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Original Article

Novel method of Kirschner wire bending for treatment of displaced patella fractures

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Abstract: Displaced patella fractures require operative treatment. Tension band wiring is the most common technique for the fixation such fractures; however, the procedure is often complicated by wire migration. Herein, we described a novel method of Kirschner wire (K-wire) bending during tension band wiring that may help to prevent wire migration. In our five-step method, two K-wires inserted into the patella were bent and cut to form hooked ends, which could be pushed against the superior border of the patella to serve as an anchor to hold the tension band in place, thus preventing its migration. Using this technique, we had managed over 20 patients in our department over a period of 3 years, without any complications.

Keywords: Kirschner wire bending, patella fracture, tension band wiring

Introduction

Patella fractures account for only about 1% of all fractures [1]. These fractures present a therapeutic challenge for orthopedic surgeons. Displaced patella fractures with an articular incongruency of 2 mm or more require operative treatment. Currently, the treatment for these types of fractures consists of open reduction and internal fixation to restore extensor continuity and articular congruity [2]. Tension band wiring is a widely accepted fixation method for the treatment of displaced patella fractures because of its biomechanical and economic advantages. However, the technique is often complicated by wire migration [3]. To avoid this complication, surgeons have employed many alternative methods, but an optimal solution for this problem is still lacking. To resolve this problem, we devised a novel method of bending Kirschner wires (K-wires) during tension band wiring such that wire migration is prevented. The aim of the present study was to determine the safety and efficacy of our technique in a cohort of patients with displaced patella fractures who were treated over a 3-year period.

Surgical technique

Our method of K-wire bending for the fixation of patella fractures required only standard instruments, namely, wire clippers, suction tip, pliers, and an impactor (**Figure 1**). The procedure consists of five key steps: The first step was to ensure anatomical reduction of the fracture and to fix it with two K-wires, which were placed parallel to each other. Then, an anterior tension band consisting of a stainless steel wire was placed in a vertically oriented, figure-of-eight pattern around the two K-wires on the anterior aspect of the patella (**Figure 2A**). Secondly, the K-wires were held firmly with the pliers at a site 2-3 cm away from the superior border of the patellar bone, and the protruding ends of the K-wires were bent backwards with a suction tip, until the K-wires formed a 130° angle with the horizontal plane (**Figure 2B**, **2C**). Thirdly, the K-wires were bent further with pliers until they formed a 170° angle with the horizontal plane (**Figure 3A**, **3B**). The bent K-wires were cut with wire clippers at a site less than 5 mm from the bend created, leaving two hooked ends (**Figure 3C**). Fourthly, the hooked ends were pushed towards the bone with an impac-

Figure 1. Tools required: wire clippers, suction tip, and pliers.

tor, thus fixing the stainless steel wire in place to prevent its migration (**Figure 3D**). Fifthly, the K-wires protruding from the inferior border of the patella were cut with wire clippers, leaving a 5-mm-long wire segment protruding from the bone (**Figure 4**).

Illustrative case

A 56-year-old woman fell down from a standing height and injured her left knee. X-ray examination showed a left comminuted patellar fracture (**Figure 5A**, **5B**), which was repaired with our wiring technique. Postoperative X-ray examination showed acceptable fracture reduction and fixation (**Figure 5C**, **5D**). From the third postoperative day, the patient began to do functional exercises. The fracture healed very well, and the implant was removed 1 year after the surgery (**Figure 5E**, **5F**). The patient regained knee function.

This study was approved by the ethics committee of the local Hospital. And the patient consent had been gotten.

