

Modified Tension band & longitudinal K .wires fixation versus Circumferential Cerculage wire in treatment of patellar Fractures.

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الخلاصة

لقد قمنا بمعالجة (32) مريضاً من كسر عظمة الرضفة في كل من م. الصدر التعليمي و م. الحكيم العام و م. المناذرة العام وكانت (16) مريضاً عولجت بطريقة شد الرباط المحوريين اثنان من الكي واير الطولية و (16) مريضاً بطريقة السد ركولاج واير المحيطي في الفترة من تشرين الثاني 2006 لغاية كانون الأول 2008 كانت النتائج ممتازة وجيدة في طريقة التثبيت الكسر بشد الرباط المحوريين اثنان من الكي واير الطولية أكثر من التثبيت بطريقة السد ركولاج واير المحيطي باعتماد هذه الطريقة في معالجة مثل هذا النوع من الكسور .

Abstract

Fracture of patella comprises approximately 1% of all skeletal injuries. We managed 32 patients with closed transverse patellar fractures in a prospective study during the period between November 2006 and December 2008 (with mean follow up one year) at al Sader, al Hakeem and al Manathera hospitals. All cases were treated by open reduction and internal fixation. There were 16 cases randomly fixed by modified tension band and longitudinal Kirschner wires (MTB&LKW) method and 16 randomly fixed by circumferential cerculage wire (CCW) in patients' age (20-50 years). The results were assessed by a Lysholm & Gillquist score. Regarding (MTB&LKW) method, the outcome was excellent in 50%, good in 37,5 %, and fair in 12,5% case but the outcome was excellent in 31,75%, good in 25%, fair in 25% and poor in 18,25 % with (CCW) method. We concluded that the (MTB&LKW) fixation method is superior to (CCW) method in that it shortens the average time for union and allowed less fracture displacement than did other method.

The aim of the study is to determine whether modified tension band fixation method results in better outcomes compared with those after circumferential Cerculage wire fixation method in the treatment of closed patellar fractures.

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Introduction, Anatomically, the patella is the largest sesamoid bone in the body.

Three fourths of the patella's proximal posterior surface is covered with some of thickest articular cartilage found in the human body.

Its articular surface is divided by a longitudinal ridge separating it into medial and lateral facets. The patella functions to improve the lever arm of the extensor mechanism. The patella exposed to complex loading consisting of tensile, bending and compressive forces. 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 . the size of patellofemoral contact area is 2 to 4 cm², or 13%to 38%of the articular surface, and is oriented in a transverse band through most of the range of motion. Fracture of patellar comprises approximately 1% of all skeletal injuries resulting from either direct or indirect trauma. The anterior subcutaneous location of the patella makes it vulnerable to direct trauma, such as the knee striking the dashboard of an automobile or from a fall on the anterior knee or hard blow to the front of the knee. These fracture caused by indirect mechanisms result from a violent contraction of the quadriceps with knee flexed. These fractures usually are transverse. Most of patellar fractures are caused by a combination of both direct and indirect forces. The most significant effects of fractures of the patella are loss of continuity of the extensor mechanism of the knee and potential incongruity of the patellofemoral articulation. The patellar fractures can be classified as undisplaced and displaced and further subclassified according to fracture configuration into transverse, vertical and stellate. Transverse fractures usually involve the central third of the patella but can involve the proximal (apical) or distal (basal) poles. A variable amount of comminution of the poles may be present. The patient usually presents with pain in the affected knee. Patellar fractures generally are associated with a hemarthrosis and tenderness .In fractures that are displaced or have concomitant retinacular tears, a palpable defect may be present .Inability of the patient to actively extend the affected knee usually indicates a disruption of the extensor mechanism and a torn retinaculum ,which require surgical treatment. Skin should be examined for abrasions, laceration and contusions. Open wound in the vicinity of a patellar fracture may be a sign of an open fracture, which is a surgical

emergency. If uncertainty exists as to whether the open wound communicates with the joint, the saline test can be used .

