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Original Research Article

FUNCTIONAL OUTCOME OF COMMINUTED PATELLAR FRACTURE FIXATION USING PATELLAR MESH PLATE

KHAN B, TAREEN NU, JUNAID M

Orthopedic Resident Department of Orthopedic CMH Rawalpindi, Pakistan
**Corresponding author email address: najeeb_tareen@yahoo.com*

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Abstract *Comminuted patellar fractures pose a challenging problem in orthopedic surgery due to the complexity of fracture patterns and the potential for compromised knee function. This study aimed to evaluate the functional outcomes of patients with comminuted patellar fractures treated with patellar mesh plate fixation at CMH Rawalpindi's Department of Orthopedic Surgery. A retrospective study was conducted at the Department of Orthopedic Surgery at CMH Rawalpindi between September 2022 and August 2023. This retrospective study comprised 28 patients with comminuted patellar fractures treated at the Department of Orthopedic Surgery at CMH Rawalpindi between September 2022 and August 2023. The non-probability purposive sample approach was utilized to enroll 28 patients. who had surgery with a patellar mesh plate. The patients were seen in the outpatient department at 6 and 18 weeks. At 18 weeks, the variables specified in the Modified Hospital for Special Surgery Knee Score were recorded, and the Knee Score was computed and analyzed. This study included 18(64.28%) male patients and 10(35.71%) female patients. The average age was 24.96±5.09 years, ranging from 15 to 75 years. There were 2(7.14%) patients aged 15-25 years, 10(39.28%) patients aged 26-35, 8(28.57%) patients aged 36-45, 2(7.14%) patients aged 46-55, 3(10.71%) patients aged 56-65, and 2(7.14%) patients aged 66-75 years. The MHSSKS assessed the patient's well-being. The age distribution of our patients was: 11 patients (39.28%) were 75–56 years old, 12(42.85%) were 55–36 years old, and 5(17.85%) were 35–25 years old. This mean score quantifies our patients' knee function and health. The "Excellent" category indicated significant improvements in knee function and quality of life in 13 patients (46.42%). Twelve patients (42.85%) had a "Good" functional result, and three patients (10.71%) had a "Fair" functional result, suggesting some knee function improvement, but less than those in the Excellent and Good groups. Patellar mesh plate fixation affects comminuted fracture rehabilitation and recovery via functional outcome categories. Patellar mesh plate fixation could be an effective surgical treatment for comminuted patellar fractures with good functional results. However, patient considerations and fracture characteristics should be addressed while choosing a therapy. These results need to be confirmed by larger future studies with longer follow-ups.*

Keywords: Patellar fracture, Comminuted fracture, Patellar mesh plate, Functional outcome, Fracture fixation, Knee joint

Introduction

Patellar fractures are prevalent in orthopedic treatment and have several fracture forms and therapeutic problems. Complex clinical scenarios include comminuted patellar fractures, commonly including numerous fracture pieces, displacement, and knee joint extensor mechanism disruption. These fractures may come from high-energy trauma, falls, or sports accidents and affect patients' quality of life with pain, knee function loss, and mobility (Li et al., 2023). The patella, also known as the kneecap, is the most significant sesamoid bone found inside the human body. It serves a crucial role as the central point of rotation for the knee extensor mechanism (Millis and Levine, 2013). By elevating the extensor mechanism is positioned anterior to the axis of rotation of the knee joint, the patella transfers the extensor mechanism's tensile stresses to the patellar tendon. It increases the complex's effectiveness. As a result, the quadriceps muscle acts as a pulley and is 30% stronger due to the accelerated lever arm. The patella is embedded into the quadriceps muscle to a 50% degree by its tendinous part's insertion into the proximal patellar pole. Patella fractures account for 0.5% to 1.5% of all skeletal injuries (Gwinner et al., 2016; THAKUR et al.). The treatment of a patellar fracture depends on the size of the broken pieces, the kind of fracture, the congruency of the articular surface, and the strength of the extensor mechanism. Self-determination of the kind of management a

recommended first restoration (Gwinner et al., 2016; Wild et al., 2010). Modified tension band wire is a common surgical treatment technique for patella fractures and is effective for almost all fracture types. Due to the better consistency in biomechanical investigations when paired with a tension band wire, two similar cannulated lag screws are the preferred therapy for horizontally displaced two-part fractures (Yu et al., 2020). The orthopedic community debates the best therapy for comminuted patellar fractures. Tension band wire, cerclage wiring, and cannulated screw fixation have been used to treat these fractures. However, every technique has limits, and attaining excellent results may be difficult, especially in severe comminution.

Patellar mesh plates for fracture fixation are a new surgical breakthrough. Patellar mesh plates bridge damaged patellas and distribute stresses uniformly to stabilize fixation. This method may improve fracture stability, postoperative discomfort, and knee function.

Methodology

Study Design

The Department of Orthopedic Surgery at CMH Rawalpindi did this retrospective study. The medical records and radiographic data of patients who had patellar mesh plate fixation for comminuted patellar fractures between September 2022 and August 2023 were reviewed for the research.

