

Functional Outcome of “Reconstruction Patellar Plate” in the treatment of patella fractures

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ABSTRACT

Background: The patellar fractures treatment has changed by enhancements in both an improved understanding of patellar function and fracture fixation techniques. The goals of operative fixation include repair of extensor mechanism, restoration of articular congruity, secure fixation and early movements. In this Study Reconstruction patellar plate was introduced in the management of patellar fracture.

Aim: To determine the Functional outcome of fixation method of patella fractures by Open Reduction and Internal Fixation with Reconstruction Patellar Plate.

Methods: This Prospective study was performed at Department of Orthopaedic Surgery at Lahore General Hospital for a period of 12 months after the approval Research Board of University of health Sciences, Lahore. Non probability purposive sampling method was used to induct 30 patients (who met the inclusive Criteria) underwent reconstruction patellar plate for the treatment of patella fracture. The patients were followed in outpatient department at 4 weeks and 16 weeks. Variables mentioned in Modified Hospital for Special Surgery Knee Score were recorded and Knee score was calculated and graded at 16 weeks.

Results: In this study, overall mean age was 25.26 ± 5.02 years. There were 19 (63%) male and 11 (37%) female subjects. The mean of Modified Hospital for Special Surgery Knee Score (MHSSKS) was 84.90 ± 8.87 . In this study, there were 12(40%) patients with excellent functional outcome, 14 (46.67%) patients with good functional outcome and 4(13.34%) patients with fair functional outcome. There was no patient with poor functional outcome.

Conclusion: Reconstruction Patellar Plate fixation method of patella fractures by Open Reduction and Internal Fixation produced good Functional outcome, which can be familiarized as an alternate to tension band method for the treatment of transverse patellar fracture.

Keywords: fracture, patellar, reconstruction patellar plate, tension Band wiring

INTRODUCTION

Patella serves as the fulcrum for the knee extensor mechanism and is the major sesamoid bone of the human body¹. Patella organize the extensor mechanism tensile forces to the tendon of patella and by uplifting the extensor mechanism ahead of the axis of knee joint rotation. It improves efficiency of the complex. Consequently, the quadriceps muscle serves as a pulley and due to the accelerated lever arm, is reinforced by 30%². With 50% insertion of its tendinous part to the proximal patellar pole, the patella is embedded into the quadriceps muscle³.

Of all skeletal injuries, about 0.5% to 1.5% are Fractures of patella⁴. The diagnosis is made by physical findings, mechanism of injury and radiological findings⁵. The type of management of fractures of patella rest on fragments size, type of fracture, congruity of the articular surface and the integrity of extensor mechanism. Self-determining of the type of management an initial restoration is suggested⁶.

Modified tension band wiring is frequently used operating management for fractures of patella and can be

used for nearly all kind of fracture. For horizontally displaced two-part fractures owing the greater constancy in biomechanical studies combined with a tension band wiring two comparable cannulated lag screws are the treatment of choice⁷.

There are many treatment options available for fractures of patella fixation like inter-fragmentary screw fixation, tension band wiring and combinations of intra-fragmentary screw and tension band wiring. The objective of this study was to know the functional outcome of fixation method of patella fractures by Reconstruction Patellar Plate. Reconstruction patellar plate is very similar to Titanium-nickel shape memory alloy (Ti-Ni SMA) claw Plate. In our setup we frequently use modified tension band wiring for patella fractures fixation. Fixation of patellar fracture with Reconstruction Patellar Plate has never been accomplished in our Setup. The consequence of this method has never been considered or related with any other technique in our hospital. Compared with traditional Tension Band wiring founded practices, during surgery, manipulation process of Reconstruction Patellar Plate is modest with abridged time of operation and loss of blood⁸. This study can help us to provide evidence regarding effective use of Reconstruction Patellar Plate for patellar fracture fixation.

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METHODOLOGY

All Cases between 15-70 years of age with isolated fracture of the patella classified as AO 34-C1 (transverse) and 34-C2 (transverse plus second fragment) were admitted in the Department of Orthopedic Surgery through Accident and Emergency or OPD after ethical committee approval. Demographic data and history were taken relevant to the mode of injury and time since injury. All the patients were examined and diagnosis was confirmed with X-Ray knee A-P and lateral radiographs. Investigations like Hb, CBC, ECG, X-Ray chest, HBsAg and Anti HCV were done. Fitness for anesthesia and surgery was obtained preoperatively. Informed written consent was obtained preoperatively for surgery from all patients including for research inclusion also. All the patients were operated on next regular list. Standard A-P and lateral radiographs were done in the ward postoperatively. Drain was removed after 48 hours. After Operation, the knee was splinted straight. Quadriceps contraction was allowed with weight bearing during this period. The patients were allowed to ambulate while bearing weight as tolerated on the initial post-operative period within few days after surgery. Isometric quadriceps exercises was encouraged as early as possible. Active joint motion with full weight bearing was gradually performed after 14 days post-operation.

