

Screw Fixation versus tension band in patellar fracture

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Abstract

Background: The patella is an important component of the extensor mechanism of the knee. Patellar fractures are relatively uncommon injuries which need to be fixed if displacement occurs more than 2 mm. Transverse fractures comprise the largest category. Patellar fractures are intra-articular fractures which need open reduction internal fixation. The aim of this work was to compare results of fixation of patellar fracture by screw and tension banding. **Methods:** This prospective study compared the results of treatment of 20 adults patients with transverse patellar fractures by two methods of treatment at Benha University Hospital. The patients were divided into two groups (I, II) on a random selection. Group I: including 10 patients treated with cannulated screws. Group II: including 10 patients treated with the kirschner wires and tension band wiring. **Results:** There was no statistically significant difference in the modified HSS score of both groups. There was no statistically significant difference relation between age, sex, side affected, occupation, mechanism of trauma and final result. There was no statistically significant difference in the modified HSS score. There was no statistically significant relation between age, sex, side affected, occupation, mechanism of trauma and final result. The complications occurred in group I included 2 patients lost 10 degree of terminal flexion of the knee, 1 patients lost 20 degrees of terminal flexion of the knee and 1 patients lost 30 degrees of terminal flexion of the knee, while in group II, 2 patients lost 20 degrees of terminal flexion of the knee but this did not affect patient satisfaction. There were no cases with extension lag in this series. In this study, group I, 1 patients had pain due to irritative symptoms related to hardware prominence, while in Group II four patients had pain due to irritative symptoms related to hardware which was due to long wires. Two patients had superficial infection and in group II, three patients had superficial infection. **Conclusion:** There is no significant difference between cannulated screws and tension band wiring by kirschner wire for the treatment of transverse patellar fractures according to modified HSS score. But cannulated screws may be better in pain due to hardware irritation, while tension band is more rigid and allows early range of motion post operatively.

Key words: Screw Fixation, tension band, patellar fracture.

1. Introduction

Patellar fractures are relatively uncommon, accounting for one percent of all skeletal injuries. Many patellar fractures, especially transverse fractures, are associated with complete disruption of the extensor mechanism. When the extensor retinaculum is torn as well, the quadriceps muscle displaces the superior fragment proximally, making adequate reduction of the patellar fragments impossible by closed means and necessitating operative treatment. In addition, fractures with articular incongruity of greater than two to three millimeters are believed to be at increased risk to develop posttraumatic osteoarthritis as a result of the high contact forces in the patellofemoral joint. For these reasons, operative treatment of displaced transverse patellar fractures generally is indicated. [1]

The objectives of operative treatment are anatomic reduction of the articular surface and restoration of the extensor mechanism while preserving the patella. Internal fixation is used to maintain reduction until the fracture is healed. Early range of motion of the knee will reduce the incidence of postoperative knee stiffness and shorten the disability after patellar fractures. Internal fixation techniques should be strong enough to resist the bending and distraction forces across the patella during this postoperative period to allow for early motion. [2,3]

Several different techniques of internal fixation have been employed. Cerclage wiring or wires placed through drill holes were the most commonly used techniques until the introduction of the tension band wiring method by the AO group this technique was designed to resist

the forces across the patella in bending but probably is not as effective in pure distraction when the knee is in full extension. [1]

Clinically, it can be difficult to secure the tension band wire directly down against the patella, allowing the fragments to slip apart with quadriceps contraction. In addition, patient reports of skin irritation from prominent hardware are very common postoperatively. [1]

Some surgeons have used interfragmentary screws to prevent the fracture from sliding apart and to decrease the frequency of hardware irritation to the surrounding soft tissues. Others have recommended using a tension band in combination with interfragmentary cannulated screws. [3]

The aim of this work was to compare results of fixation of patellar fracture by screw and tension banding.

2. Patients and Methods

This study included 20 patients suffering from transverse patellar fractures treated on alternative random selection by computer program either cannulated screws in 10 patients [Group I] or by kirschner wires and tension band wiring in the other 10 patients [Group II]. The period from August 2020 to August 2021 with a minimum follow up period of six months. This study was a prospective one to compare the results of treatment of both groups of patients.

