



FUNCTIONAL OUTCOME OF PATELLA FIXATION WITH FIBER WIRE

Orthopaedics

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ABSTRACT

Purpose: To study the clinical and radiological functional outcome of patients who underwent open reduction and internal fixation of the patella using a non-absorbable suture material (Fiberwire). **Methods:** A prospective study was conducted at the A J Institute of Medical Sciences, Mangalore, from September 2019 to September 2021, involving 25 patients who underwent patellar fracture fixation with non-absorbable suture material. Patients had regular follow-ups at 6 months. Clinico-radiological outcomes were assessed at the end of 12 months. Functional outcomes were evaluated using the Tegner-Lysholm and Bostman scoring systems. **Results:** Among the 25 patients with patellar fractures meeting the inclusion criteria, the mean time to union was 10 weeks. Four patients presented with minor complications such as superficial infection, anterior knee pain, and an extensor lag of up to 10°. All fractures united uneventfully, and no patient required re-surgery. **Conclusions:** Patellar fracture fixation with non-absorbable suture material (Fiberwire) showed favorable outcomes by avoiding complications like a palpable implant and the need for re-surgery for implant removal. Thus, this technique can be recommended as a superior alternative to stainless steel wire for patellar fracture fixation.

KEYWORDS

Patella, fracture, fiberwire.

INTRODUCTION

Patellar fractures are uncommon, accounting for around 1% of all skeletal injuries, but they are becoming more common as transportation and industry increase. These fractures are quite prevalent in young people. The most common pattern, transverse fracture, impairs knee extension mechanics due to fragment displacement and is classed as AO/OTA 34-C1/34-C2 by the Arbeitsgemeinschaft für Osteosynthesefragen (AO) ⁽¹⁾.

Direct or indirect trauma is the most common mechanism of patellar damage. Direct trauma is caused by a direct blow during a fall onto the knee or by striking a hard object. Indirect fractures can occur as a result of a fast jump or rapid bending of the knee against fully tightened quadriceps ⁽²⁾. Post-traumatic arthritis of the patello-femoral joint and a decrease in the range of motion of the knee joint are severe complications when treatment is not completely successful ⁽³⁾.

There are various approaches to treating patella fractures. Non-operative treatment is confined to fractures with an intact quadriceps component, a separation of less than two millimeters, and no considerable articular surface displacement. Open reduction with internal fixation is the standard therapy for restoring quadriceps function and preventing osteoarthritis in the presence of considerable fracture displacement and articular incongruity ⁽⁴⁾.

Several procedures for internal fixation have been developed and used over the years, with varying degrees of effectiveness. Historically, the modified tension-band wiring technique has been the most often utilized for managing patellar fracture fixation ⁽⁵⁻⁷⁾. This technique consists of longitudinal Kirschner wires (K-wire) and 18-gauge stainless steel wire looped over the anterior side of the patella in a figure-of-eight design, transferring tension forces into compressive forces at the articular surface ⁽⁸⁾.

Some authors have advocated for non-metallic implants, such as nonabsorbable sutures, to avoid postoperative sequelae. Despite favorable results, concerns remain over the fixation stability offered by sutures. Biomechanical tests suggest that **FiberWire**, a suture made of ultra-high-molecular-weight polyethylene coated with braided polyester, retains its stiffness until failure, offering potential advantages in tension band fixation for patellar fractures ⁽⁹⁾.

Thus, this study was designed to evaluate the functional outcome of patellar fracture fixation using FiberWire.

Aims And Objective

To evaluate the clinical and radiological functional outcomes of patients undergoing open reduction and internal fixation (ORIF) using a novel transosseous tunnel technique with a high-resistance, non-absorbable suture material (FiberWire).

MATERIAL AND METHODS

Study Design: This was a single-center, observational, prospective study.

Study Site: The study was conducted in the Department of Orthopedics at a tertiary care hospital.

Study Duration: September 2019 – September 2021.

Study Population: All patients with patellar fractures referred to our hospital during the study period.

Ethical Considerations: The study commenced after obtaining approval from the institutional ethics committee and the Department of Orthopedics. Informed written consent was obtained from all patients.

Inclusion Criteria

- Patient with age more than 18 years
- Patient with trauma to surgery within 2 days
- Patient with minimum follow-up of at least 6 months
- Patient who are ready to give informed written consent and willing to participate in the study.

Exclusion Criteria

- Patients not willing to give consent for further investigations
- Patient with age less than 18 years
- Patient with evidence of an active infection
- Patient with 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

Sample Size: 25

Sampling Technique: Purposive sampling was adopted to select the individuals for the study

Study Procedure

All adult patients with patellar fractures, who underwent surgery at our hospital, were evaluated during their hospital stay. The functional outcomes were assessed at follow-up intervals. These cases typically presented with knee swelling, pain, and an inability to walk.