The surgery was performed with anterior longitudinal incision in the midline over the knee Joint. After skin and subcutaneous tissue dissection, the patella was completely exposed. The joint was irrigated and debrided. Irreparable small bone fragments and clot was removed. With towel clamp or bone clamp, the fracture was provisionally reduced⁹.

Reduction and the articular surface congruity were confirmed under C-Arm or Image Intensifier (Both A-P view and Lateral view). Then reduced Patella was fixed with Reconstruction Patellar Plate. According to the longitudinal length of the Patella, Reconstruction Patellar Plate with Suitable Size was selected (small, medium or large).

Reconstruction Patellar Plate is a claw shaped plate with five clasps, two on one side and three on the other. The plate can be separated into two by removing the two screws which keep it together in one place. The reconstruction Patellar plate was separated by removing the two screws. The part with two clasps was pushed to penetrate through the tendons of quadriceps on the superior edge of patella. It was followed by inserting the other part with three clasps to penetrate through the patellar tendon on the inferior edge of patella to catch patellar bone cortex. The screw was applied to keep the two part in place and to give compression⁸. The stability of the fracture construct was Checked by placing the knee through a range of motion. Skin was closed. Drain was removed after 48 hours. Active joint motion with full weight bearing was gradually performed after 14 Days.

The patients were followed in outpatient department at 4 and 16 weeks. Variables of Modified Hospital for Special Surgery Knee Score were recorded at 16th week. Knee score was calculated and graded.

Figure 1. Reconstruction patellar plate Surgery- Knee in full flexion



Figure 2: Reconstruction patellar plate Surgery-knee in extension



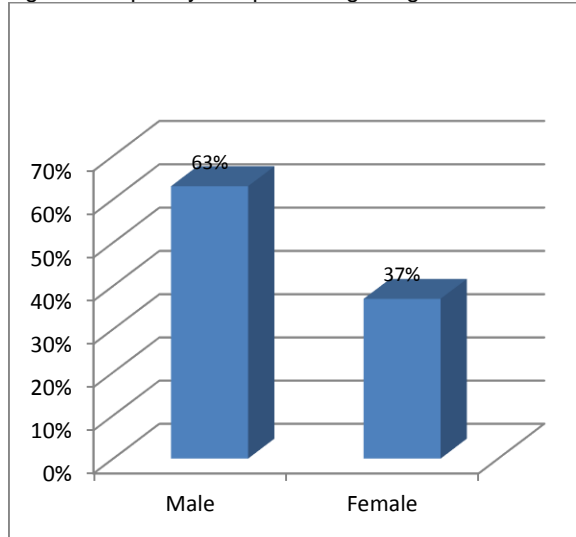
RESULTS

Distribution of patient by age (years). In this study, overall mean age was 25.26 ± 5.02 years with age range of 15- 70 years. There were 3 (10%) patients in age group 15-20 years, 12 (43.34%) patients in age group 21-30, 10 (33.34%) patients in age group 31-40, 1 (3.34%) patient in age group 41-50, 2 (6.67%) patients in age group 51-60 and 1 (3.34%) patient in age group 61-70 years.

Age (years)	n	%age
15-20	3	10
21-30	13	43.34
31-40	10	33.34
41-50	1	3.34
51-60	2	6.67
61-70	1	3.34
Mean ±SD	25.26 ± 5.02 years	

Distribution of patient by Gender: Overall, there were 19(63%) male and 11 (37%) female subjects in this study with male to female ratio of 1.7:1

Figure: Frequency and percentage of gender status



MHSSKS	n	%age
90-85	12	40
84-74	14	46.67
73-65	4	13.34
<65	0	0
Mean±SD	25.26 ± 5.02 years	

Functional outcome: In this study, there were 12(40%) patients with excellent functional outcome, 14(46.67%) patients with good functional outcome and 4(13.34%) patients with fair functional outcome. There was no patient with poor functional outcome in this study.

Functional outcome	n	%age
Excellent	12	40
Good	14	46.67
Fair	4	13.34
Poor	0	0

DISCUSSION

The patella is the largest sesamoid bone in the human body. Patella fractures are quite rare and account for approximately 1% of all fractures. In spite of the low incidence, patella fractures can lead to intense pain and impairment owing to their articulations with the distal femur and their critical function in the extensor mechanism of lower extremity. The aim of any treatment is reconstruction of extensor mechanism and reduction of articular surface. If the displacement is more than 2 mm, surgical treatment is definitely indicated¹⁰.