Postoperative Management, Fracture Characteristics and Surgical Detail

The Department of Orthopedic Surgery accepted patients within the age range of 15 to 75 years who presented with solitary patella fractures classified as AO 34-C1 (transverse) and 34-C2 (transverse with second fragment). These patients were admitted either via the Accident and Emergency department or the Outpatient Department (OPD). The diagnosis was confirmed in all instances with the use of X-ray knee antero-posterior and lateral radiographs. The investigations conducted in this study included a range of diagnostic tests, including Hemoglobin (Hb) analysis, Complete Blood Count (CBC), Electrocardiogram (ECG), chest X-ray examination, Hepatitis B surface antigen (HBsAg) testing, and Anti-Hepatitis C Virus (HCV) screening. Preoperative assessment was conducted to establish the suitability of anesthesia and surgical intervention.

All patients had surgery on the following scheduled session. Post-operative antero-posterior and lateral radiographs were obtained. The removal of the drain occurred 48 hours subsequent to its insertion. The act of splinting is used to restore the knee to its original alignment subsequent to surgical intervention. Weight bearing allowed for quadriceps contraction. A few days following surgery, patients were permitted to walk with weight as tolerated. Early isometric quadriceps workouts were advised. Post-op active joint motion with complete weight bearing was progressively undertaken after 14 days. After 14 days, complete weight-bearing active joint motion was progressively done. Outpatient follow-up occurred at 6 and 18 weeks. At week 16, Modified Hospital for Special Surgery Knee Score variables were recorded. Calculated and rated knee score

Statistical Analysis

Descriptive statistics such as means, standard deviations, and frequencies were employed to summarize demographic data and clinical outcomes. SPSS-26 was used for statistical analysis, and suitable statistical tests were used to determine the significance of observed differences.

Ethical Considerations

To ensure patient privacy and confidentiality, all patient data were transformed by ethical guidelines. The CMH Rawalpindi Institutional Review Board (IRB) approved the research.

Results

There were 18(64.28%) male patients and 10(35.71%) female patients in this study, for a male-to-female ratio of 1.6:1. The average age was 24.96±5.09 years, with a range of 15 to 75 years. There were 2(7.14%) patients aged 15-25 years, 10(39.28%) patients aged 26-35, 8(28.57%) patients aged 36-45, 2(7.14%) patients aged 46-55, 3(10.71%) patients aged 56-65, and 2(7.14%) patients aged 66-75 years (Table-I). The Modified Hospital for Special Surgery Knee Score (MHSSKS) evaluated knee function in 28 patients with comminuted patellar fractures who underwent patellar mesh plate repair. The MHSSKS assessed the patient's well-being. The age distribution of our patients was: 11 patients (39.28%) were 75–56 years old, 12(42.85%) were 55–36 years old, and 5 (17.85%) were 35–25 years old. In particular, no patients under 25 were in the group. Our patient cohort had a mean MHSSKS of 24.96 and a standard deviation 5.09. This mean score quantifies our patients' knee function and health (Table II).

We found that most patients had good functional results following surgery. The "Excellent" category indicated significant improvements in knee function and quality of life in 13 patients (46.42%). Twelve patients (42.85%) had a "Good" functional result, suggesting significant knee function gains but not the best. This shows that many patients had good outcomes after patellar mesh plate fixation. Three patients (10.71%) had a "Fair" functional result, suggesting some knee function improvement, but less than those in the Excellent and Good groups (Table III). In our research, no patient had a "Poor" functional result, demonstrating the surgical intervention's efficacy.

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These functional result categories reveal how patellar mesh plate fixation affects comminuted patellar fracture rehabilitation and recovery. The distribution of patients across these categories suggests that this surgical technique may improve knee function and quality of life for those with this difficult orthopedic disease.

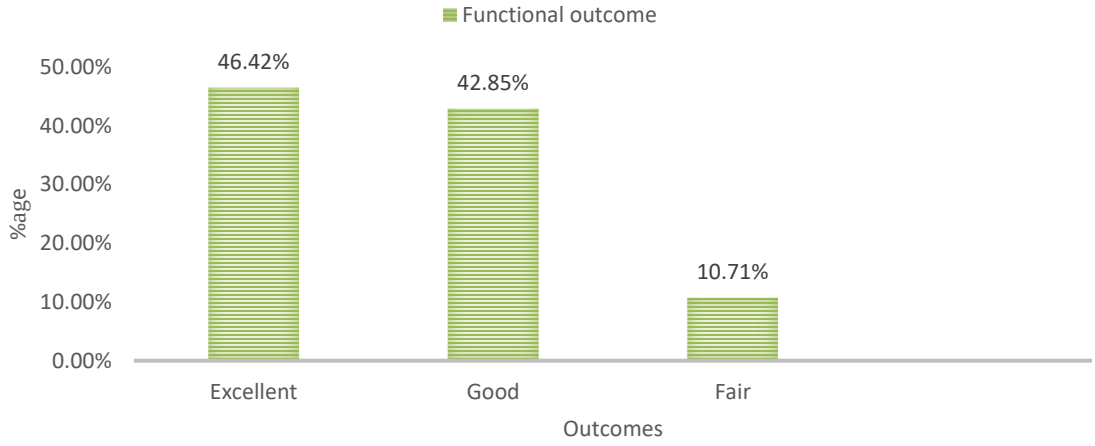

Figure 1: Functional outcomes in our enrolled patients

Table I: Gander and Age-wise Characteristics

Characteristics	Number of Patients(n=28)	%age
Gender		
Male	18	64.28%
Female	10	35.71%
Age (years)		
15-25	2	7.14%
26-35	11	39.28%
36-45	8	28.57%
46-55	2	7.14%
56-65	3	10.71%
66-75	2	7.14%
Mean ±SD	24.96 ± 5.09 years	

