

ORIGINAL ARTICLE

A Quadruple Attack for Neglected Post-Traumatic Lateral Patellar Dislocation

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Background	Neglected traumatic patellar dislocations are rare conditions nowadays. In those cases, soft tissue procedures alone are not enough, A combined approach is often indicated because there are multiple factors to attack rather than a mere torn patellofemoral ligament.
Subjects and Methods	A retrospective case series over a total of 12 patients with neglected post traumatic patellar dislocation from March 2017 to May 2020. The study included 4 males and 8 females. The right side was affected in 9 cases, while left side was affected in 3 cases. The study was approved by the Committee of Medical Ethics and the institutional review boards of Kafr El Sheikh University Hospitals. Patients were followed up both clinically and radiologically for 24 months. All patients were treated with a quadplex attack consisting of lateral release, medial patellofemoral ligament reconstruction, tibial tubercle medialization osteotomy and quadricepsoplasty.
Results	Regarding functional outcomes between pre- and final postoperative (24 months), a significant improvement for Lysholm and Kujala functional scores was observed ($p<0.05$). The mean Kujala score improved from preoperative value 54 ± 9.3 to 89 ± 1.2 points. ($p<0.05$). The mean Lysholm score improved from preoperative value of 75 ± 6.3 to 90 ± 5.4 ($p<0.05$). The mean VAS score improved from preoperative value of 44 ± 3.7 to 92.2 ± 7.1 points ($p<0.05$).
Conclusion	This combined approach has good results over 2 years follow up. Medial patellofemoral ligament reconstruction should be combined with other procedures in those group of patients.
Keywords	Lateral patellar release, Medial patellofemoral ligament, Neglected patellar dislocation, Tibial tubercle osteotomy.

INTRODUCTION

Patellar instabilities account for one of the most prevalent knee problems during growth. The overall incidence is around 50 in 100 000 children and adolescents per year with a peak at the age of 15 years. Most patellae displace laterally. After the first occurrence about 40% end up as recurrent dislocations [1, 2].

Chronic patellar dislocations are rare conditions that can be congenital or acquired. This condition can be seen in skeletally mature and immature patients. Usually in skeletally immature patients, the accepted management is soft tissue procedure. However, sometimes this is not enough. Soft tissue procedures also are not sufficient in

skeletally mature patients with the acquired form of the dislocation [3, 4].

Chronic irreducible patellar dislocation is usually congenital in most cases. However, there are cases with acquired forms of chronic patellar dislocations which are rare and usually present with a permanently laterally dislocated patella that is irreducible or partially reducible. The typical presentation is severe weakness of extension and pain leading to deformity and disability. In some neglected cases, the anatomy of the distal femur and the patella may be altered. Arthritis may develop as a sequel of neglected altered anatomy and mechanics [5].

Understandably, there is a paucity in the literature reports on the management of post-traumatic patellar dislocation, hence, options used in congenital dislocations are used for post-traumatic chronic dislocations [6, 7].

The neglected chronic patellar dislocation leads to progressive genu valgum and external tibial torsion deformities with subsequent gonarthrosis, which becomes painful and debilitating. Valgus malalignment of the lower extremity, a laterally dislocated patella, and a weak active knee extension are the typical physical findings [7].

There is no consensus regarding treatment of these patients. Many procedures have been described to address acquired chronic patellar dislocation such tibial tubercle osteotomy, notchplasty, corrective osteotomies, medial patellofemoral ligament (MPFL) reconstruction, and extensor mechanism realignment for symptomatic patients with variable degrees of success [8].

This study was done to evaluate the results of a combined approach of 4 concomitant procedures together to attack those cases with neglected post traumatic patellar dislocation.

SUBJECTS AND METHODS

A total of 12 patients with neglected post traumatic patellar dislocation were included in the study from March 2017 to May 2020. The inclusion criteria included neglected post traumatic patellar dislocation more than 3 months in skeletally mature and immature patients. Patients with chronic congenital patellar dislocation were excluded from the study. Patients with severe trochlear dysplasia (Dejour [9] B, C, D) necessitating tracheoplasty were also excluded from the study. All patients had no previous patellofemoral realignment procedure (bony or soft tissue) and no significant ligamentous knee injury with no osteoarthritis of the patella-femoral joint (grade 0 of the Kellgren–Lawrence system) [10]. Patients mean age was 21.4 ± 8.2 years (range 12-32 years). The study included 4 males and 8 females. The right side was affected in 9 cases, while left side was affected in 3 cases. No statistically significant differences were found between the patients regarding BMI, age at time of surgery.