Patella acts as a lever participate in the extension mechanism of knee joint. The accompanied forces acting upon patella are complex but simplified into two kinds: compressive and tensile forces. With the contraction of the quadriceps, tensile forces are created in quadriceps and patellar tendons over the patella. Compressive forces also appear in the patella-femoral joint at the same time which increases in daily activities¹¹. Consequently the internal fixators for the patella fracture also unavoidably encounter such high forces and should be well designed to meet those demanding circumstances¹².

Up to now modified tension band wiring technique augmented with kirschner wires or cannulated lag screw has been used as the primary treatment method. However, intra-operative difficulty in steel wire handling, postoperative complications including skin irritation, loss of fixation, fracture - gap opening and symptomatic hardware needed for removal indicates that the clinical outcome of modified tension band technique has not been perfect as usually anticipated¹³. Recently, plate fixation has become more popular for patella fracture. Plating constructs offer a low-profile design with stable fixation, permitting for earlier mobilization and potentially improved functional outcomes¹⁰.

As an alternative to modified tension band wiring technique for transverse fracture of patella, Reconstruction Patellar Plate has been studied in this study.

Figure 3. X-Ray Knee (Anterior-Posterior & lateral View) after surgery with Reconstruction Patellar Plate



In this study the Functional outcome of fixation method of patella fractures by ORIF with Reconstruction Patellar Plate was assessed. In this study, overall mean age was 25.26±5.02 years with age range of 15- 70 years. There were 3 (10%) patients in age group 15-20 years, 12(43.34%) patients in age group 21-30, 10(33.34%) patients in age group 31-40, 1(3.34%) patient in age group 41-50, 2 (6.67%) patients in age group 51-60 and 1 (3.34%) patient in age group 61-70 years. In a study by Hao W et al, the average age of patients was 43.0 years. In another study by Zhao QM et al, the mean age of patient was 45.6 years (range: 21-65).

Overall, there were 19(63%) male and 11(37%) female subjects in this study (M:F; 1.7:1). Similarly, in a study by Hao W et al, there were 10 (34.48%) females and 19 (65.51%) males (M:F; 1.9:1). However, in the contrary, there were 16 (41.02%) males and 23 (58.97%) females in a study by Zhao QM et al, with M:F 1:1.4.

The mean of Modified Hospital for Special Surgery Knee Score (MHSSKS) was 84.90±8.87. There were 12(40%) patients with MHSSKS between 90-85, 14 (46.67%) patients with MHSSKS between 84-74 and 4 (13.34%) patients with MHSSKS between 73-65. There was no patient with MHSSKS below 65 in our study. In a study by Zhao QM et al, the mean scores at the final follow-up were 28.2 (range 25–30 points) and 27.6 points (range 25–30 points) in the titanium cable tension band and nickel-

titanium (NiTi) patella concentrator (NT-PC) group, respectively.

In this study, the patients were followed at 4 and 16th week. In a study by Zhao QM et al, cases were followed up over an average period of 13 months (range, 6–18 months) after the surgery. In a study by Hao W et al, patient after surgery were followed by radiographic analysis and Lysholm Knee Score at 1, 2, 3, 6, 9 and 12 months post-operation and the mean follow uptime was 11.48 months.

Hao W et al, has been using SMA-claw (claw-like Ti-Ni SMA fixator) to delicacy patella transverse fracture. Ti-Ni SMA (Titanium-nickel shape memory alloy) is categorized by super-elasticity, shape-memory effect, corrosion resistance, excellent fatigue behavior, high damping capacity and acceptable biocompatibility.

In this study, there were 12 (40%) patients with excellent functional outcome, 14 (46.67%) patients with good functional outcome and 4 (13.34%) patients with fair functional outcome in this study. However, in a study by Hao W et al, fulfilled knee joint motion range with 1.90/141.72° (hyperextension/flexion) at three months, 4.83/143.97° at six months, and 4.82/144.82° at nine months and 5.2/145° at 1 year post-surgery. In a study by Zhao QM et al, for the titanium cable tension band fixation, the functional results were excellent (81%) and good (19%) and for the NT-PC fixation, the functional results were excellent (81%) and good (19%). No significant difference was observed in the excellent and good results ($p > 0.05$). Like this study, unsatisfactory results or poor outcome was not in any patient in the study by Zhao QM et al. (14)

This is among a very few studies that has been done to determine the Functional outcome of fixation method of patella fractures by Open Reduction and Internal Fixation with Reconstruction Patellar Plate. This study is limited by a small number of patients. Further studies should be conducted in the future.

