

Early clinical outcome for transverse patellar fracture treated by tension band with 2 k-wires or 2 cannulated screws

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Abstract

Objective The goals of surgical treatment are to re-establish continuity of the extensor mechanism and to restore a smooth articular surface using stable internal fixation to permit early knee motion.

Methods A comparative prospective study was done in Baghdad during the period from January 2016 to November 2019. We evaluated 50 patients with closed displaced (more than 3 mm) transverse patellar fracture, but only 44 patients complete the follow up divided into two groups (group 1). 22 patients was operatively treated by k-wires with tension band and (group 2), 22 patients was operatively treated by two cannulated screws with tension band. Both groups were evaluated for first 6 months after operation We evaluated the patients radiologically, clinically and functionally every 2 months period by using the modified hospital for special surgery knee score based on four standards clinical outcomes in which pain assessed by visual analog scale (VAS), range of motion by goniometry, displacement on X ray, and quadriceps strength.

Results In group 1, male were (16 patients) 72% and female were (6 patients) 28%. In Group 2, male were (14 patients) 64% and female were (8 patients) 36% with a mean age of 32 years (20–55 year) in group 1 and 34 years (26–57 year) in group 2. The VAS scores showed that the group 2 had lower pain scores and better range of motion compared to group 1. Quadriceps strength more than 75% in group 2 and no fracture displacement as compared with group 1. Excellent and good results were 63% in group 1 and 81% in group 2. Poor and fair results were 36% in group 1 and 18% in group 2.

Conclusions Fixation of patellar fracture (closed, transverse, in adult) by two cannulated screws and tension band is superior to tension band with 2 k-wires with less complications.

Keywords Patellar fracture, k wire, Tension band, Cannulated screw.

Introduction

Patella fractures account for approximately 1% of all skeletal fractures and are seen frequently in the age range of 20–50 years.^{2–4} The incidence in men is almost twice that in women.^{5,6}

In non-displaced fractures of the patella, a transverse pattern is found in 50%–80% of cases from clinical studies and can result from a tensile force applied to the extensor mechanism.^{3,5} The majority (80%) occur in the middle- to lower-third of the patella.⁵ More than 35% of these injuries are non-displaced, and there is usually minimal damage to the femoral or patellar articular surfaces, and the extensor mechanism remains intact.^{7–9}

Stellate fractures result from a direct compressive blow and account for 30%–35% of the patella fractures.^{10,11} More than half (65%) of these fractures are non-displaced.

Longitudinal or marginal vertical fractures comprise 12%–17% of patella fractures.^{9,11,12}

Patients and methods

This study was carried out over a period of 3 years between June 2016 and June 2019 in the Department of Orthopedics, Ibn Sina Training Hospital in Baghdad. Patients with open fractures or multiple fractures, comminuted fracture were excluded from the study.

44 patients (with displacement more than 3 mm, transverse closed patellar fracture with impairment to extensor mechanism) had been included, that are group 1 - 22 patients

treated by open reduction and internal fixation by 2 parallel k-wires with tension band figure of 8 wiring loop and group 2 - 22 patients by partially threaded cannulated AO screws with tension band wiring.

Pre-operative planning

Assessment of the general condition of the patients, the lower limb neurovascular status and associated fractures or dislocations. Radiographic evaluation include anteroposterior and lateral views (Fig. 1).

Surgical techniques

The patient was placed supine on a radiolucent table. A cushion under the patient buttocks to rotate the leg internally. A tourniquet around the thigh inflated while reducing the fracture the knee should be examined under anesthesia to rule out any accompanying injuries like ligamentous injuries or dislocation or any instability.

We use either general or spinal anesthesia. This technique has been modified by the AO group and is advocated as a dynamic and functional form of patella fixation.¹

Group 1

We placed two parallel 0.062 inch k-wires retrograde through the superior patellar fragment. Using 18-gauge circulate wire, with a small loop on one side, we secured the superior and inferior patellar fragments to the 0.062 inch k-wires with figure-of-eight configuration (see Fig. 2).



Fig. 1 AP and lateral x ray with transverse fracture.

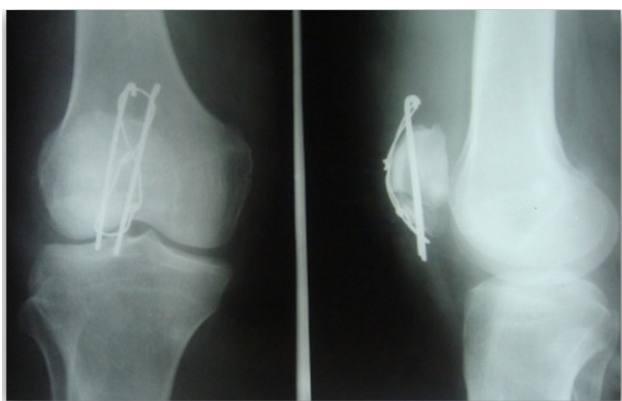


Fig. 2 Group 1-ap and lat. X ray appearance after k wires with tension band.