2.1. Inclusion criteria

1. Age group [20-60] years.

2. recent patellar fracture.
3. Closed injury.
4. Surgery date within 2 weeks of date of fracture.

2.2. Exclusion criteria:

1. Additional lower limb injury which may impact on patient rehabilitation.
2. Open fracture.
3. old non-union fracture.
4. Patients medically unfit for surgery.

I] Methods of examination

Every patient in this study was subjected to clinical and radiological examination in order to collect the data needed for analysis of the results.

Data was collected according to the following sheet:

Personal data:

1. Name.
2. Age.
3. Sex.
4. Occupation.

History of the present symptoms

1. Time of injury
2. Mechanism of injury
3. Side affected
4. Time lapsed before surgery

Clinical examination

General

Examination of the whole body for any associated injuries

Local

- 1- Palpation for tenderness
- 2- Skin condition
- 3- Extensor mechanism integrity was evaluated by active knee extension
- 4- Vascular and neurological examination of the affected limb

Medical history:

1. Past medical and surgical history.
2. Presence of debilitating diseases.

Radiological evaluation [preoperative and post operative]:

1. Antero posterior view.
2. Lateral view.

Pre operative to evaluate:

1. Type of fracture
2. Degree of separation of the fragments.

Post operative to evaluate:

1. Healing.

2. Displacement.
3. Implant efficiency.

Treatment:

All patients have been treated by open reduction and internal fixation either by using cannulated screws [group I] or kirschner wires and tension band wires [group II].

II] Methods of treatment:

First aid treatment

- The fractured limb was splinted in above knee posterior slab.
- Analgesic non steroidal anti inflammatory drugs [ketorolac] 1 ampule diluted in 10 cc normal saline and was given 3cm every 6 hours and anti-edematous measures [Chymotrypsin] 1 ampule Intramuscular were prescribed every 12 hours .
- All Patients were admitted in the hospital till time of surgery.
- Control of any associated medical condition as hypertension and diabetic .
- One dose of preoperative antibiotics [Ceftriaxone] 1gm Intravenous was given to all patiens within 30 min before induction of anaesthesia and another post operative dose was given every 12 hours .

Surgical technique:

- Basic requirements of this operations included a power drill, reduction forceps, 2 and 2.5mm kirschner wires and 1 mm stainless steel wire , 4.0 mm cannulated screws of different lengths.

Steps of surgery

- A tourniquet was applied high around the involved thigh, the knee was flexed and the patella was pulled distally before inflating the tourniquet.
- The operation was done in the supine position. To avoid external rotation of the leg, a cushion was used under the ipsilateral hip. With cushioning below the knee, flexion of 30–40 degrees was achieved.
- C- arm from contralateral side perpendicular to translucent operation table was used.
- An anterior longitudinal midline skin incision over the patella was used which can be extended proximally and distally if needed [Fig.1]



Fig. (1) anterior midline skin incision.

- Exposure of the fracture site, evacuation of the fracture haematoma and irrigation of the knee joint [Fig .34].
- Reduction using reduction forceps [Fig.3].
- Anatomical reduction of the articular surface was checked by digital palpation of the patellar articular surface inside the knee and rechecked by fluoroscopy.



Fig. (2) irrigation of the knee joint.



Fig. (3) Reduction using reduction forceps.

1-Group I: cases treated with the cannulated screw.

- Two parallel threaded guide pins were placed within the patella [Fig.4].
- Screws lengths were measured.
- Drilling the fracture fragments over the guide pins was done only for the near cortex .
- Two 4.0mm cannulated screws were inserted over the guide pins to achieve interfragmentary compression [Fig.5].



Fig. (4) Two parallel threaded.



Fig. (5) insertion of cannulated guide pins screws.

2- Group II: cases fixed by kirschner wires and tension band wiring.

