

Original Research Article

Management of comminuted patellar fracture with combined tension band wiring technique and encirclage

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ABSTRACT

Background: The objective of the study was to evaluate functional results of combined encirclage wiring and tension band fixation in comminuted patellar fractures.

Methods: This is a prospective study of 15 patients treated with this method. All fractures described herein were classified as 45-C3 (based on Orthopaedic Trauma Association classification) and were fixed with encirclage wire and tension band wire proximally looped through the quadriceps tendon and distally through the patellar ligament in a figure-of-eight configuration. Knee function was evaluated using the Rasmussen scores at final follow-up.

Results: 13 patients gained up to 90 degrees of active flexion at the end of the first week. 4 patients had 10–15 degrees of extensor lag at the end of the first week which improved after vigorous physiotherapy and none of them had any residual extensor lag at the subsequent follow-up. Two patients developed superficial infection. All fractures united at the end of 12 weeks. One patient underwent a second surgery; due to implant related complications. Malunion or non-union was not noted in any of the cases. The average Rasmussen scores was 27.9 out of 30 (range, 27–29).

Conclusions: The tension band technique combined with cable encirclage for treatment of comminuted fractures of patella is a simple and technically less demanding operative technique producing a rigid fixation, stable osteosynthesis and minimal injury to the tendon. It can be done with easily available implants.

Keywords: Comminuted patella fracture, Encirclage wiring, Tension band wiring, K-wire

INTRODUCTION

Patella is the largest sesamoid bone in the body and it plays an important role in knee joint motion. Patella fractures constitutes almost 1% of all fractures and amongst all AO-34 type patella fractures, comminuted fractures (type C3) are most common fracture.^{1,2} It is twice as common in men as compared to women.³ The fracture patella occurs as a result of direct or indirect force.^{2,3} Comminuted patellar fractures usually occur with direct trauma. These injuries are most prevalent within the age group of 20–50 years. Closed fractures of the

patella represent the vast majority of this injury. However, up to 7% of the cases result in open fractures. About one third of patella fractures require surgery, which is indicated if there is damage to the extensor mechanism or in fractures associated with 2 mm step-off incongruity.⁴ Because of the subcutaneous anterior location, the biomechanical function and the high level of force transmission during extension and flexion, stable reconstruction of patellar fractures continues to represent a major surgical challenge. The surgical management of patellar fractures is constantly evolving. Various treatment modalities have been advocated for fracture of

the patella including cancellous screw fixation, tension band wiring, encirclage wiring and basket plate fixation.^{1-3,5-8} However in spite of having various options for treatment there is no consensus about the treatment of choice for these fractures.

Aims and objectives

This study was undertaken to evaluate the efficacy of tension band wiring in figure-of-eight configuration augmented by encirclage in comminuted fractures of patella.

METHODS

Study duration and sample size

This study was conducted at department of Orthopedics at GMERS Gotri Hospital, Vadodara from April 2013 to March 2017. This is a study of 15 cases of closed fracture of patella treated by tension band wiring augmented by encirclage. It is a study of subjective assessment and objective analysis of the quadriceps and knee function after treatment of fracture of patella. Only those cases were included in analysis that had a minimum follow up period of 1 year.

Criteria for patient inclusion

Inclusion criteria were all patients having comminuted patella fractures; adult patients above 18 years of age

Criteria for patient exclusion

Exclusion criteria were patients aged less than 18 years; patients medically unfit for surgery; Gustilo-Anderson type III Compound fractures; old neglected fractures; pregnant females.

Methodology

As soon as the patients arrived in OPD (outpatient department) or casualty department, patient's history was taken, general & local examination were done, radiological examination was done and once the diagnosis was confirmed after x-ray then the patient was admitted in ward with posterior cylindrical slab. All pre operative blood investigations were done and once patient was fit anaesthetically for surgery, he was posted for elective surgery on appropriate day.

After anesthesia, the patient was placed in a supine position; a cushion was used under the ipsilateral hip to avoid external rotation of the leg, injured knee flexion of 30–40° was achieved by a cushion below. A pneumatic tourniquet was routinely applied. The fracture was approached via a midline longitudinal incision. After incising the superficial fascia, the extensor apparatus was exposed and any tear in the extensor

retinaculum was identified. The fracture site was irrigated to remove the blood clots and debris, and the integrity of the fragments was evaluated. The fracture fragments were reduced with several bone reduction forceps. The reduction was checked under image intensifier and by digital palpation.

