



Comparative Study of Modified Tension Band Wiring Versus Tension Band Through Parallel Cannulated Cancellous Screws in Patella Fractures



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Abstract

Background: Displaced patella fracture with loss of extensor mechanism of the knee is an indication for open reduction and internal fixation. Standard treatment of transverse patella fracture is modified tension band wire (MTBW). Irritation of the soft tissues by the hardware, loosening of the wires and the construct as a whole has been reported. Tension band wiring through cannulated cancellous screws (TBWCCS) is more stable and less irritable to the soft tissues and is relatively newer technique. This study compares the results of MTBW with TBWCCS.

Materials and methods: We performed a comparative study of the two procedures. Total of 40 patients, 20 in each group were enrolled in the study. All the patients were followed at regular intervals. Time taken for radiographic union was recorded. Variables of Modified Hospital for Special Surgery Knee Score (MHSSKS) were recorded and graded till the last follow-up at 24 weeks. Complications of each procedure were recorded. The data was analyzed using SPSS version 16.

Results: All fractures united at 12.20 ± 3.03 weeks in MTBW group and 11.20 ± 2.78 weeks in TBWCCS group. Complication rate was significantly higher in MTBW group. In TBWCCS group, 90% patients had good to excellent MHSSKS score while in MTBW group, 75% had good to excellent results at 24 weeks. Pain during walking was significantly better in TBWCCS group.

Conclusion: Based on our study, tension band wiring through cannulated cancellous screws (TBWCCS) is significantly effective than modified tension band wiring (MTBW) in the treatment of patellar fractures.

Keywords: Patella fracture; Tension band wiring; K wire; Cannulated cancellous screws

Introduction

Patella is the largest sesamoid bone in humans [1]. It lies within the extensor mechanism of the knee. Patella effectively augments the quadriceps function acting as a lever arm for knee extension [2]. Patella fractures are common skeletal injury which accounts for about 1% of all fractures [3]. It commonly occurs in young active age group especially 20-50 years of age [4]. Due to its subcutaneous location it is prone to injuries from direct blows and falls. The common type of patella fracture is transverse. The loss of extensor mechanism of the knee associated with patella fractures is an indication for surgery. Other indications are articular incongruity >2mm, fracture gap >3mm, osteochondral fractures and fractures with associated loose fragment in the joint [5]. The surgical treatment of patella fracture ranges from circlage wiring [6], tension band wiring [6], cancellous screws [5], cannulated

cancellous screws with anterior tension band [7], percutaneous cancellous screws [8], fiber wire fixation [9] and cable pin fixation [10]. The recommended treatment of displaced transverse patella fracture is modified tension band wiring (MTBW) using two parallel kirschner wires through patella and anterior tension band loop with stainless steel wire. This treatment as recommended and propagated by AO foundation [6] is a very effective treatment but has been reported with complications of hardware irritation (k-wire especially), implant loosening, breakage and migration thereby causing loss of reduction and failure of fixation [10]. These complications will lead to re-surgery and sometimes early removal of hardwares. By bending the k wires at both the ends, some surgeons tried to reduce the loosening and decrease skin irritation [11]. The use of cannulated cancellous screws along with the anterior tension band has gradually evolved because of

these problems [7,12]. In some biomechanical studies, the authors have shown that the tension band with screws are superior to the modified tension band technique [13,14]. The screws provide compression at the fracture site throughout the range of motion and resist tensile loading during terminal extension [15]. One of the study states that use of cannulated screws are less irritable to the soft tissues, provides a stable fixation with compression at the fracture site even in osteopenic bones and tension band principle can also be applied by passing the tension band wire through the cannulated cancellous screws [12]. The frequent complication of painful hardware in patients treated with modified tension band with k-wires and a quest for a better method for rigid fixation and less soft tissue irritation leading to a favourable outcome in fractures of the patella led us to carry out this study.

The aim of our study was to compare the results of a standard treatment method, modified tension band wiring with a relatively newer method, tension band through cannulated cancellous screws in our setup. The specific objectives were to compare modified tension band wire (MTBW) technique with tension band wiring through cannulated cancellous screws (TBWCCS) in patella fractures in terms of time taken for union, function (Modified Hospital for Special Surgery Knee Score[15]-pain, function and range of motion) and complication rate.

