Outcomes of Surgical Treatment for Patellar Fracture

Abstract

Introduction: The patella has an important role in knee extension and shock absorption. This retrospective study assessed factors influencing surgical outcomes of patellar fractures over ten years at a single center.

Materials & Methods: A descriptive-correlational design was applied to patellar fracture cases treated at a university center over a decade. Patients were stratified into follow-ups of <5 or ≥5 years. Data included demographics, medical history, functional outcomes (Koo's and WOMAC indices), pain, range of motion, and osteoarthritis severity (Kallgren/Lawrence classification). Census sampling was used. Analyses were performed in SPSS, with visualizations in Excel and GraphPad Prism.

Results & Discussion: Among 53 patients (mean age 60.45 ± 16.00; 90.6% male), 62.3% had <5-year and 37.7% had ≥5-years follow-up. Follow-up duration did not correlate with outcomes. Treatment complications significantly correlated with degenerative arthritis. Functional scores were higher ($p < 0.05$) and pain scores lower ($p < 0.05$) in patients without complications.

Conclusion: Patellar fracture surgery yielded favorable mid-term outcomes, with complications linked to poorer function and higher pain. Reoperation rates were low, supporting surgical efficacy.

Keywords: Patella, Bone fractures, Fracture fixation.

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Introduction

The patella is the largest sesamoid bone in the body and plays a role in knee extension by connecting the quadriceps tendon to the patellar tendon[(1)]. This bone, approximately 5 cm in width, is located in anterior of the knee within the quadriceps tendon[(2)]. It has been reported that nearly one percent of fractures of bones involve the patella[(3)]. Patellar fractures are more common between the ages of 20 and 50 years, with an incidence twice as high in men compared to women[(4)]. Various classifications of patellar fractures have been described in the literature, including osteochondral, transverse, comminuted, stellate, vertical, and polar fractures. Among these, transverse fractures are the most frequent[(5)]. Another classification distinguishes between direct and indirect fractures. Direct fractures typically occur due to trauma and are often associated with comminution, whereas indirect fractures usually result from excessive traction on the patella during extension.

Treatment options for patellar fractures include tension band wiring, modified tension band wiring, cerclage wiring, external fixation, total or partial patellectomy, and open reduction with internal fixation (ORIF)[(6)]. Postoperative dysfunction is the most common complication and has been observed across all surgical methods[(7)]. Among the three surgical techniques of titanium tension band, X-shaped plate, and titanium cerclage, the X-shaped plate has been shown to result in the lowest complication rates[(8)].

To date, no study has compared all available surgical methods to determine the optimal approach for treating patellar fractures by evaluating complications and patient satisfaction. Furthermore, a review of accessible databases revealed that factors influencing surgical outcomes in this context have not yet been examined.

Therefore, the present study aimed to retrospectively investigate the outcomes of patellar fracture surgery and the factors affecting them over a ten-year period (2010–2022). It should be noted that patellar fractures have not yet been evaluated in the Iranian population. The hope is that identifying the best surgical method for this type of fracture will significantly reduce complications while improving joint function and patients' quality of life.

Materials & Methods

This descriptive-correlational study included 53 patients with a mean age of 45.60± 16.00 year , 90.6% were men and 9.4% were women (Table 1). The study was conducted between 2010 and 2022 at Imam Khomeini and Bu-Ali Sina Hospitals in Sari, both affiliated with Mazandaran University of Medical Sciences. The study population consisted of patients with patellar fractures who presented to these centers. It should be noted that these patients were treated by different surgeons. Patients were categorized into two groups: those with less than 5 years and those with more than 5 years since surgery. Patients with ipsilateral femoral fractures were excluded. Radiographic evaluations of the knee, functional assessment, pain levels, and range of motion were analyzed by the same orthopedic resident using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The severity of osteoarthritis was assessed using the Knee injury and Osteoarthritis Outcome Score (KOOS2) questionnaire, which includes several domains: pain, stiffness, physical function, and quality of life. Each domain consists of multiple items, which are scored individually, and the total scores for each domain were subsequently analyzed.

Radiographic evidence of osteoarthritis was graded using the Kellgren–Lawrence (K–L) scale, classifying patients into four subgroups: none, mild, moderate, and severe osteoarthritis. The grading system is: grade 0 (normal), grade 1 (doubtful osteophyte), grade 2 (definite osteophyte and possible joint space narrowing), grade 3 (moderate joint space narrowing, multiple moderate osteophytes, and possible bone end deformity), and grade 4 (severe joint space narrowing, marked sclerosis, large osteophytes, and definite bone end deformity)[9].