Table II: Evaluation of Knee Function

MHSSKS	Number of Patients(n=28)	%age
75-56	11	39.28%
55-36	12	42.85%
35-25	5	17.85%
<25	0	0
Mean ± SD	24.96 ± 5.09 years	

Table-III: Functional Outcome

Functional outcome	Number of Patients(n=28	%age
Excellent	13	46.42%
Good	12	42.85%
Fair	3	10.71%
Poor	0	0

Discussion

Patella fractures are infrequent, accounting for 1% of fractures. Despite their low prevalence, Fractures of the patella may result in significant pain and dysfunction due to their interactions with the distal femur and their essential involvement in the extensor mechanism of the lower leg. The goal of any therapy is extensor mechanism restoration and articular surface reduction. If displacement exceeds 2 mm, surgery is required (Steinmetz et al., 2020). The patella functions in the knee joint's extension process as a lever. Although the related forces on the patella are complicated, they may be divided into two categories: compressive forces and tensile forces. Tensile stresses are generated in the quadriceps and patellar tendons over the patella during quadriceps contraction. Along with this, compressive stresses also develop in the patella-femoral joint, which increases with everyday activity (Loudon, 2016). As a result, the internal fixators for patella fractures similarly inevitably experience such high stresses and need to be carefully constructed to handle such challenging conditions. Plate fixation has recently gained popularity for patella fractures. Plating constructs possess a design characterized by a low-profile structure that facilitates stable fixing, hence enabling early mobility and yielding improved functional outcomes (Siljander et al., 2017). The total mean age in this study was 24.96±5.09 years, ranging from 15 to 75 years. There were 2(7.14%) patients aged 15-25 years, 11(39.28%) patients aged 26-35, 8(28.57%) patients aged 36-45, 2(7.14%) patients aged 46-55, 3(10.71%) patients aged 56-65, and 2(7.14%) patients aged 66-75 years. The average age of patients in the Hao W et al. study was 43.0 years (Haugen et al., 2020). . This study included 18 (64.28%) male and 10(35.71%) female volunteers (M:F; 1.6:1). Similarly, there were 10(34.48%) females and 19 (65.51%) men in a study by Hao W et al. (M: F; 1.9:1) (THAKUR et al.). The participants in this study were observed in the 6th and 18th weeks. Cases were followed up on for an average of 13 months (range, 6-18 months)

following surgery in a study by Zhao QM et al. (Lee et al., 2021)In a study by Hao W et al., patients were followed by radiographic analysis and the Lysholm Knee Score at 1, 2, 3, 6, 9, and 12 months following surgery, with a mean follow-up period of 11.48 months (Hao et al., 2015). In this study, 13(46.42%) patients had excellent functional outcomes, 12(42.85%) had good functional outcomes, and 3 (10.71%) had fair functional outcomes. In this study, no patient had a poor functional result. In research by Zhao QM et al. the functional results for the titanium cable tension band fixation were excellent (81%) and good (19%). The functional results for the NT-PC fixation were excellent (81%) and good (19%) (Zhao et al., 2017). Excellent and good outcomes were similar ($p > 0.05$). Zhao QM et al. found no patients with unsatisfactory results or bad outcomes. Few studies have examined the functional result of Open Reduction and Internal Patellar Mesh Plate treatment of patella fractures.

Limitations

The study's retrospective nature introduced potential limitations, including the absence of a control group, reliance on medical record accuracy, and limited generalizability to other patient populations.

Conclusion

In conclusion, patellar mesh plate fixation is a surgical alternative that effectively treats comminuted patellar fractures and has promising functional results. When choosing the best treatment strategy, carefully analyzing the unique patient features and fracture characteristics is essential. More prospective studies with larger sample sizes and longer-term follow-ups must confirm these results.

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We appreciate everyone who helped us accomplish this study on patellar mesh plate repair for comminuted fractures' functional outcome. We first thank our supervisor for his guidance, support, and encouragement during this research. His orthopedic surgical abilities impacted this investigation. We also appreciate the CMH Rawalpindi Department of Orthopedic Surgery staff and residents for data collection and analysis. Their help made this study successful. We thank the patients who generously shared their experiences in this study. Without them, this study would not have occurred. We also appreciate CMH Rawalpindi physicians and nurses for their excellent care of our research patients. We value your research contributions. This research should advance orthopedic surgery and enhance comminuted patellar fracture patients' function.

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Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

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Not applicable

Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.