

Original article

A Double Cerclage and Tension band Wiring Technique Fixation for Comminuted Patellar Fractures

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DOI: 10.32894/kjms.2022.137425.1048

Abstract:

- **Background:** When the patella is fractured it should be repaired and patellectomy should be avoided as much as possible even in comminuted fractures. In comminuted patellar fractures, a combination of cerclage wiring and tension band fixation is confirmed to provide good mechanical stability. The objective of the present work was to find out the effectiveness of comminuted patellar fracture fixation with combined cerclage and tension band wiring technique.
- **Method and patient:** Forty- six patients underwent surgical stabilization for comminuted patellar fracture between year 1996 to 2016. All fractures were classified as 34-C3 according to the Orthopedic Trauma Association Classification. All the patients were underwent open reduction- internal fixation with combined Cerclage and tension band wiring technique.
- **Result:** Fracture healing was occurred within an average of 3- 5 months, while in bilateral cases it was 4 - 8 months. Full range of knee movements was seen in 42 (91.3 %) cases and knee flexion more than 120° was seen in 4 (8.7 %) cases. Quadriceps power was normal in 44 (95.6 %) cases, but 2 cases had quadriceps power of grade-IV. No extensor lag and no quadriceps atrophy were seen in any cases. Forty four (95.6 %) patients could squat fully and two (4.3 %) patients could squat up to half of the normal level. All patients were able to climb up and down stairs without any problem.
- Most patients have no subjective complaints like pain, difficulty in walking, difficulty in squatting and climbing. The clinical results after operation were evaluated by the clinical

grading scales of Böstman including range of movement, pain, work, atrophy, assistance in walking, effusion, giving way, and stair-climbing during follow-up. There were no significant complications, such as infection, knee stiffness, and non-union or implant failure in any of the cases. The average follow-up period was 8 months (Ranged 6 – 18 months).

- **Conclusions:** This study had concluded that combined Cerclage and tension band wiring technique was a successful surgical treatment for comminuted fractures of the Patella.
- **Keywords:** Comminuted patella fracture, cerclage wiring, tension band wiring.

INTRODUCTION

Fractures of the patella are common and constitute almost 1% of all skeletal injuries, present a higher prevalence within the age group of 20 to 50 years old. Comminuted patellar fractures are often caused by high – energy trauma, occur in young individuals ⁽¹⁻⁸⁾.

Twice the force is required to extend the last 15° of extension of the knee than to extend from fully flexed position to 15° short of full extension ⁽⁹⁾.

The knee requires something that increases the moment arm during extension so that it can maintain a constant level of torque. Patella provides this mechanical advantage ⁽²⁻⁷⁾.

Kaufer in 1971, on the basis of experimental work showed that the patella was not without importance in the knee joint and was responsible for improving its efficiency and 30% increase in the pull of quadriceps is necessary to compensate for the loss of patella ⁽¹⁰⁻¹⁷⁾.

The patella is an important component of the extensor mechanism of the knee, significant disability and decrease in knee extension power and function is seen following patellectomy ⁽⁸⁻²²⁾.

Marya et al. studied the outcomes of patellar fractures submitted to osteosynthesis and patellectomy and found 80% of excellent outcomes in the first group and 50% in the second. Therefore, when the patella is fractured it should be repaired and excision of the patella should be avoided as much as possible even in comminuted fractures ⁽²⁰⁻²²⁾.

At present, the treatment methods of patellar comminuted fracture include the following: Circumferential cerclage wire fixation, modified tension band fixation, nickel-titanium patella concentrator, titanium cable cerclage and Partial or total patellectomy ⁽²³⁻²⁴⁾. Partial or total patellectomy results in the destruction of the extensor mechanism and normal patellofemoral joint contact surface, which reduces knee joint function, accordingly, open reduction and internal fixation is the first choice for the treatment of comminuted patellar fracture ^(2-13,24-27).

Circumferential cerclage wire fixation is suitable for the treatment of a comminuted patellar fracture. Some scholars reported that two or more fixation methods were combined to treat patellar comminuted fracture, such as circumferential cerclage wire fixation combined with modified tension band ⁽²⁸⁻³¹⁾. There is no universally accepted treatment for comminuted patellar fractures. The Orthopedic Trauma Association classification (OTA) by Muller (1979) is still the most useful comprehensive classification system for describing fractures of the patella ⁽²⁵⁻²⁷⁾. Bostrom (1972) accepted 3-4 mm fragment displacement and 2-3 mm articular incongruity for non-operative treatment. While surgical stabilization was usually indicated if fragments are displaced more than 3-4 mm if articular incongruity more than 2–3 mm present and osteochondral fracture with displacement of fragment in the joint ⁽³⁾. The objective of this study was to describe the result of surgery for 46 patients with comminuted patellar fractures treated by the technique of cerclage loop wire fixation and standard tension band principle, both applied together without using kirschner wires.

