

FUNCTIONAL OUTCOME OF PATELLA FRACTURE FIXATION USING HIGH RESISTANCE SUTURE MATERIAL- A PROSPECTIVE STUDY

Saravanan B.¹, Balaji R.², Ashok L.³, Velazagan P.⁴

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Corresponding Author:

Dr. Saravanan B.,
Email: saravananb@yahoo.com

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¹Assistant Professor, Department of Orthopaedics and Traumatology, Madurai Medical College, Tamilnadu, India.

²Assistant Professor, Department of Orthopaedics and Traumatology, Madurai Medical College, Tamilnadu, India.

³Assistant Professor, Department of Orthopaedics and Traumatology, Madurai Medical College, Tamilnadu, India.

⁴Postgraduate, Department of Orthopaedics and Traumatology, Madurai Medical College, Tamilnadu, India.

ABSTRACT

Background: Patellar fractures disrupt the knee extensor mechanism and commonly require surgical fixation when displacement is present. High-resistance non-absorbable suture fixation has been used as an alternative to reduce hardware-related problems. This study evaluated functional and radiological outcomes following patellar fracture fixation using high-resistance suture material. **Materials and Methods:** This prospective study included adult patients with patellar fractures treated by open reduction and internal fixation using high-resistance non-absorbable suture material at the Department of Orthopaedics, Madurai Medical College and Hospital, between April 2021 to March 2023. Patients were followed for a minimum of ten months, and outcomes were assessed clinically and radiologically. **Results:** The majority of patients were males (65%) and aged >60 years (40%). Road traffic accidents were the most common mode of injury (85%), and closed fractures accounted for 85% of cases, with equal side involvement. Fracture union was achieved in all patients at a mean duration of 3 months and 8 days. An excellent functional outcome was observed in 70% and good outcome in 30%. Mean Lysholm and Böstman scores were 91.8 and 27.8, respectively. All patients regained full extension without extensor lag, and most achieved knee flexion up to 130°. Functional outcome showed no significant association with age ($p = 0.853$) or fracture type ($p = 0.329$). Complications occurred in three patients (15%) and included superficial infection, anterior knee pain, and displacement <4 mm, none of which affected fracture union. **Conclusion:** Exclusive non-metallic fixation using high-resistance suture material provides stable fixation, reliable union, excellent functional recovery, early knee mobilisation, and low complication rates while avoiding implant-related morbidity associated with metallic devices.

INTRODUCTION

Patella fractures account for nearly 0.5–1.5% of all skeletal fractures and are commonly seen following road traffic accidents or falls from standing height.¹ Transverse fractures form the most frequent pattern and interfere with the knee extensor mechanism when displacement of fragments occurs.² Displacement more than 3 mm or an articular step exceeding 2 mm alters patellofemoral congruity and impairs active knee extension, which necessitates operative fixation.³ Undisplaced fractures with preserved extensor continuity can be managed conservatively

using immobilisation in extension, followed by gradual rehabilitation.⁴

The goals of operative management include restoration of the articular surface, preservation of the extensor mechanism, and early mobilisation to prevent knee stiffness.⁵ The commonly practised method is anterior tension band wiring using two Kirschner wires combined with a stainless-steel figure-of-eight construct. This technique converts tensile forces generated during knee flexion into compressive forces at the fracture site.⁶ Despite providing stable fixation, implant-related complications are frequently reported. Studies have shown hardware-related complication rates ranging from 30% to 40%, including wire migration, wire

breakage, prominent hardware, anterior knee pain, wound complications, and need for implant removal.^[7]

To reduce complications associated with metallic implants, alternative fixation methods have been explored. Cannulated cancellous screws combined with tension band principles improve fracture compression and stability, but issues such as implant prominence and secondary removal persist.^[8] In an effort to eliminate metal-related morbidity, high-resistance non-absorbable suture materials were introduced for patella fracture fixation. These materials have high tensile strength, resistance to abrasion, and reliable knot security. Biomechanical studies comparing ultra-high molecular weight polyethylene sutures with stainless steel wire have demonstrated comparable or higher load-to-failure values under cyclic loading conditions.^[1]

Early knee mobilisation after stable fixation plays an important role in preventing adhesions and quadriceps wasting. Rigid fixation allows initiation of range of motion exercises within the first postoperative week. Delayed mobilisation has been associated with stiffness, reduced flexion, prolonged rehabilitation, and difficulty in regaining pre-injury functional activity levels.^[9]

Most available literature on suture-based fixation primarily focuses on biomechanical performance or includes mixed constructs combining sutures with metallic implants. Clinical studies assessing exclusive non-metallic fixation remain limited, particularly prospective studies evaluating functional outcomes using validated scoring systems. Data regarding time to union, recovery of knee motion, extensor lag, and complication rates following fixation using high-resistance sutures alone are sparse in routine clinical settings. Therefore, this study aimed to evaluate the clinical and radiological functional outcome of patients who underwent open reduction and internal fixation (ORIF) using a high-resistance non-absorbable suture material.