Return to previous activities was assessed and categorized as poor, moderate, or good. Complications such as infection, nonunion, and symptomatic implants requiring removal were also evaluated. Finally, the WOMAC questionnaire—an internationally standardized tool for assessing treatment outcomes in patients with knee osteoarthritis—was used. This instrument consists of questions covering symptoms, stiffness, pain, and physical activities. Each question is scored on a 5-point Likert scale (0–4), yielding a total score ranging from 0 to 100. A score of 0 represents the maximum level of disability, while 100 indicates no disability. Improvement in the WOMAC score reflects clinical recovery.

All evaluations were performed after obtaining approval from the Ethics Committee of Mazandaran University of Medical Sciences and securing the necessary permissions. Informed consent was obtained from all participants prior to inclusion.

Table 1: Demographic variables in participants

Variable	Category	Frequency	Relative frequency (%)
Gender	Male	48	90.6
	Female	5	9.4
Education level	Diploma	6	11.3
	Associate degree	2	3.8
	Bachelor's degree	21	39.6
	Master's degree	17	32.1
	Doctorate or higher	7	13.2
Employment status	Homemaker	1	1.9
	Student	6	11.3
	Self-employed	29	54.7
	Employee	17	32.1
Having children	Yes	36	67.9
	No	17	32.1

Data Analysis

For descriptive purposes, descriptive statistical methods were applied, including mean and standard deviation for normally distributed quantitative variables, median and interquartile range for non-normally distributed quantitative variables, and frequency and relative frequency for qualitative variables. Box plots, pie charts, and bar charts were also employed. For analytical purposes, chi-square and independent t-tests were used. Data were analyzed using SPSS version 22, with a significance level set at 0.05. Graphs were generated using Excel 2019 and GraphPad Prism version 10.

Results

A total of 53 patients were evaluated for underlying comorbidities. Among them, 28.3% had diabetes, 35.8% had hypertension, 22.6% had hyperlipidemia, and 7.5% had rheumatoid arthritis. The time elapsed since surgery was less than 5 years in 62.3% of patients and more than 5 years in 37.7%.

Surgical techniques included tension band wiring in 73.6% and cerclage wiring in 26.4% of patients (Table 2). The KOOS questionnaire results in two groups showed no significant differences in function divided by time since surgery (P = 0.321) and also Similarly in pain scores (P = 0.550).

When patients were categorized based on surgical technique, no significant differences were observed in either functional outcomes (P = 0.334) or pain scores (P = 0.278). However, when patients were divided into groups based on the presence or absence of complications, a significant difference in both function and mean pain levels was clearly observed (P < 0.001 for both) (Figure 1).

