

Functional Outcomes of Fractured Patella Fixation by using Modified TBW Osteosynthesis with 3K Wires- A Prospective Study

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ABSTRACT

Introduction: Fractures of Patella are 1% of all skeletal injuries. Till now, there are various successful, satisfied and less skilful methods are in use for internal fixation for fracture of the patella. As per previous studies, a perfect anatomical reduction during surgery is necessary for excellent outcomes irrespective of the method of fixation used. The conventional method of osteosynthesis for patella fracture with tension band wiring (TBW) is being done always with the help of two parallel Kirschner wires. Here in this present study, three parallel Kirschner wires were used for better functional outcomes. Objective/Aim: To determine the better functional outcomes of patellar fracture fixation by using modified TBW osteosynthesis with 3k wires.

Material and Methods: A prospective cohort study was carried out from November 2016 to November 2019 in a total of 22 patients with patellar fracture operated by TBW with 3 parallel Kirschner wires. Patients were followed up postoperatively for one year and assessed by Lysholm knee score, pain status, working status and other variables. Normality of data was tested by Kolmogorov-Smirnov test and paired t-test/Wilcoxon rank-sum Test.

Results: The total mean age was 38.68 in present study. On post-operative day lysholm score, pain status and work status was 0, 5 and 5 respectively. After 1-year lysholm score and work status was 99.46 and 1.09 respectively. The mean pain status was zero after 6-months.

Conclusions: The results of the study of patellar fracture fixed with TBW with 3 Kirschner wire was satisfactory and having a favorable outcome without any complication.

Keywords: Patellar Fracture, Tension Band Wiring, 3-Kirschner Wire, Lysholm Score.

either alone or in combination, may be used to fix a fracture. The anatomical reduction should be accomplished regardless of the procedure of fixation. Shao et al.⁶ compared the minimally invasive surgical technique (MIST) to the open conventional surgical procedure. They observed that the MIST group performed better clinically and functionally than the other groups. Apart from this the reduction of the fracture along the anterior extra-articular surface does not guarantee articular congruency; a mini arthrotomy facilitates and solves this type of problem. Lorich DG et al.⁷ did a study on patella fracture osteosynthesis using a low-profile mesh plate to resolve this issue. They observed better articular reduction, good radiographic results, and excellent function outcome without disrupting vascular supply.

The modified tension-band technique has gained popularity as a fixation method thanks to the Swiss Association for the Study of Internal Fixation. In this technique, 2 parallel Kirschner wires are threaded longitudinally through the cannulated screws, then over the anterior surface of the patella, through the centre of the other cannulated screw, and back over the anterior surface of the patella, where the wire is twisted to the other end.⁸ Theoretically, when the knee is in extension, this build should provide resistance to fracture displacement from anterior distraction, as well as resistance to displacement as the knee moves into flexion.⁹ TBW is most often used for patella fractures and has been shown to produce satisfactory outcomes. It converts exerted tensile force on anterior surface on patella into compression force at articular surface.^{3,10}

Metal inserts, for example, tempered steel K-wires and screws have commonly been utilized for this strategy for fixation. Additionally, undeniably more genuine difficulties, for example, movement of the messed up wire either intra-articular or in delicate tissue, have likewise been reported.¹¹ We looked at the utilitarian result of the Tension band wiring in patients with fracture patella fixed with 3K-wire. There

INTRODUCTION

The patella is the largest sesamoid bone in the human body, located in front of the knee and embedded in the quadriceps tendon. It has a thickness of 1.5 cm to 2cm¹. Patellar fractures account for nearly 1% of all skeletal injuries and they can occur as a result of either direct or indirect trauma.^{2,3} The most common patella fracture is a transverse fracture of the middle third of the patella, which occurs twice as often in men as in women between the ages of 20 and 50.⁴ Patellar fractures are becoming more common in women and the elderly. Furthermore, compared to younger patients, elderly female patients with patellar fractures had a greater risk of postoperative complications and a higher percentage of low energy injury.^{4,5}

In the literature, different types of internal fixation for patellar fractures have been described. Wires or screws,

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was a slight opening at the reduction site during flexion of the knee following the TBW treatment with 2 k-wire, which was detected at the time of surgery. The third K-wire, put in the middle portion of the patella, will restrict the reduced fracture site from opening at the tensile surface. Better fixation, early ambulation of the patient and improved knee function can all be early obtained in the postoperative period.

MATERIAL AND METHODS

Present study was a prospective cohort study was done on 22 randomized cases from the period of November 2016 to November 2019. Prior approval from Institutional Ethics Committee and informed consent from participants were taken before study. All patients with displaced transverse fracture patella AO type C1.1 (18-60 years of age) attending OPD and the Emergency Department of the hospital were included. Patients having type II and type III compound fractures, grossly comminuted, vertical or marginal fractures, old fractures (more than 2-3 weeks) and undisplaced transverse fractures were excluded from present study.

