

## Case Series

# Chronic patellofemoral instability and pain treated effectively by anteromedial tibial tubercle transfer (Fulkerson osteotomy) with or without medial patellofemoral ligament reconstruction

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## ABSTRACT

Bony malalignment and soft tissue injury (torn or stretched medial patellofemoral ligament-MPFL) in chronic patellar instability (subluxation and dislocation) is considered as a surgical indication for distal realignment in the form of anteromedial tibial tubercle transfer (Fulkerson osteotomy) with or without MPFL reconstruction that effectively unloads the lateral patella while making the patellofemoral joint more congruous, stable and pain free. It is a prospective study of 22 patients of chronic patellar instability and pain. Follow up ranged from 24 to 36 (average 30) months. Preoperative assessment included clinical examination, Lysholm, international knee documentation committee (IKDC) score and radiological examination. 18 patients with history of dislocation and pain having bony malalignment and torn MPFL were treated with Fulkerson osteotomy and MPFL reconstruction and 4 patients with history of subluxation and pain having bony malalignment only were treated with Fulkerson osteotomy alone. There was a significant improvement in postoperative Lysholm and IKDC scores. Union at osteotomy site for all patients was seen. None of the patients had further episode of dislocation or subluxation. Pain at femoral site of MPFL reconstruction in 2 cases persisted for 3 months followed by spontaneous resolution. One of our patients had profuse swelling at the site of operation postoperatively which was treated with rest, ice pack, compression and limb elevation. Out of 22 patients undertaken infection at osteotomy site was seen in 1 patient for which implant removal was done from osteotomy site after union. Fulkerson osteotomy and MPFL reconstruction is a successful procedure to treat patellofemoral pain and instability.

**Keywords:** Fulkerson osteotomy, Medial patellofemoral ligament, Patellofemoral pain

## INTRODUCTION

Patellofemoral pathology including chronic patellar instability (subluxation and dislocation) and pain is a debilitating knee condition that frequently involves young, active patients and results from improper biomechanics of the patellofemoral joint.<sup>1</sup>

Various treatment modalities ranging from non-invasive physiotherapy to invasive proximal and distal realignment procedures including patellar taping, lateral release,

medial patellofemoral ligament (MPFL) repair, MPFL reconstruction and tibial tubercle osteotomy have been described till date.<sup>2,3</sup>

Tibial tubercle osteotomy is a common treatment option for a wide variety of patellofemoral joint disorders including chondromalacia patellae, anterior knee pain syndrome, and patellofemoral arthritis and patellar instability. Tibial tubercle osteotomy reduces the patellofemoral contact stress and can modify patellar tracking to correct patellar alignment to unload the patella

or can be used in combination with soft tissue stabilization procedures for instability. Transfer of tibial tubercle is often necessary in patients with abnormal tibial tubercle position and patellar height in which soft tissue procedures alone have proved ineffective with a high rate of recurrence and increased incidence of patellofemoral arthritis.<sup>4</sup>

Bony malalignment and soft tissue injury (torn or stretched MPFL) is considered as a surgical indication for distal realignment in the form of anteromedial tibial tubercle transfer (Fulkerson osteotomy) with or without MPFL reconstruction that effectively prevents the patella from tracking laterally and unloads the patella thus making the patellofemoral joint more congruous and stable and pain free.<sup>5-8</sup>

In this study, we hypothesized that the Fulkerson osteotomy procedure with or without MPFL reconstruction would be efficient to treat patients with chronic patellofemoral instability and pain, and our purpose was to evaluate the results and efficacy of the procedure.

### CASE SERIES

This study was performed according to a protocol that was approved by institutional ethics committee at PARAS HMRI, Patna. All subjects provided their informed consent to participate in the study. A total of 22 patients were included from June 2014 to December 2017, with a mean patients age of 21.5 years (range, 17-28 years), including 22 cases of chronic patellofemoral instability and pain.

#### Inclusion criteria

Patients with a recurrent patellar dislocation and those with anterior knee pain with recurrent subluxation who gave consent to be a part of study.

#### Exclusion criteria

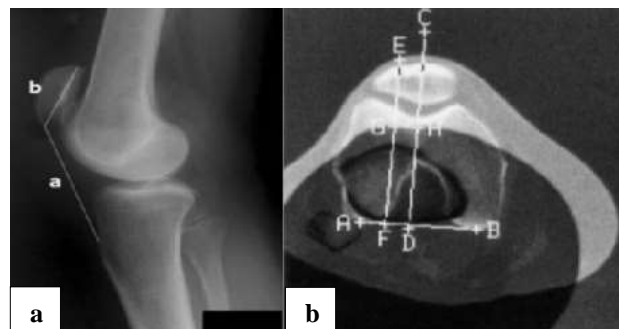
Patients with open growth plates and those who did not give consent to be a part of study were excluded.

