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To study the treatment of comminuted patellar fractures using modified cerclage wiring

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Abstract---Aim: To study the treatment of comminuted patellar fractures using modified cerclage wiring. Methods: This study was done in the department of Orthopedics, after taking the permission from the ethical committee. 50 cases of simple unilateral closed comminuted patellar fracture were treated by modified cerclage wiring. During follow-up, the Böstman clinical grading measures were used to evaluate the effects of the surgery in eight areas: range of mobility, discomfort, work, atrophy, assistance in working, effusion, giving way, and stair-climbing. 28–30 points were outstanding, 20–27 points were decent, and fewer than 20 points were low on these measures. Results: Using Böstman's clinical grading systems, the ultimate follow-up average score was 29.2 (range 19–30). The average score of 41 (82%) exceptional patients was 29.2±0.6, while the average score of 9 (18%) good patients was 25.11±1.9. Patients' knee flexion activity range was 130° (range 110–140), and the prognosis was favourable. Conclusion: A unique and successful strategy for treating a comminuted patellar fracture is modified cerclage wiring. This approach can give a firm and secure fixation, allow patients to do early functional exercises, and has a positive therapeutic impact.

Keywords---patellar fractures, modified cerclage wiring, treatment comminuted.

Introduction

Patellar fractures account for roughly 1% of adult fractures.¹ Comminuted patellar fractures account for 55% of surgically treated patellar fractures.² Surgical therapy is suggested for extensor mechanism disruption, articular step-off greater than 2-3 mm, and displacement greater than 4 mm.¹ Surgeons continue to face difficulties in managing comminuted patella fractures.³ The surgical therapy of patellar fractures aims to restore the extensor apparatus, restore articular cartilage congruity, decrease patellar bone loss, and promote early range of knee flexion. There are numerous surgical procedures for managing patellar comminuted fractures available today, including circumferential cerclage fixation,² modified tension band fixation,⁴ nickel-titanium patella concentrator,⁵ cable-pin system,⁶ titanium cable cerclage,⁷ fixation by plating and screws⁸, and partial or total patellectomy.⁹ ORIF is the best option in comminuted patellar fractures because it allows for stable fixation to the fragments, allowing for early range of motion.¹⁰ To treat comminuted patellar fractures, different methods of fixation were combined, such as combining a modified tension band with circumferential cerclage fixation,¹¹ combining a nickel-titanium patellar concentrator with nonabsorbable suture cerclage¹², and combining headless compression screws with wiring.¹³

Materials and Methods

This study was done in the department of Orthopedics, after taking the permission from the institutional ethics committee. 50 cases of simple unilateral closed comminuted patellar fracture were treated by modified cerclage wiring.



Figure 1: Unilateral closed comminuted Patellar fracture fixed with Modified Cerclage Wiring

Methodology

The procedure was conducted under spinal or general anesthesia, and the patient was positioned supine with the injured knee extended. A tourniquet was applied. An anterior median incision was created in the knee joint. After incising the superficial fascia, the extensor apparatus was exposed and examined to see if it had been damaged. The patella was then totally exposed, and the broken patella

was seen. Hematoma present in the joint was suctioned. Under direct view, the fracture was reduced with reduction forceps and temporarily fixed with a towel clamp and Kirschner wires (K-wires). More K-wires were needed to enter the fracture line in some comminuted patellar fractures.

The quantity of K-wires utilised in each patient was determined by the kind of fracture and the size of the fracture. An image intensifier was used to examine the articular surface. When the articular surface was smooth, the first stainless steel wire was periodically sutured around half of the patella. A number of steel wires were conserved throughout the suturing operation. The second steel wire was periodically sutured around the opposite side of the patella, and a number of steel wires were conserved. The reserved steel wire in front of the patella was penetrated with the third steel wire. The third steel wire was secured to the reserved steel wire section, and the locking was tightened uniformly.