- Two parallel 2 mm wires were placed across the fracture line [Fig.6].
- The 1 mm stainless steel wire was passed under the quadriceps and patellar tendons deep to k-wires crossed over anterior patella in figure of eight pattern .
- the wires were tensioned by twisting both limbs of the wire simultaneously, then cutting the wires ends .
- bending the wires ends to avoid soft tissue irritation .[Fig.7].
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Fig. (6) wires are placed.

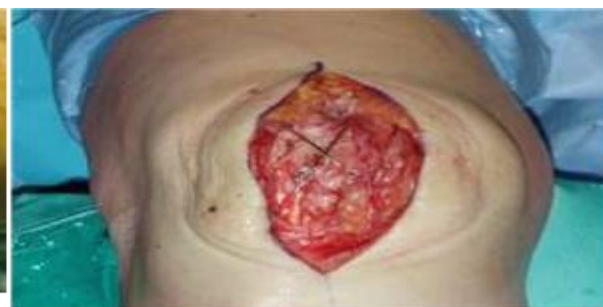


Fig. (7) tension band wiring after bending the wires.

Methods of statistical analysis:

The data collected were tabulated and analyzed by SPSS [statistical package for social science] version 22.0 on IBM compatible computer.

Two types of statistics were done :

Descriptive statistics :

A. Qualitative Data : categorical or nominal .

B. Quantitative Data : Mean [x-], standard deviation[SD], median and range

Analytic statistics :**A. Qualitative Data :**

- Chi-square test [X^2]

- Kruskal wallis test.
- Paired samples t-test
- Wilcoxon signed-rank test.

Levels of significance:

- P-value of [> 0.05] was considered statistically insignificant.
- P-value of [< 0.05] was considered statistically significant.
- P-value of [< 0.001] was considered highly statistically significant.

3. Results

No significant differences were noted between both groups regarding age [$P = 0.77$], gender [$P = 1.0$], occupation [$P = 0.735$], and co-morbidity [$P = 1.0$] [Table 1].

Table (1) General characteristics of the studied patients.

			Group I [n = 10]	Group II [n = 10]	P-value
Age [years]	Mean \pm SD		35 \pm 8	34 \pm 10	0.77
Gender	Males	n [%]	8 [80.0]	7 [70.0]	1.0
	Females	n [%]	2 [20.0]	3 [30.0]	
Occupation	Heavy manual worker	n [%]	5 [50.0]	3 [30.0]	0.735
	Light worker	n [%]	3 [30.0]	4 [40.0]	
	Housewife	n [%]	2 [20.0]	3 [30.0]	
Co-morbidity	Hypertension	n [%]	7 [70.0]	8 [80.0]	1.0
	DM	n [%]	2 [20.0]	1 [10.0]	
	No	n [%]	1 [10.0]	1 [10.0]	

Independent t-test was used for age. Fisher's exact test was used for categorical data

No significant difference was noted between both groups regarding the mechanism of injury [$P = 0.650$] [Table 2].

Table (2) Mechanism of injury in the studied patients.

			Group I [n = 10]	Group II [n = 10]	P-value
Mechanism of trauma	Severe trauma	n [%]	3 [30.0]	4 [40.0]	0.650
	Moderate trauma	n [%]	7 [70.0]	5 [50.0]	
	Mild trauma	n [%]	0 [0.0]	1 [10.0]	

Fisher's exact test was used

No significant difference was noted between both groups regarding total HSS score [$P = 1.0$] [Table 3].

Table (3) Total HSS score of the studied patients

			Group I [n = 10]	Group II [n = 10]	P-value
Total HSS score	Excellent	n [%]	6 [60.0]	7 [70.0]	1.0
	Good	n [%]	4 [40.0]	3 [30.0]	

Fisher's exact test was used

No significant differences were noted between both groups regarding pain on walking [$P = 1.0$] or on rest [Table 4].

Table (4) Pain on walking and at rest in the studied patients.