PATIENT and METHOD

The work was conducted at two different teaching hospitals in Kirkuk and Erbil city between year 1996 to 2016. Forty- six patients underwent surgical stabilization for comminuted patellar fracture, with a average age of 34 years (range, 20 – 62 years) , unilateral patellar fracture occurred in 44 patients and was bilateral in 2 patients , male patients were affected in 34 patients (74 %) and only 12 patients (26 %) were female .

The cause of the injury was road traffic accident in 38 patients and fall on knee in 8 cases (fall from a height). All fractures were classified as 34-C3 (based on Orthopedic Trauma Association classification).

Interval between trauma and surgery was less than 48 hours in 40 cases and more than 10 days in 2 cases. Four cases were open fracture - type 1- requiring urgent wound debridement, irrigation and osteosynthesis of the patella.

Surgical procedure

The operation was performed under general or spinal anesthesia.

Tourniquet was applied to the upper part of the thigh and the part was painted with iodine and spirit and draped.

A longitudinal midline skin incision was made over the patella, the skin and fascia were retracted to expose the fracture site.

The knee was flexed to 15 – 20 degrees, the extensor apparatus was exposed, the patellar fracture fragments, medial & lateral parts of the retinaculum and the patellar tendon should be

exposed and to observe the pattern of fracture fragments displacement and to assess the extent of damage to extensor expansions around the patella. The quadriceps apparatus tear was seen in all cases. Anatomical reduction & alignment of the fracture fragments should be obtained, with great attention should be directed toward perfect reduction of the posterior articular surface of the patella.

Surgical technique – wiring

The operative procedure performed by using the technique of double wire fixation (both wires were of 18 G braided stainless steel) applied in two planes, at first both wires should be passed deep to the insertion of the quadriceps tendon above the patella and beneath the patellar ligament below the inferior pole of the patella.

The first cerclage wire applied circumferentially in the deep plane at the periphery of the posterior articular surface of the patella like cerclage loop wire application (figure of 0) and the second wire should cross over the anterior surface of the patella in tension band principle (figure of 8) – configuration.

The operative time was short ranging from 30 to 40 minutes.

The stability and efficiency of the fixation and the maintenance of reduction of the fragments must be tested by forcing the knee to be flexed up to 90 degrees (s. t into full flexion) and into full extension, by repeating this movements once or twice, the surgeon must be sure under direct observation that the anatomical alignment of the fragments at the posterior articular surface will remain in perfect reduction and there will be no any separation or displacement will occur . Repair of medial and lateral retinacular tears was mandatory to strengthen the extensor expansions at medial, lateral sides and over the anterior surface of the patella. Repair of retinacular attachments around the patella was found to add more stability in addition to the major stability achieved from union after bony healing at the patellar fracture lines.

In these patients' patellectomy was not indicated even in severely comminuted fractures because anatomical reduction, stable fixation, repair and reconstruction was possible for the anterior knee structures including quadriceps expansions, retinacular repair, patellar fracture fragments and patellar ligament.

The affected knees were protected with a cylinder back slab for 2 weeks. The patient was advised to start quadriceps exercises from the first post operative day. Flexion of the knee joint to 90 degrees should be encouraged after 2 weeks postoperatively.

Partial weight bearing was started 4 – 6 weeks after the surgery. Full weight bearing was allowed in all cases 8 weeks after the surgery.

RESULTS

Forty six patients with comminuted fracture patella were included in this study. Majority of cases (32 patients) about 70% were in the age group of 25 – 40 years. The youngest patient was of 20 years age and oldest was 62 years of age. Fracture healing was occurred within average of 3 - 5 months, while in bilateral cases 4 - 8 months, fracture union was confirmed on follow – up x – rays when the fracture lines was not visible, trabeculae were seen across the fracture sites and no bony absorption occurred at the fracture lines. The average follow-up period was 8 months (range, 6 – 18 months).

Each follow up patients were questioned about subjective complaints like pain, difficulty in walking, squatting, climbing, and stepping downstairs and the ability to perform normal daily activity. The full function of the knee joint should correspond to the achievement of around 140 degree of knee flexion. By end of the fourth postoperative month.

Range of movements of knee seen full in 42 cases (91.3 %) and knee flexion more than 120° in 4 cases (8.7 %). Quadriceps power was normal in 44 cases (95.6 %) but 2 cases (4.3 %) had quadriceps power of grade-IV. No extensor lag and No quadriceps atrophy were seen in all cases.

All patients were able to climb up and down stairs without any problem.

Most patients suffered from discomfort and irritation of the skin by the implant - wire. Bursa was seen in two patients. Most patients have no subjective complaints like pain, difficulty in walking, difficulty in squatting and climbing.

Early mobilization provided good outcomes, because it allows for a wider ROM. Late mobilization undoubtedly determined a stronger joint stiffness.

There were no significant complications, such as infection, Knee stiffness, non-union or implant failure in any of the cases. The cases were graded according to Böstman clinical scale assessment: Forty patients (87 %) were graded excellent and good results in six patients (13%).