Materials and Methods

The study was carried out in department of Orthopaedics and Trauma at Nepal Medical College Teaching Hospital in Kathmandu, Nepal. The study design was a comparative study. The study period was from July 2016 to January 2018. Total of 40 patients, 20 in each group were enrolled in the study. All the patients who met the inclusion criteria were enrolled in the study. Adults of age more than 18 of any sexes with a recent (<2 weeks) isolated transverse patella fracture or minimally comminuted fracture that could be treated with either technique in the study was included in the study. Fractures displaced more than 3mm, ≥ 2 mm of articular incongruity and loss of extensor mechanism were included in the study. Patients with associated fractures around the knee or associated other injuries of the same or contra lateral leg and patients with pre-existing condition of the knee e.g. rheumatoid arthritis, advanced osteoarthritis, infective arthritis were excluded from the study. Patients unfit for surgery based on pre-operative evaluation and checkup were also excluded from the study. Demographic data and history were taken relevant to the mode of injury and time since injury. All the patients were examined, and diagnosis was confirmed with radiographic examination. Baseline investigations were done and fitness for anesthesia and surgery was obtained preoperatively. Informed written consent was obtained from all patients preoperatively for surgery including for research inclusion also. Cases with odd serial numbers were treated with TBWCCS and cases with even serial numbers were treated with MTBW. All the patients were operated on next regular list. Standard antero-posterior and lateral radiographs was performed postoperatively. The knee range of motion exercises was started after few days

post operatively as pain allowed. The patients could ambulate while bearing weight as tolerated on the initial post-operative period within few days after surgery. The patients were discharged after they were ambulatory. Isometric quadriceps exercises were encouraged as early as possible. Sutures were removed at 2 weeks postoperatively. Post-operative protocol was similar in both groups.

The patients were followed in out-patients department at 4, 8, 12, 16, 20 and 24 weeks. Time taken for radiographic union was recorded. Variables of Modified Hospital for Special Surgery Knee Score (MHSSKS) [15] were recorded on every follow up. Knee score was calculated and graded. Failure of fixation was reported as a discredit to the procedure. The data was entered into the proforma and analyzed using SPSS version 16. The t test was used to compare average of the groups for time and various scores. To compare complications and qualitative variables chi-square test was used.

Results

The total number of patients in this study was forty with age ranging from 18 to 65 years. Out of these patients, 35 patients were male, and 5 patients were female, with male to female ratio of 9:1 in MTBW group 5.66:1 in TBWCCS group. The minimum age of patient was 18 years and maximum were 65 years in both the groups with a mean age of 38.97 years. The mean age of MTBW group was 41.15 years and in TBWCCS group was 36.8 years. Majority of the patients (80%) sustained patella fracture after a road traffic accident. The motor cycle accidents were the commonest mode of injury in both groups. Few patients had car accidents which were also included in the road traffic accident category and 4 (10%) patients had history of slip and fall and some had fall from stairs. Left side was the commonly involved side on both groups. Total 11 and 12 patients had patella fracture of the left side in MTBW group and TBWCCS group respectively. Patients were evaluated with radiographs for fracture healing during follow-up visits. The average healing time in MTBW group was 12.20 ± 3.03 weeks and in TBWCCS group was 11.37 ± 2.78 weeks with p value of 0.28 i.e the union time between two groups was similar and there was no difference statistically (Table 1). The MHSSKS of patients were calculated during follow-up visits and the final score at 24 weeks was calculated for all patients. Score was graded as excellent, good, fair and poor if the score was 90-85, 84-74, 73-65 and <65 respectively. In MTBW group, 15 patients had good to excellent grades and in TBWCCS group, 18 patients had good to excellent results. Five patients had fair to poor results in MTBW group and in TBWCCS group only two patients had fair results and no poor results. Scores were significantly better in TBWCCS group as indicated by p value <0.05 (Table 1). In Modified Hospital for Special Surgery Knee Score (MHSSKS) pain is divided as pain at rest and pain during walking. Both have been graded as none, mild, moderate and severe and 0, 5, 10 and 15 points has been given respectively. Range of motion at the knee has been given 1 point for every 8 degrees of movement in the scoring system. Pain during walking was present in 15 cases in MTBW group and 5 patients in TBWCCS group and p value was significant (<0.05) (Table 1). Pain at rest was present in 6 patients in MTBW group and in 2 patients in