patellar fractures should be roentgenographically evaluated with anteroposterior, lateral and axial (Merchant) views.transverse fractures are best seen on a lateral view. A comparison view of the opposite knee sometimes is necessary to differentiate an acute fracture from a bipartite patella, which is a failure of fusion of the suprolateral portion of the patella and usually is bilateral ^(1, 2, 3, 4, 5, 6, 7, 8). If the fracture is not displaced and the extensor mechanism is intact, the fracture may be treated conservatively by placing the affected extremity in a cylinder cast for 4-6 weeks. The patient is allowed to bear weight in the cast. Once radiographic evidence indicates union and once clinical signs of healing (not tender to palpation) are present, the patient is changed to a removable brace. Once the patient is able to perform a straight leg raise without extensor lag and has greater than 90° of knee flexion, brace use may be discontinued. Only one third of patella fractures require surgery, which is indicated if there is damage to the extensor mechanism or in fractures associated with 2-3 mm step-off incongruity and open fractures ^(9,10,11,12). The objectives of surgical treatment include precise anatomic reduction of the articular surface by secure and stable fixation, and restoration of the knee-extensor mechanism, thus allowing early mobilization. Currently, several fixation methods of patellar fractures includes modified tension band wiring, Circumferential cerclage wires, and screw fixation and recently bioabsorbable fixation which may reduce the frequency of hardware symptoms ^(13,14,15,16).The most common method is a modified tension band technique. The biomechanical principle of modified tension band fixation is to convert a tensile force into a compressive force while the knee is flexed. If a fractured patella were to be brought through a range of motion, tension and distraction would be present at the fracture site. By placing a tension band at the anterior surface (tension surface of bone), this tensile force is converted into a compressive force and this will assist in fracture healing ^(16,17,18,19,20).Regarding Complications, Infection Rates are 2-10%. This is due to the subcutaneous location of the patella and lack of overlying soft tissue. Wound healing may be problematic, when there is a soft-tissue lesion. Immobilization of knee is indicated to avoid further stress to the soft tissue to allow healing. Deep infections require surgical debridement and prolonged antibiotic therapy. Untreated infections can lead to septic arthritis with a poor prognosis. Stiffness occurs with prolonged immobilization.

Once the soft tissues have stabilized, early motion, physical therapy, Patellar mobilizing exercises are necessary to avoid stiffness and mandatory to allow better tracking of the patella. Manipulation under anesthesia or arthroscopy may be required for arthrofibrosis. Hardware prominence is best avoided by careful intraoperative techniques. Wire ends should be within soft tissue and not immediately subcutaneous. Up to 15% of patients with symptoms require hardware removal once the fracture is healed. Loss of fixation/loss of reduction, this can occur in up to 20% of fractures treated with internal fixation. It often is due to inadequate fixation, unrecognized comminution, or aggressive postoperative therapy. If only minimal displacement occurs, the fracture may be treated with immobilization until healing occurs. With loss of extensor mechanism or unacceptable incongruity, the fracture must be revised with hardware or by a partial patellectomy. The prognosis depends primarily on the quality of articular restoration. Any intra-articular incongruities lead to posttraumatic arthritis. A certain component of the prognosis also depends on the amount of chondral damage sustained at the time of injury. Some of these changes are irreversible; anatomic restoration of the joint minimizes the long-term degenerative changes. Functional outcome depends on the ability to achieve early; pain-free, stable range of motion. Future treatment options may include osteochondral allograft reconstructions of the patella for posttraumatic arthritis ^(19,20,21,22,23).

Patients and Methods

This study done from November 2006 to December 2008, we managed 32 cases of closed displaced transverse patellar fractures (CDTPF) at al Sader, al Hakeem and al Manathera hospitals to evaluate the best method for treatment of this type of fractures with mean follow up of 12 months ranging 9-18 months .In this study; we had selected only cases of (CDTPF) in patient with age ranging from 20-50 years old (the mean age is 34 years) who were otherwise healthy and carried no systemic diseases. All patients were diagnosed as being a case of (CDTPF) clinically and confirmed by plane X-rays films. The patients included in this study were chosen according to Inclusion criteria which include male or female with closed displaced transverse patellar fractures, multiple injured patients (but not includes ipsilateral lower limbs injury) and patellar bilateral fracture.

