



## Outcome study of application of modified tension band wiring (TBW) in patellar fracture: A prospective study

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### ABSTRACT

**Introduction:** Fractures of patella are notorious fractures to treat owing their subcutaneous position and anatomical alignment which is difficult to restore. In the study, open reduction and internal fixation (ORIF) with modified tension band wire technique was used. **Aims:** Clinically evaluate the results and efficacy of this principle and technique in management. **Methodology:** It was prospective descriptive study conducted in GMC, Akola. **Results:** Patellar injury was more commonly associated with Indirect trauma (56)%. Maximum case of patellar injury was caused due to RTA (75%) followed by fall injuries (25%). Patellar injury was simple in nature in 89.60% cases. Transverse fracture (81.25%) was most common patellar fracture followed by comminuted (16.67%) patellar fracture. According to Reich and Rosenberg criteria 58.3% got excellent results, 33.3% good and remaining all were having fair results. **Conclusion:** ORIF with modified tension band wire technique is simple, inexpensive technique, effective means of fixing fracture, advantage of early mobilization of the joint, reduces edema and stiffness of joint, thus leading to a better and early functional recovery and with minimum complications.

**KEYWORDS :** ORIF, K wire, Patellar fracture.

### Introduction

Fractures of the Patella are one of the most common fractures encountered by an orthopaedic surgeon. These are notorious fractures to treat owing their subcutaneous position and anatomical alignment which is difficult to restore. As these fractures are partially intraarticular, they are constantly being subjected to deforming forces from the extensor muscles (Quadriceps in patella fractures)<sup>[1]</sup>.

It is while treating these fractures, that anatomical reduction of the fracture fragments is absolutely necessary to maintain the articular congruity and thus function. It is also difficult to restore the desired anatomical continuity and congruity of their articular surfaces after reduction and thereby causing anatomical complications like Osteoarthritis, Stiffness of joints, Non union etc. Improper treatment leads to early Osteoarthritis and if proper physiotherapy is not taken, there occurs stiffness of the concerned joints. Hence, it is not only proper treatment which is required for a good outcome, but also the attention towards physiotherapy, which should be taken care off.

The evolution of treatment of fracture patella has changed considerably from closed anatomical reduction to different operative surgeries with varying degrees of success. Thanks to Fredrick Pauwel who stated the principle of Tension Band Wiring in 1935 regarding treatment of avulsion fractures like Olecranon, Patella and Medial Malleolus have become an ease. If a fracture is to unite, it requires mechanical stability, which is obtained by compression of the fracture fragments. Conversely, distraction or tension interferes with fracture healing. Therefore, tension forces on a bone must be neutralized or, more ideally, converted into compression forces to promote fracture healing. This is especially important in articular fractures, where stability is essential for early motion and a good functional outcome. K wire is based on principle of application of Tension Band Wires (TBW); the distractive forces at fracture site are converted to compressive force. The implant absorbs the tension and the bone compression<sup>[2,3]</sup>.

In the study, Modified tension band wire technique was used which included use of 2 K wires and SS wire. The 2 K wires used, anchors to the TBW loop made by the SS wires and prevents tilting/rotation of the fragments and also holds the reduced fracture fragments in place. Present study was conducted to study the technique of tension band wiring and its principle as a modality of treatment in fractures like patella and clinically evaluate the results and efficacy of this technique in management of patellar fractures.

### Materials and Methods:

The Study was carried out in Government Medical College & Hospital, Akola, (Maharashtra, India), from the month of July 2013 to December 2013, total 54 cases of fracture Patella was treated in our orthopedic surgery unit by using open reduction with internal fixation with tension band wire. During the study period 6 patients lost their life due other injuries related complication so total 48 cases were included in the study. All closed displaced fractures of patella were included in study. As soon as the patient was admitted, a detailed history was taken and a meticulous examination of the patient was done. The required information was recorded. Radiographs were taken in approximate views and diagnosis was established by clinical and radiological means. Then splinting of fractures was done with above knee POP slab for patellar fractures. Care of the associated injuries and illness were taken and necessary medicines were started. Patient and his family were explained about the nature of injury, possible complications and need of surgery. About the purpose of study patients were verbally informed. Written and informed consent was obtained from patient/family. For the study permission from ethical committee was taken before the commencement of study.