This retrospective study was approved by the Committee of Medical Ethics and the institutional review boards of Kafr El-Sheikh University Hospitals. Written informed consents were obtained from all the patients submitted to the study on their follow ups.

Most of the patient complained of weak extensor mechanism, lower limb deformity, abnormal appearance of their knees and anterior knee pain. The pain was noted to be dull achy in nature exacerbated by walking and

relieved by rest. All patients could bear weight on the affected lower extremity but with pain. They all sustained trauma to their affected limb and reported normal knee function before the traumatic event. In most cases, they sustained a non-specific, non-contact trauma mechanism with a history of sudden ‘giving way’ or ‘locking’ under load in the stance phase, in combination with a movement of valgus-flexion-external rotation. After trauma, their knees got swollen. They heard an audible pop in their knees, however, none of them sought medical attention. Some of them reported frequent attacks of falls and subsequent traumatic event to their affected knees.

The mean time before operative intervention was 9.3 ± 4.92 months (range from 6 to 36 months). On the physical examination, diffuse swelling of the affected knee was observed. No skin changes, scars, or sinuses were noted. Some cases had obvious deformed distal femur with valgus deformity (Figure 1). There was mild tenderness on the patellae, which were laterally displaced, was noted along with an empty, shallow femoral notch. The patella was irreducible and did not relocate in full extension. Active and passive range of motion was noted. Most of the patients had an acceptable ROM. The mean flexion was 95.43 ± 4.24 degrees (ranging from 80 to 120 degrees). The mean extension was 2.3 ± 0.39 degrees (ranging from 5 to -10 degrees).

Plain knee radiographs were obtained for all patients, which demonstrated a patellar dislocation with an abnormal trochlear groove. Radiographs of the contralateral knee were unremarkable. Whole limb scanogram was checked for concomitant severe valgus deformity. Subsequently, a computerized tomography (CT) scan and a magnetic resonance imaging were obtained, which demonstrated that the patella was dislocated laterally and formed a pseudo-joint with the lateral aspect of the lateral femoral condyle. The hypoplastic lateral condyle was demonstrated along with a shallow trochlear groove. All patellofemoral radiologic parameters were noted and analyzed (Figures 2-5).

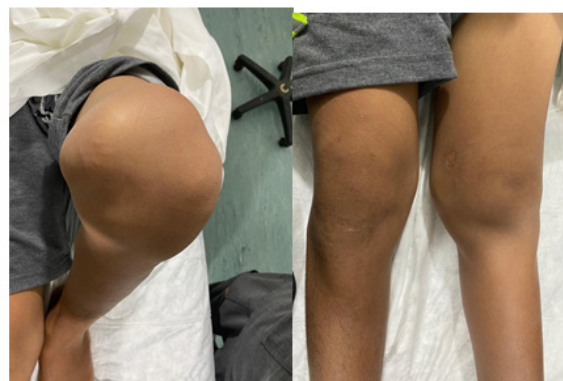


Figure 1: deformed distal femur with near full extension and flexion.

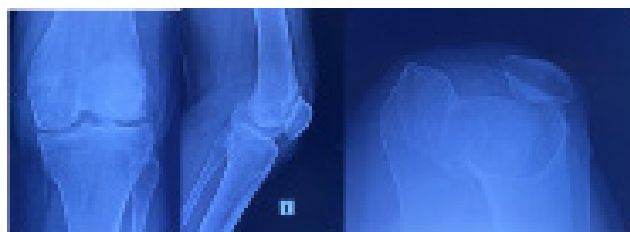


Figure 2: Preoperative AP, lateral and Merchant view of left knee showing irreducible lateral patellar dislocation



Figure 3: AP and Merchant views showing left knee showing irreducible lateral patellar dislocation