Surgical procedure

Under spinal anaesthesia, in supine position, an anterior longitudinal midline incision was given on the affected knee (figure 1a). Cleaning the fracture surfaces with normal saline was done to remove the blood clot and small fragments. Large major proximal and distal fragments were reduced accurately by using clamps with special attention to restoring a smooth articular surface. The patella was divided in the sagittal plane into three equal parts and 3 Kirschner wires were put at equidistance as parallel as possible in the centre of each part after holding the reduction with reduction clamp then tension band wiring was done. After that pass a strand of 18/20 gauze stainless steel wire transversely through the quadriceps tendon attachment, as close to the bone as possible, deep to the protruding Kirschner wires, over the anterior surface of the reduced patella in a figure of '8' manner (figure 1b). After confirming the reduction, proximal ends of the three Kirschner wires were bended acutely anteriorly and cut them little short. When they were cut, rotate the Kirschner wires 180 degrees; with an impactor, embed the bent ends into the superior margin of the patella posterior to the wire loops. Cut the distal ends of the Kirschner wires short inferiorly. Repair the retinacular tears with multiple interrupted sutures. Suction drainage was done and closure of the wound was done in multiple layers after aseptic dressing cylindrical slab was applied in full extension of the knee for 2weeks.

Post-Operative Period

The limb was placed in full extension in a posterior plaster slab or cast. The patient was allowed to ambulate while bearing weight as tolerated on the first postoperative day ask to patient for walk with weight bearing as much as patient can tolerate. Isometric and stiff-leg exercises are encouraged, beginning on the first postoperative day. Active range-of-motion exercises were performed when the wound has healed, at 2 to 3 weeks. Progressive resistance exercises were started and the brace discontinued at 6 to 8 weeks if healing

is evident on the radiograph as compared to pre-operative radiographs. (Figure 2a,b) The unrestricted activity was resumed when full quadriceps strength has returned at 18 to 24 weeks. In patients with less stable fixation or extensive retinacular tears, the active motion should be delayed until fracture healing has occurred. Initiating range-of-motion exercises by the end of the 2nd week is desirable but not always possible. A controlled motion knee brace advised to patient, allowing full extension and flexion to the degree. A follow up was also done after 1 year for x-ray and other parameters. (Figure 2c)

Follow Up

Functional outcome was recorded using Lysholm score and work status by using work scale immediately after surgery and then on 3rd day, 7th day, 14th day, 1 month, 6th month, and 1 year. Radiographs were obtained immediately post-operatively and then at 1st month, 3rd month, 6th month and 1 year. Pain was assessed by **Denis et al** pain scale immediately after the surgery, on the 3rd day, 14th day, 1 month, 3rd month and 6th month.

Statistical Analysis

Parameters for statistical analysis were Lysholm score¹², Pain Score (Dennis et al.), work status (Dennis et al.). Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean \pm SD and median. Normality of data was tested by Kolmogorov-Smirnov test. A non-parametric test was used when the normality was rejected. Quantitative variables were compared using the paired t-test/Wilcoxon rank-sum Test (when the data sets were not normally distributed) across follow up. A p-value of <0.05 was considered statistically significant. The data was collected as per protocol in the MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0 .

RESULTS

This study included 22 patients having fractured patella, operated by using tension band wiring fixed with 3-K wires. Table 1 shows demographic profile of the cases included in present study. Maximum number of cases (41.0%) belongs to the age group 31-40 years followed by age group 21-30 years and 41-50 years. In present study, male outnumbered female patient with ratio of 2.7:1.

Figure 1 shows Lysholm score all patients during follow up in present study. As per figure 1, score was 0 on post-operative day and increased to 99.46 with $SD \pm 1.47$ at one year post-operatively showing significant improvement in Lysholm score. The mean value for Lysholm score at immediate postoperative was 0, after 3rd day was 9, after 7th day was 29, after 14th day was 74, after 1 month 85.36, after 6th was 99.14 and the end of 1 year was 99.46; was showing in increasing trend means a better outcome. Two cases having Lysholm score 95 at the end of 1 year, had slight difficulty in squatting and climbing the staircase.