Exclusion criteria were comminuted fractures ,pathological fractures, history of previous patellar fracture, cases subjected to previous surgery on the ipsilateral patella including those undergone bone-patella-bone autograft donations for anterior crutiate ligament reconstruction, pregnancy, open fractures, concurrent spinal cord injury, injury associated to nerve injuries, Delayed entry into the study more than 3 weeks after the initial injury, Patients with other medical disease like metabolic bone disease, diabetes mellitus or congenital heart diseases, non-displaced fracture and ipsilateral lower limbs injury. The patients with acute injury were first received in the casualty unit or as an outpatient in the orthopedic clinic and the patients are sent then to the X-ray department for two views (anteroposterior and lateral views) for two limbs. The distal pulse and capillary refilling were examined then the limb was carefully placed in above knee POP back slab. The limb was gently elevated. Analgesia is given to the patients. The operation was performed on the first day in 18 cases (56, 25%), between 2 and 8 days following trauma in 10 cases (31, 25%), and after the 8th day in 4 cases (12.5%). The patients are admitted to the orthopedic ward for definitive management. Randomizing of patients into two groups was performed consecutively based on their order of presentation and hospitalization. After approval of Ethics committee in our hospitals and complete explanation of treatment plan to patients and their close relatives, a written consent was taken from patient and their close relatives. In the theater, we gave peroperative antibiotics (either cefatoxime alone or combination of ampicilline, cloxacilline and gentamicine according to what antibiotic available in the hospital). All the patients were operated under general anesthesia with supine position with above knee tourniquet, via a midline longitudinal incision exposure of entire anterior surface of patella, and the quadriceps and patellar tendon; then we exposed the fracture fragments and looked for any defect in the extensor mechanism or defects in retinaculum which might extend several centimeters medially or laterally, or both; The modified tension band technique often begins with placing 2 parallel Kirschner wires (K-wires). These wires can be placed outside-in after the fracture was reduced and provisionally stabilized by two large towel clamp. Another technique by which to place K-wires is the inside-out technique. This involves drilling the wires through the fracture site prior to reduction. Once the wires were passed through the fracture, the wire end nearest the fracture surface was made flush with the fracture.

The fracture was then reduced and the wires were advanced across the fracture. The ideal level of the pins was in the center of the patella, approximately 5 mm below its anterior surface. Once the K-wires are placed, a 1-mm modified tension band wire is placed as close to the anterior border of the patella as possible. Keeping the modified tension band at the anterior half of the patella is very important. The modified tension band is made into the shape of a figure of 8. It was laid as close to bone as possible throughout its entire course. While tightening the modified tension band with the knee extended, the congruity of the articular surface was checked by palpating the retropatellar surface through the medial and lateral retinacular defects. Following fracture fixation, the arc of motion was assessed. The twisted ends are cut, leaving approximately 1 cm of wire remaining. These ends are then bent over with a large needle driver, and the ends are rotated to lie within soft tissue. They were not being left proud because they can cause irritation of the overlying skin. The K-wires are also cut. The proximal ends are bent over, again using a G 14 needle driver. The ends are rotated to lie within the quadriceps tendon and are advanced until the ends contact the proximal pole of the patella. The distal ends are then cut to avoid prominence within the patellar ligament. This method was done for only 16 fractures while the rest of the fractures were fixed by circumferential cerclage wires alone. Circumferential cerclage wires involved placement of a 1-mm cerclage wire around the periphery of the patella through same approach without the placement of two k-wires. No soft tissue (quadriceps or patellar tendon) was intervened between the K wires or bone surface and the tensioned wire; so the tensioned wires are placed directly adjacent to the patellar surface and directly against the K wires; After fixation of a patella fracture, closing the arthrotomy and repairing with the interrupted sutures the synovium, the ruptured capsule and the retinacula were done from the outer ends toward the midline of the joint. This adds to the healing of the extensor mechanism and helps prevent patellar subluxation. A drain was placed into the knee joint prior to closure. The patients were then placed into a well-padded sterile dressing and a posterior splint from the groin to ankle is put which was replaced by an extension knee cylinder cast after removal of the stitches (usually 12-14 days). Postoperatively, parenteral antibiotic were given for three days. Postoperative rehabilitation is dependent on the stability of fixation, and status of the soft tissue.