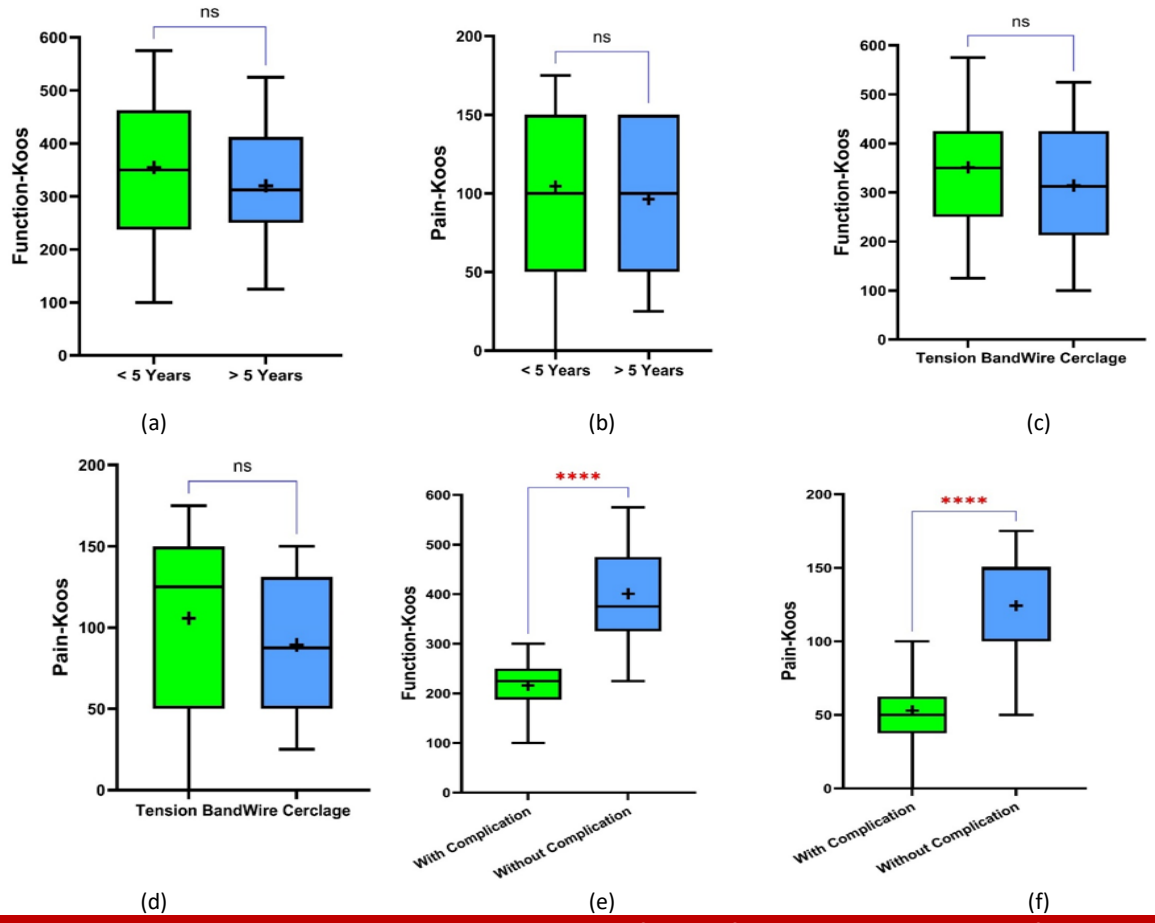

Figure 1: The KOOS questionnaire results: Comparison of mean function based on time after surgery (P = 0.321) (A). Comparison of mean pain based on time after surgery (P = 0.550) (B). Comparison of mean function based on type of surgery (P = 0.334) (C). Comparison of mean pain based on type of surgery (P = 0.278) (D). Comparison of mean function based on the presence of complications (P < 0.001) (E). Comparison of mean pain based on the presence of complications (P < 0.001) (F).

The WOMAC questionnaire results indicated no significant differences in function, pain, or range of motion between groups categorized by time since surgery (P = 0.608, P = 0.342, and P = 0.721, respectively). Likewise, no significant differences were observed in these variables between groups categorized by surgical technique (P = 0.395, P = 0.340, and P = 0.072, respectively). In contrast, when patients were grouped according to the presence of complications, significant and meaningful differences were observed across all three variables (P < 0.001 for each).

Complications assessed in this study included nonunion, wire breakage, infection, and symptomatic implants requiring removal. Overall, 17 patients (32.1%) experienced complications, whereas 36 patients (67.9%) remained complication-free (Figure 2).

Table 2: Frequency distribution of underlying comorbidities among study participants

Variable	Category	Frequency	Relative frequency (%)
Diabetes	Yes	15	28.3
	No	38	71.7
Hypertension	Yes	19	35.8
	No	34	64.2
Hyperlipidemia	Yes	12	22.6
	No	41	77.4
Rheumatoid arthritis	Yes	4	7.5
	No	49	92.5

