

ORIGINAL RESEARCH

Evaluation of the functional result of early knee mobility in transverse patellar fractures treated with modified tension band wiring

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Received date: 20 April, 2024

Acceptance date: 23 May, 2024

ABSTRACT

Aim: To evaluate the functional result of early knee mobility in transverse patellar fractures treated with modified tension band wiring. **Material and methods:** This research was a prospective observational study including 50 patients who met the inclusion criteria and were treated with open reduction and internal fixation. Functional result was assessed at a 6-month follow-up and compared to the findings in the current body of research. The assessment of pain was conducted using a visual analogue scale. The research included patients aged 20 to 60 years with displaced transverse (two part) patellar fractures, who presented within 2 weeks after the injury. Only closed fractures with extensor mechanism lag at the knee were included. **Results:** The assessment of fractures was conducted based on clinical criteria, namely when painless movements could be performed without assistance and there was an absence of discomfort. Among the 50 patients, the fracture healed within 11 weeks in 17 of them. The current research found that the fracture was successfully healed at 13.5 weeks in 26 patients, whereas in 7 individuals, the fracture took 16.2 weeks to heal. The mean duration of union was 13.11 weeks. In the current research, after a 6-month follow-up, it was found that 40 patients had no discomfort, 5 patients experienced pain at the extreme range of motions, and 10 patients had pain that limited their ability to walk excessively. Among the 50 patients, 39 had a range of motion beyond 90 degrees, whereas 11 patients showed a range of motion below 90 degrees. **Conclusion:** The efficacy of MTBW in achieving stable fixation and facilitating early rehabilitation highlights its efficiency in the treatment of transverse patellar fractures.

Keywords: Knee mobility, Transverse patellar fractures, Modified tension band wiring

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INTRODUCTION

Transverse patellar fractures are often occurring injuries that usually arise from direct trauma to the knee or rapid vigorous contraction of the quadriceps muscle. Fractures in the knee may greatly hinder its function by causing damage to the extensor mechanism, resulting in challenges with walking and carrying out everyday tasks.

The Patella, also known as the knee cap, is a triangular bone around 5cm in diameter. It is located inside the tendon where the quadriceps femoris muscle attaches. The quadriceps femoris tendon extends from the lower pole and attaches to the upper

tibia[1]. The patella is a crucial element of the knee's extensor mechanism[2]. The fracture of the patella has been recognized since the time of Hippocrates. It accounts for roughly 1% of all fractures and is more common among those aged 20 to 50 years. Males are twice as likely to be impacted by this fracture compared to females [3,4]. The patella's anterior subcutaneous position renders it susceptible to direct trauma, such as the knee forcefully colliding with the dashboard of a car or experiencing a fall on the front of the knee. Patellar fracture may result from either direct or indirect trauma. Comminuted or displaced fractures are often caused by direct impact, whereas

transverse fractures of the patella are generally caused by the quick and forceful contraction of the quadriceps muscles during knee flexion. However, the fracture of the patella often occurs as a consequence of a combination of both direct and indirect force[5]. The primary goal of treatment is to restore the extensor mechanism, provide stable immobilization of the fracture, and promote early mobilization to prevent stiffness and achieve optimal functional recovery. Modified tension band wire (MTBW) is a commonly used surgical method for treating transverse patellar fractures. This technique offers reliable immobilization, enabling prompt mobilization of the knee, which is essential for averting joint rigidity and facilitating recovery. Implementing early mobilization after MTBW therapy has the potential to result in enhanced functional results, including increased range of motion, muscular strength, and overall knee function[6].

MATERIAL AND METHODS

This research was a prospective observational study including 50 patients who met the inclusion criteria and were treated with open reduction and internal fixation. Patients who met the selection criteria were included in the research after undergoing a thorough history, clinical examination, providing written permission for the operation and anesthesia, and receiving an explanation of the potential consequences associated with the procedure. The data was analyzed using suitable statistical techniques. Functional result was assessed at a 6-month follow-up and compared to the findings in the current body of research. The assessment of pain was conducted using a visual analogue scale. The research included patients aged 20 to 60 years with displaced transverse (two part) patellar fractures, who presented within 2 weeks after the injury. Only closed fractures with extensor mechanism lag at the knee were included. Fractures that occur after a period of 2 weeks, fractures that have not shifted, fractures that are open, fractures that are broken into several pieces, fractures that run lengthwise, patients with multiple injuries. Relevant radiological examinations were conducted. Antero-posterior, lateral, and axial images were obtained. Computed tomography (CT) scan was performed in cases with uncertain and intricate fractures. Baseline blood tests, chest X-rays, and electrocardiography (ECG) were performed. Prior to the procedure, the patient provided written permission after being fully informed, and received antibiotic prophylaxis.

