

Original Research Article

A prospective study to estimate the outcome of patellar fracture fixation with suture material of high resistance properties

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ABSTRACT

Background: Patella fractures make from 0.5% to 1.5% of all bone fractures. The most common fracture type, transverse fracture, impairs knee extension mechanics due to fragment displacement. In the years that followed, newer procedures were pursued in order to alleviate the aforementioned difficulties. K-wires were successfully replaced with cannulated screws. Furthermore, cerclage wiring was replaced with alternative implants without jeopardising the figure-of-eight tension band build.

Methods: A prospective study was conducted over a period of 18 months to evaluate the outcome of patellar fractures fixation with newer techniques and sutures. The study had 35 participants.

Results: This study included patients in the age group of 21-77 years. Among the total of 35 patients in the study, Maximum number of patients in our study were in the age range of 41-60 years which comprised 42.86%. In this study of 35 patients, 20 were male patients and 15 patients were female i.e. 57.14% of our study group comprised of male patients while 42.86% comprised of female patients.

Conclusions: The above study clearly demonstrates that the high resistance suture materials can be used as a potential alternative or may even be better to the existing prevalent fixation of patella fractures with stainless steel and wires. Fibertape fixation presents a lot of advantages over the traditional stainless steel and wire fixation. Biomechanically, fibertape has demonstrated tensile strength and stiffness equal to stainless steel and in certain specific parameters proved even more stronger than the stainless steel.

Keywords: Fixation, Functional outcome, High suture material, Patellar fractures

INTRODUCTION

Patella fractures make from 0.5% to 1.5% of all bone fractures.^{1,2} The most common fracture type, transverse fracture, impairs knee extension mechanics due to fragment displacement. Joint incongruity or displacement of more than 3mm necessitates surgical intervention.⁴ Conservative therapy can be attempted in cases of small displacements or undisplaced fractures with mobility

constraints. The gold standard approach is still osteosynthesis with Kirschner wires (K-wires) and tension band wiring, which produces good functional results.

A substantial number of implant-related problems occurred in the majority of instances, reaching up to 40%. Complications include delayed wound healing, surgical adhesions, knee stiffness, and prolonged work incapacity. Wire breakage and migration were caused by the use of

5,6-K-wires, resulting in uncomfortable and visible hardware in the knee.⁷

In the years that followed, newer procedures were pursued in order to alleviate the aforementioned difficulties. K-wires were successfully replaced with cannulated screws.⁸ Furthermore, cerclage wiring was replaced with alternative implants without jeopardising the figure-of-eight tension band build.

In this context, high-resistance sutures emerged as a solution to the earlier hardware-related difficulties linked with K-wires or cannulated screws. Plate fixation has also been demonstrated to be effective in patellar fractures.⁹

The aim of this study was to evaluate clinical and radiological functional outcome of patients who underwent open reduction and internal fixation (ORIF) using a novel trans-osseous tunnel technique with a high resistance non-absorbable suture material.

METHODS

In this prospective study, patients with patellar fractures who underwent fracture fixation with suture material were included at Department of Orthopaedics, Mahatma Gandhi Medical College and Hospital, Jaipur for 1 year from December 2020 to July 2022.

Time bound complete enumeration. Consenting participants who met the eligibility criteria between December 2020 and July 2022 were included. Purposive probability sampling method was used for data collection.

As a result, our sample size for this study was limited to 35 participants only.

Inclusion criteria

Age more than 18 years, any fresh fractures (i.e. trauma to surgery within 2 days). Minimum follow-up of at least 10 months were included.

Exclusion criteria

Age less than 18 years, evidence of an active infection, previous metal implantation, patients in whom a knee surgery was done prior to the recent trauma, and patients with other comorbidities like head injury which affects the rehabilitation were excluded.

Operative technique

The patient was positioned supine in the operating table. Tourniquet was not applied as a routine. A midline longitudinal incision was used for all the cases. Before inspecting the fracture per se, the medial and lateral retinaculum were visualized and inspected for any tears associated with the trauma and which may need to be repaired. Then fracture site is visualized. Fracture

hematoma is let out. Blood clots were removed from the fracture ends. The knee joint proper was inspected for any intra-articular loose fragments. Then preliminary fracture visualization is done under direct vision using reduction clamp.

Table 1: Tegner Lysholm knee scoring scale.

Section	Scoring	Outcome
Limp	0-5	<65-poor
Using cane or crutches	0-5	
Locking sensation in the knee	0-15	65-83-fair
Giving way sensation from the knee	0-25	84-90-good
Pain	0-15	
Swelling	0-10	>90-excellent
Climbing stairs	0-5	
Squatting	0-10	



Figure 1: Diagnosis of comminuted fracture right patella longitudinal fracture (pre-op knee x-ray).