Patients were evaluated with history, clinical examination and radiological examination (X-ray/computed tomography-CT/magnetic resonance imaging-MRI).

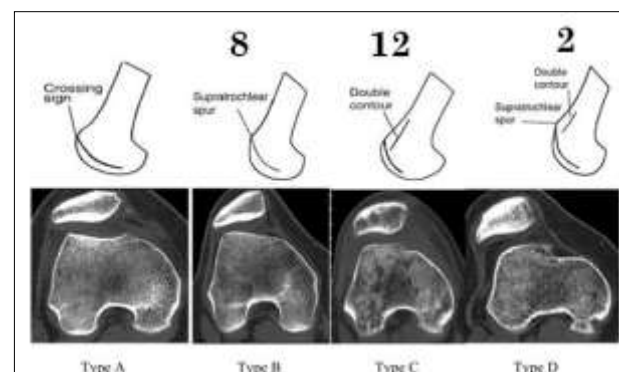
The clinical examination included patellar tilt test and apprehension test along with patellar 'J' sign was evaluated and positive in 18 patients wherein we did Fulkerson osteotomy along with MPFL reconstruction and in remaining 4 patients who had good tracking of patella after Fulkerson osteotomy, we did Fulkerson osteotomy alone.

The radiological examination included measurement of Insall Salvati index (Figure 1) as per which 14 patients

were classified as having Patella Alta. The tibial tuberosity - trochlear groove distance (Figure 2) was measured which was greater than 20 mm in all of our subjects. According to Dejour classification, there were 8 knees of type B, 12 knees of type C and 2 knees of type D (Figure 3).



**Figure 1: (a) Insall salvati index was assessed in all our patients (14 patients were classified as having Patella Alta), and (b) assessment of tibial tuberosity - trochlear groove-TT-TG) distance which was >20 mm in all patients.**



**Figure 2: Dejour classification (8 knees were of type B, 12 were of type C and 2 were of type D).**

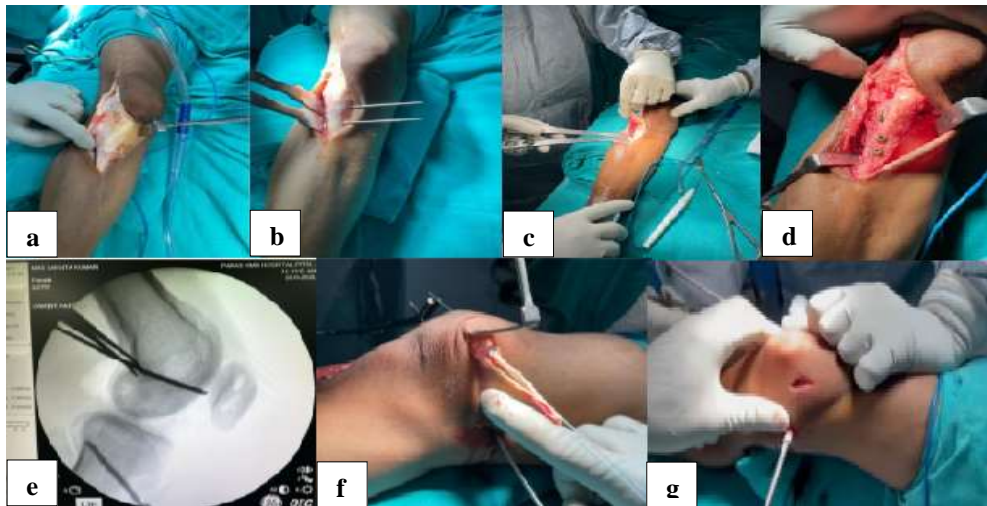
### Surgical technique

#### Patient positioning and preparation

After induction of general anesthesia, an examination under anesthesia was done to assess patellar stability. A single dose of antibiotic was administered for infection prophylaxis. Next a tourniquet was placed high on the thigh and the patient was positioned supine with the surgical area prepared and draped in standard fashion.

#### Exposure of tibial tubercle and placement of K-wires

A longitudinal incision approximately 8 to 10 cm in length was taken to adequately expose the patellar tendon. With the use of ruler the site of osteotomy was evaluated. Afterwards, two 2.0 mm K-wires were placed in proximal aspect of tibia in an oblique position (45° angle) with care taken to place the k wires parallel to each other from medial to lateral side.



