Original Article

www.ijrhs.com
ISSN (o):2321–7251

Minimally invasive tension band wiring fixation for patella fractures: A study of 19 cases

Naveen Sharma [1], Hemant Chaturvedi [2], Shailendra Pratap Singh [3], Agrawal Ashish Rakesh [4]

Department of orthopaedics (NIMS Medical College & Hospital), Jaipur, Rajsthan, India. 1- Assistant professor, 2,3 & 4- DNB Resident

Submission Date: 14-05-2014, Acceptance Date: 29-05-2014, Publication Date: 31-07-2014

How to cite this article:

Vancouver/ICMJE Style

Sharma N, Chaturvedi H, Singh SP, Rakesh AA. Minimally invasive tension band wiring fixation for patella fractures: A study of 19 cases. Int J Res Health Sci [Internet]. 2014 Jul 31;2(3):761-6. Available from http://www.ijrhs.com/issues.php?val=Volume2&iss=Issue3

Harvard style

Sharma, N., Chaturvedi, H., Singh, S.P., Rakesh, A.A. Minimally invasive tension band wiring fixation for patella fractures: A study of 19 cases. *Int J Res Health Sci*. [Online] 2(3). p.761-6 Available from: http://www.ijrhs.com/issues.php?val=Volume2&iss=Issue3

Corresponding Author:

Dr. Naveen Sharma, Assistant professor (NIMS Medical college & Hospital), PN 354,Vivek-Vihar, New Sanganeir Road, Sodala, Jaipur, Rajsthan-302019. Email id: naveenorthokem@gmail.com

Abstract:

Introduction: Patellar fractures constitute about 1% of all skeletal injuries and are seen frequently in the age range of 20 to 50 years. The aim of surgical treatment comprises of maximal possible preservation of patella, stable fixation resulting in the precise anatomical reduction of the articular surface and restoring the knee-extensor mechanism, thereby allowing early mobilization and satisfactory functional outcomes. **Material and methods:** 19 patients with transverse fracture of patella were treated in our institute, using percutaneous tension band wiring. Comminuted fractures, open fractures, patients with injury > 15 days, life threatening conditions and previous knee injury were excluded from the study. Follow-up was done at 3weeks, 6 weeks, 10 weeks and then at monthly interval for first 6 months and then at 3 monthly interval for next 12 months. **Results:** All patients had successful functional outcomes evaluated in terms of range of knee motion, power of knee extensors, rate of union, VAS score, Lysholm score and Knee society clinical rating scale. All patients achieved successful union with an average time for union 10.1 $\pm$ 1.9 weeks. Excellent Lysholm and KSCRS scores were achieved at 18 months. Complications were noted only in two patients which was knee irritation. **Conclusion:** In our study, we concluded that percutaneous tension band wiring of patella is associated with satisfactory union rate as well as good functional outcome requiring less surgical time. Closed method can be used for displaced fractures of patella, however whether this technique can be used for comminuted fractures needs further evaluation.

Key words: Knee Society Clinical Rating Scale; Lysholm Knee Scoring Rating System; Patella Fracture; Percutaneous Tension Band Wiring; VAS Score.

Introduction

Patellar fractures constitute about 1% of all skeletal injuries [1] and are seen frequently in the age range of 20 to 50 years [2-4]. Displaced patellar fractures are defined by separation of fracture fragments more than 3 mm or articular incongruity of

more than 2 mm. Non-comminuted, transverse fractures comprises approximately 52% of displaced patellar fractures [1,2,5,6]. With this injury pattern, evaluation of the integrity of the extensor mechanism is critical. Fracture fragment separation (>3 mm) is suggestive but not diagnostic of retinacular and extensor mechanism disruption. The aim of surgical treatment comprises of maximal possible preservation of patella, stable fixation resulting in the precise anatomical reduction of the articular surface and restoring the knee-extensor mechanism, thereby allowing early mobilization and satisfactory functional outcomes [7,8]. Open repair of displaced patellar fractures is the most widely used technique. Complications associated with open treatment are infection, delayed wound healing, broken wires, irritation, immigration of K-wires, fixation failure, and revision of fixation [9-12]. All the above complications were related with open approach, fixation device, or both. Displaced transverse fractures of patella are easier for anatomic reduction by closed manipulation and are potential candidates for percutaneous tension band wiring. Percutaneous fixation of patellar fractures being less invasive is associated with reduced postoperative wound complications, the possibility of delayed operation, shorter surgical times, less pain, and improved functional outcome scores by Knee Society Clinical Rating Scale (KSCRS). There are few studies in which closed methods for patellar fractures were described. However, they were not often indicated for significantly displaced transverse patellar fractures. In our study, we used closed reduction and percutaneous fixation using two parallel K- Wires and figure of eight wiring in displaced transverse fractures of patella. Percutaneous tension band wiring for transverse fractures of the patella were evaluated by us in terms of pain, operating time, mobility, functional score, and complications.