Upon admission, all patients underwent a clinical evaluation, including an X-ray of the knee in both anteroposterior and lateral views, along with necessary hematological and radiological investigations. Post-operative X-rays were evaluated immediately. Patients were re-assessed clinically at 6 months, with a focus on the following parameters: pain, function, range of motion, and absence of deformity.

Prior to their inclusion in the study, patients were fully informed about the study's objectives and methodology. Written informed consent was obtained from all participants, and they were assured of the confidentiality of their data. Data collection was carried out using a pre-tested semi-structured questionnaire. A comprehensive history, clinical examination, and relevant hematological and radiological investigations were performed in all cases, following the study protocol.

Surgical Steps

- Positioning:** The patient was positioned supine on the operating table.
- Tourniquet Application:** A tourniquet was applied as a routine measure.
- Incision:** A midline longitudinal incision was used for all cases.
- Inspection:** Before examining the fracture, the medial and lateral retinaculum were inspected for any tears associated with trauma that might need repair.
- Fracture Visualization:** Preliminary visualization of the fracture was done using a reduction clamp under direct vision.
- Fracture Reduction:** After achieving joint congruity, two guide wires were inserted on the medial and lateral aspects of the patella.
- Drilling and Fixation:** Tunnels were created over the guide wires using a cannulated drill while maintaining initial reduction with reduction clamps.
- Suture Placement:** No. 5 Fiberwire was passed through the medial and lateral guide wire tunnels. The non-absorbable suture material was then tied with the knot placed postero-superiorly.
- Final Checks:** The reduction clamp was removed after knot application. The fracture reduction was inspected for any step deformities and residual incongruity in the articular surface, followed by C-arm imaging to confirm proper alignment.
- Knee Stability:** The stability of the fracture reduction was checked by flexing and extending the knee on the table.
- Wound Closure:** A thorough wound wash was done. A drain was placed if necessary, and the wound was closed in layers with sterile dressing applied.

Post-operative Functional Assessment

The following criteria were used to assess post-operative functional outcomes:

Section 1 - Limp

- I have no limp when I walk. (5)
- I have a slight or periodical limp when I walk. (3)
- I have a severe and constant limp when I walk. (0)

Section 2 - Use of Cane or Crutches

- I do not use a cane or crutches. (5)
- I use a cane or crutches with some weight-bearing. (2)
- Putting weight on my injured leg is impossible. (0)

Section 3 - Locking Sensation in the Knee

- I have no locking or catching sensation in my knee. (15)
- I have a catching sensation but no locking in my knee. (10)
- My knee locks occasionally. (6)
- My knee locks frequently. (2)
- My knee feels locked right now. (0)

Section 4 - Giving Way Sensation in the Knee

- My knee never gives way. (25)
- My knee rarely gives way, only during athletics or vigorous activities. (20)
- My knee frequently gives way during athletics or vigorous activities, preventing participation. (15)
- My knee frequently gives way during daily activities. (10)
- My knee often gives way during daily activities. (5)
- My knee gives way with every step I take. (0)

Section 5 - Pain

- I have no pain in my knee. (25)
- I have intermittent or slight pain during vigorous activities. (20)
- I have marked pain during vigorous activities. (15)
- I have marked pain during or after walking more than 1 mile. (10)
- I have marked pain during or after walking less than 1 mile. (5)
- I have constant pain in my knee. (0)

Section 6 - Swelling

- I have no swelling in my knee. (10)
- I have swelling only after vigorous activities. (6)
- I have swelling after ordinary activities. (2)
- I have constant swelling in my knee. (0)

Section 7 - Climbing Stairs

- I have no problems climbing stairs. (10)
- I have slight problems climbing stairs. (6)
- I can climb stairs one at a time. (2)
- Climbing stairs is impossible for me. (0)

Section 8 - Squatting

- I have no problems squatting. (5)
- I have slight problems squatting. (4)
- I cannot squat beyond a 90-degree bend in my knee. (1)
- Squatting is impossible for me. (0)

Scoring

- Poor:** Less than 63
- Fair:** 64-83
- Good:** 84-90
- Excellent:** >90

90 – excellent BOSTMAN SCORING SYSTEM BOSTMAN SCORING SYSTEM	
Variable	Points
Range of movement (ROM)	
Full extension and the ROM>120 or within Within 10 degree of normal side	6
2) Full extension, movements 90* to 120 *	3
PAIN	
1) None or minimal on exertion	6
2) Moderate on exertion	3
3) In daily activity	0
WORK	
1) Original job	4
2) Different job	2
3) Cannot work	0

Atrophy (Difference in Circumference of Thigh 10 cm Proximal to Patella)