Figure 2: Three month post-op x-ray.

The patella articular surface is inspected for any incongruity. The fracture reduction is achieved after attaining perfect joint congruity. Then two guide wires were inserted in the medial and lateral aspect of the patella. Then tunnels were created over the guide wires using the cannulated drill bit while the initial reduction is still maintained by the reduction clamps. The guide wires were

then removed. No 2 Fibertape is fed onto the bead pin and introduced in the medial tunnel in a distal to proximal fashion and on its exit in the medial proximal end it is brought across to the lateral distal end and then using the bead pin the Fibertape finally arrives at the lateral proximal end and the high resistance suture material is then tied with the knot placed in the postero-superior aspect. Care must be taken to bury the knot under sufficient soft tissue cover to protect the superficial tissues from irritation and subsequent patient discomfort. The reduction clamp can be removed after the application of the knot.



Figure 3: Nine month post-op x-ray.



Figure 4: One year post-op x-ray.



Figure 5: Pre-op of 56 year old male with comminuted fracture patella.

Statistical analysis

All the data was collected through forms and coded in Microsoft Excel. Mean and standard deviation were calculated through SPSS (TRIAL version 28.0). Kruscal Wallis test ($p=0.451$) and c^2 value 1.591 was used to

demonstrated relationship between functional outcome and age.



Figure 6: Immediate post-op of 56 year old male with comminuted fracture patella.



Figure 7: Three months post-op of 56 year old male with comminuted fracture patella.



Figure 8: Six months post-op of 56 year old male with comminuted fracture patella.



Figure 9: One year post-op.

RESULTS

Our study included patients in the age group of 21-77 years. Among the total of 35 patients in the study, Maximum number of patients in our study were in the age range of 41-60 years which comprised 42.86%. In our study of 35 patients, 20 were male patients and 15 patients were female i.e. 57.14% of our study group comprised of male patients while 42.86% comprised of female patients (Table 2).

Table 2: Socio-demographic profile and fracture scenario of study participants.

Characteristics	No.	%
Age (in years)		
21-40	11	31.43
41-60	15	42.86
>61	9	25.74
Gender		
Male	20	57.14
Female	15	42.86
Fracture type		
Transverse fracture II	20	57.14
Comminuted fracture	12	34.29
Inferior pole fracture	3	8.57

The association between age and functional outcome, the mean \pm SD age 46.72 \pm 16.62 years in the excellent outcome (range 54), 54.25 \pm 21.50 years in the good outcome (range 43) and 52.50 \pm 21.25 years in the fair outcome (range 33). This is statistically not significant as shown by the calculation. There is no association between age and functional outcome by Kruskal Wallis test ($p=0.451$) and χ^2 value 1.591. Functional outcome and hence union is not influenced by the age of the patient.

In the category of excellent outcome, out of the 25 patients, 9 patients underwent comminuted fracture type, 2 patients underwent inferior pole fracture and maximum 14 patients underwent transverse fracture type. Similarly in the good outcome, out of the 8 patients, 1-1 patient underwent comminuted and inferior pole fracture type and maximum 6 patients underwent transverse fracture type. 2 patients underwent comminuted fracture type in the category of fair outcome (Table 3).

Table 3: Functional outcome of patellar surgery.

Outcome of surgery	Mean	SD	Range
Fair	52.50	21.25	33
Good	54.25	21.50	43
Excellent	46.72	16.62	54

There is no association between type of fracture and functional outcome by Pearson χ^2 value = 5.568 and significant 2-tailed p -value 0.234. Type of fracture did not influence the eventual functional outcome of the study. All fractures united by a mean duration of 3 months 17 days.

This is statistically not significant as shown by the calculation.

DISCUSSION

The use of Fiber-Tape for the fixation of patella showed that the functional outcome of the cases were good. The scores evaluated for the functional outcome study was Lysholm score. Average Lysholm score is 91.14. There was no hardware related complications encountered in the course of the study. These are the most important results of the study.

Minor complications like superficial infection, anterior knee pain, displacement <4mm were noted in the study. Among the 35 patients who were included in the study, 1 patient presented with post-operative superficial infection which settled with intravenous antibiotics for 5 days. The patient was clinically normal and did not present with any further complications. The final scores of the patient were lysholm score-85. All the patients presented with good union at the end of the follow up. Though 2 patients presented with post-operative fixation failure with fracture displacement of <4mm, it eventually united and did not influence the final union. Scores of the first patient were Lysholm score-83 and second patient were Lysholm score-88.