Material and Methods

Our study was approved by our institutional ethical committee, and written informed consent was obtained from each patient. 19 patients with transverse fracture of patella were treated in our institute between 2012-2013, using closed reduction and percutaneous tension band wiring using two parallel K-Wires and figure of eight wiring .Out of 19 patients, 10 patients were male and 9 patients were female. Comminuted fractures, open fractures, patients with injury > 15 days, life threatening conditions and previous knee injury were excluded from the study. Follow-up was done at 3weeks, 6 weeks, 10 weeks and then at monthly interval for first 6 months and then at 3 monthly interval for next 12 months.

Patient was placed on the table in the supine position under spinal anaesthesia. After betadine painting and draping, fractures were reduced percutaneously using a reduction clamp and with knee in 40^0 flexion, two vertically directed image guided 1.5 mm K-wires were drilled percutaneously parallel to each through the patellar fracture and the fragments from proximal to distal. K-wire placements and articular congruence were then confirmed under image intensifier in antero-posterior and lateral views. A stainless steel wire was then placed in a 'Figure of eight' configuration by introducing a 18-guage wire through an approximately 4 mm incision given at the superior-lateral border of the patella using a wire passer with knee in extension. Another similar superomedial incision given at the medial patellar border and the upper pole for the exit of the wire. Another approximately 4 mm inferolateral incision given at the inferior and lateral border of patella for exit of the wire diagonally from the inferolateral portal which is then reintroduced towards the inferomedial portal under the skin and over the patella and made to exit from the inferomedial portal made by a similar incision on the inferior and medial border of patella. The wire is then finally made to exit from the superolateral portal (entry portal), thereby forming a "Figure of eight" configuration under the K-wires, and closing with an s.c. twist-tight knot touching the bone surface. K-wires were bent proximally to form a hook and interiorized until the hooks touched the bone surface. The K-wires were then cut at the distal end, with the knee in maximal flexion. The four portals were closed with non-absorbable suture. Placement of the K-wires and the tension-band placement were verified by antero-posterior (AP) and lateral views under image intensifier.

We classified all patellar fractures according to the Orthopaedic Trauma Association fracture classification [13]. All patients were initiated physiotherapy and rehabilitation 24 hours after surgical procedure concluded which comprised of isometric and isotonic quadriceps muscle contractions for 20 minutes, five times a day. A knee immobiliser was given so that the patient could walk and bear weight as early as day 2. Patient was redressed on the fifth postoperative day and discharged. On discharge, patients were prescribed

the same standardized rehabilitation home program. Intravenous antibiotics such as cefuroxime (1.5 g twice a day) and analgesics drugs such as diclofenac (75 mg twice daily) were prescribed during hospitalization. On discharge, oral antibiotics such as cefuroxime (500 mg twice a day) and oral analgesics and antiinflammatory drugs such as diclofenac (100 mg twice daily) were used. Clinical evaluation of the wound and suture removal was conducted at the 10th postoperative day. Follow-up was done at 3weeks, 6 weeks, 10 weeks and then at monthly interval for first 6 months and then at 3 monthly interval for next 12 months. Pain was measured using a visual analogue scale (VAS) at 3 and 6 weeks using a scale from 0 (no pain) to 10 (the most intense pain). We measured active flexion and extension of the knee by using goniometer at weeks 3, 6 and 10 by two independent observers (a physiotherapist and an orthopaedic surgeon, who didn't participate in the surgical procedure). Functional Outcome was determined by the Knee Society Clinical Rating Scale (KSCRS) [14] and Lysholm knee scoring rating system [15] at week 10 and then at monthly interval for first 6 months and then at 3 monthly interval for next 12 months, as follows; <60 points - poor; 60-69 points - fair; 70-84 points - good, and 85-100 points – excellent. We measured quadriceps wasting according to the girth of the thigh at the point of maximum bulk. Medical Research Council grading was used to assess the extensor power of the knee.