			Group I [n = 10]	Group II [n = 10]	P-value
Pain on walking	Mild pain	n [%]	4 [40.0]	4 [40.0]	1.0
	No pain	n [%]	6 [60.0]	6 [60.0]	
Pain at rest	No pain	n [%]	10 [100.0]	10 [100.0]	-

Fisher's exact test was used

No significant difference was noted between both groups regarding knee stiffness [$P = 0.471$] [Table 5].

Table (5) Knee stiffness of the studied patients.

			Group I [n = 10]	Group II [n = 10]	P-value
Knee stiffness	No loss	n [%]	6 [60.0]	8 [80.0]	0.471
	Loss 10 degrees	n [%]	2 [20.0]	0 [0.0]	
	Loss 20 degrees	n [%]	1 [10.0]	2 [20.0]	
	Loss 30 degrees	n [%]	1 [10.0]	0 [0.0]	

Fisher’s exact test was used

No significant difference was noted between both groups regarding infection [P = 1.0] [Table 6].

Table (6) Infection in the studied patients.

			Group I [n = 10]	Group II [n = 10]	P-value
Infection	Superficial infection	n [%]	2 [20.0]	3 [30.0]	1.0
	No infection	n [%]	8 [80.0]	7 [70.0]	

Fisher’s exact test was used

4. CASES

Group I :

A male patient 31 years old, heavy worker. He had a transverse fracture of his right patella after falling on flexed knee. He did not have any associated medical history or associated injuries .The operation was performed one day after the trauma using Two cannulated screws . Follow up was continued 6 months and graded as good [Fig. 8].



Fig. (8) post operative AP and Lateral views.



Fig. (9) Range of motion at the end of follow up Full ROM , no flexion deformity , no loss of terminal flexion, no extensor lag

Figure (9) case 1 group 1

Group II:

A male patient 45 years old, light worker, after road traffic accidents He had a transverse fracture of his right patella. Surgery was performed one days after the trauma fixed by Kirchner wires with tension band wiring through it . Follow up was continued for 6 months and the patient was graded as excellent [Figure 9].



Fig. (10) Post operative AP and Lateral views.



Fig. (11) Range of motion at the end of follow up Full ROM , no flexion deformity , no loss of terminal flexion, no extensor lag

Figure (1) case 1 group II

5. Discussion

The mean score was 81.92 ± 13.93 where 6 patients [60%] had excellent result, 4 patients [40%] had good results and no patients had fair result in Group I.

The mean score was 85.73 ± 11.42 where 7 patients [70%] had excellent result, 3 patients [30%] had good result and no patients had fair result in Group II.

As regard to fixation fracture patella using tension band wiring over parallel kirschner wires, **Agarwala et al.** [4] described the results of eighty patella fractures, twenty-four of which had anterior cerclage wires anchored over parallel Kirschner wires; the remaining had anterior cerclage and/or circumferential wiring that was not secured through bone. Both fixation methods resulted in 40% [thirtytwo of eighty] excellent, 45% [thirty-six of eighty] good and 15% [twelve of eighty] fair. They used modified HSS knee score. With the same outcome final score as concluded in this study

As regard to fixation patella using cannulated, **Berg EE.** [5] managed ten patients with displaced transverse patellar fractures with parallel cannulated screws. They use modified HSS knee scoring system. Seven patients [70%] had excellent and good results while three patients [30%] had fair results. **Hatab et al.** [6] Twenty patients were treated by open reduction and internal fixation with cannulated screws. They used modified HSS knee scoring system. The final results of the study showed

fourteen patients [70%] had excellent results, five [25%] good result, one [5%] fair result and no patient had a poor result. With high outcome final result, that support what concluded in this study