TBWCCS group and but the p value was not significant (0.2). Range of motion at knee was full in 12(60%) patients in both groups. Out of the remaining 8(40%) patients; in MTBW group, 5 patients had ROM >120° and 3 had <120° and in TBWCCS group and all 8 patients had ROM >120° (Table 1). There were no complications in our patients regarding anesthesia. Only three patients developed

superficial wound infection, two from MTBW group and 1 from the TBWCCS group. Four patients from MTBW group developed painful hardware and one developed loosening and breakage of hardware even though union was achieved in these patients and hardware were removed after union was achieved. There was no case of nonunion in this study (Table 1).

Table 1.

Variable	MTBW	TBWCCS	Combined	p value
Sex -Male -Female	18 02	17 03	35 05	
Side of involvement -Right -Left	09 11	08 12	17 23	
Mode of injury -RTA - Fall injury - Others	14 03 03	18 01 01	32 04 04	
Union -08 weeks -12 weeks -16 weeks	05 09 06	07 10 03	12 19 09	0.28
MHSSKS (Knee score) Excellent Good Fair Poor	05 10 02 03	08 10 02 00	13 20 04 03	0.29
Pain during walking Severe Moderate Mild None	01 03 11 05	00 01 04 15	01 04 15 20	0.01
Pain at rest Severe Moderate Mild None	00 02 04 14	00 00 02 18	00 02 06 32	0.2
Range of Motion (ROM) 80 degrees 96 degrees 112 degrees 120 degrees 128 degrees 136 degrees 144 degrees	01 01 01 00 03 02 12	00 00 00 02 02 04 12	01 01 01 02 05 06 24	0.43

Complications	02	01	
- Superficial infection	04	00	0.01
- Painful hardware	01	00	
- Loosening or hardware breakage			

Discussion

Modified anterior tension band wiring has been the recommended treatment for internal fixation of patella fractures wherever applicable. The primary advantage of tension band is that it converts distractive forces into compressive forces [6]. Irritation of the local soft tissues by the impingement of the k-wire ends is a frequent complication reported in this type of fixation [10]. Different surgeons have tried to modify this technique to reduce these complications [11,12]. Some authors have reported both clinically and biomechanically, that use of cannulated cancellous screws are less irritable to the soft tissues, provides a stable fixation with compression at the fracture site and tension band principle can also be applied by passing the tension band wire through the cannulated cancellous screws [7,12,13].

In this study the maximum number of patients in both the groups were males, 18 (90%) in MTBW group and 17 (82.35%) in TBWCCS group. This can be explained by our cultural setup where males have a more active lifestyle and remain out-door more often to earn their living, while females stay mostly indoor. Road traffic accidents were the major cause of injury in both groups, 70% in MTBW group and 90% in TBWCCS group. Two wheelers like motorcycle and scooters are a very common mode of transportation in Nepal. Motorcycle riders are very prone to injuries and a major part of the skeletal injuries are due to motorcycle accidents in Nepal [16].

Three of the patients (2 in MTBW group and 1 in TBWCCS group) i.e 7.5% of patients developed postoperative infection. These were superficial wound infection and were treated successfully with antibiotics and wound care. In different studies, the rate of infection after surgical treatment in patella fractures is 3-10% [17-20]. The infection rate in this study is like those studies and the infection was dealt with prolonged antibiotic treatment and care of the wound.