Results:

There were 19 patients in our series out of which 10 were males and 9 were females. Mean age of the study population was 44.6 ± 13.6 yrs. 8 patients had fracture on right side and 11 patients had fracture on left side. Average fracture displacement was 19.3 ± 8.3 mm. Mean surgical time was 39.2 ± 7.8 minutes. Mean period of follow up was 20 ± 2.6 months. All the 19 patients selected for percutaneous tension band wiring had successful functional outcomes evaluated in terms of range of knee motion, power of knee extensors, rate of union, VAS score, Lysholm score and knee society clinical rating scale. All our patients achieved successful union with an average time for union 10.1 ± 1.9 weeks. Average flexion achieved at 10 weeks was 140.8 ± 6.8 degrees. Excellent Lysholm and KSCRS scores were achieved at 18 months. Complications were noted only in two patients which was knee irritation due to hardware. There was no infection, malunion, non union or hardware failure.

Table 1: Characteristics of the total study population

		Total (n=19)
Gender	Male	10
	Female	9
Age (yr)		44.6 ± 13.6
	16-35	6
	36-55	7
	>55	6
Weight (kg)		68 ± 7.6
Height (mts)		1.58 ± 6.4
Fracture Displacement (mm)		19.3 ± 8.3
Side	Right	8
	Left	11
AO/OTA Type	Transverse, middle (45-C1.1)	15
	Transverse, distal (45-C1.3)	4
Mechanism of Injury	Fall	14
	RTA	4
	Forced Flexion	1

Table 2: Evaluation regarding surgical time, pain, knee joint functional outcomes, and complications

	Total (n=19)	
Surgical time (min)		39.2 ± 7.8
Pain (VAS Points)	3 weeks	2.8 ± 1.2
	6 weeks	1.1 ± 1.2
Flexion (in degrees)	3 weeks	69.2 ± 4.3
	6 weeks	131.6 ± 6.2

	10 weeks	140.8 ± 6.8
Extension (in degrees)	3 weeks	-0.8 ± 3.2
	6 weeks	-0.7 ± 3.4
	10 weeks	-0.6 ± 3.7
KSCRS (points)	10 weeks	84 ± 4
	12 months	85 ± 3
	18 months	86 ± 1
Lysholm scores	10 weeks	89.6 ± 4.2
	12 months	95.9 ± 3.4
	18 months	96.1 ± 3.2
MRC Grading for Knee Extensors	3 weeks	3.8 ± 0.3
	6 weeks	4.9 ± 0.2
Union Time (wks)		10.1 ± 1.9
Complications	Total	2
	Infection	0
	Non-Union	0
	Mal-Reduction	0
	Loss of Reduction	0
	Irritation	2
	Broken wires	0
	Wire Migration	0
	Patellar tendon tear	0
	Skin Scarring	0
	Refracture	0

Discussion

The results of our study showed that the percutaneous tension band wiring technique could provide satisfactory osteosynthesis, good functional outcome, few complications and reoperations. Surgical time required is less as compared to open technique.

Bias was eliminated as all the surgeries were performed by single surgeon. Good functional outcome can also be attributed to minimal exposure reducing the rate of infection and better soft tissue healing. There are only few studies describing percutaneous fixation of patellar fracture with fluoroscopic or arthroscopic assistance. Luna-Pizarro described a method of percutaneous patellar osteosynthesis system for modified tension band wiring. They designed a device with better results as compared with open surgery [16]. Tandogan in their study used percutaneous cannulated screws for patellar fractures. They performed surgery in patellar fracture with gap less than 8 mm. For more displacement, they suggested open approach as according to them it was impossible to apply the figure-eight wire percutaneously [17]. Yanmis described circular external fixator with arthroscopic assistance for comminuted patellar fractures [18]. Carpenter in his study demonstrated that mechanical strength of fixation done using figure of eight wiring through two parallel cannulated screws was better as compared to modified tension band wiring technique (as described by Luna-Pizarro) and parallel screws alone [19].

In our technique, we used figure of eight wire construct through two parallel K-wires with fluoroscopic assistance. In our study, it was confirmed that modification of well defined open approach is associated with promising results as radiological and functional outcomes associated with percutaneous technique are good with less complications and also that displaced patellar fractures can be managed by percutaneous technique.

Still reduction as well as fixation of comminuted patellar fractures by closed methods is difficult to achieve. So we recommend open reduction and fixation for communited patellar fractures with multiple displaced fragments and articular step-off.