Weight bearing was allowed after five days, except when there were associated lesions. Direct communication between us and therapist was done to ensure proper rehabilitation and maintaining full knee extension. Periodic radiographic evaluation was carried out to look for union, to assess the need for additional procedures and to check for complications. Patients were examined on 5th day, 10th day, 14th day, 3 weeks, 6 weeks and 3 months, 6 months, 9 months, one year, 15 months and 18 months for assessment of infection, union rate, loss of fixation or loss of reduction and hardware prominence.

The following data were used for all patients in our study:- Name, age, sex, date of injury, date of presentation, cause of injury (fall onto the knee, blow against the dashboard of a car and catching the foot against a solid obstacles), any history of previous surgery. On examination, we put following point in consideration: - which limb is injured, vascular injury, nerve injury. X-ray findings were recorded in an anteroposterior view and lateral view. Any displacement was noticed. Treatment weather Modified tension band fixation or circumferential cerclage wire:-1- Intra-operative complications. 2- Time of union, 3- post-operative complications.

Results

From the 32 patients in this study, 19(59, 375%) sustained RTA, 13(40,675%) catching the foot against a solid obstacles, 20(62, 5%) fractured the right humerus and 12 (37, 5%) fractured the left humerus, were 20(62, 5%) males and 12 (37, 5%) females. We randomly divided the patients into two groups, group one was 16 cases which were fixed by MTB&LKW and group two in which CCW fixation was done which were also 16 cases. Functional results were evaluated according to a Lysholm & Gillquist score⁽²¹⁾, which involved following factors: - union time, number of hospital days postoperatively, pain and functional capacity (include range of motion and time to return to daily and labor activities) were assessed at 3, 6, 9, 12, 15, and 18 months postoperatively .as in table number 1. Delayed union of the fracture was reported in 5 cases, 2 of which were with MTB&LKW method and 3 cases in CCW method .all cases required additional time of follow up and all fractures eventually united on follow-up. There were 8 cases of joint stiffness. 3 cases in MTB&LKW method and 5 cases in CCW method all cases treated with regular isometric and stiff-leg exercise physiotherapy program. The delayed return to daily activity occurred into 3 cases, 1 case in MTB&LKW method and 2 cases in CCW .they were also

treated with physiotherapy program. The wound infection occurred into 3 cases, 2 cases in MTB&LKW method and 1 case in CCW. they were a superficial wound infection. They were treated oral antibiotics and all cases were well cured. The loss of reduction occurred into 4 cases, 1 case in MTB&LKW method and 3 cases in CCW .they were also treated with revision of internal fixation of MTB&LKW method with delayed the initiation of physiotherapy program than primary surgery, table 3 .The mean union time depending on clinical and radiological signs of group one was 9 weeks while that of group two was 12 weeks. The mean of the time to return to daily and labor activities(which need full quadriceps strength) for group one as 20 weeks while that of group two was 30 weeks. The mean of hospital days for group one as 3 days while that of group two was 6 days. Regarding mean of range of motion in knee joints in group one was 3 (excellent) while that of group two was 2 (good). The mean of score regarding pain in group one was 3 (absent) while that of group two was 2 (mild to moderate). The score was excellent for 13 patients (8 with MTB&LKW and 5 with CCW), good for 10 patients (6 with MTB&LKW and 4 with CCW), fair for 6 patients (2 with MTB&LKW and 4 with CCW), and poor for 3 patients (all of them with CCW method) as in table 4.

Table (1) shows the parameters used in scoring system.