The average time of fracture union was 12.20 ± 3.03 & 11.20 ± 2.78 weeks in MTBW and TBWCCS group respectively without significant statistical difference. In the study done by Berg [12], in which he has studied the outcome of TBW with cannulated cancellous screws (CCS) only, the time to fracture union was 13 weeks on average which is similar to the time of union in this study. In the study by Khan et al. [7] which studied only the outcome of TBW with cannulated cancellous screws, fracture union time is about 10.7 weeks in average. In the study by Tan et al. [21] which compared the MTBW and TBW with CCS, they had union time of about 10 weeks in average in both groups. The results of Modified Hospital for Special Surgery Knee score (MHSSKS) was good to excellent in 90% and 75% in TBWCCS group and MTBW group respectively. Fair to poor MHSSK Score was seen in 5 patients in MTBW group while 2 patients in TBWCCS group had fair results and no patient had poor results. Scores were better in TBWCCS group, but it is not statistically significant (Table 1). The pain during walking is better in TBWCCS group and statistically significant (Table 1). This can be attributed to the less soft tissue irritation by the screws in comparison to the k wires. As a result, patients in TBWCCS group had less pain and better function, and better quality of fixation allowing better range of motion at the knee. In other literature, the MHSSK Score is good to excellent in 73-90% of patients. The study of Berg [12] on tension band through cannulated screw fixation had 70% good to excellent modified HSS knee score. This result was not comparable to our study which had 90% good to excellent outcome in patients treated with the same technique. This might be due to the inclusion of patients with other pre-existing afflictions in the fractured limb in the study by Berg. He included patients affected by polio and other afflictions in his study. We excluded the patients with associated afflictions in the affected limb. The study by Tan et al. [21] had good to excellent Bostman scores in 90% in MTBW group and 100% in TBWCCS group. Khan et al. [7] had good to excellent Bostman scores in 100% in his study.

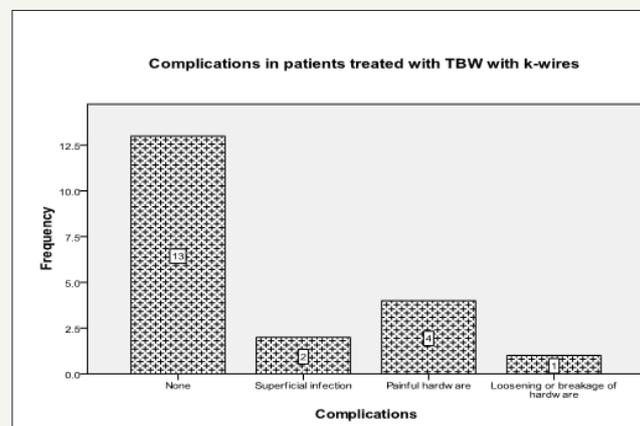


Figure 1: Complications in patients treated with TBW with k-wires.

In this study, 7 patients in MTBW group had complications including superficial infection, painful hardware and loosening and breakage of hardware while only one patient in TBWCS group had complication which was superficial infection. In this study, in MTBW group, five patients had hardware problems out of which 4 (20%) had painful hardware and 1 (5%) had loosening & breakage of hardware (Figure 1). The reported rate of painful hardware after patella fracture fixation is 15% [18,19] which was similar in our study in MTBW group. In TBWCCS group, only 1 patient had superficial infection and no other complications were seen. There is statistically significance between the rate of complications between the TBWCCS and MTBW group. TBWCCS group has lower rate of complications than the MTBW group. The rate of loosening of hardware and loss of reduction is 0-20% in the literature [18,22,23]. Only one patient (5%) in our study had loosening of hardware at 16 weeks and breakage of hardware at 24 weeks follow-up although the fracture united inspite of it.

During tension band wiring with cannulated cancellous screw fixation, we noticed that in initial few surgeries the screw size we measured during surgery was always longer appearing in the postoperative radiographs. Then we started using screws shorter than the actual measurement, but the screw threads always crossed the fracture site. Another important point is that the screw thread should cross the fracture site and the threads should lie only on the far fragment during insertion to achieve compression at the fracture site.

Limitation

The sample size was small so further studies with a larger sample size would be better to establish the conclusion.

Conclusion

Based on our study, tension band wiring through cannulated cancellous screws (TBWCCS) is significantly effective than modified tension band wiring (MTBW) in the treatment of patellar fractures.

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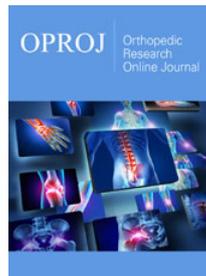
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