Conclusion

In our study we concluded that closed method for tension band wiring of patella is associated with satisfactory union rate as well as good functional outcome requiring less surgical time. Closed method can be used for displaced fractures of patella however whether this technique can be used for comminuted fractures needs further evaluation.

References

1. Lotke PA, Ecker ML. Transverse fractures of the patella. Clin Orthop.1981:158:180–184.

2. Boström A. Fracture of the patella. A study of 422 patellar fractures. Acta Orthop Scand Suppl 1972;143:1-80.

3. Harris RM. Fractures of the patella and injuries to the extensor mechanism. In: Bucholz W, et al. Rockwood and Green's fracture in adults. 6th ed. Philadelphia: Lipincott Williams &Wilkins, 2006;1979-97.

4. Ashby ME, Shields CL, Karmy JR. Diagnosis of osteochondral fractures in acute traumatic patellar dislocations using air arthrography. J Trauma 1975;15(11):1032-3.

5. Bostrom A. Longitudinal fractures of the patella. Reconstr Surg Traumatol 1974;14: 136-146.

6. Bostman O, Kiviluoto O, Nirhamo J. Comminuted displaced fractures of the patella. Injury Br J Accid Surg 1981;13:196-202.

7. Catalano JB, Iannacone WM, Marczyk S, et al. Open fractures of the patella: long term functional outcome. J Trauma. 1995;39:439–444.

8. Hung LK, Chan KM, Chow YN, et al. Fractured patella: operative treatment using the tension band principle. Injury. 1985;16:343–347.

9. Perry CR, McCarthy JA, Kain CC, Pearson RL. Patellar fixation protected with a load-sharing cable: a mechanical and clinical study. J Orthop Trauma 1988;2:234e40.

10. Us AK, Kinik H. Self locking tension band technique in transverse patellar fractures. Int Orthop 1996;20:357e8.

11 Wu CC, Tai CL, Chen WJ. Patellar tension band wiring: a revised technique. Arch Orthop Trauma Surg 2001;121:12e6.

12. Gosal HS, Singh P, Field RE. Clinical experience of patellar fracture fixation using metal wire or non-absorbable polyester: a study of 37 cases.Injury 2001;32:129e35.

13. Orthopaedic Trauma Association. Fracture and dislocation compendium. J Orthop trauma. 1996;10(Suppl 1):51–55.

14. Insall JN, Dorr LD, Scott RD, et al. Rationale of the Knee Society clinical rating system. Clin Orthop. 1989:248;13.

15. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. Clin Orthop 1985;198:43e9.

16. Luna-Pizarro D, Amato D, Arellano F, Hernandez A, Lopez-Rojas P. Comparison of a technique using a new percutaneous osteosynthesis device with conventional open surgery for displaced patella fractures in a randomized controlled trial. J Orthop Trauma 2006;20:529e35.

17. Tandogan RN, Demirors H, Tuncay CI, Cesur N, Hersekli M. Arthroscopic-assisted percutaneous screw fixation of select patellar fractures. Arthroscopy 2002;18:156e62.

18. Yanmis I, Oguz E, Atesalp AS, Ozkan H, Kurklu M, Demiralp B, et al. Application of circular external fixator under arthroscopic control in comminuted patella fractures: technique and early results. J Trauma 2006; 60:659e63.

19. Carpenter JE, Kasman R, Matthews LS. Fractures of the patella. In:Schafer M, editor. Instructional course lectures, vol. 43. Rosemont:American Academy of Orthopaedic Surgeons; 1994. p. P97e108.

Figure 1 – [A.] Pre-Operative photograph and the [B.] anterio-posterior and [C.] lateral X-Rays of the patient.

Figure 2 – [A.] Intra-operative photograph and fluoroscopic images in [B.] anterio-posterior and [C.] lateral views showing two vertically directed 1.5 mm K-wires drilled percutaneously parallel to