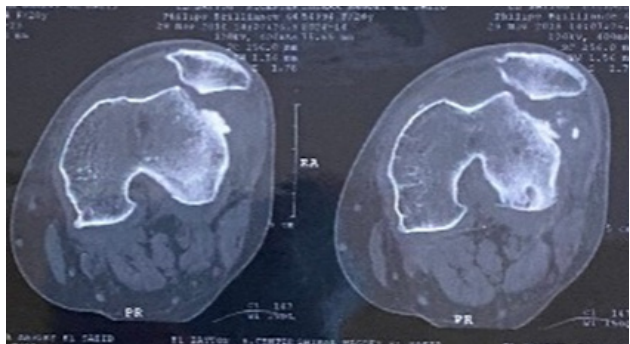


Figure 4: Axial CT films showing irreducible lateral patellar dislocation

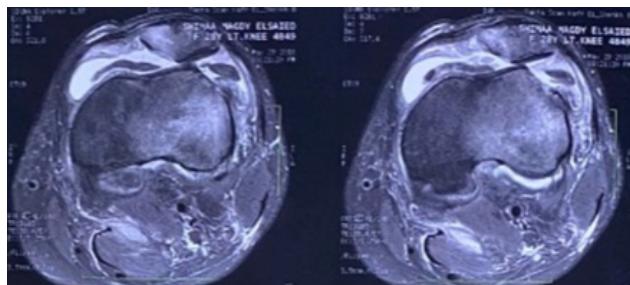


Figure 5: Axial MRI films showing irreducible lateral patellar dislocation

The diagnosis was performed as neglected post-traumatic chronic patellar dislocation, which is a rare condition that has been scarcely reported in the literature.

We advocated a unique quadruple approach to treat those patients.

Surgical technique:

All patients were operated in supine position under general anesthesia. A high thigh tourniquet was used in all patients. a vertical midline incision was used to expose the patella and the whole extensor mechanism from quadriceps tendon to about 4cm below tibial tuberosity. A sharp dissection was carried out to dissect patellar retinaculum medially and laterally. In some cases, iliotibial band was released due to severe adhesions between it and the lateral retinaculum.

The first attack: Lateral patellar release

Lateral release was performed by dividing the quadriceps from the fibrous adhesions to the iliotibial band and the lateral intermuscular septum. The lateral capsule was incised laterally to the dislocated patella and along the lateral border of the patellar tendon to the tibial tuberosity. The patella was released from the lateral aspect of the lateral femoral condyle and reduced into the typically underdeveloped shallow groove of the femoral condyle (Figures 6, 7).

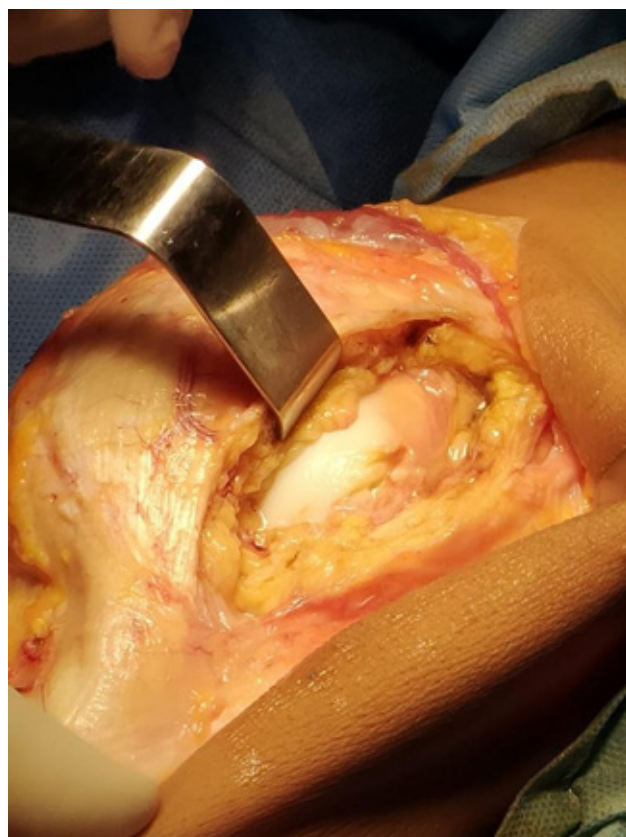


Figure 6: intraoperative photo showing lateral patellar release



Figure 7: intraoperative photo showing partial reducibility of the patella after lateral patellar release

The second attack: Tibial tubercle osteotomy

A complementary TT medialization was performed if the preoperative TT–TG distance was greater than 20 mm. For patients who had patella-alta with a C-D index greater than 1.3, TT medialization was combined with a TT distalization.

