Original Article | Journal of Orthopaedic Case Reports 2024 October:14(10):Page 230-235

Comparative Study of Inferior Pole of Patella Fracture Treated with Transosseous Technique using Modified Krackow's Technique Versus Traditional Anterior Tension Band Wiring

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Learning Point of the Article:

Transosseous repair is an effective in management of inferior pole of patella fracture.

Abstract

Introduction: The inferior pole of patella constitutes around 9.3–22% of all the patella fractures presenting to the hospital. The management of inferior pole fractures has been debated since a long from early day of partial or full patellectomy to the current dictum of open reduction and fixation because of the importance of extensor mechanism of the knee. There are various modalities of management of the inferior pole of patella fracture. The use of braided polyester wire has shown to have a higher load to failure and less implant fatigue, leading to the use of trams osseous repair technique with fiber wire as an alternative to tension ban wiring.

Materials and Methods: Twenty patients were divided into two groups of 10 each: Group A comprised of patients operated with tension band wiring (TBW) and Group B with patient operated with transosseous repair. Both groups underwent the same physiotherapy postoperatively and the results were compared.

Results: Radiological outcomes and the WOMAC score of the patients are comparable in both groups. The return to full range of motion is also similar in both groups with similar physiotherapy given in both groups.

Conclusion: This shows that with careful patient selection transosseous repair can be used as an alternative to TBW.

Keywords: Transosseous repair, modified Krackow's technique, inferior pole of patella fracture, trauma, tension band wiring, poly braided sutures.

Introduction

Patella is the largest sesamoid bone in the human body, the inferior pole of which connects to the patellar ligament. Patella fracture amounts to roughly 1% of all the cases that are present in an emergency [1, 2], in them fracture of the distal pole of patella and its avulsion falls under a separate category for classification. The fracture of the inferior pole of patella accounts for 9.3–22% of all patella fractures. The inferior pole of patella fractures is usually comminuted and has low bone mass making them difficult to fix [2, 3] historically, there has been a debate about surgical management for inferior pole of patella or resection; however, the recent studies suggest that resection of the inferior pole of patella leads to disruption in the extensor mechanism by the reduction in lever arm at the knee joint. The fracture at inferior pole of patella also causes a disruption in the extensor mechanism at the knee joint limiting the range of motion severely [4, 5], thus surgical management and fixation of the inferior of patella have become the standard of care.

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2024.v14.i10.4874

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Submitted: 12/07/2024; Review: 26/08/2024; Accepted: September 2024; Published: October 2024

DOI: https://doi.org/10.13107/jocr.2024.v14.i10.4874

Figure 1: Intraoperative images of transosseous fixation using modified Krackow's technique. The strands are passed from inferior to superior direction and are pulled together to get bone-to-bone interface.

The multifragmentary fracture is complex and difficult to treat. Preservation of the inferior pole of the patella and reconstruction and maintenance of the patellar height may be difficult to achieve in every case. The criteria for good fixation should include aiding in fracture reduction, enabling stable fixation, and early mobilization. There has been a shift in management strategy from anatomical reconstruction to preservation of extensor mechanism. There are various strategies for the management of the inferior pole of patella fracture ranging from Kirchner wire fixation, tension-band wiring, cannulated screw fixation with tension-band wiring, and suture anchors to Krackow's figure of 8 suturing each with their own advantage and drawback. Tension band wiring (TBW) is considered a workhorse technique in patella fracture fixation with good results; however, the drawback of this technique is the use of metal implants which can cause hardware irritation, implant breakage, and earlier removal of the hardware being the cause of most re-operation with this technique [6]. As well, the metal implants lead to an increase in stress risers at patella tendon and require removal [7]. To counter this, the use of braided polyester suture was suggested. McGreal et al. demonstrated that braided polyester suture was 75% as strong as wire and performed equivalent to cerclage wire with cyclical loading [8]. Wright et al. investigated the properties of fiber wire, a braided polyblend suture, in comparison to stainless steel in tension banding and found that double-strand fiber wire had a significantly higher load to failure [9]. Gosal et al. found reduced reoperation rates in fractures treated by anterior tension band with braided sutures compared to the stainless-steel wire [10]. Both of these techniques are fairly easy to operate and do not require any special equipment whatsoever. The aim of this study is to determine the fracture union occurring in both these methods and the range of motion and functional outcome obtained through both these methods through various phases of rehabilitation.