MATERIALS AND METHODS

This was a prospective study involving 20 adult patients at the Department of Orthopaedics, Government Madurai Medical College and Hospital, conducted from April 2021 to March 2023. Approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participating patients before surgery.

Inclusion and exclusion criteria

Adult patients aged >18 years with fresh patellar fractures who underwent surgery within two days of injury and had a minimum follow-up of ten months were included in the study.

Patients <18 years, those with active infection, prior metal implantation, previous knee surgery, or associated conditions such as head injury that

interfered with postoperative rehabilitation were excluded.

Methods

At admission, demographic and injury-related variables including age, sex, side involved, mode of injury and nature of injury (open or closed) were recorded. Fractures were classified radiographically as transverse or inferior pole fractures. All procedures were performed under standard operating room conditions with the patient in the supine position, and a tourniquet was not used routinely. A midline longitudinal incision was employed in all cases. The medial and lateral retinacula were inspected for associated tears and repaired when present. The fracture site was exposed, fracture haematoma evacuated and blood clots and interposed soft tissues were removed from the fracture ends. The knee joint was inspected for intra-articular loose fragments. Fracture reduction was achieved under direct vision using a reduction clamp and articular congruity was confirmed. Two guide wires were inserted through the medial and lateral aspects of the patella while maintaining reduction, and patellar tunnels were created over the guide wires using a cannulated drill bit, after which the guide wires were removed. No. 5 FibreTape was passed through the tunnels using a bead pin in a figure-of-eight configuration from distal to proximal on the medial side, then across to the lateral distal end and finally exiting at the lateral proximal end. The suture was tied with the knot positioned at the posterosuperior aspect of the patella and buried beneath adequate soft tissue to minimise irritation. The reduction clamp was removed, and fracture reduction was reassessed for any particular step and further confirmed under C-arm fluoroscopy. Stability of fixation was assessed intraoperatively by gentle knee flexion and extension. Retinacular repair was performed where required. Thorough wound irrigation was given; a drain was placed when necessary, and the wound was closed in layers followed by a sterile dressing.

The instruments used for the procedure included a reduction clamp, guide wires, a cannulated drill bit and a bead pin for passage of the FibreTape. Patients were followed for a minimum of 10 months, and during follow-up, radiological assessment was performed for fracture union and maintenance of reduction, and for detection of fracture displacement greater than 4 mm. Range of motion of the knee and extensor lag were assessed clinically. Functional outcome was evaluated using the Lysholm knee score and the Böstman patella fracture score. The Böstman scoring system assessed range of movement, pain, ability to work, quadriceps muscle atrophy, need for walking aid, effusion, giving way and stair climbing, and the total score was graded as excellent (28–30), good (20–27) and unsatisfactory (<20); for statistical analysis in this study, outcomes were grouped as excellent and good. The Lysholm score evaluated limp, support, locking, instability, pain, swelling, stair climbing and squatting and was interpreted as excellent (>90), good (84–90), fair (65–83), and poor

(<65). Postoperative complications such as superficial infection, anterior knee pain and fracture displacement were recorded.



Figure 1: Patient positioning



Figure 2: Midline longitudinal incision



Figure 3: Fracture hematoma let out and fracture edges identified



Figure 4: Final figure-of-eight construct

Statistical Analysis

Statistical analysis was done using SPSS v. 29. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean values. The chi-square test was used to assess the association, and a p-value <0.05 was considered significant.

RESULTS

The majority of patients were older than 60 years (6, 40%). Males predominated the study group (13, 65%). Road traffic accidents were the main cause of injury (17, 85%). Closed fractures were more common than open injuries (17, 85%). Right and left side involvement was equal (10 each, 50%). [Table 1]

Table 1: Demographic and injury characteristics

Variable	Category	N (%)
Age range (years)	20–30	3 (15%)
	30–40	2 (10%)
	40–50	5 (20%)
	50–60	4 (15%)
	>60	6 (40%)
Sex	Male	13 (65%)
	Female	7 (35%)
Side involved	Right	10 (50%)
	Left	10 (50%)
Mode of injury	Road traffic accident	17 (85%)
	Accidental fall	3 (15%)

Nature of injury	Closed	17 (85%)
	Open	3 (15%)
Gender vs mode of injury	Male – RTA	12
	Male – fall	1
	Female – RTA	6
	Female – fall	1

Excellent functional outcome was observed in most patients (14, 70%). Functional outcome was not influenced by age ($p = 0.853$) or fracture type ($p = 0.329$). Complications were infrequent and occurred in three patients (15%), with each complication seen in one patient (5%) (Table 2). Fracture union was

achieved in all patients, with a mean time to union of 3 months and 8 days. Functional outcome assessment showed a mean Lysholm score of 91.8 and a mean Bostman score of 27.8. All patients achieved full extension without extensor lag, and the majority attained knee flexion up to 130°. [Table 2]