With the patient in supine position, the operative knee was held in 45° of flexion by a foot roll and side support. A diathermy blade was used to mark the line of osteotomy, which is just anterior to the anterolateral-compartment muscles. The osteotomy was performed with an oscillating saw, starting proximally and angling the blade upward at the distal extent. The ideal tuberosity fragment should be about 1 cm thick and 8-9cm long. The tuberosity fragment was elevated with an osteotome, taking care to maintain the distal soft-tissue attachments. The patellar tendon was released from the fat pad. With the knee in extension, medialize the tuberosity fragment was done till reaching desired level. Fixation of the osteotomy was carried out using 2 cancellous 6.5mm screws (Figures 8, 9).

The third attack: Medial patellofemoral ligament reconstruction using an autologous semitendinosus tendon

The Semitendinosus graft was harvested and whipstitched. Two parallel patellar tunnels were made in the superior half of the patella using 4.5mm cannulated drill bit. The graft passed in a C shaped fashion in those tunnels. The two ends were fixed in the femur in the Schottle point [11] between adductor tubercle and medial

epicondyle. The point was confirmed using fluoroscopy at the intersection of posterior cortical line with Blumensaat line. The graft was fixed with an interference screw in about 30 degrees of knee flexion without over tensioning of the graft (Figures 10, 11).

The fourth attack: Quadricepsoplasty

The tracking of the patella was checked carefully. In all cases the knee flexion was restricted due to the shortened quadriceps, the quadriceps tendon was lengthened proximal to the patella by pie crusting of the quadriceps tendon proper and fleshy fibers of vastus muscles. technique using scalpel no.11. The procedure stopped when 120 degrees flexion was achieved on Table.

On closure, a lateral capsular defect was noted in most cases and was patched using a rotational flap from iliotibial band or abundant medial capsule or retinaculum to prevent synovial fluid leakage in all knees (Figure 12).



Figure 8: intraoperative photo showing tuberosity osteotomy



Figure 9: intraoperative photo showing fixed tuberosity fragment after medialization.

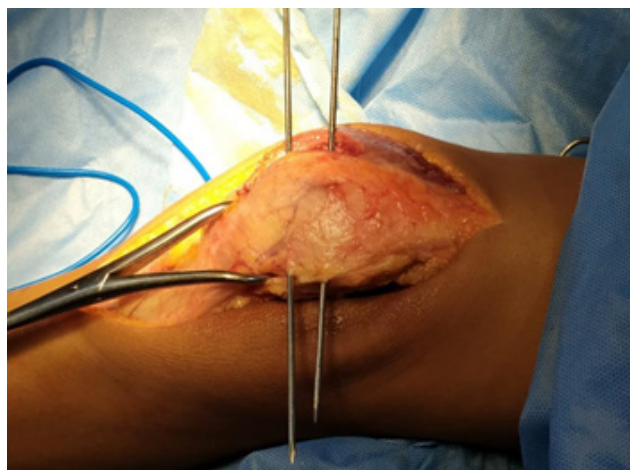


Figure 10: intraoperative photo showing 2 parallel KW used for drilling the patellar tunnels

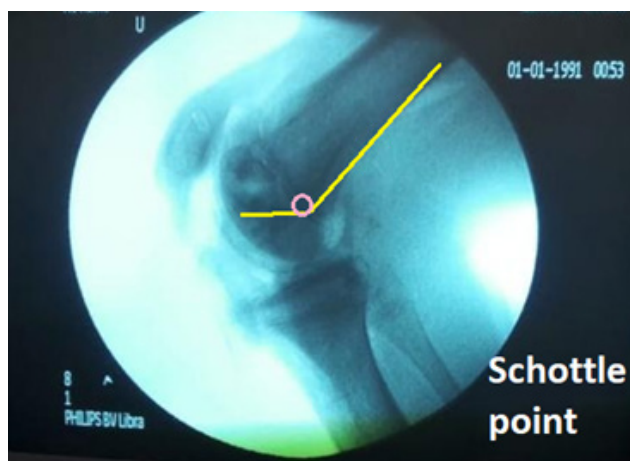


Figure 11: Fluroscopic view showing the ideal Schottle point.