Aims

a. To assess the radiographic union at the fracture site

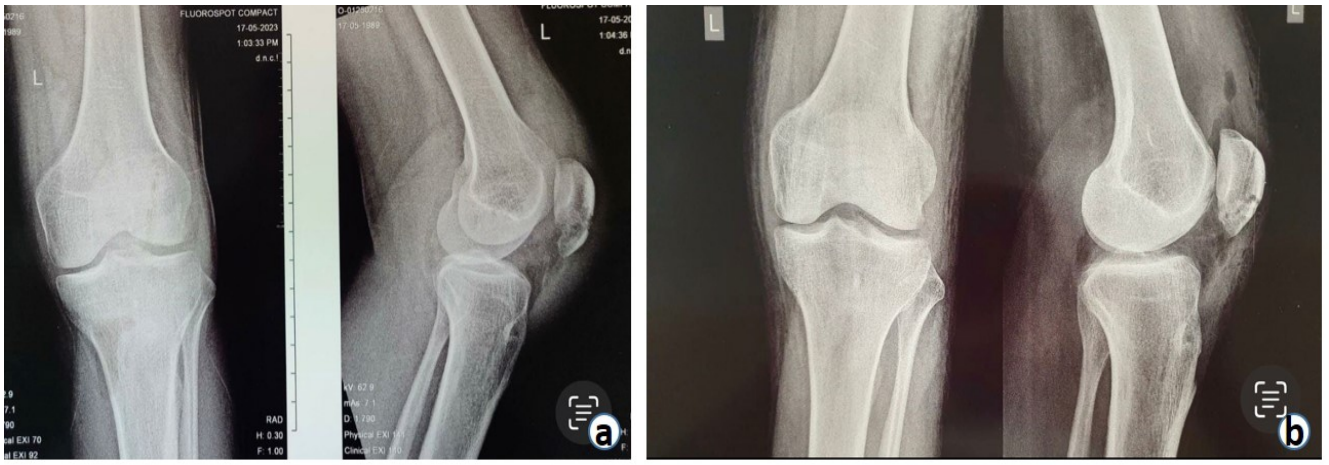

Figure 2: Anteroposterior and lateral view of a plain radiograph of the left knee showing the left inferior pole of patella fracture, (a) pre-operative (b) 9-month post-operative X-ray patient underwent open reduction internal fixation with transosseous technique.

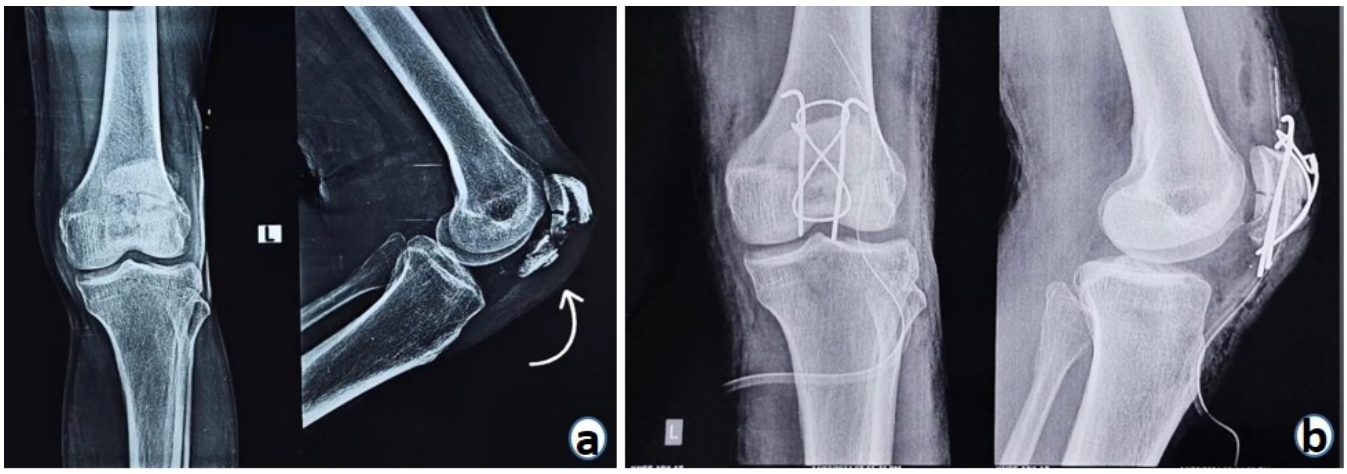

Figure 3: Anteroposterior and lateral plain radiograph of the left knee showing left inferior pole of patella fracture (a) Pre-operative (b) post-operative 9 months underwent open reduction internal fixation with tension band wiring.

b. To assess the functional outcome and range of motion in both these operative modalities throughout various stages of physical rehabilitation.