- <12 mm: 4 points
- 12 to 25 mm: 2 points
- >25 mm: 0 points

Assistance In Walking

- None:** 4 points
- Cane part of the time:** 2 points
- Cane all the time:** 0 points

Effusion

- None:** 2 points
- Reported to be present:** 1 point
- Present:** 0 points

Giving Way

- None:** 2 points
- Sometimes:** 1 point
- In daily life:** 0 points

Stair Climbing

- Normal:** 2 points
- Disturbing:** 1 point
- Disabling:** 0 points

Total Score Classification

- Excellent:** 30 to 28 points
- Good:** 27 to 20 points
- Unsatisfactory:** <20 points

RESULTS

This observational study was conducted in the Department of Orthopedics at a tertiary care hospital. A total of 25 patients with patellar fractures treated with K-wire and FiberWire were included, after obtaining written informed consent. Key findings include:

- The average age of participants was 51.69 years, with the majority (28%) being over 65 years old.
- Male predominance was observed, with a male-to-female ratio of 2.12:1.
- Transverse fractures (48%) were the most common type, followed by comminuted fractures (32%).

Type of fracture	No of patients	Percentage
Transverse	12	48
Comminuted	7	32
Transverse (part 1)	2	8
Transverse (part 2)	1	4
Inferior pole	3	12
Total	25	100

- Patellar union was achieved in 48% of patients by 3 months post-surgery, and in 96% of patients by 4 months.

Time for union	No of patients	Percentage
3 months	12	48
4 months	12	48
>4 month	1	4
Total	25	100

- The average range of motion (ROM) was 0 to 130° in 72% of patients.

Range of motion	No of patients	Percentage
0-110	1	4
0-120	5	20
0-130	18	72
10-130	1	4
Total	25	100

- The mean Lysholm score was 90.68 ± 4.89 , and the mean Bostman score was 27.28 ± 2.45 .

Lysholm score	No of patients	Percent age	Bostman score	No of patients	Percent age
< 80	1	4	<20	0	0
80- 90	7	28	20-25	5	20
90-100	17	68	25-30	20	80
Average score	90.684.89		Average score	27.28	2.45

- 92% of patients reported no major complications, with only minor issues such as superficial infections and extensor lag in a few cases.

Complications	No of patients	Percentage
No	21	84
Superficial infection	2	8
Anterior knee pain	1	4
Extensor lag	1	4

- Outcome ratings were excellent in 68%, good in 24%, and fair in 8% of patients.

Outcome	No of patients	Percentage
Excellent	17	68
Good	6	24
Fair	2	8

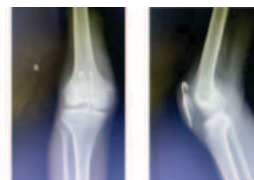


Pre-Operative X-ray patient 1

Pre-Operative X-ray patient 2

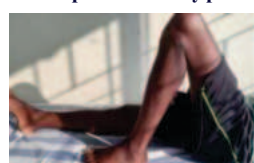


Intra Operative Images

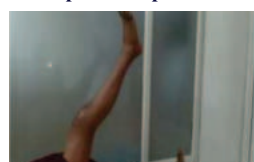


Post-Operative X-ray patient 1

Post-Operative X-ray patient 2



Post-op follow up after 6 months of patient 1



Post-op follow up after 6 months of patient 2

DISCUSSION

Patellar fractures are relatively uncommon form of skeletal injury encountered by the orthopaedic surgeon. It represents approximately 1% of all skeletal injuries. The patella is a sesamoid bone embedded in the quadriceps/patella tendons that displaces the tendons away from the centre of rotation, thereby increasing the moment arm and increasing the force of knee extension. The extensor mechanism of the knee is crucial for ambulation. The pull of the quadriceps tendon makes stable reconstruction of patella fractures a major surgical challenge. The indications for surgical fixation of a patella fracture are an absent extensor mechanism (patient not able to lift leg straight), articular displacement >2 mm, or interfragmentary displacement >3 mm. Regardless of surgical technique, the goals of surgical treatment are the anatomical reduction of the articular surface, stable fixation able to withstand the deforming forces acting on the patella during the healing process and the preservation of a functional extensor apparatus to start early range of motion.⁽¹⁰⁾

Historically, the most commonly used technique for managing patellar fracture fixation is represented by the modified tension-band wiring technique. Over the years, this technique was further modified by different authors using either K-wires or cannulated screws with different stainless steel wire configurations. The present study was thus conducted to evaluate the functional outcome of patients with patellar fracture using K wire.

This was an observational study conducted in the department of orthopedics of a tertiary care hospital after obtaining permission from institutional ethics committee and department of orthopedics. In this study 25 patients with patellar fractures treated with K wire were involved after obtaining written informed consent.