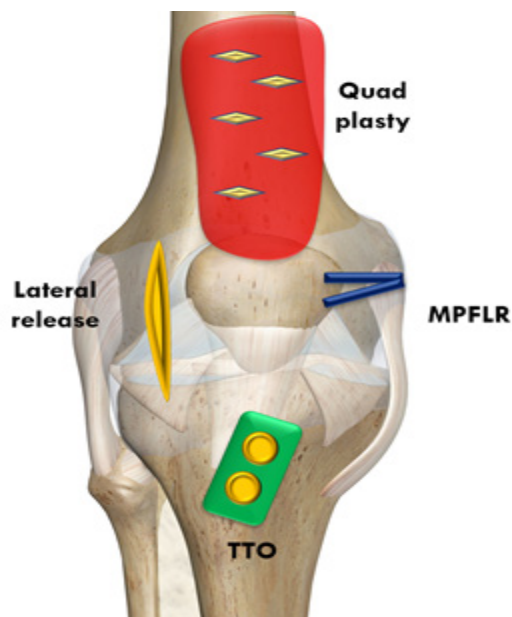


Figure 12: the quadruple attack approach for the neglected traumatic patellar dislocation, MPFL: medial patellofemoral ligament reconstruction, lateral release, tibial tubercle osteotomy (TTO) and quadricepsplasty.

Postoperative management and outcome assessment:

Postoperative Rehabilitation: Patients followed a standardized postoperative rehabilitation protocol with regularly scheduled office visits. In the first 2 weeks after surgery, patients were partial weight-bearing and performed range of motion exercises with active flexion and passive extension. Progression to full weight bearing was permitted 6 weeks after surgery. Return to work and daily activities was initiated at 4 months. Patients were seen for regularly scheduled follow-up in monthly intervals for the first year unless complications arose.

All patients were followed up till one year post operatively. Their knees were reexamined, and knee scores (Kujala [12] and Lysholm [13]) were recorded. The pain was assessed using the Visual Analogue Scale (VAS) [14]. In addition to a standardized clinical examination of knee range of motion. The functional scores were performed preoperatively, at 6 months, 12 months and at a minimum of 2 years at final follow-up. Plain radiographs were performed concurrent to the clinical evaluation follow-up (preoperatively, at 6 months, 12 months and 24 months).

Patellar height was assessed on lateral view according to the Caton-Deschamps [15] index. The patellar tilt angle was evaluated on an axial view (Merchant view) and a lateral view. Preoperative TT-TG distance was determined from CT when available or MRI axial images. Measurements were performed by a musculoskeletal radiologist.

Statistical analysis:

Patient criteria with continuous measures were reported as means with standard deviations as a measure of variability. All analyses were performed using SPSS software (Version 21, SPSS Inc., Chicago, IL, USA) with p values <0.05 being significant. Each knee was evaluated as an independent case.

RESULTS

The study included 12 patients with mean age of 21.4 ± 8.2 years (range 12-32 years). The study included 4 males and 8 females (Figure 13). The right side was affected in 9 cases, while left side was affected in 3 cases. The mean time before operative intervention was 9.3 ± 4.92 months (range from 6 to 36 months). The average BMI was 28.5 ± 11.0 kg/m². The mean operative time was 98 ± 13.2 minutes. The mean Q angle was 15.3 ± 3.5 degrees. The mean HKA was -5.2 ± 1.6 degrees of valgus deformity (2-9 degrees).

Regarding range of motion, the mean preoperative flexion was 95.43 ± 4.24 degrees (ranging from 80 to 120 degrees). The mean preoperative extension was 2.3 ± 0.39 degrees (ranging from 5 to -10 degrees). The flexion

improved significantly from preoperative values. The mean flexion improved to 110.2 ± 2.3 degrees. ($p < 0.05$). No patient postoperatively lacked full extension. At 2 months postoperatively, 2 patients had postoperative stiffness that was resolved under aggressive physical therapy (Figure 14).