Inclusion criteria

1. Closed inferior pole of patella fractures
2. Skeletally mature patients
3. Fractures treated through transosseous fixation or TBW
4. Fractures with more than 2 mm displacement on plain radiograph [11, 12].

Exclusion criteria

1. Open injuries/fractures
2. Skeletally immature patients
3. patients lost through inadequate follow-up (<6 months)
4. Patients who underwent repeat surgeries.

Material and Methods

The study is a prospective study comparing post-operative functional and radiological outcomes between the anterior TBW group and transosseous repair group. The study contains 20 patients divided into two groups of 10 each allotted by randomization, irrespective of age, fracture pattern, and sex. The sample size was calculated considering patella fracture prevalence 1 in 100 patients as per the study by Egol et al. and a confidence interval of 95%. The patients were divided into Group A (operated with TBW) and Group B (operated with modified Krackow's technique using fiber wire). All the operations were performed in the same hospital, using the same techniques, although with some minor variations. The TBW was performed using 2 parallel Kirschner wires of 1.6 and 1.8 mm in size which was shortened after size-appropriate bending and TBW.

The transosseous repair using Krackow's technique involved drilling four tunnels across the fracture site using a beath pin 2.4 mm × 15 mm in a slightly flexed position from inferior to superior pole of the patella. Next, double-loaded sutures of No. 5 fiber wire two strands on a single beath pin were sutured to patella tendon in Krackow's configuration, fiber wire was passed across the patella using the beath pin, and the sutures were knotted near the superior pole of the patella in full extension. Intraoperative picture is shown in Fig. 1, figure showing the sutures being passed in Krackow's configuration.

Post-operative rehabilitation protocol was maintained similar in both patients with some minor changes as per patient comfort, fracture fixation, and patient-to-patient difference in weight-bearing capabilities.

Results

The demographic distribution regarding age of the patient, fracture pattern, and gender of the patient showed no significant variation in both the groups as seen in Table 1.

Average age for Group A of TBW averaged 47.2 years and for Group B of transosseous repair with Krackow's technique averaged 42.7 years. The primary criteria of the success/failure of the operative modalities were taken in regard to the radiographic assessment of the fracture site, which was assessed for displacement at the fracture site, malunion, non-union, implant failure, etc.

In the case of TBW, displacement at the fracture site was considered significant if post-operative displacement was found to be more than 3 mm. Whereas in the case of transosseous

Modalities	Tension band wiring (Group A)	Transosseous repair (Group B)
Age	47.2 years	42.7 years
Gender	7/3 (male/female)	6/4 (male/female)
Fracture pattern	4/5/1 (comminuted/transverse/apex)	4/4/2 (comminuted/transverse/apex)

Table 1: The demographic distribution among the group for age, gender, and fracture pattern.

fixation, there were 2 criteria (A) displacement of more than 3 mm and (B) avulsion of the patella ligament. Fig. 2 shows pre-operative (Fig. 2a) and post-operative X-ray at 9 months (Fig. 2b) of the patient who underwent transosseous repair for inferior pole of patella fracture, and Fig. 3 shows pre-operative X-ray (Fig. 3a) and post-operative X-ray of the patient undergoing TBW (Fig. 3b). Secondary parameters were related to the functional outcomes in the patient taken through various stages in the physical rehabilitation of the patient. The functional outcomes were measured in the patient on the following criteria: (A) Early establishment of full range of motion and (B) WOMAC score measured at 4-week, 8-week, and 6-month interval.

As per radiographic criteria, one patient out of 10 showed displacement at the fracture site in the group of patients operated with TBW, while there was displacement in two patients (1 displacement at the fracture site and 1 avulsion of the patellar tendon) in the group of patients operated with modified Krackow's technique using fiber wire. Functional assessment of the patient was measured in the patient giving both groups; the same physiotherapy, range of motion, and knee bending were started from 0 to 30° in the 1st week postoperatively, along with static hamstrings and quadriceps strengthening exercises. 30–60° range of knee flexion was aimed to be achieved by the end of 3 weeks and flexion up to 90° at the end of 4 weeks. The patient was shifted from non-weight-bearing walking to partial weight-bearing walking in the 3rd week of physical therapy.