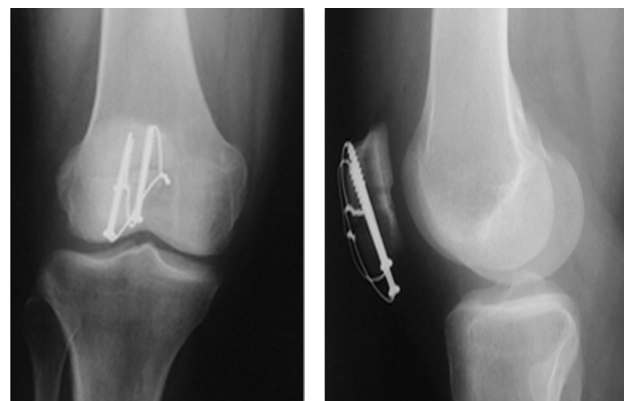


Fig. 3 Group 2-ap and lat X ray after fixation by cannulated screws with tension band.

Group 2:

By using 0.062 inch k-wire as a guide, a 4 mm partially threaded with 32 mm cancellous screws, after complete fixation by 2 parallel cannulated screws, then we passed a 18 gauge wires through the holes of the screws either in a figure of 8 fashion or in 2 different wires and tighten individually (Fig. 3).

Post-operative care

Broad spectrum IV antibiotic was started before surgery and continued for 2 days, then changed orally for 7 days. After surgery we applied a long leg bulky dressing. Post-operative X rays were taken in anteroposterior (AP) and lateral (lat) views. Average time of surgery was approximately 80 min. The range of hospital stay post-operatively was 2–3 days. The patient is allowed to ambulate while bearing weight as tolerated on the second post-operative day.

Follow-up

All patients were followed up biweekly in the first month both clinically and with conventional radiographs (including lateral and AP X ray). Patients were re-examined at 2, 4, and 6 months after the operation, and evaluated on clinical as well as radiological parameters. Union of the fracture was defined when more than 80% bridging of the fracture line by bone was

observed on the lateral side of the radiograph. The final results of the procedure were assessed using the modified hospital for special surgery (HSS) knee score using the following criteria pain, displacement, range of motion and quadriceps strength (Table 1).

The scores for each component of this scale were assessed by use of a questionnaire in combination clinical objective criteria.

The scoring scale has a maximum of 100 points

>90: excellent results

81–90: good results

71–80: fair results

<70: poor results

All data were arranged and tabulated in numbers, percent and mean + standard deviation association between different variables measured by using chi-square and Fischer test by using EP16. $p < 0.05$ considered as a level of significance.

Results

The results are summarized in the below table depends on the age of the patients, sex and side of fracture (Table 2).

Post-operative radiographs reveal anatomical reduction in both groups, in which time for radiological union (indicated by disappearance of fracture line) was 10 weeks (ranging from 9 to 11 weeks) in group 1, and 9 weeks (ranging from 8 to 10 weeks) in group 2.

Table 1. (HSS) knee score.

Descriptor	Points(100)
* Rest pain	
.continous,bed chair status,narcotics	0
.intermittent,occasional narcotics	2
.after excessive activity	5
*Support required because of pain	
.double support only	10
.limits excessive walking only	15
.single support only	20
*No support required due to pain	
.limits routine walking	25
.limits excessive walking	30
.wether related ache, starting discomfort	35
*No pain	40
<i>Malalignment(displacement on x ray)</i>	<i>Max. 25</i>
*No displacement	25
*Displacment less than 2 mm	15
*Displacment more than 2 mm	0
<i>Motion(measured as total possible arc)</i>	<i>max. 25</i>
*0-10	0
*11-30	4
*21-50	10
*31-70	15
*41-90	20
*>50	25
<i>Quadriceps strength(measured as 10 of normal for the age and sex)</i>	<i>Max. 10</i>
*>75 % can not break quadriceps power	10
*50-74% can break quadriceps power	5
*<50% hard to move through arc of motion	0

Table 2. Comparison according age, sex.

	Group 1	Group 2
Mean age (years)	32(20-55)	34(26-55)
Male:Female	16:6	14:8
Sites:		
Right	15	10
Left	7	12
RDW (%)	11.83 ± 0.4	11.10 ± 2.5

Table 3. Results of both group comparison.

Patients	Excellent	Good	Fair	Poor
Group 1	8	6	6	2
Group 2	14	4	4	0
Total	22	10	10	2

According to the modified HSS knee score, our results were as shown in the below Table 3.