Methodology

The patient was positioned in a supine posture on the table. A medial longitudinal incision was performed to disclose the fracture. The proximal and distal pieces were aligned and secured tightly using patella reduction clamps in order to reestablish a seamless articular surface. Two 2 mm K-wires were inserted in

a retrograde fashion, passing from the lower to the upper pole, about 5 mm deep to the front surface of the patella. The wires were placed along the lines that divide the patella into its medial, central, and lateral thirds, and were kept as parallel as possible. The tightening process included employing stainless steel wire in a figure-eight pattern. The decrease was verified using both physical examination and X-ray imaging, including anteroposterior and lateral views. The upper ends of the two K-wires were inserted into the top edge of the patella after bending it sharply, and the protruding ends of the K-wires were trimmed to a shorter length at the bottom. The retinacular lips were surgically repaired and the wound was closed using a vacuum drain. During the post-operative period, the patient received intravenous antibiotics and sufficient pain relief. The knee was immobilized in a straightened position using a posterior splint or knee brace. Isometric workouts began on the first day after the surgical procedure. Dressing changes were performed every other day. An X-ray of the knee was performed in both the anteroposterior (AP) and lateral perspectives.

Physical rehabilitation began two weeks after the incision had fully healed. The sutures were removed two weeks post-surgery. Weight bearing commenced after a duration of 6 weeks. Postoperative follow-up was conducted at 2, 4, 8, 12, 16, and 24 weeks. During each visit, the local site was inspected for any indications of local inflammation or infection. The range of motion of the knee was evaluated, and the patient's functional status was recorded. Additionally, X-rays of the affected knee were obtained. Radiological union occurred when the bone trabeculae intersected the fracture line. The study documented the healing of the fracture, the proper alignment of the broken bone, and any long-term consequences such as failure to heal or infection.

Statistical analysis

The data were analyzed using descriptive statistics to provide a concise summary of patient characteristics and outcome indicators. The study used paired t-tests to assess the differences in functional outcomes before and after surgery. A p-value less than 0.05 was deemed to be statistically significant.

RESULTS

The research included a total of 50 cases, with 39 being men and 11 being females. The average age of the participants was 42.57 years, ranging from 20 to 60 years. The predominant cause of trauma in the current research was road traffic accidents, accounting for 64% of cases, followed by falls in 26% of cases and assaults in 10% of instances. Among the 50 patients, 30 had trauma on the right side and 20 experienced trauma on the left side. In this research, 21 patients provided reports on the day of their injury, 14 patients provided reports one day after, 11 patients provided reports two days after, and 4 patients

provided reports one week later. The average reporting delay was 3.67 days. There were 12 patients who were inactive, 28 patients who had mild physical activity, and 10 patients who had high physical activity. Out of the patients, 24% (12) were discovered to have additional injuries. These included head injury (n=4, 8%), chest injury (n=2, 4%), fracture of the proximal humerus (n=1, 2%), fracture of the lateral malleolus (n=2, 4%), and blunt trauma to the abdomen (n=2, 4%). In this research, 40 patients had surgery within the first week, whereas 10 individuals underwent surgery beyond the first week. The assessment of fractures was conducted based on clinical criteria, namely when painless movements could be performed without assistance and there was an absence of discomfort. Among the 50 patients, the fracture healed within 11 weeks in 17 of them. The current research found that the fracture was

successfully healed at 13.5 weeks in 26 patients, whereas in 7 individuals, the fracture took 16.2 weeks to heal. The mean duration of union was 13.11 weeks. In the current research, after a 6-month follow-up, it was found that 40 patients had no discomfort, 5 patients experienced pain at the extreme range of motions, and 10 patients had pain that limited their ability to walk excessively. Among the 50 patients, 39 had a range of motion beyond 90 degrees, whereas 11 patients showed a range of motion below 90 degrees. Complications were identified in 17 participants in the current investigation. Eleven individuals were seen to have a superficial infection, which was treated by thoroughly cleaning the wound, administering intravenous antibiotics, and applying sterile dressings regularly. Hardware complications were seen in six individuals, leading to the removal of the implant after the fracture had fully healed.