**Figure 3:** (a) Adequate exposure of the tibial tubercle, (b) placement of K wires to guide the osteotomy (the K-wires are placed at an angle of 45° to the tibial shaft taking care that the two K-wires must be parallel to each other), (c) osteotomy of tibial tubercle along K-wires, (d) anteromedialization and fixation with 3 screws in a lag fashion, (e) creation of femoral tunnel at the MPFL insertion site on femur (Schottle's point) after creation of trough on patella, (f) graft (ipsilateral gracilis) passage via tunnel in patella, and (g) insertion of interference screw after docking of graft in femoral tunnel.

#### *Osteotomy of tibial tubercle*

A small oscillatory saw was used to perform an osteotomy along k- wires. The amount of anteriorization (range 7 to 15 mm) and medialization (range 10 to 15 mm) to be achieved was determined based on imaging, tibial tuberosity-trochlear groove (TT-TG) measurements, and intraoperative stabilization.

In 14 cases of patella Alta we also did a distalization (approximately 6 mm) procedure.

#### *Fixation of tibial tubercle portion*

Two provisional 2.0 mm K-wires were placed 1cm from the marked position of screws. The screws (2 to 3 in number) were then fixed into tibial tubercle in lag fashion taking care to avoid potential damage to patellar tendon. Once the screws were fixed into place, the wires were removed and screws were tightened again to ensure proper and stable fixation of the fragment transposed.

A subchondral lesion on under surface of patella was noted in almost 40% of our patients.

Patients were evaluated for maltracking at the end of the Fulkerson osteotomy. In those who still had maltracking (18) patients, we did a MPFL reconstruction using ipsilateral gracilis graft.

#### *Closure*

After achieving hemostasis the subcutaneous and skin layers were closed in standard fashion.

#### *Postoperative protocol*

After surgery knee was placed in a knee brace. Exercises such as ankle pumping, quadriceps strengthening, straight leg rising, and patella pushing were advocated and taught to the patients. From 2nd day after surgery gradual passive range of motion was begun and full range of motion was achieved in 3 to 4 weeks. Active range of motion was allowed only after 6 weeks. During 6th to the 8th week weight-bearing as tolerated with a hinged brace was advocated. From 3rd month onwards mild jogging and partial sports activities were recommended.

#### *Follow up indicators*

Assessment of the patients was done at 2 weeks, 6 weeks 3 months and 6 months postoperatively. Complications and outcomes were recorded at the time of follow-up. Follow up ranged from 24 to 36 (average 30) months. The Lysholm and IKDC scoring system were used for the clinical assessment of the results. Data were processed with statistical package for the social sciences (SPSS) 19.0 statistical software. The values of preoperative and postoperative data were compared using the paired t-test. Statistical significance was set at  $p < 0.01$ .

#### *Ethical considerations*

A voluntary informed consent in writing was obtained from the patient/legal guardian prior to enrolment in the study program after approval from ethical committee. Also, there was no additional burden on the institution for carrying out the present study apart from routine investigations and cost of surgery. No company/institution have funded this project.

**Case 1**



**Figure 4: 19 years female with left sided recurrent dislocation of patella and post-operative subluxation of right patella (operated elsewhere 5 years back with lateral release and medial plication).**