Excellent and good results were 63% in group 1, and 81% in group 2. Poor and fair results were 36% in group 1 and 18% in group 2 (see Fig. 3a,b, level of significance was $p=0.047$ which is significant).

The results of each standards individually was as below:

1. Pain: At the end of the 6 months, the results of both groups was as the following (Fig. 4):

Group 1: 14 patients have no pain 63%,8 patients have pain on exertion 37%.

Group 2: 20 patients have no pain 90%,only 2 patient have pain on exertion 10%.

2. Range of motion: By the end of the 6 months, the results are the following (Fig. 5).

Group 1: The mean was 20 degree loss of terminal flexion.

Group 2: The mean was 10 degree loss of terminal flexion.

3. Fracture displacement: By the end of the 6 months, post-operative displacement was defined as a fracture site displacement of greater than 2 mm as compared to the position

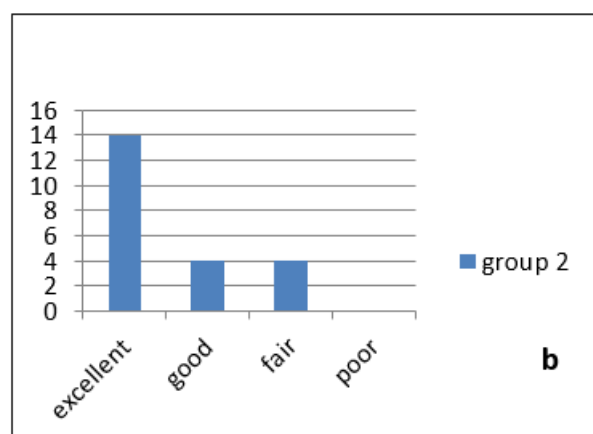
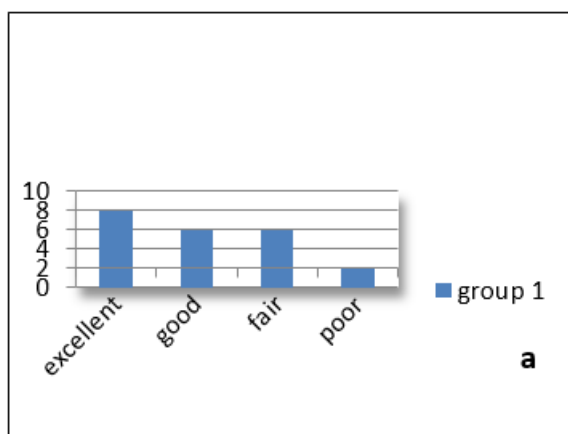


Fig. 3 a,b Results of both groups 1 and 2.

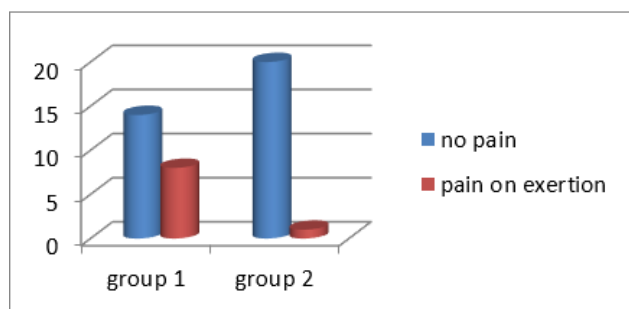


Fig. 4 Differences in post-operative pain in both group.

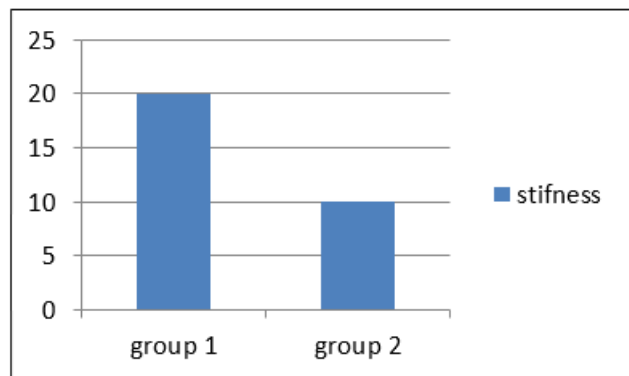


Fig. 5 ROM differences in both group.

on the immediate postoperative imaging tests the results of both groups were as below:

Group 1: Only 2 patients has displacement.

Group 2: No displacement were recorded in group 2.

4. Quadriceps strength: By the end of the 6 months, the results were as in Fig. 6.

Group 1: 10 patients have quadriceps strength more than 75% and 14 patients have the strength between 50 and 75%.

Group 2: 16 patients have strength more than 75%, and the 6 patients have it between 50 and 75%.

