# Patellar Fracture Fixation by Cerclage and Tension Band Wiring Technique versus Kirschner wires and Tension Band Wiring Technique .

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ABSTRACT

**Background**: Fractures of patella constitute 1% of all fractures. Various techniques have been described for internal fixation of patella fractures. Superiority of one technique over the other has long been debated.

**Objective:** We reviewed a series of seventy patients with transverse or comminuted fractures of patella treated with cerclage and tension band wiring technique to assess if it had any advantages over k. wires and tension band wiring technique.

**Type of the study**: Retrospective study.

**Methods**; Seventy patients with displaced patella fracture, with a mean age of 47 years (range 13-75) were divided into two groups :group A 36 patients were treated with cerclage and tension bands technique ,and group B 34 patients were fixed by 2 K. wires and tension bands technique. Clinical outcome was assessed using the system of Bostman score. Range of motion and evidence of radiological union were assessed at regular follow-ups.

**Results**; All patients in group A gained Excellent result and good result, while only one patient gained poor result in group B . One patient (2.8%) developed superficial infection in group A and three patients( 8.8% ) developed superficial infection in group B. All fractures had united at the end of 10 weeks. Twenty two patients (31.4%) underwent a second surgery for wire removal; 5 cases in group A ( 13.9 % ) two of them due to implant related complications and 15 ( 44.1%) patients for group B mainly due to pain and interference with daily activity. Malunion or non-union was not noted in any of the cases. .

**Conclusion**; The advantages of the cerclage and tension bands technique for fixation of displaced patella fracture are early mobilization, elimination of k-wire related complications, and ease of use in comminuted fracture pattern as well and a lower reoperation rates as compared to other method of fixation by 2 K. wires and tension bands technique. We strongly recommend its use in cases of displaced comminuted transverse fractures of patella .

**Keywords**: Patella fracture, tension band, cerclage wiring, K-wire.

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The patella is the largest sesamoid bone; it is embedded in the quadriceps tendon, provides the mechanical advantage and leverage that increases the force of knee extension. Tensile forces are transmitted from the quadriceps to the tibia via the patella, the patella is also subjected to compressive forces at the articulation with the femur [1]. The magnitudes of these forces vary with the degree of flexion and, with maximal tensile force occurring at 45 to 60 degrees of flexion, the joint contact forces of 3.3 times body weight occur during stair climbing, with up to 7.6 times body weight occurring during squatting[2].

Patellar fractures account for 1% of all skeletal fractures [1] and results from direct, indirect or combined forces. Because of its subcutaneous location this bone is prone to injury from direct force that usually resulting in comminuted fracture. Indirect injury results from violent contraction of the quadriceps muscle in the flexed knee.[3] these fractures usually are transverse and may be associated with tears of the medial and lateral retinacular expansions.

Most patellar fractures are caused by a combination of direct and indirect forces. The most significant effects of fracture of the patella are loss of continuity of the extensor mechanism of the knee and potential incongruity of the patellofemoral articulation. .Patella fracture occurs more often between 20-50 years age and in men two folds of women. Patellar fractures should be radiographically evaluated with anteroposterior, lateral, and axial (Merchant) views [1] Fractures with 2mm or less separation are indicated for non-operative treatment. This includes 4-6 weeks of immobilization in a splint or cast on the conservative side and as little as 2 weeks of immobilization on the aggressive side .Aggressive non-operative treatment may include weight bearing as tolerated as early as 1-week post fracture.

About one third of the patella fractures need operative treatment. Since the patella is subjected to strong tensile forces, patella fractures require rigid fixation with anatomical reduction. Surgery is indicated when displacement and step-off incongruity of articular fragments are more than 2 and 3 mm, and extensor mechanism is disrupted[4]. There are a variety of methods for surgical treatment of patellar fractures such as lag screws, Kirshner wires, tension band wiring (TBW), modified TBW, cerclage wiring (CW), two parallel Kirschner wires (K-wires) are combined with

figure of eight metallic TBW[5,6]. TBW through cannulated screws [7]. New procedures include arthroscopic techniques also using screws perpendicular to the fracture line as well as circumferential wiring, basket plate, and partial or total patellectomy. Recently, non-metallic and modified methods of fixation have been studied to cause less irritation and hardware failure. Patients have been treated using K-wires and non-metallic substitutes for TBW. Also, biodegradable cannulated screw fixation has been tested [8-10] intraosseous cellular response to biodegradable implants is considered mild, and does not influence bone union [11].