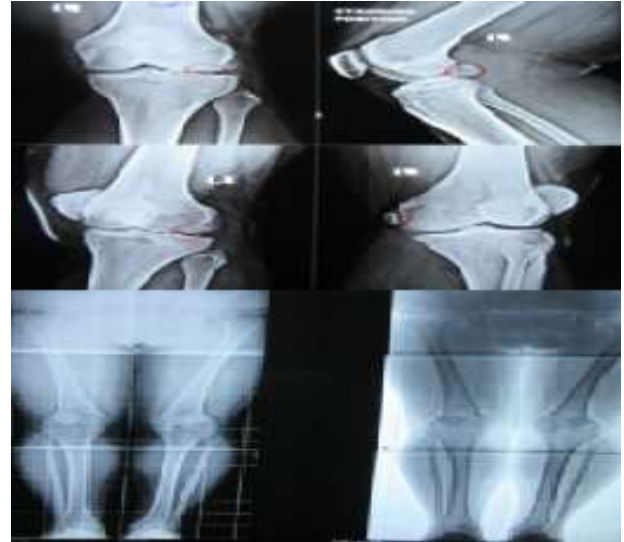


**Figure 5: Fulkerson osteotomy with screw fixation was done for right as well as for left knee within a span of week.**

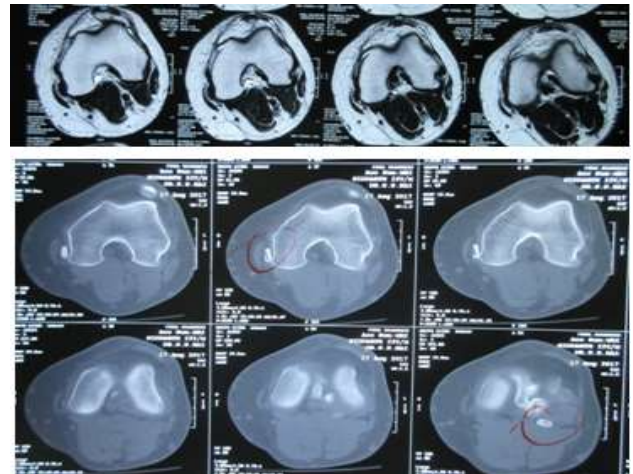


**Figure 6: Follow-up at 1 year.**

**Case 2**



**Figure 7: 24 year male with complaints of recurrent locking, patellar subluxation and pain in left knee for 5 years.**



**Figure 8: MRI and CT finding suggestive of loose bodies with incongruent patello-femoral articulation.**



**Figure 9: Subchondral lesion on under surface of patella.**



**Figure 10: Fulkerson osteotomy and fixation with 3 screws was done.**

Out of 22 patients 18 underwent Fulkerson osteotomy with MPFL reconstruction and 4 patients underwent Fulkerson osteotomy alone.

Pain at femoral site of MPFL reconstruction in 2 cases persisted for 3 months followed by resolution of their symptoms. Out of 22 patients undertaken, infection at osteotomy site was seen in 1 patient for whom implant removal was done from osteotomy site after union. One of our patients developed profuse swelling around the osteotomy site post operatively and was managed with rest, ice pack, compression and elevation.

The mean Lysholm scores improved significantly from 39.18 (range 24-60) to 76.09 (range 47 to 94) postoperatively, at 1 year follow-up. The value of t is 20.471311. The value of p is <0.00001. The result is significant at  $p < 0.01$ .

The mean IKDC scores improved significantly from 23.5 (range 5.7 to 60.9) preoperatively to 76.67 (range 52.9-96.6) postoperatively at 1 year of follow up. The value of t is 26.875614. The value of p is <0.00001. The result is significant at  $p < 0.01$ .

At the last follow up there were no cases of recurrence of patellar dislocation and no stiffness as well.

## DISCUSSION

Patients with chronic patellofemoral instability with anterior knee pain who are treated with Fulkerson procedure with MPFL repair have shown significant increase in post-operative subjective scores and resolution of their symptoms.<sup>9</sup>

As our understanding regarding the biomechanics of patellofemoral joint has developed so have the surgical procedures for tibial tubercle osteotomy. Hauser first described distal and medial transfer of the tibial tuberosity for recurrent patellar dislocation in 1938.<sup>10</sup> Although this procedure was initially effective in resolving instability with good to excellent results in 67% to 74% of cases, several studies have reported a high incidence of late onset patellofemoral osteoarthritis. In 1963 Maquet modified the

procedure by displacing the tibial tuberosity anteriorly to reduce the patellofemoral joint stress.<sup>11</sup> Maquet later suggested that 2.0 to 2.5 cm advancement may lead to a reduction in patellofemoral stress forces by about 50% and thereby reported good or excellent outcome in 36 of the 37 cases that he studied at a mean follow up duration of 4.7 years. The single failure in his series was due to skin necrosis over the elevated tubercle. Cox modified Hauser's technique by transferring the tuberosity medially without translating it distally.<sup>12</sup> 10 to 15 years follow-up showed 62.5% good to excellent results with osteoarthritis occurring in those patients who presented with high grade chondral lesion at the time of surgery. The Elmslie-Trillat procedure is one of the most common tibial tubercle osteotomy performed which moves the tibial tubercle only medially without moving it anteriorly which leads to corresponding increase in stress in addition to restricted motion due to scar formation and adherence of the patellar tendon to underlying tibia.<sup>13</sup> In 1983 Fulkerson introduced the anteromedialization technique.<sup>14</sup> The technique advocated by Fulkerson translates the tibial tubercle both anteriorly and medially and is technically better.<sup>14</sup>

All patients in our study presented with chronic patellofemoral instability and pain for which anteromedialization of the tibial tubercle was done along with distalization procedure (for those with Patella alta) thereby leading to subsequent reduction in patellofemoral joint stress to avoid serious complications as patellofemoral arthritis; so all patients were painless and had no radiographic sign related to patellofemoral arthritis at follow-up.

Admittedly, the shortcoming associated with this study was that there was no case control study on different surgical methods.

Despite these shortcomings we observed that our patients were relieved of their symptoms at subsequent follow-up with good to excellent post-operative outcome.

## CONCLUSION

Therefore we conclude that anteromedial tibial tuberosity osteotomy and MPFL reconstruction is a successful procedure to control patellofemoral pain and instability.

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*Ethical approval: Not required*

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