Discussion

Unfortunately, the vast majority of published studies on the results and outcomes from treatment of patellar fractures are retrospective studies and there is very little standardization of the methods used to analyze results. It is difficult to compare the various outcome-based studies of the treatment of patella fractures in the literature. Most studies evaluate outcome from subjective findings and not always consider X-ray appearance.¹³

Of the various surgical techniques for internally fixing transverse fractures of the patella and more commuted fractures, anterior tension band wiring, particularly when combined with cannulated screws, gives the best results besides better stability and fixation. Advantages included a low-profile construct that caused lesser degrees of implant irritation to local soft tissue structures.

Accumulated results from several studies which assess the success of fracture patella treated by tension band through cannulated screws show 57% excellent results, 29% good results, and 14% poor results.¹⁴⁻¹⁷

Berg¹⁸ in 10 patients showed 70% excellent or good results based on the hospital for special surgery knee score utilizing

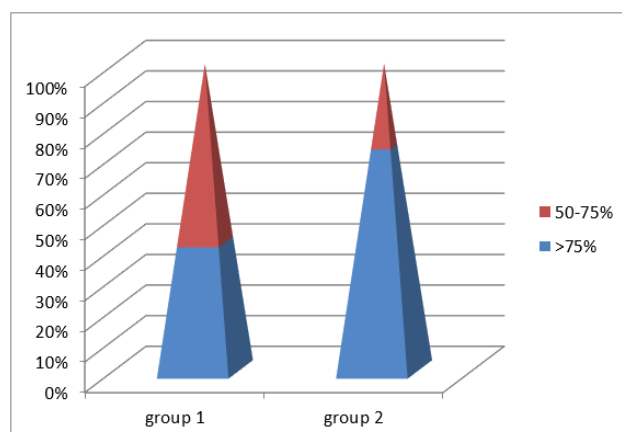


Fig. 6 Both groups quadriceps strength.

figure-of-eight tension band wires placed through parallel cannulated compression screws.

In our study, according to the modified HSS knee score, the current study showed that excellent and good results were found in 63% in group 1 and in 81% in group 2 (level of significance was $p=.047$ which is significant).

This difference between group 1 and 2 may be attributed to applying the advantage of compression screw technique and tension band principles that enhancing the stability and helps prevent failure of fixation at higher loads and lesser degree of tissue irritation which causes decrease range of motion and subsequent decrease in quadriceps strength.

Knee stiffness was the most obvious complication in both groups, it related to type of fixation and degree of combination and extent of tissue dissection, and period of immobilization, in group 1 knee stiffness was within a mean of 20° and about 10° in group 2, this may be due to increased irritation by k wires which protrude through patellar tendon and due to better fixation done by screws which permit early mobilization.

Anterior knee pain due to hardware prominence was also a big concern in patients of group 1 and this also could be due to irritation done by k-wires. Pain was ranging from mild to moderate in group 1 which necessitate removal of implant in 2 patients (18%). Smith et al in his study reported 9 from 87 (12%) had the same complain.¹⁹ Pain in group 2 was mostly mild pain and responded to analgesia with no hardware removal.

Smith et al.¹⁹ looked at the complications of operative treatment of patellar fractures in a consecutive series of 87 fractures. Their major complication was displacement of the fracture of 2 mm or more which occurred in 22 fractures (16%).

In our study, implant failure (more than 2 mm displacement between fracture fragment) occurred in 2 case in group 1 (9%), and this is may be due to intraoperative tightening or post-operative loosening, or patients non-compliance, with no displacement happened in group 2.

In group 1, quadriceps strength after the period of follow up was more than 75% in 10 patients and the others were between 50 and 75% according to modified HSS knee score.

In group 2, quadriceps strength was more than 75% in 16 patients and the rest were between 50 and 75%. This difference between 2 groups may also be attributed to better fixation done by lag screws and lesser degree of irritation which permits early rehabilitation and short period of mobilization.

There were several limitations of this study. First, our technique was indicated for displaced transverse patellar

fractures only, Second, this was a single-center and open-label trial, and the sample size was relatively small. Thus, this study design might be a cause of bias. Moreover, one experienced surgeon performed the k-wire technique, and another experienced surgeon performed the cannulated screws technique.

Conclusions

From the various surgical techniques for internally fixing transverse fractures of the patella, tension band wiring, with cannulated screws, gives the best results.

Loss of motion is one of the most common complications. Adherence to the guidelines for rehabilitation and a co-operative patient will minimize the risk of knee stiffness.

It is important to establish, on the operating table immediately following fixation, how much flexion can safely be done before placing excessive stress on the repair.

Conflict of interest

No conflict of interest

Authors' contributions

All authors made substantial contributions to the study design and acquisition, analysis, and interpretation of data.

Ethics and consent

This study done written informed consent was obtained from all patients enrolled in this study, and all patients were over 18 years old.

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