The first and second steel wires on both sides of the patella were then tightened to an acceptable degree without overtightening by two surgeons simultaneously, and the locking was fastened with uniform force. The image intensifier was employed once more to inspect the articular surface. The bending knee joint is used to check fixation stability, and knee flexion is 90° to establish that there is no separation between fracture pieces. To minimise irritation of the soft tissue, the distal tip of each wire was clipped and cut. The incision was then cleansed, the anterior patellar ligament was sutured, and the incision was closed. All patients were successfully operated on without the need for blood transfusions, and the surgery time ranged from 56–82 minutes (67.1±8.2 minutes).

Management after surgery

Patient's knee was not immobilized with any slab or brace following the procedure. Under the supervision of physiotherapist, functional activities with CPM were begun on the first day following surgery. At 4 weeks postoperatively, patients were allowed to use crutches for partial weight-bearing and later total weight-bearing. 2 days, 1 month, 2 months, 3 months, 6 months, and 12 months following the procedure, knee joint X-rays were obtained. The following are the fracture healing criteria: no local pain or discomfort, excellent walking without assistance, and imaging evidence of trabecular bone growth along the fracture line.

During follow-up, the Böstman clinical grading measures were used to evaluate the effects of the surgery in eight areas: range of mobility, discomfort, work, atrophy, assistance in working, effusion, giving way, and stair-climbing. 28–30 points were outstanding, 20–27 points were decent, and fewer than 20 points were low on these measures. ¹⁴

Results

There were 34 men and 16 females, ranging in age from 22 to 70 years (average 41.25± 10.63 years), with 28 left patella and 22 right patella. There were 15 cases of traffic collision injury, 26 cases of tumble, and 9 cases of fall in the injury mechanism. According to the AO/OTA categorization, 15 instances were classified

as type 34-C2 (three pieces) and 35 cases were classified as type 34-C3 (more than three fragments). The interval between the injury and the procedure was 2–6 days (3.5 ± 2.1 days).

Table 1. Demographic parameter of the patients

Gender	Number	Percentage
Male	34	64
Female	16	36
Age mean	41.25 ± 10.63	
Side of patella		
Left side	28	56
Right side	22	44
Mode of injury		
Traffic accident	15	30
Tumble	26	52
Fall	9	18

Table 2. AO/OTA classification

	Number	%
Type 34-C2	15	30
Type 34-C3	35	70

Table 3. Böstman scale points

Points	
28-30	Excellent
20-27	Good
Below 20	Poor

Table 4 Böstman scale Score

Böstman scale Score	Number	Percentage	Mean
Excellent	41	82	29.2 ± 0.6
Good	9	18	25.11 ± 1.9
Poor	0	0	-

50 patients were monitored over a period of 5–36 months (15.9 ± 6.2 months). The duration between surgery and fracture healing was 2.6–3.6 months (3.01 ± 0.19 months). There were no problems such as internal fixation loosening, bone re-displacement, non-union, infection, internal fixation breakage, or traumatic osteoarthritis.

Using Böstman's clinical grading systems, the ultimate follow-up average score was 29.2 (range 19–30). The average score of 41 (82%) exceptional patients was 29.2 ± 0.6 , while the average score of 9 (18%) good patients was 25.11 ± 1.9 . Patients' knee flexion activity range was 130° (range 110–140), and the prognosis was favourable.

Discussion

Displaced comminuted patellar fractures necessitate surgical intervention. Several approaches to surgical therapy of comminuted patella fractures have been documented. The surgical treatment of a comminuted patellar fracture involving the articular surface is frequently complicated and challenging, owing to the fragile patellar bone and the presence of numerous tiny pieces. There are several issues in the treatment of circumferential cerclage wire fixation, including loosening and breaking of steel wire, re-displacement of bone, failure of internal fixation, and further harm to the articular surface due to a lack of fixed dependability. Cerclage wire fixation is used in conjunction with other fixing techniques.¹⁵

Tension band fixation based on AO principles is the current standard of treatment and the most commonly acknowledged form of fixation for displaced uncomplicated transverse fractures with little comminution.¹⁶ A comminuted patellar fracture is difficult to cure with this approach alone. Tension band fixation with interfragmentary screws or cerclage wires can provide excellent outcomes for complicated patellar fracture patterns. Hambright et al.¹⁷ presented an improvement to the classic tension band design that employed extra wires and numerous tension bands to collect and fix comminuted fracture patterns, with 27 patients having good clinical results.