A rent was created with D-knife in quadriceps tendon at superolateral border of patella. A mosquito artery forceps was passed through quadriceps tendon superior to the patella from lateral to medial side as close to the patella as possible. Needle holder was then passed through the passage created from lateral to medial side. Pre-tensioned 1 mm gauge stainless steel wire was then passed through the passage by holding with needle holder exiting at the other end. A twist was applied to wire over body of patella in figure of eight fashion followed by passing wire from patella tendon from medial to lateral side in similar way. An encirclage wire was then passed around peripheral margin of patella ensuring reduction held by small towel clip or pointed reduction clamp. Both wire loops were tightened simultaneously. The remaining extra wire loop was cut and bent.

Before closure of wound a test of range of motion (ROM) was conducted immediately to assess the stability of the fixation, and it was assured that the passive flexion of the knee could be reached 90°. Retinacula were repaired with vicryl if torn. A standard wound closure was performed in layers with use of #2 vicryl for the subcutaneous tissue and Ethilon stitches for the skin.

Follow up

In follow up we have seen for knee ROM (range of movement) by extensor leg, flexion restriction and quadriceps strength. Functional activity was checked by walking, squatting, sitting cross legged, ascending stairs leading with affected leg first, descending stairs leading with affected leg first & standing on affected limb. Final follow up was done with x-ray to see union at fracture site. The patients were then subsequently followed-up at end of 1st week, 1 month, 2 month, 3 month, 6 months and 1 year. The Rasmussen scores were used, which address fractures around the knee specifically, and was used to examine function, pain, gait, deformity and ROM.¹⁴⁻¹⁶ All assessments were evaluated and recorded by a blinded reviewer.

RESULTS

We included 18 patients in this study; three were lost to follow up. A total of 15 patients were available for follow-up and were assessed. 10 patients were male and 5 were female and injuries occurred due to involvement in a motor vehicle accident. The mean age of the patients was 33 (18–69) years. Fractures occurred on the right knee in 11 patients, on the left side in 4 patients. One patient also had a closed fracture of the ipsilateral femur, requiring internal fixation with an interlocking nail. Road

Traffic Accident was commonest mode of injury. According to AO classification, all fractures were coded as 34-C3 characterized by comminuted and complete articular involvement with loss of the extensor mechanism. The average time from injury to surgery was 6.1 days (range, 2-12 days). The mean follow up was 28 (15–40) months. Mean time to achieve radiological union was 10.7 weeks after the surgery (range 8-12 weeks). 13 patients gained up to 90 degrees of knee flexion at the end of the 7 days while 4 patients had 10 degrees of extensor lag which improved after exercise. No patient had residual extensor lag. 2 patients developed postoperative knee stiffness. They were managed with Continued Passive Motion machines; active static and dynamic quadriceps exercises and were re-assessed at the 4 weeks follow-up. 1 out of the 2 patients achieved knee flexion and the remaining 1 was then subjected to manipulation under anaesthesia (MUA) at end of 1 month. At 12 weeks follow-up, all the patients had full range of movement and could walk, squat, climb up and down stairs without any restrictions. No patient had early displacement after operative fixation. The average Rasmussen score was 27.9 out of 30 (range 27–29).

Table 1: Sex and age wise distribution of patients.

Variable	Numbers	% (n=15)
Sex		
Male	10	66.67
Female	5	33.33
Age (years)		
18-30	3	20
31-40	2	13.33
41-50	3	20
51-60	5	33.34
61-70	2	13.33
Total	15	100

Table 2: knee ROM (range of movement).