There was no significant difference observed in the range of motion comparison among the groups – the average return to the full range of motion in Group A averaging at 7 weeks while that of Group B averaging at 7.5 weeks. There is also a slight delay in shifting the patient from non-weight-bearing walking to partial weight-bearing walking postoperatively in Group B. The WOMAC score was compared at 4 weeks, 8 weeks, and 6 months postoperatively; the scores recorded for Group A (TBW) are 39.1, 18.1, and 10.3 at 4 weeks, 8 weeks, and 6 months, respectively. The scores recorded for Group B (transosseous repair) are 36, 16.8, and 9, respectively. The scores in both these groups showed a drastic fall in patient discomfort and improvement in the functional outcome in the patient between the 4th and 8th weeks. The functional outcome and the return to full active range of motion in both these groups

	Tension band wiring (Group A)	Transosseous repair (Group B)
Radiological displacement	1 out of 10 (10)	2 out of 10 (20)
Full range of motion achieved at	7.1 weeks	7.2 weeks
WOMAC score at 4 weeks	39.1	36
WOMAC score at 8 weeks	18.1	16.8
WOMAC score at 6 months	10.3	9

Table 2: The results of both groups including radiological displacement, full range of motion achieved, and WOMAC score measured at 4 weeks, 8 weeks, and 6 months.

are comparable. The data for each are given in Table 2.

Discussion

Inferior pole of patella fractures is traditionally difficult to treat, owing to small fracture fragments and them being comminuted combined with low bone mass making it difficult to treat [2]. There have been a lot of debates and changes in the way we approach the patella fractures, from the earlier days of partial/total patellectomy to contemporary onus on fracture fixation of the patella fracture due to increased understanding of the extensor mechanism of the knee. The current workhorse of the patella fracture fixation is TBW. The TBW is preferred currently with low cost, minimal implant requirement, and ease of the technique, but there have issues regarding cyclical loading failures of implant, implant fatigue, metal irritation, and the requirement of re-surgeries for the removal of the implant, and hence, a shift was made to shift to non-metallic suture for fixation as suggested by Shah and Shyam [13]. The patient with transosseous repairs needed external auxiliary stabilization and need for early mobilization to be effective [2, 14]. Our study was aimed at comparing the clinical and radiological parameters in both modalities of management that is TBW and transosseous fixation with modified Krackow's technique.

Our study showed that both modalities of fracture fixation are equally effective. Although the patient with modified Krackow's technique showed higher fracture displacement, there was no patient with recorded clinical failure. The clinical parameters with respect to the range of motion and WOMAC score were comparable in both groups, the pain and discomfort in initial 4 weeks being slightly higher in the group that underwent TBW. There was a drastic improvement and fall in the WOMAC score in both groups from the 4th to 8th week. The full range of motion was achieved in both the groups in between 6 and 8 weeks postoperatively. The weight-bearing on the affected limb was started by the patients operated with TBW earlier than those who underwent transosseous repair because of the need for auxiliary bracing in the patients with tranosseous repair with modified Krackow's technique. The patients were given a long knee brace or the duration of 2 weeks postoperatively, which was changed to hinge knee brace at 3rd week postoperatively.

Conclusion

Both techniques have demonstrated comparable efficacy in managing inferior pole patella fractures, each with its own set of drawbacks and complications. Functional outcomes, as measured by WOMAC scores at 4 weeks, 8 weeks, and 6 months postoperatively, were similar between the two techniques. Patients undergoing transosseous repair experienced a slightly delayed return to full knee range of motion and delayed weight-bearing compared to those treated with TBW, as well as requiring auxiliary external bracing in the initial post-operative period.

Depending on the surgeon's preference, either technique can be considered as an alternative to the other.

Clinical Message

Transosseous repair may not be the ideal technique for the management of all fracture patterns but with careful patient selection of the inferior pole of patella fracture has shown to be a good alternative management to anterior TBW. It has been shown to produce similar clinical and functional outcomes like TBW.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this case report

How to Cite this Article

Solunkhe S, Shah M, Patil V, Kuity K. Comparative Study of Inferior Pole of Patella Fracture Treated with Transosseous Technique using Modified Krackow's Technique Versus Traditional Anterior Tension Band Wiring. Journal of Orthopaedic Case Reports 2024 October;14(10):230-235.