Regarding functional outcomes between pre- and final postoperative (24 months), a significant improvement for Lysholm and Kujala functional scores was observed ($p < 0.05$). The mean Kujala score improved from preoperative value 54 ± 9.3 to 89 ± 1.2 points ($p < 0.05$). The mean Lysholm score improved from preoperative value of 75 ± 6.3 to 90 ± 5.4 ($p < 0.05$). The mean VAS score improved from preoperative value of 44 ± 3.7 to 92.2 ± 7.1 points ($p < 0.05$) (Figure 15).

According to the Dejour classification [9], 6 cases had Grade A trochlear dysplasia. None of the cases had high grade dysplasia (B-D) and none had a positive crossover sign. The mean preoperative congruence angle was 34 ± 2.8 degrees (0-45), and the mean sulcus angle was 142 ± 11.4 (111-160). The mean preoperative TT-TG was 24.6 ± 3.2 mm (17-27 mm). Regarding patellar height, Caton Deschamps [15] (CD) index decreased after surgery from a mean of 1.7 ± 0.9 to a mean of 1.2 ± 0.8 ($p < 0.05$). Regarding patellar tilt, the mean Merchant angle improved significantly for all the patients after surgery from a mean of 42 ± 6.9 to 15.3 ± 4.3 degrees. No cases developed patellofemoral arthritis according to KL grading till 24 months postoperatively (Figures 16-19).

Regarding complications, 2 patients had postoperative stiffness with limited painful ROM. this was improved after 4 months of aggressive physical therapy. No case had recurrent patellar dislocation. Seven cases had positive apprehension test that lasted for 6 months postoperatively. Ten patients had anterior knee pain for 8 months at the TTO site. The pain improved after healing of osteotomy. In two of them, the screws were removed to decrease soft tissue irritation and were improved by the hardware removal. One case had post operative skin necrosis and was managed conservatively with daily dressing till complete skin healing. Her last follow up ROM was 0-95 degrees (Figure 20, 21).

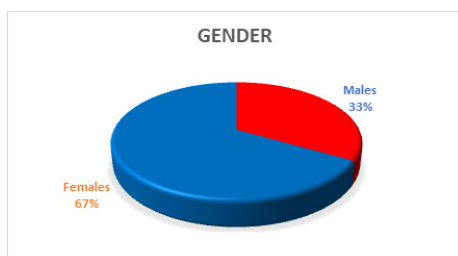


Figure 13: Gender distribution among cases submitted to the study.

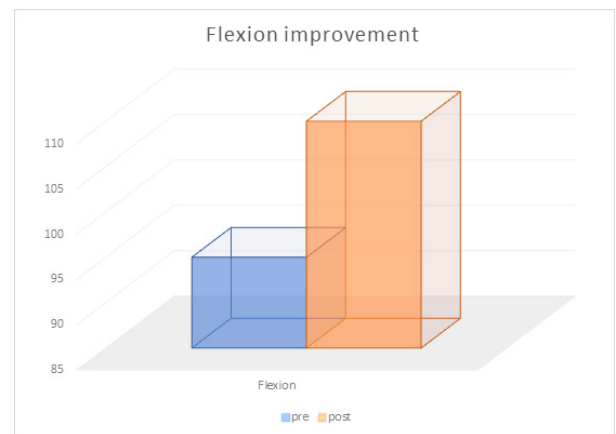


Figure 14: Improvement of flexion range at the end of follow up.

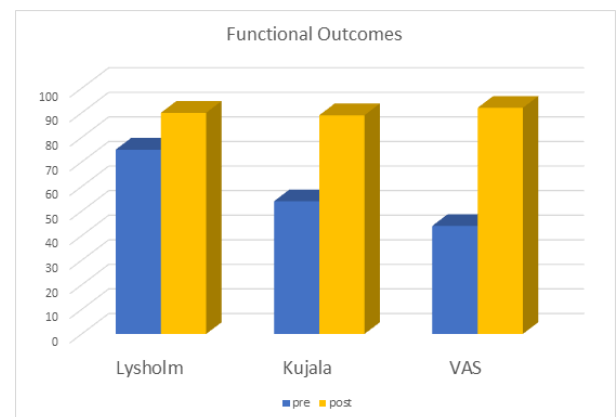


Figure 15: improvement of functional outcomes at the end of the follow up.