Table 1: Basic parameter of the participants

Parameter	Number	Percentage
Gender		
Male	39	78
Female	11	22
Mode of injury		
RTA	32	64
Fall	13	26
Assault	5	10
Side involved		
Right	30	60
Left	20	40
Delay in surgery (weeks)		
Less than 1	40	80
More than 1	10	20
Type of occupation		
Sedentary workers	12	24
Light workers	28	56
Heavy workers	10	20
Associated injuries		
Head injury	4	8
Chest injury	2	4
Fracture proximal humerus	1	2
Fracture lateral malleolus	2	4
Blunt trauma abdomen	2	4

Table 2: Clinical outcome

Parameter	Number	Percentage
Pain		
No pain	40	80
Require double support	0	0
Require single support	0	0
Limit excessive walking	10	20
Limit routine walking	0	0
Clinico-radiological consolidation		
United within 11 weeks	17	34
United within 13.5 weeks	26	52
United within 16.2 weeks	7	14
Range of motion		

11°-30°	0	0
50°-70°	0	0
71°-90°	11	22
>90°	39	78
Quadriceps strength		
<50%	0	0
50-74%	9	18
>75%	41	82

Table 3: Reich and Rosenberg (1954) scale for patella fracture.

Results	Pain	Movement	Number	Percentage
Excellent	No pain or occasional	No limitation	36	72
Good	Pain on prolonged activity	Limitation of 10°-20° of flexion	12	24
Fair	Pain while climbing or during work	Flexion >75°	2	4
Poor	Constant pain	Flexion <75°	0	0

DISCUSSION

There are several surgical methods available for the treatment of a transverse fracture of the patella by open reduction and internal fixation. However, in cases when the knee joint is flexed at a 90-degree angle, the articular surface may be disrupted due to the posterior angulation of the fractured fragment [7,8]. However, Levak et al [9] observed that the deployment of tension band wiring approach eliminates the risk of articular surface distraction and allows for early mobilization. The current research found that the highest occurrence of trauma was detected among individuals in their fourth decade of life, with an average age of 42.57 years. These findings are consistent with previous studies by Mohapatra et al (37 years), Mahindra et al (40.46 years), and Yang et al (63.73 years)[10-12]. Fractures were more prevalent on the right side (60%) compared to the left side (40%), which aligns with the

findings of earlier investigations conducted by Asimuddin et al and Mahindra et al [11,13]. In this research, 39 participants (78%) were men and 11 participants (22%) were females, resulting in a male to female ratio of 3.5:1. Asimuddin et al, Ramu et al, and Lone et al [13-15] also reported similar findings. The primary cause of fracture in our research was road traffic accidents, accounting for 64% of cases. Falls accounted for 26% of fractures, while assault accounted for 10%. These findings align with earlier studies conducted by Asimuddin et al, Mohapatra et al, and Mahindra et al [10,11,13]. The process of radiological union was completed in a range of 10 to 16.2 weeks, with an average duration of 13.11 weeks. Asimuddin et al, Mohapatra, and Mahindra et al [10,11,13] reported similar findings. The functional result was evaluated using the Reich and Rosenberg scale.

Table 4: Time of radiological union

Study	Average time of union (weeks)
Mohapatra et al¹⁰	13.6
Mahindra et al¹¹	12.7
Asimuddin et al ¹³	10 (8-12)
Present study	13.11

Out of a total of 50 cases, 36 (72%) had an exceptional result, 12 (24%) had a good functional outcome, and 2 (4%) had a fair outcome. The findings of our study were consistent with those of Asimuddin et al., Mohapatra, and Lone et al. [10, 13, 15]. Among the 50 patients, problems were found in 17 individuals, representing a prevalence rate of 34%. Eleven individuals were seen to have a superficial infection, which was treated by thoroughly cleansing the wound, administering intravenous antibiotics, and applying sterile dressings on a daily basis. Hardware symptoms were seen in six individuals, who had implant removal once the fracture had healed. The findings of our study were similar to those reported in the current literature by Asimuddin et al, Mahindra et al, and Lone et al [11, 13, 15]. The current

investigation did not notice any neurovascular problems.

CONCLUSION

The efficacy of MTBW in achieving stable fixation and facilitating early rehabilitation highlights its efficiency in the treatment of transverse patellar fractures. To validate these results and investigate the long-term consequences of early mobilization after MTBW, more research with bigger sample numbers and extended follow-up periods is required.

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