Patella fractures have been treated by various methods over the past century. The gold standard technique followed till now is the application of stainless steel wire figure of eight configuration anterior tension band placed anteriorly after inserting two axial K-wires through the patella.¹⁰

In this study, 9 patients underwent comminuted fracture type, 2 patients underwent inferior pole fracture and maximum 14 patients underwent transverse fracture type in the category of excellent outcome. Similarly in the good outcome, out of the 8 patients, 1-1 patient underwent comminuted and inferior pole fracture type and maximum 6 patients underwent transverse fracture type. 2 patients underwent comminuted fracture type in the category of fair outcome. There is no association between type of fracture and functional outcome by Pearson χ^2 value = 5.568 and significant 2-tailed p -value 0.234. Type of fracture did not influence the eventual functional outcome of the study. All fractures united by a mean duration of 3 months 17 days.

A more comminuted fracture may demand the use of two cannulated cancellous screws instead of K-wires which also provides a stable construct.¹¹ The number of implant related metallic complications were very high in these patients as there was a high incidence of K-wire migration and the stainless steel wire knots that were not buried properly produced skin irritation, ulcers and infections. These complications ranged from 0-60%.^{13,14} All these factors played an important role in influencing the removal of the implant.

LeBrun et al. reported in a case series of 27 patients with a mean follow up of 6.5 years, the hardware removal rate was 52%.¹⁵ Hoshino et al made a retrospective study in the patella fractures that were operated and showed that elective implant removal was done in 37% of patients with K-wires and 23% of patients with cannulated screws.^{16,12} McGreal et al subjected the cadaveric patella for 20,000 cycles of alternating flexion and extension cycles and concluded that the braided polyester suture material is an effective alternative to stainless steel wire in tension-band fixation of patella.²⁰ Patel et al, in his study concluded that while comparing stainless steel with that of high resistance non absorbable polyester suture materials, the results showed equal strength in both the materials in terms of quality of fixation.²¹

The biomechanical test also established that FiberWire maintained its initial stiffness until failure.²² This was confirmed by our study: Using a FiberTape patella fixation. Among the 35 patients in our study, two patients presented with mild loss of reduction post-surgery (<4mm). This could be attributed to the fact that there may be adhesion and adjustment of the suture material through the surrounding peripatellar soft tissue which can happen even during simple application of load such as during quadriceps muscle contraction. Any significant loss of reduction, linked to FiberTape breakage or failure, did not occur in the study. This clearly establishes the effectiveness of suture material. In addition, all treated fractures healed at an average of 3 months 17 days postoperatively.

Kumar et al analysed a case series of 63 patella fractures who were treated by the conventional methods of fixation to elaborate on the findings of implant related complications. All these factors resulted in implant removal and re-surgery in these patients eventually. The timing of implant removal was a mean of 11 months (range 3-20).²³ However no cases in our present study with suture material needed re-surgery due to implant related complications or failure.²³ Wright et al conducted a biomechanical study to solve this issue. The study demonstrated that FiberWire, both single- or double-strand, is more resistant than the stainless steel and that an in vivo study is justified and will result in greater patient satisfaction and decreased reoperation rates.^{23,26,27} Based on the above studies and results, we went ahead with the fixation strategy of using the FiberTape as a sole material in the construct with good functional results comparable to that of the conventional metallic fixation. The study included both the transverse and comminuted fractures into account. This implant did not present discomfort and did not need second surgeries for implant removal.

Limitations of the study that must be taken into account are this study is a single-center study with a relatively small sample of patients. Minor complications were observed (pain, knee stiffness) were observed during the course of the study and all of them were conservatively treated and unrelated to the type of osteosynthesis

performed. None of the patients presented with symptoms of discomfort secondary to implant that required re-surgery. Another limitation is there is no control group in the study.

CONCLUSION

The study therefore establishes the fact that the high resistance non-absorbable suture material can act as a stable safe and highly efficient alternative to the conventional method of fixation or can be used as a potential alternative or may even be better to the existing prevalent fixation of patella fractures with stainless steel and wires. Fibertape fixation presents a lot of advantages over the traditional stainless steel and wire fixation. Biomechanically, fibertape has demonstrated tensile strength and stiffness equal to stainless steel and in certain specific parameters proved even stronger than the stainless steel.

Recommendations

These high resistance suture materials like FiberWire and FiberTape should be used for efficient non-metallic fixation of patella on par with that of traditional metallic fixation with reduced complications and re-surgery rates.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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