Table 1: Demographic and preoperative clinical characteristics of the patients

Clinical characteristics	Frequency	Percentage (%)
Gender		
Male	34	(73.9)
Female	12	(26.1)
Site of the fracture		
Unilateral	44	(95.7)
Bilateral	2	(4.3)
Cause of the injury		
Car accident	38	(82.6)
Fall on the knee	8	(17.4)
Fracture classification		
34-C3.1	0	(0.0)
34-C3.2	46	(100.0)
Total	46	(100.0)

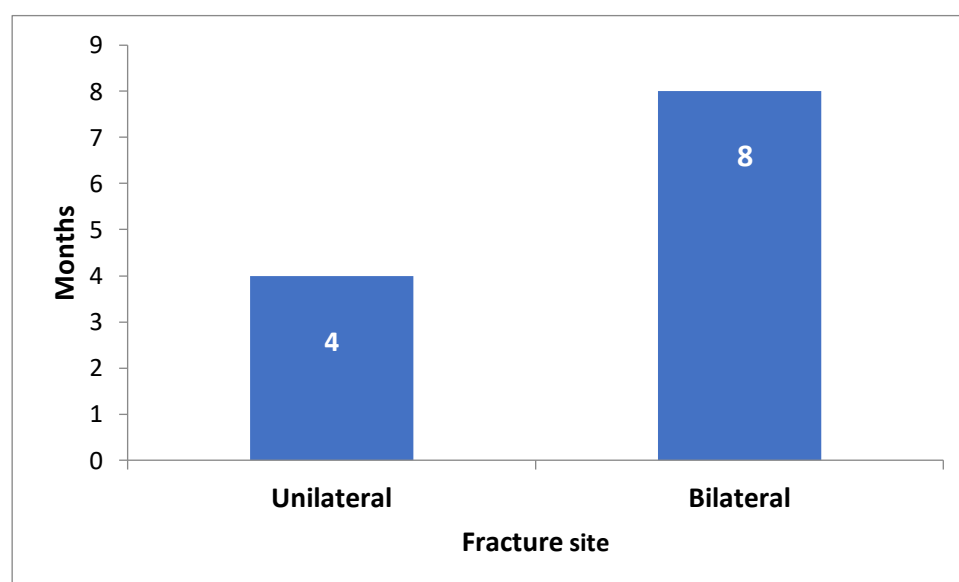


Figure 1: Mean fracture healing of the patients in months



Figure 2: A 58 year old patient with severe comminuted bilateral patellar fracture.

A: After removal of the wires bilaterally - with healing of the fracture

B: Bilateral fixation for comminuted fracture patella - post-operative x – ray

Table 2: Postoperative clinical characteristics of the patients

Clinical characteristics	Frequency	Percentage (%)
Knee movement		
Full range	42	(91.3)
More than 120°	4	(8.7)
Quadriceps power		
Normal	44	(95.7)
Grade IV	2	(4.3)
Squatting position		
Full squatting	44	(95.7)
Half squatting	2	(4.3)
Treatment outcome		
Excellent	40	(87.0)
Good	6	(13.0)
Total	46	(100.0)

DISCUSSION

Clinically the aim of surgery was to achieve fracture healing, to restore normal quadriceps power and full range of knee movements, to avoid joint incongruity at the posterior articular surface of the patella to prevent post-traumatic arthritis at patello-femoral joint.

As early as in 1909, Heineck reviewed 1100 patella fractures and concluded that total patellectomy for simple fractures is to be condemned. He recommended that patellectomy should be done only in severely comminuted fractured ^(6,13-15).

Campbell observed that total patellectomy has a role only in severely comminuted and grade-III compound fractures ^(1,2).

In this study the result of surgery on 46 patients with comminuted patellar fractures was assessed and, in most patients, it was found that the activity of daily living Scale (ADLS - score) of the Knee was good and full range of knee motion (ROM) was achieved by end of the fourth postoperative month. Excellent outcomes were found in (87 %) of the cases, and good outcomes were seen in (13 %) of patients. These findings were comparable to Dudani and Sancheti (1981) ⁽²²⁾, and comparable with that of Srinivaslu et al. (1984) ^(2,3).

This procedure was found to be an effective surgical intervention for the treatment of comminuted patellar fractures because complete healing of the fracture and full range of knee motion (ROM) was achieved in nearly all cases.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

CONCLUSION

The patella is essential for effective function of quadriceps and for proper biomechanics of knee joint so it should be preserved wherever possible.

A combination of cerclage wiring and tension band fixation was found to be a successful surgical technique for treatment of comminuted patellar fractures.

Normal functioning knee joint is very important especially in a country like Iraq where social habits and needs require a full range of knee flexion. Most of our patients were satisfied with range of motion gained particularly necessary for the oriental habits of squatting and sitting cross-legged.

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