Figure 16: Postoperative X-Ray film showing fixation of TTO and MPFL tunnels

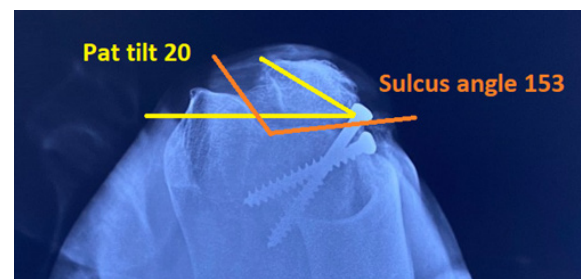


Figure 17: Postoperative X-Ray film showing centralized patella inside the groove.

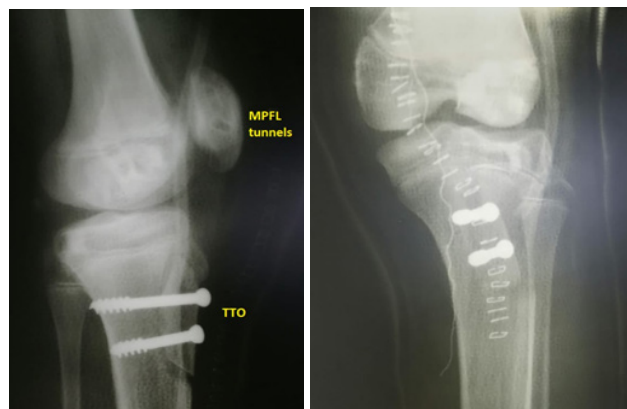


Figure 18: Postoperative X-Ray film showing fixation of TTO and MPFL tunnels



Figure 19: Postoperative X-Ray at the end of the follow up



Figure 20: the case with healed necrotic skin area with maximum flexion to 95 degrees and full extension.

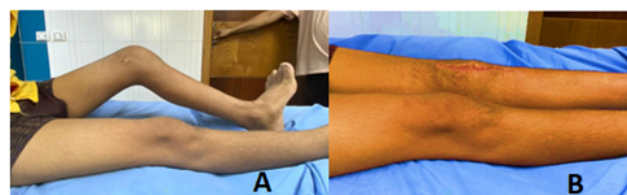


Figure 21: A case with flexion deformity postoperative (A) that was improved on physical therapy (B)

DISCUSSION

Chronic permanent dislocations of the patella are rarely seen in clinical practice. They reported to be found more congenitally or in patients with significant ligamentous laxity and small patella embedded in a short, laterally displaced extensor mechanism. However, some cases of neglected dislocations reported a traumatic event to a previously normal patella. These cases constitute a real surgical challenge because it is difficult to treat them as an acute case with only medial patellofemoral ligament reconstruction. A combined approach is usually indicated due to the stiffness and fibrosis located on the lateral side of the joint with altered remodeled anatomy of the distal femur and trochlear geometry [2].

As a supplement to MPFL reconstruction or soft tissue techniques, the extensor mechanism can be realigned further distally in various ways depending on the state of the physis, the often under-appreciated proximal malposition of the patella (alta) and the localization of the tibial tuberosity (TT). A laterally shifted tuberosity can be a consequence of a long-standing dislocation. Using osteotomy, the TT can be shifted medially (Hauser, Elmslie) [16], distally (Roux, Magnussen) [17] or ventrally (Maquet) [18]. In the unstable patello-femoral joint a deficient trochlea and high-riding patella often co-exist. A patella alta can either be corrected by shortening of the patellar ligament (open physis) or distalisation of the TT. Trochleoplasties are only applicable after closure of the distal femoral growth plate [8, 19].

Weber *et al.*, had proposed an algorithm for management of patellar dislocations in general. MPFL Reconstruction is the most important restraint to lateral patellar displacement from 0 to 30 degrees of flexion. MPFL reconstruction is indicated in all cases with patellar dislocation. Trochleoplasty [20] is indicated in abnormal trochlear morphology identified on a true lateral radiograph as overlap of the posterior condyles or on an axial MRI or CT scan. Medial tibial tubercle transfer (Elmslie-Trillat procedure) [16] and anteromedialization of the tibial tubercle (Fulkerson procedure) [21] have been described to solve the problems of patella alta and lateralized tibial tubercle [22, 23].