In the surgery, open reduction and internal fixation with tension band K wire was done. Standard procedure was followed. 2mm 2 Kirshner wires were inserted through the fracture site into proximal fragment in a retrograde manner, by tilting the fragment anteriorly. The wires were placed about 5mm deep to anterior surface, parallel to each other along two lines which divided Patella into Medial, central and Lateral thirds. The wires were withdrawn until they were flushed to the fracture site. Then the fracture fragments were accurately reduced, held with the clamp. Absolute care was taken to achieve accurate articular congruity in anatomical position and then the wires were driven through the distal fragments. Wire ends were kept long enough, to protrude beyond patella, both superiorly and inferiorly<sup>[3]</sup>.

Then the 18 G stainless steel wire was passed transversely through the quadriceps tendon attachment as close to the bone as possible deep to protruding K wires. Then figure of 8 loop was made on anterior surface of reduced patella, by transversely passing the wire through patellar tendon attachment on inferior fragment again here close to the bone and deep to the protruding K wire. The loop wire was tightened with tensioner, and then twisted and cut short. Articular surface of patella was again checked for articular congruity. Upper ends of the two K wires were bent acutely and cut short. The cut ends were rotated 180 degrees and impacted embedded into superior margin of patella posterior to the wire loop. Inferior protruding ends of K wire were also cut short. Retinacular tears were sutured. Skin was

closed in layers with suction drain in situ. Wound was dressed and tourniquet was released. Static and isometric exercises within the limit of pain were also encouraged from second or third post op day<sup>[3]</sup>.

After check dressing on 2<sup>nd</sup> day, Physiotherapy in the form of isometric quadriceps setting exercises was started. Non weight bearing crutch walking was taught once the suture removal was done. The patient was discharged on the 14<sup>th</sup> post operative day after suture removal. Non weight bearing crutch walking and active full range of movement at Knee were advised for patella fracture patients. Patient was assessed clinically as well as radiologically after 1 month for any discomfort or pain. Patient was assessed on week 8<sup>th</sup> and 12<sup>th</sup> clinically and radiologically and depending upon "Reich and Rosenberg criteria for Patellar fractures" (1954)<sup>[4]</sup> the results were assessed and the patient was started weight bearing after there was radiological union. We had advised for removal of hardware after about 1 year and earlier if patient had any symptom.

## RESULTS:

**Table 1: Distribution of age group of patients and patellar fracture**

Age in years	No. of patients (n=48)
21-40	11 (22.92)
41-60	17 (35.42)
60-80	20 (41.66)
Sex	No. of patients (n=48)
Male	31 (64.58%)
Female	17 (35.42%)

Table 1 shows that >60 years age group was most common age group (41.66%) followed by 41-60 (35.42%). Average age patellar fracture was 53.75 years in our study. In present study male (64.78%) were having more patellar injury compare to females (35.42%).

**Table 2: Different variables related to patellar fracture**

Side of patellar injury			
Right (%)	Left (%)	Total(%)	
33 (68.75)	15 (31.25)	48 (100)	
Mechanism of Injury			
Direct Trauma (%)	Indirect Trauma (%)	Total	
21 (43.75)	27 (56.25)	48 (100)	
Mode of Injury			
Road Traffic Accidents(RTA)	Fall	Total	
36 (75)	12 (25)	48 (100)	
Nature of Injury			
Simple	Compound	Total	
43 (89.60%)	05 (10.40%)	48 (100)	
Type of Fracture			
Transverse	Oblique	Communitated	Total
39 (81.25%)	01 (02.08)	08 (16.67%)	48 (100)
Time interval between Injury and Surgery			
Within 48 hours	2-10 days	11-30 days	Total
08 (16.7%)	40 (83.3%)	00	48 (100)