Additional wires and several tension bands may cause significant soft tissue injury surrounding the fracture, and issues such as wire migration, fractured K-wires, discomfort from stainless steel wire loops may develop. To treat a patellar comminuted fracture, we used a modified cerclage wiring fixation. This method is also known as "wire mesh." Intermittent sutures are used to secure the surrounding steel wire, and the surrounding ligament is adjusted indirectly. The tension surrounding the patella is converted into pressure between compression fracture fragments.

The third steel wire in front of the patella can relieve knee flexion stress, offer a strong and stable fixation effect, and allow patients to do early knee joint functional activities. Avoiding joint stiffness may be a therapy strategy for comminuted patellar fractures. In our study, 82 percent of patients with outstanding outcomes and 18 percent of patients with good outcomes attained adequate outcomes, which were also applicable to the elderly with osteoporosis. In our study, patients were given functional exercises soon after the procedure, and CPM-assisted functional exercises began on the first day, which may be one of the important reasons for the positive results following the operation.

Lue et al.¹⁸ employed non-absorbable suture cerclage in conjunction with a nickel-titanium patellar concentrator to treat comminuted fracture patterns; 75.8 percent of patients had excellent outcomes, while 24.2 percent had good outcomes. Because of traction of the patellofemoral constructions during knee flexion, these authors hypothesised that for comminuted patellar fractures, laterally misplaced pieces cannot be firmly repaired by the nickel-titanium patellar concentrator. Wurm et al.¹⁹ used an angular stable patella plate to repair

a patella fracture and had a 6% complication rate. None of the patients reported any limitations in their ability to extend their arms. The average flexion was 127°. Matejci et al.²⁰ investigated the use of a basket plate in the treatment of comminuted fractures of the distal pole of the patella and found it to be effective. We suggest a novel modified cerclage wiring fixing approach. To repair the patella, only three steel wires are utilised, which is simple to do, inexpensive, and causes minimal damage to the blood supply in the fracture. It has the ability to provide stable fixation. According to our findings, when compared to existing procedures, this novel approach obtained comparable clinical results and had a low rate of internal fixation problems.

The patella is made up of several cancellous bones, and the fracture heals swiftly. If a patellar comminuted fracture can be repaired stably, the recovery time can be estimated. The period from surgery to fracture healing in this study was 3.01 ± 0.19 months, which was comparable to the average healing time of 2.81 months for comminuted patellar fracture reported by previous researchers. Patient considerations have a direct impact on the prognosis of patellar fracture following surgery. The risk of nonunion and infection increases more than sixfold in patients with a history of cerebrovascular accident, and the frequency of subsequent surgery increases eightfold in diabetic individuals.²¹

Throughout clinical treatment, the authors consider that during the process of continuous suture of a steel wire, the flexibility of the steel wire diminishes and fatigue increases, resulting in a decrease in steel wire toughness.²² As a result, we employed numerous steel wires (mostly three) to suture and ring, which could not only limit the change in toughness of the steel wire but also be easy to operate and resist creep of the steel wire under specified strain. Steel wire did not get loosened or broke. Of course, there are drawbacks, such as the need of two persons to tighten the lock simultaneously.

Wu et al.²³ used tension band wiring and achieved a measured knee joint flexion angle of 138.9° (110–140) following surgery. Chang et al.²⁴ used tension band wiring via cannulated screws to achieve a knee joint flexion angle of 123° (100–140). Our patients, who were treated with modified cerclage wiring, had a knee joint flexion angle of 130° (110–140), indicating that this novel approach produced a similar range of motion to those previously described. The function of K-wire is to convert complicated comminuted fractures into simple fractures. Because of the low stability of loose fragments, particularly comminuted fractures of the articular cartilage surface, the fragments are easily displaceable and difficult to fixate immediately and reliably with simple towel clamp reduction.

Conclusions

A unique and successful strategy for treating a comminuted patellar fracture is modified cerclage wiring. This approach can give a firm and secure fixation, allow patients to do early functional exercises, and has a positive therapeutic impact.

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