index of the patellar subluxation and is measured between the zero reference line of the sulcus angle and a 2nd line projected from the apex of sulcus angle to lowest point of articular ridge of the patella [16]. In a normal knee the lowest point on the articular ridge of the patella should lie no more than 16 degrees lateral to the bisected sulcus angle. While a sulcus angle of more than 145 degrees indicates trochlear dysplasia [17]. The lateral patellofemoral angle evaluated on an axial radiograph of the patella with the knee flexed 20 degrees on an axial radiograph [18].This angle is between a line parallel to the lateral facet of the patella and a line drawn across the posterior femoral condyles. While the Lateral patellar tilt is the angle formed between the posterior condylar line (projected in this figure) and a line drawn through the maximum width of the patella [19].

Magnetic resonance imaging is utilised to evaluate the structures supporting the patella on the medial side as well as identifying any chondral injuries. The tibial tubercle to trochlear groove (TT-TG) distance is assessed using CT or MRI. This is a measurement of the offset of the tubercle relative to the true trochlear groove and should lie <20 mm lateral to the midline of the femur at the proximal edge of the femoral condyles.

Reduction Technique

Reduction of patellar dislocation is an easy, safe and simple. Preprocedural sedation and analgesia is used as needed. The surgeon standing on the lateral side of the dislocated patella extends the knee while applying antero-medially directed force from the lateral surface of the patella. This overcomes the femoral condyle and aids reduction. For a medial dislocation the force is applied antero-laterally as the surgeon stands on the medial side of the dislocated patella. Pre and post reduction

radiographs are always taken to rule out osteochondral fractures. These fractures are rarely due to the reduction procedures and primarily due to the dislocation itself.

Non Operative Treatment

Treatment regimens vary from immediate mobilization to cast immobilization in extension for 4-6 weeks. While immobilization with braces or splints does risk three fold higher chances of dislocation, cast immobilization carries its usual complication of stiffness [15]. Adequate rehabilitation protocols include stretching and strengthening exercises Strengthening of the quadriceps muscles is the initial management in most patients. Stretching of the lateral retinaculum, hamstrings, quadriceps, Achilles tendon, and iliotibial band is also performed. Physiotherapy includes closed chain exercises and strengthening of the vastus medialis obliquus [20]. Patellofemoral load reduction is enhanced by proper weight loss programs while patellar taping and patellar brace are meant to modify position of the patella. Open-chain exercises generally promote more rectus femoris muscle activity while closed-chain exercises produce more vastus activity [20]. It is presumed that the weakness of gluteal muscles results in adduction and internal rotation of the femur during weight-bearing activities, which may accentuate the patellar instability. Therefore the strengthening of the gluteal muscles is accordingly advocated.The benefits of patellar taping include control of excessive motion during physiotherapy, shortening the medial retinacular tissue and MPFL to allow for healing [15,21,22].

Operative Treatment

Surgery is indicated in the presence of correctable and defined anatomical abnormalities. This is done only after adequate rehabilitation procedures have failed to help the patient regain functional control of their knees [23].

Medial Patellofemoral Ligament Reconstruction

Several procedures have been described for Medial Patellofemoral Ligament Reconstruction (MPFL). The advantages of this procedure have been elucidated as being that of a minimal access surgery with almost immediate and full mobilization being performed as a day care surgery in many centres.Biomechanically it has been considered to be more stable also [15]. This prevents the lateral displacement without necessarily correcting the tracking [23]. Unfortunately no consensus has been arrived with regard to the choice of graft, its positioning, and other parameters.

Adductor magnus,semitendinosus,tibialis anterior, bone-quadriceps tendon autograft or bone-patellar tendon allograft have all been proposed and employed [24-28]. No consensus has been reached regarding the knee flexion angle at which to tension the graft [33,36]. Dynamic reconstruction by transferring the distal end of the semitendinosus behind the proximal aspect of the medial collateral ligament to the medial margin of the patella has also been proposed by Ostermeier et al. The type of fixation of the medial patellofemoral ligament ranges from suture repair, suture anchor repair, and allograft reconstruction. Reported results have been good but not uniformly so [25,28]. The procedure does not address the potential osseous malalignment and can hence result in potential abnormal loading of the patellofemoral ligament [15].

Deepening Trochleoplasty

In cases of severe trochlear dysplasia deepening trochleoplasty has been performed. The principle is to remove the excess subchondral bone and then depress the articular cartilage to form a groove [23]. Several techniques have been described [29]. Abnormal patellar tracking with a J-sign, dome-shaped trochlea noted on a lateral radiograph are considered its indications [30]. A new trochlear sulcus is created proximal and 3 to 6 degrees lateral to the previous sulcus by removing cancellous bone and repositioning the cortical bone.

Concern over articular and subchondral injury have always limited its widespread utility.Post operative arthrofibrosis has been reported in many cases [30].

Lateral Release

Isolated lateral release is deemed to be quite ineffective [31]. The unacceptable rate of failure is attributed to the inability of the procedure to align the patella more medially [32]. The general consensus is that a lateral release may be performed along with a medial plication or a reconstruction of the medial patellofemoral ligament or an osseous procedures for an osseous malalignment [33,34].

Medial Reefing

Medial reefing has been proposed in the treatment of patellar instability associated with

lateral retinacular release or tibial tuberosity transfer. As primary treatment has been clearly abandoned [23,35].

Tibial Tubercle Osteotomy

An abnormal lateral position of the tibial tuberosity can cause lateral tracking of the patella resulting in patellar instability hence recurrent dislocations. Computer tomography and/or Magnetic Resonance Imaging are used for a precise pre-operative assessment of the tibial tubercle-trochlear groove distance. More than 15 mm is considered to be an indication for surgery in patients with unstable patella [36]. When required the distalization of the tubercle corrects the patella alta and the medialisation corrects the tracking hence stabilising the patella. The case against Tibial Tubercle Osteotomy includes reports of non union, difficulty in kneeling , risks of tibial fracture and an extended approach.

Post Operative Management

The surgery achieves the mechanical stability, thereafter the immediate aim is to obtain full range of motion. As soon as pain permits hamstring and quadriceps exercises are started. Early mobilisation reduces the risk of venous thrombo-embolism. When walking aids are removed proprioceptive exercises to strengthen gluteal and core exercises are needed. Quick , progressive return to routine daily activities is preferred.

Complications

The commonest complication still remains continuing instability. With the commonest cause being poor muscle control. Poor quadriceps, gluteal and core muscles have been implicated and so has been obesity and hypermobile joints [23]. In trochleoplasty this may still be due to a maltracking patella.

Outcome Measures

Various scoring systems have been employed to assess the outcome measures after treatment for patellar instability, namely the Bartlett Patellar Score, Fulkerson Knee Instability Scale, Kujala anterior knee pain scale, Fulkerson knee instability scale, Lysholm knee scoring scale, Tegner activity level scale, Short Form-36, Musculoskeletal Function Assessment injury and arthritis survey (MFA) and the modified International Knee Documentation Committee (IKDC) knee ligament standard evaluation form [37]. Unfortunately none of these measures is specifically tailor made for patellar instability.

Summary

The management of patellar instability continues to evolve and improve. Non operative management is still recommended for primary acute patellar dislocation. The importance of a thorough clinical examination can never be overestimated. Once conservative options have failed the surgical management is specifically based on the underlying pathological condition. For chronic instability, proper prospective randomised control trials are still missing for determining the ideal surgical management. A Cochrane review clearly demonstrated that the current levels of evidence are inadequate to draw a firm conclusions on the superiority of surgical or non surgical methods of treatment over one another.

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