In the present study, right side patellar fracture (68.75%) was found more common than left side patellar fracture (31.25%). Patellar injury was more commonly associated with Indirect trauma (56)%. Maximum cases of patellar injury were caused due to RTA (75%) followed by fall injuries (25%). Patellar injury was simple in nature in 89.60% cases. Transverse fracture (81.25%) was most common patellar fracture followed by communitated (16.67%) patellar fracture. Maximum

patients (83.30%) were operated with in 2-10 days of injury. (Table 3)

**Table 3: Persistence of pain in operated patients (n=48)**

Follow up time	Persistent pain
4 weeks	35 (72.7)
8 weeks	22 (45.8)
12 weeks	08 (16.5)

There was persistence of pain in 35 (72.7%) patients at the end of 4 weeks which gradually subsided to 08 (16.5%) patients of patella fracture at the end of 12 weeks. (Table 3)

**Table 4: Movements of Patella according to post-operative time**

Duration (weeks)	Range of Restriction			
	No Restriction	10-20 degrees	20-50 degrees	>50 degrees
04	09(18.8%)	14(29.1%)	17(35.4%)	08(16.7%)
08	21 (43.7)	16(33.3%)	07 (14.7)	04(8.3%)
12	28 (58.3)	15(31.2%)	05(10.5%)	00

The present study shows that after 4 weeks of follow up only 18.8% post operated cases were having free movements but as time progresses and with physiotherapy about 58% cases were having free movements at the end of 12 weeks with only 10.5% cases having range of restriction from 20-50degree. (Table 6)

**Table 5: Time taken for Radiological union**

Time	4 weeks	8 weeks	12 weeks	16 weeks
Radiological union	05 (10.5%)	35 (72.7%)	05 (10.5%)	03 (6.3%)

Present study shows that 72.7% cases shows radiological union in 8 weeks . all cases were united by the end of 16 weeks. (Table 5)

**Table 6: Complications develop after operation**

Complication	Patella
Joint Stiffness	05 (10.5%)
Migration of K wires	04 (08.3%)
Superficial Infection	00
Deep Infection	00
Osteoporosis	00

Out of 48 operated patients only 10.5% encountered joint stiffness and 8.3% faced migration of K wire. Other common complications were not observed. (Table 6)

**Table 7: Evaluation of Results**

Excellent	Good	Fair	Poor	Total
28(58.3%)	16(33.3%)	04(8.4%)	00	48

According to Reich and Rosenberg criteria<sup>[4]</sup> 58.3% got excellent results, 33.3% good and remaining all were having fair results.(Table 7)

## Discussion

The aim of treatment of fracture is not only achieving union but also to preserve the optimum function of adjacent joints. In fracture of patella, it is important to maintain perfect anatomical reduction of fragments to obtain articular congruity by rigid fixation. In this context, AO-ASIF group from Swiss has made valuable contribution by developing several methods of rigid internal fixation and evolving them into practical instrumentation. TBW technique is one such method that AO-ASIF group have defined, evolved and modified. It is suitable chiefly for avulsion fractures at insertion of muscle, tendon and ligament<sup>[5]</sup>.

The average age in present series was found to be 53.75 years for patella fracture. **Levack B et al.**<sup>[6]</sup> conducted study on patellar fracture and observed 49 years was average age for patellar fracture. In present study, fracture was more in males (64.78%) compare to females (35.42%). Similar pattern of results was observed in study conducted by **Maini PS et al.**<sup>[7]</sup> Probably due to males are more exposed to trauma. In our study, right side patellar fractures (68.75%) were found more common than left side patellar fractures (31.25%). which were comparable with study conducted by **Maini PS et al.**<sup>[7]</sup> they observed 55% on right side and 45% on left side patellar fracture. In our study Indirect trauma (56%) was more commonly associated with patellar injury.

**Maini PS et al.**<sup>[7]</sup> found 65% direct trauma was associated with patellar injury. Transverse fractures (81.25%) were more common in present study indicating indirect trauma and transverse fractures go hand in hand most of time. **Maini PS et. al.**<sup>[7]</sup> observed 70 % of Transverse Fractures in their study. In the present study related to tension band wiring, we noted difficulty in maintaining reduction of fragments while introducing K wires, passing K wires through bone, soft tissue, bending ends of K-wires. Many workers (**Macko D et al, Maini PS al.**)<sup>[8,7]</sup> have met with similar complications with the use of K wire.