There has been some confusion as to the difference between permanent post-traumatic dislocation of the patella and congenital dislocation of the patella. These two abnormalities differ in two ways: in the former there is an adaptive flattening of the patella, and in the latter, there is a propensity for flexion contractures with laterally contracted extensors and hypoplasia of the patella and trochlear groove. However, many of the pathologic manifestations of congenital dislocation of patella are compatible with

adaptive changes from an early severe dislocation of the recurrent type [24].

Noda *et al.*, [25] treated a 34-year-old woman with a chronic patellar dislocation using a staged protocol. Their patient had limb length discrepancy (LLD), valgus instability, extension gap, and inability to actively extend the knee. The first stage involved a supracondylar femoral osteotomy with gradual correction of the deformity followed by a second stage of a lateral release combined with hamstring autograft MPFL reconstruction. At the 3-year postoperative follow-up, the quadriceps function has improved, and active range of motion (ROM) was 0-130 degrees [25].

Attia *et al.*, [3] treated a 45 years old with a left post-traumatic chronic patellar dislocation that has been neglected and remained irreducible for 20 years. Their patient has maintained his full knee range of motion and has minimal symptoms and hence was treated nonoperatively. He was able to perform activities of daily living as a fulltime construction worker, has no LLD, and his quadriceps strength is equal to the contralateral side. Hence, he was treated non operatively [3].

Other authors advocated management of chronic post traumatic dislocation with knee arthroplasty especially if there is any signs of arthritis on the x rays. In *et al.*, [24] treated 2 cases of chronic post-traumatic patellar dislocations with TKA using a standard subvastus approach with extensor mechanism realignment procedures. A similar technique has been advocated by Junqueira *et al.*, [7] who treated one case of chronic post-traumatic dislocation without patellar resurfacing. Another recent report of two cases was published by Albuquerque *et al.*, [26] who treated two elderly obese ladies with post-traumatic chronic patellar dislocation with posterior stabilized TKA with patellar resurfacing and lateral release with a successful outcome at 2 years of follow-up. Fujiwara *et al.*, [6] reported on two cases of chronic dislocation treated with TKA through a lateral approach without extensive release or relocation procedures for the patella with good outcomes at 3 years.

Bullek *et al.*, [27] treated 3 cases (5 knees) with TKA using a constrained condylar knee, proximal patellar realignment, and extensive lateral release. The patella was resurfaced in 3 knees. Two patients had bilateral congenital dislocations that had failed previous surgeries, and one patient with juvenile rheumatoid arthritis had unilateral severe valgus after a malunited supracondylar femur fracture. All their patients had valgus malalignment and valgus instability. All did well except one knee that was complicated by skin necrosis requiring gastrocnemius flaps and skin grafts. Hanssen and Rand [28] recommended a similar technique. This technique is quite complex and

technically demanding because it mandates addressing the 2 primary components of the deformity, namely the dislocated extensor mechanism and valgus external rotation malalignment. The medial collateral ligament is usually attenuated, and the correction requires extensive lateral release. This makes balancing of the knee extremely difficult and requires constrained prostheses. Peroneal nerve palsy may also complicate the surgery [7, 29, 30].

Torisu [31] treated a 50-year-old patient with bilateral congenital patellar dislocation with proximal patellar realignment. The patient had marked valgus, external torsion deformity but was asymptomatic apart from inability to extend his knees. He had improved quadriceps function postoperatively.

The limitation of this study is the small number of cases and short time of follow up. However, the rarity of those cases can justify these limitations. Moreover, the lack of a control group (acute reducible patellar dislocation) is another drawback for the study.

Quadrable attack approach is a difficult decision for the patient and for the doctor to tackle the whole abnormalities one time. Soft tissue procedures in those patients are never enough and a combination with bony procedure like TTO and fine tuning of the extensor mechanism using piecrusting technique of the quadriceps tendon are usually indicated with MPFL reconstruction and lateral release.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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