each through the patellar fracture from proximal to distal

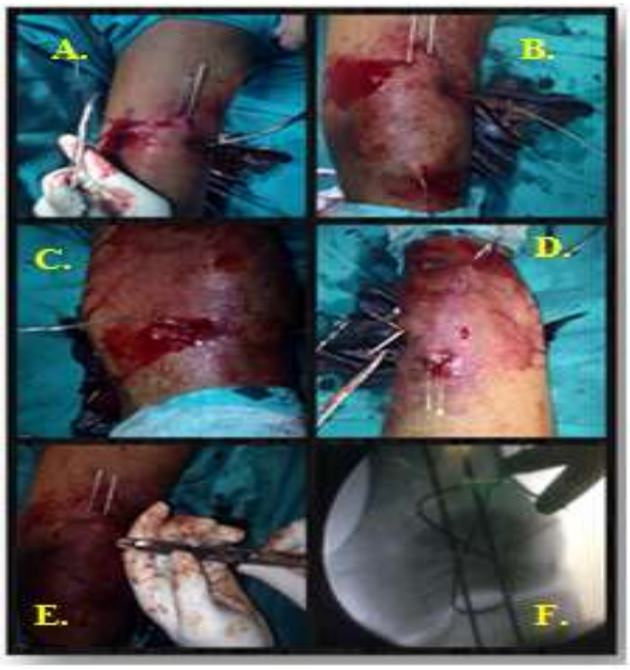

Figure 3 – [A-E] Intra-operative photographs and [F] fluoroscopic image showing percutaneous placement of stainless steel wire in 'Figure of eight' configuration.

Figure 4 – [A.] Intra-operative photograph and fluoroscopic images in [B.] anterio-posterior and [C.] lateral views and Post-operative X-rays in [D.] anterio-posterior and [E.] lateral views showing final fixation.

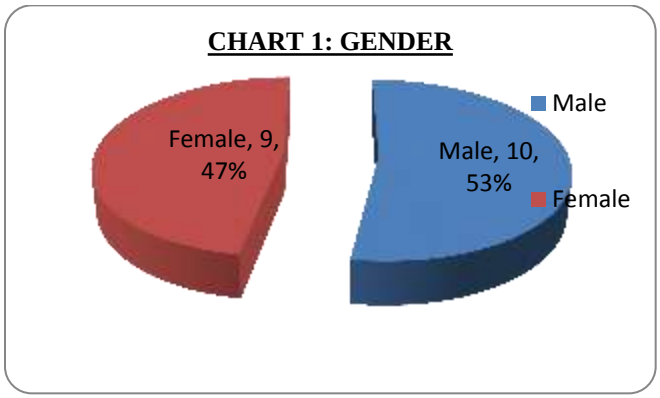

Figure 5 – Gender specific incidence of patellar fractures

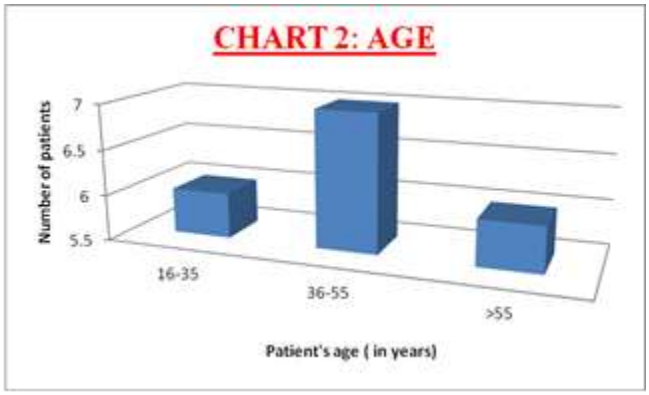

Figure 6- Age related incidence of patellar fractures

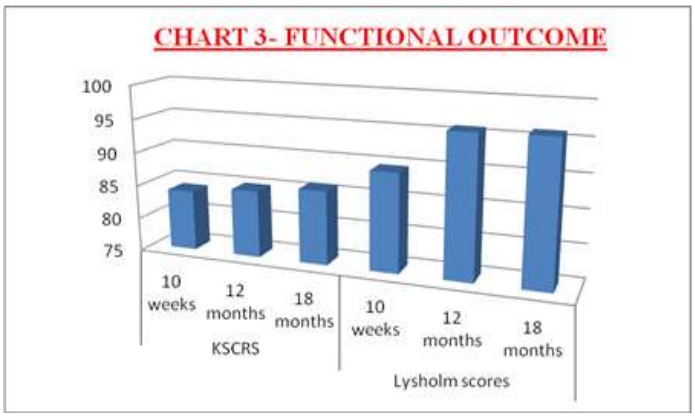

Figure 7 – Functional outcome of percutaneous tension band wiring in patellar fractures in terms of the Knee Society Clinical Rating Scale (KSCRS) and Lysholm knee scoring rating system at 10 weeks, 12 months and 18 months.