In present study, pain persisted was in 08 (16.5%) of cases of fracture patella after 12 weeks postoperatively. Pain could be due to periarticular adhesions, superficial necrosis, over protruding K wires. **Srinivasulu et al**<sup>[8]</sup> found similar observation in 20% case after 12 week of operation. After 12 weeks postoperatively 05 (10.5%) cases had restriction of movements more than 20 degrees. It was due to late seeking of medical advice, migration of K wires, superficial infection and periarticular adhesions. In our 48 case study, we came across 05(10.5%) cases of joint stiffness and 04 (8.3%) cases of migration of K-wire. Contrast to this **Maini PS et al**<sup>[7]</sup> observed 11% cases' wound infected post operatively.

Out of 48 cases studied, 28 (58.3%) cases were Excellent, 16 (33.3%) cases were Good and 04 (8.4%) cases were fair. We did not encountered any Poor results in our study. In study conducted by **Maini PS et al**<sup>[7]</sup> they observed 36.6% cases were Excellent, 38.4% cases were Good, 35.4.% cases were fair and 14.3% cases were poor.

**CONCLUSION**

Occurrence of the patella fracture is common in working population that hinders their working capacity temporarily. Symmetrical static tension produced by separate tightening on both sides of wire loop at the time of surgery and dynamic component of compression provided during functional load at the fracture site are the two most influencing advantages of this technique. This fracture which undergoes local overloading, but remains stably fixed, exhibits direct 'contact healing' and internal remodeling as demonstrated by **Rah et al (1971)** thus allowing Early union. Thus observing and comparing the results of our study the following conclusion are drawn that tension band wiring is simple, inexpensive technique, effective means of fixing fracture, good patient compliance, advantage of early mobilization of the joint, reduces edema and stiffness of joint, thus leading to a better and early functional recovery and with minimum complications; However, the technique has some disadvantages as second procedure is required for removal of the metallic implant and risk of K wire sliding and causing skin problems. The advantages of technique far outweighs its drawbacks. Therefore like application of tension band principle in operative management of fracture patella has gained great popularity.



**Pre operative Lateral view**



**Pre operative A/P view**



**Immediate post operative Lateral view**



**Immediate post op AP view**



**After Union Lateral view**



**After Union A/P view**



**Image 1: Exposure of the fracture fragments**  
**Image 2: Reduction held by the reduction holding Clamp and 2 K wires.**



**Image 3: Post operative wound closure**

**REFERENCES**

1. KE Cramer, BR Moed. Patellar Fractures: Contemporary Approach to Treatment. *J Am Acad Orthop Surg*. 1997 November; 5(6): 323–331. | 2. Muller ME, Allgower M, Schiender R, Willenegger H: *Manual of Internal fixation :Techniques recommended by AO-ASIF Group 3rd Ed* : 1991, Springer Verlag. | 3. Netz P, Stromberg L. Non-Sliding pins in traction Absorbing wiring of fractures : A modified technique, *Acta Orthop Scand* 53:355, 1982. | 4. Reich RS, Rosenberg NJ. Treatment of patellar fractures. *Surg Gynecol Obstet* 1954; 98: 553-563. | 5. Heim U, Pfeiffer KM. Internal fixation of small fragments :Technique recommended by AO-ASIF Group 3rd Ed : 1988, Springer Verlag. | 6. Leveck B, Flannagan JP, Hobbs S. Results of surgical treatment of patellar fractures *JBJS* 1985; 67B: 416-419. | 7. Maini PS, Sangwan SS, Sharma S, Chawla P, Kochar A. Rigid fixation of various fractures by tension band wiring. *I J Orthop* 1986 July; Vol. 20: 162-7. | 8. Macko D, Szabo RM. Complications of Tension band Wiring of Olecranon fractures. *JBJS* 1975; 57B: 399. | 9. Srinivasulu, K., Marya, R. S.,Bhan, S. and Dave, P.K.: Results of surgical treatment of patellar fractures. *Ind. J. Orthop* (1986). 20: 158. |