Parameters	state	Score	state	Score	state	Score		
1- union time in weeks	6-8	3	9-11	2	>12	1		
2- number of hospital days postoperatively	1-2	3	3-5	2	>6	1		
3- Range of motion in degrees for knee	Full range	3	Loss up to 20°-35° of extension	2	Loss more than 40° of extension	1		
4- Loss of fixation/loss of reduction	absent	3	present	1				
5- pain	absent	3	Mild to moderate	2	severe	1		
6- time to return to daily and labor activities in weeks	Excellent	14-18	Good	19-23	fair	24-28	poor	>30

Table(2) shows the prognosis of each scoring System.

The score	The prognosis
17-19	Excellent
13 -16	Good
10-12	Fair
6-9	Poor

Table (3) shows postoperative complication.

Type of complication	Patient treated by MTB&LKW		Patient treated by CCW	
	number	percent	number	percent
1-delayed union	2	12,5%	3	18,75 %
6- joint stiffness	3	22%	5	22%
3-delayed return to daily activity	1	6%	2	0%
4- wound infection	2	6%	1	22%
5- loss of reduction	1	0%	3	0%

Table (4) the score of each method.

score	MTB&LKW method	P&S method
excellent	8 (50%)	5(31,25%)
good	6(37,5%)	4(25%)
fair	2(12,5%)	4(25%)
poor	0	3(18,75%)

Discussion

In the 1800s, treatment of patella fractures was quite controversial. Owing to lack of adequate fixation techniques, surgical experience, and imaging, treatment most often was extension splinting. This led to poor results because of intra-articular incongruity, nonunion and poor motion ⁽²³⁾.

In our study there is relation between the prognosis and type of treatment, there is better results with MTB&LKW method than with CCW method. There is no relation between the side of injury and gender of patient with the score.

Webber et al, compared experimentally the rigidity afforded by circumferential wiring, modified tension band wiring Magnuson wiring, and modified modified tension band wiring using two anteriorly placed wires combined with two transfixing Kirschner wires .they found that most secure fixation was obtained with modified modified tension band wiring .this study agrees with our study as it reach same conclusion although it took different types of fixation but we took only two method ^(2,24).

Benjamin et al, in their study of 120 patients for three years follow up, evaluated modified tension band wiring, Lotke wiring, Magnuson wiring, and screws fixation alone in transverse fractures and found that the modified tension band technique is best method for fixation. This study also agrees with our as it reach same conclusion although it took larger sample, longer period of follow up and different types of fixation ⁽²⁾. Burvant et al in, their study 45 transverse fracture for three years which were fixed by modified tension band ,Pyrford technique , tension band with screws, Pyrford technique with screws and screws alone ,they concluded adequate fixation was obtained with all method ; however ,displacement of fragments was slightly greater with screws alone and with Pyrford technique alone and modified tension band provided the securest fixation . This study goes with our as it concluded same results although it took larger sample ,longer period of follow up and many types of fixation ^(2,25).

Rabalais et al compared 2 tension-band techniques, with stainless-steel wire and ultra-high-molecular-weight polyethylene cable, in transverse patella fractures in 8 cadaver knees. Fixation consisted of figure-of-8 and parallel wire configurations along with Kirschner wires and polyethylene cable.

The parallel wire configuration showed better results than the figure-of-8 construct in monotonic and cyclic loading models, and the ultra-high-molecular-weight polyethylene cable and the 18-gauge steel wire performed similarly. This study also agrees with our as it reach same conclusion although it took very small sample, no follow up (as it done dead people) and different types of fixation ⁽²⁶⁾. Carpenter et al, studied transverse fractures and fixed with screws alone, modified tension band with Kirschner wires and tension band wire placed through cannulated screws and found that specimens fixed with the tension band through cannulated screws failed at highest load while specimens fixed with the modified tension band with Kirschner wires underwent more load than other methods ^(17,23).

In our study, we have been able to compare these two methods, and the outcomes showed that there is difference between them in union time, number of hospital days postoperatively, pain and functional capacity. Thus, we can conclude that In transverse, noncomminuted patella fractures, fixation with modified tension band and longitudinal Kirschner wires was superior to the circumferential cerclage wire.



A

B

Figure (A) Ap & lat views of patellar fracture fixed by MTB&LKW.
 Figure (B) lat & AP views of patellar fracture fixed by CCW.

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