Owing to the subcutaneous location of the bone there is increased incidence of implant related complications in patellar fractures. The complications include hardware failure, non-union, intra-articular non-union and development of post-traumatic arthritis, deep infection and sinus tract formation, arthrofibrosis and knee stiffness, persistent oedema, wasted muscle and atrophic bones, symptomatic hardware, migration of broken cerclage wire, stress avulsion of the tibial tuberosity, patella baja, patellar necrosis from blood interference, and peripheral nerve disturbance especially of the branches of the saphenous nerve[12,13,14,15,16,17,18,19,20].

**Patients and Methods:** For this prospective, comparative clinical study, between June 2003 and June 2014. 86 patients underwent operative treatment of a patellar fracture figure (1) in Al-Kindy teaching hospital and Al-Shaheed hospital , we excluded 16 patients who had inadequate follow-up, thus the final 70 patients included in this study. The patients divided into two groups ;Group A include 36 patients, fracture patella fixed by cerculge and tension band technique and group B include 34 patients the fracture fixed by K. wires and tension band technique .The mean follow up was 4 years. There were 46 (65.7%) male and 24 (34.3%) female with a mean age 47 years (range from 11 to 75 years).

Surgical fixation was performed with patients in the supine position with the injured knee extended, tourniquet used for about one hours for both groups. A transverse curved incision was made over the patella approximately 10 cm long with the apex of the curve on the distal fragment, gave enough exposure for reduction of the fracture and repair of the ruptured extensor expansion and synovium. The interior of the joint irrigated to remove blood clots and small particles of bone. In group A ,fixation of displaced fracture patella by using a No. 1 stainless steel wire at the superolateral border of the patella, passing it transversely immediately next to the superior pole of the patella through the quadriceps tendon& then along the medial border of both fragments midway between the anterior and posterior surfaces& transversely through the patellar tendon from the medial to the lateral side around the distal border of the patella and then proximally along the lateral side of the patella at the end of the procedure the wire ends were next to each other at the supero-lateral corner of the patella, the cerclage wire was passed around the equator of the patella, as close as possible to the bone. The cerclage wire was then tightened to prevent further displacement of the fragments. Another wire was passed proximally transversely through the quadriceps tendon attachment, as close to the bone as possible and distally through the patellar tendon, posterior to the cerclage wire and in the form of a figure-of- eight fashion over the anterior patellar surface; while tightening of both wires alternately figure (2). In group B fixation of displaced fracture patella by using two parallel K. wires pass from superiolateral and superiomedial to inferiolateral and inferiomedial side of the patella with the cerclage wire in the form of a figure-of- eight fashion over the anterior patellar surface figure (3). In both techniques congruity of the articular surface was checked by palpating the retro patellar surface to ensure that the reduction is anatomical. The tightened wire knots were buried under the soft tissue at the superolateral corner of the patella to prevent impingement related problems post-operatively. The stability of fixation was assessed by bending the knee and looking for any opening in the fracture site. . 58 patients (82.9%) were having significant tear in the extensor expansion necessitated repair. The synovium, ruptured capsule, and extensor mechanism repaired with interrupted sutures from their outer ends toward the midline of the joint. A posterior splint from groin to ankle was applied for immobilization for 3 weeks while the other 12 patients (17.1%) without tear no immobilization was applied. The patients were encouraged to perform quadriceps-setting exercises and within a few days should be lifting the leg off the bed.

**Table-I: Profile of the Patients**

| Variable | Number of Patients | Percent age |
|---|---|---|
| Gender | | |
| Male | 46 patients | 65. 7% |
| Female | 24 patients | 34.3% |
| Type of Fracture | | |
| Comminuted | 38 patients | 54. 3% |
| Transvers | 32 patients | 45.7% |
| Side | | |
| Rt | 37 patients | 52.9% |
| Lt | 33 patients | 47.1% |
| Mechanism of Fracture | | |
| Road Traffic Accident | 36 patients | 41.4% |
| Other Traumatic Events | 34 patients | 48.6% |

Of the 12 patients treated without splint all gained up to 90 degree of active flexion at the end of the first week.

Most common complication was atrophy of the quadriceps muscle but in comparison with healthy leg it was not significant. Twenty one patients (30%) had 10-15 degrees of extensor lag at the end of the 8 weeks which improved after vigorous physiotherapy and none of them had any residual extensor lag at the subsequent follow-up. Table 2

Mild degrees of patellofemoral arthritis were seen in only 1patient(1.4%).