Figure 2 shows Pain Status in present study during follow up. As per figure 2, on post-operative day, all the patients

Parameter	Observations		
	Age group	No. of cases	Percentage cases
Age	21-30	5	22.8%
	31-40	9	41.0%
	41-50	5	22.8%
	>50	3	13.6%
	Total	22	100.0%
Gender	Gender	No. of cases	Percentage cases
	Male	16	72.8%
	Female	06	27.2%

Table-1: Demographic Profile of Cases in Present Study

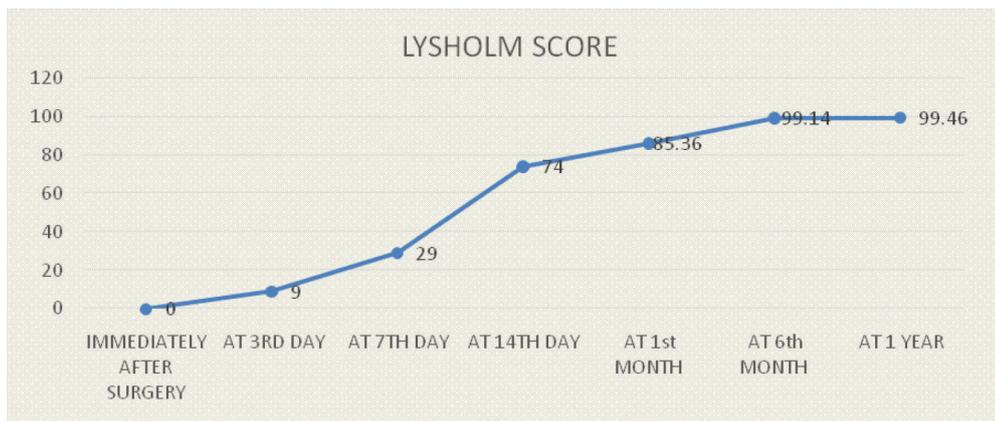


Figure-1: Lysholm Score in present study during follow up



Figure-2: Pain Status in present study during follow up



Figure-3: Work Status in present study during follow up

showed maximum value on the pain scale i.e. was 5, on the 3rd day mean value was 3.64, on the 14th day it was 2 and at the end of the 6th month, patients had no complaint of pain, the value on the pain scale was one.

Figure 3 shows Work Status in present study during follow

up. As per figure 3, on post-operative day, 3rd day and 7th day, mean of work status was 5, on 14th day, it was 4 followed by 3 mean work status after 1 month. At the end of 6th month and at the end of 1st year, mean of the work status of the patients was 1.09.



Figure-1: (a) showing longitudinal midline incision (b) 3 Kirschner wires with stainless steel wire

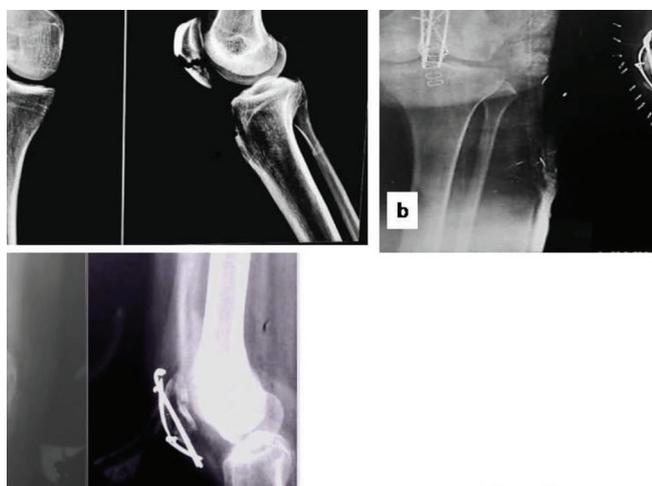


Figure-2: Comparison of pre-operative radiograph with post-op radiograph

DISCUSSION

In this study, the functional outcome of tension band wiring in fracture patella fixed with three K-wire was evaluated with the help of the Lysholm score and work status for one year & pain status followed for six months.

In the study conducted by Rathi A et al¹³ percutaneous fixation was performed in 23 patients of patellar fractures with TBW with two parallel k wires, the mean follow-up period was 20 months. One case had patella-femoral arthritis; two had superficial infections in this study. In this study, the mean follow-up period was one year with no cases of infection, fixation failure and patella-femoral arthritis reported.

In the study conducted by Jin ho Cho et al¹⁴ percutaneous tension band wiring was done for patella fractures using cannulated screws. In his study, the average age was 45 years; in our study average age is 38.68 years. The mean follow-up period was 15 months compared to one year in our study. Findings by Miller et al¹⁵ demonstrated factors predictive of failure of fixation. Age is a strong predictor of failure; the average age of patients who achieved successful fixation was

51 years compared to 65 years for those who had failure of fixation. In this study, the average age of the patients was 38.68 years with no case of fixation failure. Epidemiologic studies demonstrated that the incidence of fracture patella in men is twice as high as in women.