Table 2: Functional outcomes and complication profile

Variable	Category	Outcome N (%)		P value
Overall functional outcome	Excellent	14 (70%)		-
	Good	6 (30%)		-
Age (years)	<40	Excellent	4	0.853
		Good	1	
	40–59	Excellent	6	
		Good	3	
	>60	Excellent	4	
		Good	2	
Type of fracture	Transverse	Excellent	12 (75%)	0.329
		Good	4 (25%)	
	Inferior pole	Excellent	2 (50%)	
		Good	2 (50%)	
Complications	Superficial infection	1 (5%)		-
	Anterior knee pain	1 (5%)		-
	Displacement <4 mm	1 (5%)		-

DISCUSSION

Patellar fractures disrupt the extensor mechanism and knee joint congruity, and stable fixation with early mobilisation is essential for optimal functional recovery. This study evaluated the clinical, radiological, and functional outcomes of patellar fractures treated with exclusive high-resistance non-absorbable suture fixation. The technique resulted in universal fracture union, predominantly excellent functional scores, restoration of full active knee extension without extensor lag, and knee flexion up to 130° in most patients, with minimal complications and no implant-related morbidity.

In our study, the study population was mainly elderly, with male predominance. Road traffic accidents were the commonest cause of injury. Most fractures were closed, and right and left knee involvement was equally distributed. Kruse et al. found that the median age was 67 years, with predominance of patients above 60 years, females constituted 64%, low-energy trauma accounted for 85%, road traffic accidents 7.5%, and side involvement was nearly equal (left 51.5%, right 48.5%).¹⁰ Shirsat et al. found that in a retrospective study of 92 patellar fractures, most patients were aged 31–40 years (30.43%), males constituted 59.78%, right-sided involvement was common (55.43%), indirect trauma predominated (61.96%), and transverse or oblique fractures accounted for 84.78% of cases.¹¹

Similarly, Diamond and Achor found in a two-centre series of 39 patients that males constituted 56.4% of cases. Most patients were aged 31–40 years (30.8%).

Road traffic accidents were the leading cause of injury (53.8%). Closed fractures predominated (89.7%), with no clear side dominance reported.¹² While demographic distribution was comparable in terms of age and side involvement, the mechanism of injury differed among a few studies, with high-energy RTA predominating in our study.

In our study, most patients had excellent functional recovery. Outcome was not influenced by age or fracture type. Although transverse fractures showed excellent outcomes, the difference was not significant. Complications were minimal and limited to a small number of cases. Similarly, Noothan et al. found that all fractures united with similar union times (≈ 13 weeks). Mean Bostman scores at 20 weeks were comparable between Fibre Wire and SS wire groups ($p = 0.201$). Complications were infrequent, including hardware prominence, minor displacement, infection, and anterior knee pain.¹³ Muralidhar et al. found in a 20-patient series that functional outcome was excellent in 14 patients (70%), good in 4 (20%), and poor in 2 (10%). Complications occurred in 5 patients (25%), including superficial infection and extension lag, with no cases of non-union or malunion.¹⁴ These studies support our findings by showing high rates of fracture union, predominantly excellent functional outcomes, lack of association with age or fracture type, and low complication rates following surgical fixation of patellar fractures.

In our study, all patients achieved full extension without extensor lag, and the majority attained knee flexion up to 130°. Kennedy et al. found that all

patients demonstrated full active knee extension without extensor lag. At final follow-up, 65% of patients achieved knee flexion up to 130°, while the remaining patients had flexion between 110° and 120°.^[15] Anand et al. reported restoration of full knee extension in 23 out of 24 patients, with only one patient showing a 10° extensor lag. Approximately two-thirds of patients achieved knee flexion up to 130°, while the remaining had flexion between 110° and 120°.^[16] Restoration of full active knee extension without extensor lag and achievement of flexion up to 130° in the majority of patients can be observed across the study. Thus, indicating that stable fixation allows effective early mobilisation and reliable recovery of the extensor mechanism.

Limitations

The small sample size limited statistical strength. Lack of a comparison group restricted outcome comparison. Follow-up was insufficient for long-term assessment. Single-centre design may limit the generalisability of the findings.

CONCLUSION

Fixation of patellar fractures using high-resistance non-absorbable suture material resulted in reliable fracture union and good functional recovery in most patients, with few complications. Functional outcome was not influenced by age or fracture type, and stable fixation allowed early knee mobilisation. The technique avoided implant-related irritation seen with metallic devices. Future studies with larger sample sizes and comparative groups are recommended. Long-term follow-up is required to assess the durability of outcomes and late functional performance.

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