Time	Knee flexion	Extensor lag	Knee stiffness
End of 1st week	Up to 90° (13 pts)	10-15° (4 pts)	0
End of 4th week	>100° (13 pts)	0	2 pts
Final follow-up	>120° (all pts)	0	0

Two patients had superficial infection in the postoperative period. One of them healed well with local mupirocin ointment while the other required wash-out, debridement and resuturing of the wound. This superficial infection did not affect the union time. All the fractures achieved union by the end of 12 weeks. At 1 year follow up 1 patient had broken wire in the radiographs without any implant related symptoms but union had already been achieved till then. He was operated for implant removal. Complications, such as

malunion or non-union were not encountered in any of the patients. Two patients underwent implant removal for irritation due to the wire ends at two and three years after the initial surgery respectively.

Table 3: Activities examined after surgery.

Activity	Possible with ease (%)	Possible with difficulty (%)	Not possible (%)
Can walk without pain or support	15(100)	0	0
Sitting cross legged	9(60)	6 (40)	0
Squatting	10(66.67)	5 (33.33)	0
Ascending stairs with affected leg first	15(100)	0	0
Descending stairs with affected leg first	15(100)	0	0
Standing without support	15(100)	0	0
Lifting /carrying weight	15(100)	0	0
Climbing slopes	15(100)	0	0
Walking on uneven ground	15(100)	0	0
Standing on affected leg	15(100)	0	0

DISCUSSION

We studied 15 patients with transverse as well as comminuted fractures of patella treated at our hospital with a combination of 'figure of eight' tension band wiring and encirclage. Amongst different techniques used for fixation of patella fractures, encirclage wiring has been used for long time, however when used alone (especially in comminuted fractures) it is not rigid enough to allow adequate stabilization.¹⁷ Schauwaker described open tension band wiring in figure of eight fashion for patellar fractures.⁹ The Tension band wiring is good technique for transverse fractures. The revolution in the management of patellar fractures was brought on with the introduction of tension band wiring in 1950s, which was further modified by adding Kirschner wires (K-wires) to the construct to increase its strength, allowing early mobilization and rehabilitation.¹³ A tension band is a device which will exert a force equal in magnitude but opposite in direction to the bending force. Still complications may occur due to k-wires.¹⁸ Pyrford technique was described as a combination of tension band wiring and encirclage wiring especially in comminuted type C3 fracture. Curtis, in a cadaveric study comparing the AO method to the Pyrford technique using an encirclage wire and an anterior tension band wire looping

through the quadriceps tendon, found that the latter gave greater strength of fixation.⁹ There are many published studies regarding fixation of patellar fracture still superiority of one technique over other is yet to decide.

Benjamin et al. compared various methods of patellar fracture fixation and found that modified AO tension band wiring is more stable for fixing patella fractures¹⁸. However, this method might have disadvantage due to k-wire post-operatively like pain, irritation due to k-wires and backing out of wires.²⁰ Because of this complication one may require K-wire removal which may add possible risk of non-union. Curtis compared the pyrford technique using anterior tension band wiring and an encirclage wire to AO method.⁹ He concluded that the pyrford technique had greater strength of fixation. The pyrford technique can also be used to fix a comminuted patellar fracture. Symptomatic k-wire related complication is commonest disadvantage following fixation of a patellar fracture. Rates of k-wire removal for irritation are 0% to 50%.²⁰ K-wire irritation might require another operation for removal.²¹ So, newer method is necessary which may not require implant removal or is free from implant related complication without compromising union rates. There is not enough literature available about implant related complication and their removal rate.²²⁻²⁵ Dy et al compared various fixation techniques and stated that nonunion rate was 1.3%, an infection rate was 3.2% and second surgery rate was 34% after patella fracture fixation.²¹

The only limitation in our study was small sample size and there was no control group in our study. Larger population/meta-analysis and more long-term follow-up are needed for more affirmative conclusion. Study should be conducted in larger group.

CONCLUSION

The tension band technique combined with cable encirclage for treatment of comminuted fractures of patella is a simple operative technique producing a stable osteosynthesis. This is a technically less demanding technique which can be done with easily available implants. The method we used allows a rigid fixation and minimal injury to the tendon, which provides an efficient approach to promote earlier recovery of knee function and is free from k-wire related complications. Supervised physiotherapy plays pivotal role in final outcome of treatment.