Wild M et al¹⁶ found road traffic accidents in 78.3%, followed by work-related accidents in 13.7% and domestic accidents in 11.4% patients. In present study out of 22 patients, 12 patients (54.54%) had road traffic accidents as a mode of injury, 5 patients (22.72%) were due to fall from stairs and 5(22.72%) were due to sports injury. In the study conducted by Jin ho Cho et al¹⁴ percutaneous tension band wiring was done for patella fractures using cannulated screws. The mean Lysholm score was 93. In this study, 2 patients out of 22 had a Lysholm score of 95. The mean value of the Lysholm score was 99.46. In the study conducted by El-Sayed et al¹⁷ fourteen patients were treated with an arthroscopy system and closed reduction of the fractured patella fix with the percutaneous screw. The mean period of follow up was 26 months. The mean final Lysholm score of their study was 93 but in our study, it was 99.46.

CONCLUSIONS

In this study, the 3k-wire fixation (tension band wiring) was done to improve the functional outcome and to allow early mobilization of the patient. But there was no significant difference in functional outcome as compared to previous studies held with the 2K- wire group. At present, there is no significant benefit to using this 3K-wires technique as compared to the conventional one.

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REFERENCES

1. Sayum Filho J, Lenza M, Tamaoki MJ, Matsunaga FT, Belloti JC. Interventions for treating fractures of the patella in adults. *Cochrane Database Syst Rev.* 2021;2(2):CD009651.
2. Aksu N, Atansay V, Karalök I, Aksu T, Kara AN, Hamzaoglu A. Relationship of Patelofemoral Angles and Tibiofemoral Rotational Angles With Jumper's Knee in Professional Dancers: An MRI Analysis. *Orthop J Sports Med.* 2021;9:2325967120985229.
3. Wild M, Fischer K, Hilsenbeck F, Hakimi M, Betsch M. Treating patella fractures with a fixed-angle patella plate-A prospective observational study. *Injury.* 2016;47:1737-43.
4. Larsen P, Court-Brown CM, Vedel JO, Vistrup S, Elsoe R. Incidence and Epidemiology of Patellar Fractures. *Orthopedics.* 2016;39:e1154-e1158.
5. Byun SE, Sim JA, Joo YB, Kim JW, Choi W, Na YG, Shon OJ. Changes in patellar fracture characteristics: A multicenter retrospective analysis of 1596 patellar fracture cases between 2003 and 2017. *Injury.* 2019;50(12):2287-2291.
6. Shao J, Wang J, Chen Y, Mao N, Zhang Q, Ni H. Comparison of a minimally invasive surgical technique with open surgery for transverse patella fractures.

- ExpTher Med. 2019;18:4203-4208.
7. Lorich DG, Warner SJ, Schottel PC, Shaffer AD, Lazaro LE, Helfet DL. Multiplanar fixation for patella fractures using a low-profile mesh plate. *Journal of orthopaedic trauma*. 2015;29:e504-10.
 8. Muller ME, Allgower M, Schneider R, et al.: in Schatzker J (translated by): *Manual of Internal Fixation: Techniques Recommended by the AO Group*, ed. 2. New York, Springer-Verlag, 1979, pp. 348-352.
 9. Henrichsen JL, Wilhem SK, Siljander MP, Kalma JJ, Karadsheh MS. Treatment of Patella Fractures. *Orthopedics*. 2018;41:e747-e755..
 10. Nienhaus M, Zderic I, Wahl D, Gueorguiev B, Rommens PM. A Locked Intraosseous Nail for Transverse Patellar Fractures: A Biomechanical Comparison with Tension Band Wiring Through Cannulated Screws. *J Bone Joint Surg Am*. 2018;100(12):e83.
 11. Kyung MG, Lee SH, Kim MB. Complications Related to Implant Fixation of Patellar Fractures: Comparison of Ring Pins versus Bent K-Wires. *J Knee Surg*. 2017;30:560-564.
 12. Briggs KK, Steadman JR, Hay CJ, Hines SL. Lysholm score and Tegner activity level in individuals with normal knees. *The American journal of sports medicine*. 2009;37:898-901
 13. Rathi A, Swamy MK, Prasantha I, Consul A, Bansal A, Bahl V. Percutaneous tension band wiring for patellar fractures. *Journal of Orthopaedic surgery*. 2012 ;20:166-9.
 14. Cho JH. Percutaneous cannulated screws with tension band wiring technique in patella fractures. *Knee surgery & related research*. 2013;25:215.
 15. Miller MA, Liu W, Zurakowski D, Smith RM, Harris MB, Vrahas MS. Factors Predicting Failure of Patella Fixation. *The journal of trauma and acute care surgery*. 2012;72:1051-5.
 16. Wild M, Windolf J, Flohé S. Fractures of the patella. *Der Unfallchirurg*. 2010;113:401-11.
 17. El-Sayed AMM, Ragab RK. Arthroscopic-assisted reduction and stabilization of transverse fracture of the patella. *Knee* 2009; 26:54–57.

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