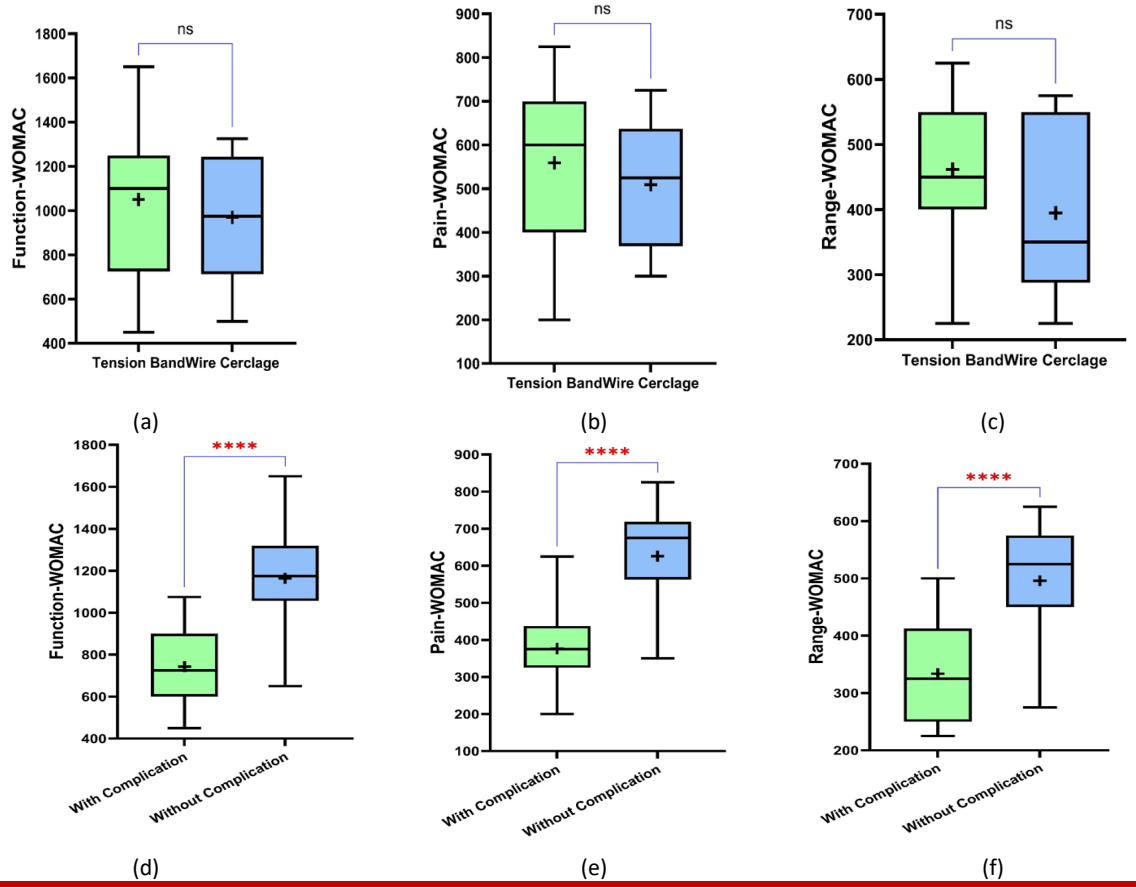

Figure 2: Comparison of mean function based on the type of surgery (P = 0.395) (A). Comparison of mean pain based on the type of surgery (P = 0.340) (B). Comparison of mean range of motion based on the type of surgery (P = 0.072) (C). Comparison of mean function based on the presence of complications (P < 0.001) (D). Comparison of mean pain based on the presence of complications (P < 0.001) (E). Comparison of mean range of motion based on the presence of complications (P < 0.001) (F).

Discussion

Surgical interventions for patellar fractures performed in Sari between 2010 and 2022 demonstrated no significant association between the type of surgery and the time required to return to activity. However, a significant association was observed between the presence of complications and the development of osteoarthritis. Moreover, patients without complications had better functional outcomes and reported lower levels of pain. Overall, the mean functional scores were higher in patients without complications compared to those with complications. These findings highlight the importance of addressing postoperative complications in improving patients' quality of life.

Various studies have employed different methods to evaluate treatment outcomes, with most reporting favorable or satisfactory results[10–14]. However, just a few studies have repoted patient's outcome measures[15]. Our findings suggest that the KOOS questionnaire can show the functional recovery and quality of life after patellar fractures. This instrument demonstrated acceptable patient relevance, high reliability, and satisfactory responsiveness. For full content validation, comprehensiveness, clarity of information, and professional grading remain critical[16]. The present study confirmed a good correlations across all 11 KOOS subscales at follow-up intervals of less than and more than five years.

Another tool employed in this study was the WOMAC questionnaire, which is among the most widely used instruments for assessing patients with osteoarthritis and patellar surgery, providing more detailed information directly from patients. Previous research has shown that individuals with patellar fractures may experience chronic pain and limitations in daily activities, negatively affecting quality of life[17]. With regard to surgical techniques for reduction and fixation of patellar fractures, our findings confirm the efficacy of surgery, in alignment with outcome criteria established by other investigators in this field[18–21].

In a study by Giesinger et al., pain and total WOMAC scores were found to be the best predictors of treatment success[22]. Conversely, Lungu et al., in a similar study with a different population and therapeutic intervention, highlighted the high sensitivity of WOMAC items related to function and stiffness, arguing that responses to these items are strongly influenced by individual and environmental factors[23].

Differences in results between these studies may stem from variations in study design, patient populations, or other confounding factors. Vina et al. reported that patients who improved following surgery demonstrated, on average, lower WOMAC scores for pain, disability, and stiffness compared to those who did not improve at two years postoperatively, underscoring the need to carefully monitor potential adverse effects of newer treatment options[24].

In 2020, 94.4% return-to-sport rate following patellar tendon rupture repair was reported by Beranger et al., a finding not corroborated by our study[25].

Conclusion

This study, which included a small group of patients—mainly those need additional surgery for hardware-related complications—reported generally positive outcomes. The limitations of this are retrospective design, single-center setting, short term follow-up, failure to compare different types of implants and potential confounding influences such as patient compliance to rehabilitation protocols and experience of surgeon .

Future studies are recommended to include a larger sample size, achieve a more balanced distribution of male and female participants, and incorporate direct comparisons among different implant types. Additionally, longer follow-up periods would provide more comprehensive insights into long-term outcomes.

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