The results of the knee joint function were excellent in 24 patients (66.7%) and good in 12(33.3%), 79 &no one with poor result in group A which is better than in group B were excellent in 18 patients (52.9%) and good in 15 (44.1%), 79 & one with poor result (3%) by using Bostman et al score. Table-3.

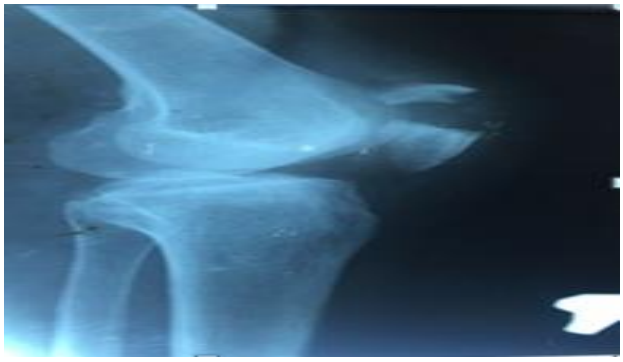

Figure 1: fracture patella(preoperative)

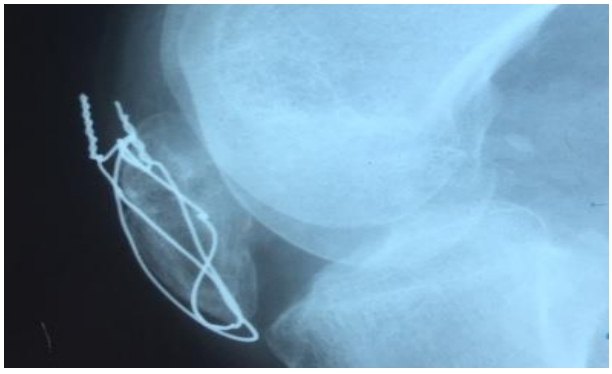

Figure 2: fixation by cerclage and tension band wire

Figure 3: fixation by K.wires and tension band wire

Figure 4: after extraction

**Table (2) shows postoperative complications.**

| Type of complication | Group A | | Group B | |
|---|---|---|---|---|
| | No. | Percent | No. | Percent |
| Delayed union | None | | None | |
| Joint stiffness | 1 | 2.8% | 2 | 5.9% |
| Delayed return to daily activity | 1 | 2.8% | 1 | 2.9% |
| Wound infection | 1 | 2.8% | 3 | 8.8% |
| Loss of reduction | None | | None | |
| Wire fracture | 2 | 5.6% | 1 | 2.9% |
| atrophy of the quadriceps muscle &extensor lag | 9 | 25% | 12 | 35.3% |

**Table (3) shows Results of Bostman scale**

| Result | Group A | | Group B | |
|---|---|---|---|---|
| | Number of patients (36) | Percent | Number of patients (34) | Percent |
| Excellent---29 to 32 points | 24 | 66.7 % | 18 | 52.9 % |
| Good--23 to 28 points | 12 | 33.3 % | 15 | 44.1 % |
| Poor--below 23 points | None | -- | 1 | 3% |

**Discussion:** The aim of surgical treatment in patella fracture is anatomic reduction, repair the extensor mechanism, restore articular congruity and preservation of patellar bone stock.

A consensus on the ideal method of fixation for patella fractures does not exist. Weber et al [22] emphasized that cerclage wiring alone was not strong enough to allow early mobilization, hence prolonged post-operative immobilization was needed. Thus there was a need of a method of fixation that allowed early post-operative mobilization.Subsequently, surgeons from Rowley

Bristow orthopaedic hospital, Pyrford described the combination of cerclage wiring and tension band wiring for patella fractures. The Pyrford technique led to a greater strength of fixation, certainly enough to allow early mobilization[23] Benjamin et al [24] compared three methods of patellar fixation (Lotke's wiring, Magnusson's wiring and Modified AO technique) and concluded that modified AO tension band wiring is the most stable fixation for patella fractures. However C. Max Hoshino et al [25] reported that this technique led to k-wire related complications post-operatively like backing out of wires, pain and irritation due to k-wires. These complications left the surgeon in dilemma of removing the implant and risking non-union or leaving it inside with the concomitant patient suffering.