The average age of participants in our study was 51.69 years, with the majority (28%) of patients being 65 years or older. Almost half of the patients (nearly 48%) were under the age of 50. In our study population, males outnumbered females by a ratio of 2.12:1. In Peter Larsen's⁽¹¹⁾ extensive review of 724 patients with patella fracture, the gender distribution was 425 (56%) females and 331 (44%) males, with a mean age of 46 ± 22 years for males and 61 ± 18 years for females. Levack's et al.⁽¹²⁾ studied 30 patients, 21 of whom were male and 9 of

whom were female. In his case series of patients with patella fracture, Lawrence Camarda⁽⁹⁾ reported an average age of 46.6 years (range 20–75), with a male predominance (70.58 %). Because men are more likely to be involved in car or other road traffic accidents, there were more male patients who presented with patella fractures. The age also has a direct correlation with the fact that the main cause of the injury in elderly people was primary osteoporosis, whereas the cause of injured patella in young patients was a road traffic accident because they are breadwinners for the family, spend more time outside, and live a more active lifestyle, making them more vulnerable to road traffic accidents. The majority of patients enrolled had a transverse fracture (48%) followed by a comminuted fracture (32%). In 12% of patients, an inferior pole fracture was reported. In his study, Lawrence Camarda⁽⁹⁾ found transverse fractures in more than half of the study population (53 %), comminuted fractures in nearly one-third (35 %), and inferior pole fractures in the remaining 11 % of patients. R Rajesh⁽¹³⁾ reported that out of 30 patients, transverse type fracture occurred in 17 (57%) patients, vertical type fracture occurred in 1 (3%), comminuted displaced type fracture occurred in 9 (30%) patients, lower pole type fracture occurred in 2 (7%), and comminuted undisplaced type fracture occurred in 1 (3%).

Patellar union was completed in 48 % of patients after surgery in three months, in the remaining 48 % in three to four months, and in the remaining 4 % in more than four months. At the latest follow-up, more than two-thirds (72%) of patients had range of motion (ROM) from 0 to 130°, with the remaining 20% having ROM up to 120°. Almost identical to our study, the ROM in the majority of patients in R Rajesh⁽¹³⁾ study was >120°, while the remaining patients had ROMs ranging from 90° to 120°. In a study conducted by Lawrence Camarda, the average ROM for flexion was 131.10 (range 120–140) and 0.50 for extension (range 0–3).⁽⁹⁾ There were no significant differences in ROM between the injured and uninjured contralateral knees, and all fractures healed (time to union 9.2.2 weeks) with no fixation failure in the group studied.

The average Lysholm score among study population was 90.68 ± 4.89, with almost two-third (68%) patients had score between 90 to 100. Whereas, the average Bostman score was 27.28 ± 2.45, with majority in the range of 25–30. Lawrence Camarda⁽⁹⁾ reported the average Bostman scores at 3 months postoperatively and final follow-up as 25.2 ± 2 (range 20–30) and 28.3 ± 1.6 (range 26–30), respectively. Further, the mean Lysholm score at final follow-up was 91 points ± 5.7 (range 83–100). Chengwu Liu⁽¹⁴⁾ in his study reported, at 1, 3, 6, and 12 months after operation, the Lysholm scores and Bostman scores both gradually increased with the time.

The majority of the study population (84 %) reported no complications, whereas superficial infection, anterior knee pain, and extensor lag were reported in the remaining 16% patient each. The extensor lag was 10 degrees. As a result, the outcome was excellent or good in 92 percent of patients and fair in the remaining 8 percent. There was no patient who had a bad outcome. Lawrence Camarda⁽⁹⁾ reported displacement of 4mm in two patients, anterior knee pain and knee stiffness in one patient each, in a study that was almost identical to ours. R Rajesh⁽¹³⁾ reported excellent to good results with K wire in 98 percent of patients in his study. In his study, 1 patient each had a superficial infection and mild pain.

Thus, the findings of our study and similar other studies clearly show that K wire used for patella fractures improves functional outcome immediately after surgery with minimal complications. Our study had a few limitations because it was conducted in a single centre in South India, and as a result, our findings may not be applicable to the entire country. Due to the larger sample size and multicentre study's involvement in various regions of the country, it will provide better, more robust data that can be trusted. Because of the study's design, no long-term outcomes or complications could be tracked.

CONCLUSION

The study concludes that:

- Open reduction and internal fixation using FiberWire resulted in excellent to good outcomes in 92% of patients.
- Patellar union was achieved in 96% of cases within 3 to 4 months.
- The average ROM was 0 to 130°, with a high average Lysholm and Bostman score, indicating favorable functional outcomes.
- No major complications were reported, making FiberWire a promising alternative to traditional stainless steel wire for patellar

fracture fixation.

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