CONCLUSION

Results of this study suggest that the Reconstruction Patellar Plate fixation method of patella fractures by Open Reduction and Internal Fixation produced good Functional outcome, which can be familiarized as an alternate to tension band method for the treatment of transverse patellar fracture.

Conflict of interest: None

REFERENCES

1. Fox AJ, Wanivenhaus F, Rodeo SA. The basic science of the patella: structure, composition, and function. *J Knee Surg.* 2012 May;25(2):127-41. doi: 10.1055/s-0032-1313741. PMID: 22928430.
2. Defrate LE, Nha KW, Papannagari R, Moses JM, Gill TJ, Li G. The biomechanical function of the patellar tendon during in-vivo weight-bearing flexion. *J Biomech.* 2007;40(8):1716-22. doi: 10.1016/j.jbiomech.2006.08.009. Epub 2006 Oct 27. PMID: 17070815; PMCID: PMC1945121.
3. Allen VR, Kambic RE, Gatesy SM, Hutchinson JR. Gearing effects of the patella (knee extensor muscle sesamoid) of the helmeted guineafowl during terrestrial locomotion. *J Zool (1987).* 2017 Nov;303(3):178-187. doi: 10.1111/jzo.12485. Epub 2017 Jul 19. PMID: 29200662; PMCID: PMC5697681.
4. Springorum HP, Siewe J, Dargel J, Schiffer G, Michael JW, Eysel P. Einteilung und Therapie der Patellafraktur [Classification and treatment of patella fractures]. *Orthopade.* 2011 Oct;40(10):877-80, 882. German. doi: 10.1007/s00132-011-1780-z. PMID: 21938491.
5. Galla M, Lobenhoffer P. Frakturen der Patella [Patella fractures]. *Chirurg.* 2005 Oct;76(10):987-97; quiz 998-9. German. doi: 10.1007/s00104-005-1081-3. PMID: 16170504.
6. Wild M, Windolf J, Flohé S. Patellafrakturen [Fractures of the patella]. *Unfallchirurg.* 2010 May;113(5):401-11; quiz 412. German. doi: 10.1007/s00113-010-1768-x. PMID: 20446078.
7. Gwinner C, Märdian S, Schwabe P, Schaser KD, Krapohl BD, Jung TM. Current concepts review: Fractures of the patella. *GMS Interdiscip Plast Reconstr Surg DGPW.* 2016 Jan 18;5:Doc01. doi: 10.3205/iplrs000080. PMID: 26816667; PMCID: PMC4717300.
8. Hao W, Zhou L, Sun Y, Shi P, Liu H, Wang X. Treatment of patella fracture by claw-like shape memory alloy. *Arch Orthop Trauma Surg.* 2015 Jul;135(7):943-51. doi: 10.1007/s00402-015-2241-7. Epub 2015 May 26. PMID: 26009255.
9. Kakazu R, Archdeacon MT. Surgical Management of Patellar Fractures. *Orthop Clin North Am.* 2016 Jan;47(1):77-83. doi: 10.1016/j.ocl.2015.08.010. PMID: 26614923.
10. Henrichsen JL, Wilhem SK, Siljander MP, Kalma JJ, Karadsheh MS. Treatment of Patella Fractures. *Orthopedics.* 2018 Nov 1;41(6):e747-e755. doi: 10.3928/01477447-20181010-08. Epub 2018 Oct 16. PMID: 30321439.
11. Melvin JS, Mehta S. Patellar fractures in adults. *J Am Acad Orthop Surg.* 2011 Apr;19(4):198-207. doi: 10.5435/00124635-201104000-00004. PMID: 21464213.
12. Schindler OS. Basic kinematics and biomechanics of the patellofemoral joint part 2: the patella in total knee arthroplasty. *Acta Orthop Belg.* 2012 Feb;78(1):11-29. PMID: 22523923.
13. Schuett DJ, Hake ME, Mauffrey C, Hammerberg EM, Stahel PF, Hak DJ. Current Treatment Strategies for Patella Fractures. *Orthopedics.* 2015 Jun;38(6):377-84. doi: 10.3928/01477447-20150603-05. PMID: 26091213.
14. Zhao QM, Gu XF, Cheng L, Feng DH. Comparison of titanium cable tension band and nickel-titanium patella concentrator for patella fractures. *Adv Clin Exp Med.* 2017 Jul;26(4):615-619. doi: 10.17219/acem/62692. PMID: 28691409.