Rates of implant removal for symptomatic hardware have ranged from 10% to 60%. [26,27], Although symptomatic implant irritation is not as serious a complication as fixation failure or postoperative infection, it does require the patient to undergo a second operation, which carries inherent surgical risk and increases the overall cost of fracture care[26] Thus a method needs to be devised by which the re-operation rates can be decreased without compromising the union rates. Although there was crowding of the wire knots at the supero-lateral pole of patella in the above described method, only 22cases (31.4%) extraction was done, five cases (13.9 %)in group A two patients had one or more broken wires in the radiographs with implant related symptoms but union had already been achieved and 17 patients (50 %)in group B mainly due to pain and interference with daily activity, one of them had one broken wire in the radiographs with implant related symptoms but union had already been achieved .We agree with Sanjay Agarwala et al [28] who reported (8.3%) underwent second surgery due to implant related complications.

The functional result was better by using combined cerclage and tension band wiring technique than K. wire and tension band wiring technique for fixation of comminuted patellar fracture. Curtis [23] in a cadaveric study compared the AO method to the Pyrford technique using a cerclage wire and an anterior tension band wire looping through the quadriceps tendon. He found that while the AO technique is adequate for most cases, the Pyrford technique led to a greater strength of fixation. The Pyrford technique can also be applied to a comminuted fracture of the patella, which can be difficult to fix with interfragmentary k-wires and a simple tension band.

T K Ong et al [29] found very encouraging result based on the mean score of 92.5 per cent on the Activity of Daily Living Scale. Using Bostman score in our study we got no poor result in group A and one pateint (3%) in group B had poor result, Schemitch et al [27] reported 20% poor result by using other methods of fixation. Wejdi [2] got 12,5% fair result inTBW &43%fair &poor result in circlage wire alone. Studies describing fixation of various types of patellar fractures report that, in general, 25–42% of patients treated with K-wires and metal TBW experience suboptimal results and postoperative pain or irritation [30]. Mehdi Nasab SA1 [31] observed more significant hardware problems in their patients treated by TBW, the rate of. Pin wire removal was (70.8%)with TBW while it was (15%) with cerclage wire. Dy et al. [26] in their meta analysis involving 737 patella fractures fixed with various fixation techniques,a non-union rate 1.3% & substantial re-operation rate of 34% after patella fracture fixation. The high reoperation rate was attributed to the use of k-wires in the construct. Some authors have commented that cannulated screws are technically difficult to place properly because a screw that is too short will not provide adequate fixation, while a long screw may abrade the tension-band wire, causing it to fail prematurely, Once the anterior tension band has failed, isolated cannulated screws do not provide optimal fixation[32]. C. Max Hoshino et al [25] in studying complications following tension-band fixation of patellar fractures with cannulated screws compared with k-wires reported that cannulated screws may be twice as likely to fail as Kirschner wires. The incidence of fixation failure was 3.5% in the Kirschner-wire group and 7.5% in the screw group. In our study 1 patient (2.8%) sustained superficial infection in group A and 3 patients (8.8%) in group B,which was similar to the incidence of postoperative infection after fixation of patellar fractures ranged from 3% to 10%, [33].Dy et al[26] in their metanalysis involving 737 patella fractures fixed with various fixation techniques, reported an infection rate of 3.2%, It is possible that prominence of Kirschner wires causes more soft-tissue irritation and wound-healing problems, which may increase the risk of postoperative infection [25]. Two studies compared fixation using TBW through biodegradable self-reinforced polyglycolide (SR-PGA) and self-reinforced polyl-L-lactide (SR-PLLA) plugs with fixation using K-wires and metallic cerclage wire. In two patients, slightly delayed wound healing was observed, possibly tissue reaction to plug or the suture material. [34,35] At a straight pull tensile test, Chatakondu et al [36] found a significant lower tensile strength for non-absorbable Ti-Cron suture compared with stainless steel wire (14.89 vs. 35.25 kg). The author states that suture breakage however is unlikely to cause any problems. [36] Two studies compared operative treatment using cerclage wire or a K-wire system with conservative treatment using a plaster cast for immobilization.[37,38] In both studies, the operative group exhibited better outcome in terms of extensor function and mobility status compared with conservative non-operative group treated by a cylindrical cast.

## Conclusion

The advantage of fixation of displaced patella fracture by using cerculage and tension band tension technique are early mobilization, higher functional score, & elimination of k-wire complications, lower complication & reoperation rates as compared to fixation by K. wires and tension band technique.

**Recommendation:** we recommend cerculage and tension band tension technique for fixation of displaced transverse patella fracture

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