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REFERENCES

1. Canale ST, Campbell's Operative Orthopaedics 10th edition Mosby, Philadelphia; 2003: 2786-2705.

2. Browner BD, Levine AM, Jupiter JB, Trafton PG, Krettek C. Skeletal Trauma, 4th edition, Saunders, Philadelphia; 2008.
3. Harris RM. Fractures of the patella in: Bucholz RW, Heckmann JD, editors, Rockwood and greens fractures in adults, 2nd edition, New York, Lippincott William J and Wilkins; 2001.
4. Carpenter JE, Kasman R, Matthews LS. Fracture of the patella. Instr Course Lect. 1994;43:97-108.
5. Kastelac M. Inferior patellar pole avulsion fractures: osteosynthesis combined with pole resection Veselco M. J Bone Joint surgery Am. 2004;86(4):696-701.
6. Singh RP, Shah RR, Srivatsava MP. Treatment of inferior pole avulsion fractures with pole resection and patellofibular circlage wire. Nepal Med Coll J. 2007;9(2):93-5.
7. Burvant JG, Thomas KA, Alexander R, Harris MB. Evaluation of methods of internal fixation of transverse patellar fractures a biomechanical study. J Orthop Trauma. 1994;8(2):147-53.
8. Jakobren J, Christensen HS, Rasmusen OS. Patellectomy- A 20 year follow up. Acta Ortho Scand. 1985;56:430-2.
9. Curtis MJ. Internal fixation for fractures of the patella. A comparison of two methods. J Bone Joint Surg Br. 1990;72:280-2.
10. Wild M, Windolf J, Flohé S. Patellafrakturen Fractures of the patella. Unfallchirurg. 2010;113(5):401-11.
11. Boström A. Fracture of the patella. A study of 422 patellar fractures. Acta Orthop Scand Suppl. 1972;143:1-80.
12. Torchia ME, Lewallen DG. Open fractures of the patella. J Orthop Trauma. 1996;10(6):403-9.
13. Muller ME, Allgower M, Schneider R, Willinger H. Manual of Internal Fixation: Techniques Recommended by the AO Group. Berlin: Springer-Verlag; 1979: 248-53.
14. Rasmussen PS. Tibial condylar fractures: impairment of knee joint stability as an indication for surgical treatment. J Bone Joint Surg Am. 1973;55:1331-50.
15. Merchant TC, Dietz FR. Long-term follow-up after fractures of the tibial and fibular shafts. J Bone Joint Surg Am. 1989;71:599-606.
16. Knee Function-Rasmussen. J Orthopaedic Trauma. 2006;20(8):88.
17. Weber MJ, Janecki CJ, McLeod P, Nelson CL, Thompson JA. Efficacy of various forms of fixation of transverse fractures of the patella. J Bone Joint Surg Am. 1980;62(2):215-20.
18. Benjamin J, Bried J, Dohm M, McMurtry M. Biomechanical evaluation of various forms of fixation of transverse patellar fractures. J Orthop Trauma. 1987;1:219-22.
19. Lotke PA, Ecker ML. Transverse fractures of the patella. Clin Orthop. 1981;158:180-4.
20. Hoshino CM, Tran W, Tiberi JV, Black MH, Li BH, Gold SM, et al. Complications following tension-

- band fixation of patellar fractures with cannulated screws compared with Kirschner wires. *J Bone Jt Surg Am.* 2013;95:653–9.
21. Dy CJ, Little MTM, Berkes MB, Ma Y, Roberts TR, Helfet DL, et al. Meta-analysis of re-operation, nonunion, and infection after open reduction and internal fixation of patella fractures. *J Trauma Acute Care Surg.* 2012;73:928–32.
 22. Melvin JS, Mehta S. Patellar fractures in adults. *J Am Acad Orthop Surg.* 2011;19:198–207.
 23. Lotke PA, Ecker ML. Transverse fractures of the patella. *Clin Orthop Relat Res.* 1981;(158):180–4.
 24. Torchia ME, Lewallen DG. Open fractures of the patella. *J Orthop Trauma.* 1996;10:403–9.
 25. Catalano JB, Iannaccone WM, Marczyk S, Dalsey RM, Deutsch LS, Born CT, et al. Open fractures of the patella: long-term functional outcome. *J Trauma: Inj Infect Crit Care.* 1995;39:439–44.

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