As shown in the results of this study, Several comparative studies had been done to evaluate different methods of the treatment of patellar fractures with the same results of this study, **Tian et al.** [7] retrospectively reviewed 101 patients, 52 patients were fixed by the modified tension band group and 49 were fixed by the titanium cable cannulated Screw tension band group. the result were better [$p = 0.01$] in the titanium cable-cannulated screw tension band group [excellent 45 patients [91.8%]; good, four [8.2%]; fair and poor, none] than in the modified K-wire tension band group [excellent 36 patients [69.3%]; good nine [17.3%]; fair four [7.7%]; poor three [5.7%]], **Wang** [8] Seventy two patients were retrospectively among whom 37 patients were fixed by the modified tension band technique and 35 patients were fixed by the titanium cannulated lag screws. the result were better in the titanium cannulated lag screws group [excellent 32 patients [91.4%]; good 3 [8.6%]; fair and poor, none] than in the modified tension band group [excellent 21 patients [56.6%]; good 9 [24.5%]; fair 6 [16.2%]; poor 1 [2.7%]], the previous series were almost similar to this study which showed the higher mean score [modified HSS knee score] in

cannulated screws with tension band wiring than kirschner wires with tension band wiring.

In this study the mean age of patients was in group I 35 ± 8 years, While in group II the mean age was 34 ± 10 years . Which was less than the mean age in **Hatab et al** [6] study [39.25 years], **Tian et al** [7] study [56.6 years] and **Berg EE**[5] study [63 years] There was no statistically significant relation between age and final score.

In this study group I included 8 patients [80%] were males and two [20%] were females, in group II 7 patients [70%] were males and three [30%] were females, In most studies males were more than females, as males are more active so they are more liable to trauma. There was no statistically significant relation between sex and final score.

In this study, group I , Three patients had fractured due to severe trauma [30%], 7 patients were fractured due to moderate trauma [70%], while in group II, 4 patients were fractured due to severe trauma [40%], and 5 patients were fractured due to moderate trauma[50%], and 1 patients were fracture due to mild trauma. [10%], **Berg EE**[5] had reported three fractures [30%] occurred from severe trauma , four [40%] had moderate trauma, and three [30%] had mild trauma . in this study, patients were younger than in **Berg EE** [5]study , males were more than female and osteoporotic patients were not included, so high-energy trauma was the main mechanism of trauma .

In this study, group I , 1 patients had pain due to irritative symptoms related to hardware prominence ,while in Group II four patients had pain due to irritative symptoms related to hardware which was due to long wires, **Tian et al** [7]study, a large number, fifty-two patients were in the modified tension band group five patients experienced skin irritation and 49 were in the titanium cablecannulated screw tension band group with no patients had skin irritation, in **Wang et al**[8] study five patients treated by tension band wiring affected by skin irritation due to kirschner wires prominence and no patients treated by cannulated lag screws had skin irritation, the previous series were almost similar to this study which showed higher irritation with kirschner wires more than cannulated screws.

In this study , group I included 2 patients lost 10 degree of terminal flexion of the knee, 1 patients lost 20 degrees of terminal flexion of the knee and 1 patients lost 30 degrees of terminal flexion of the knee, while in group II, 2 patients lost 20 degrees of terminal flexion of the knee but this did not affect patient satisfaction, no patients were developed any flexion contracture or extensor lag, **Agarwala et al.** [4] study reported full extension in 89% of patients and flexion of 135 degrees or more in 59% of patients, **Hatab et al**[6] study no patient had a flexion contracture or an extensor lag, three patients lost of terminal flexion , one patient lost 30 degrees, another lost 20 degrees while the last lost 10 degrees, the previous series were almost similar to this study which showed no patients had developed any flexion contracture or extensor lag but patients had loss

of terminal flexion of the knee improved after condensed physiotherapy sessions.

In this study, group I , two patients had superficial infection and in group II, three patients had superficial infection. **Berg EE** [5]study and **Hatab et al** [6]study included no infection patients, in this study ,the patients were developed just superficial infection were usually occurred in old age patients and all patients effectively treated by parenteral empirical antibiotic .

6. Conclusion

There is no significant difference between cannulated screws and tension band wiring by kirschner wire for the treatment of transverse patellar fractures according to modified HSS score. But cannulated screws may be better in pain due to hardware irritation, while tension band is more rigid and allows early range of motion post operatively.

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