Discussion

The patella is very important to the knee extensor mechanism, and can be fractured in traumatic injuries [2]. Displaced patella fractures with an articular incongruency of 2 mm or more are thought to confer an unacceptable risk of post-traumatic osteoarthritis, and are thus an indication for surgery [4]. The most common surgical technique used for the treatment of

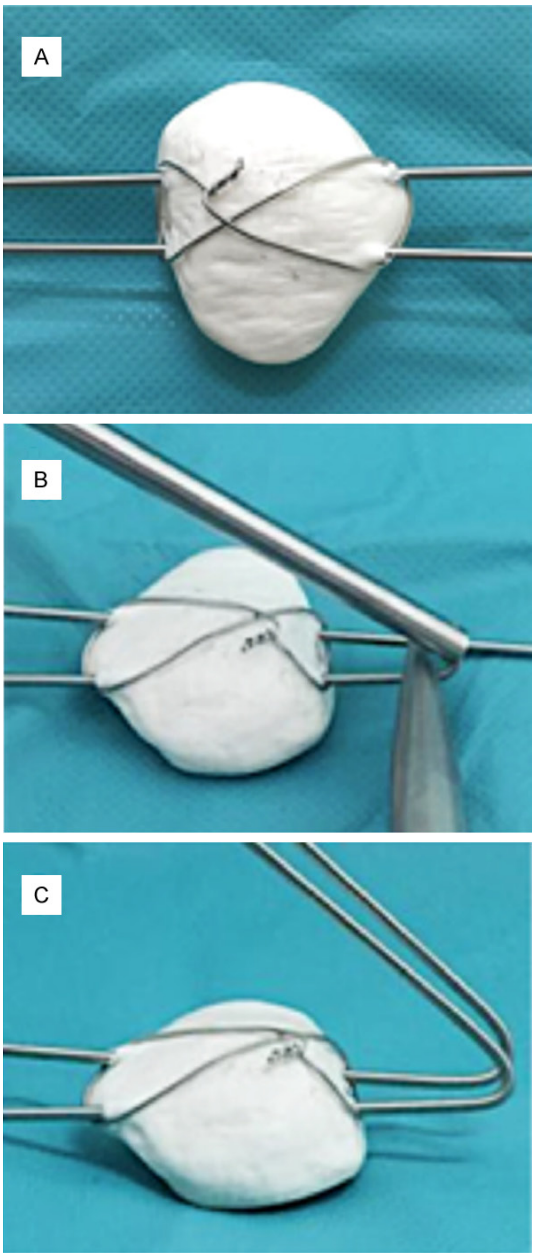

Figure 2. A. Anatomical reduction and fixation of the fracture is performed by placing two Kirschner wires parallel to each other. An anterior tension band consisting of a stainless steel wire is placed in a vertically oriented, figure-of-eight pattern. B, C. Each Kirschner wire is firmly held with pliers at a point 2-3 cm away from the superior border of the patella and bent with a suction tip until it forms a 130° angle with the horizontal plane.

displaced patella fractures is tension band wiring around K-wires. Since the technique was first reported in the early 1950s, it has been popularized by the AO group and is thought to be a dynamic and functional technique for

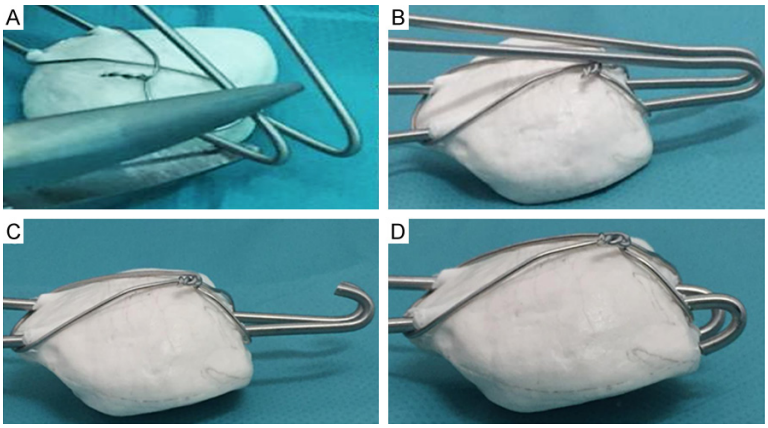

Figure 3. A, B. The bent end of each Kirschner wire is held with pliers and further bent to produce an angle of 170° with the horizontal plane. C. The Kirschner wires are cut with wire clippers at a point less than 5 mm from the bend in the wires, leaving hooked ends. D. The hooked ends of the Kirschner wires are pushed toward the superior border of the patella with an impactor to fix the stainless steel wire in place and prevent its migration.

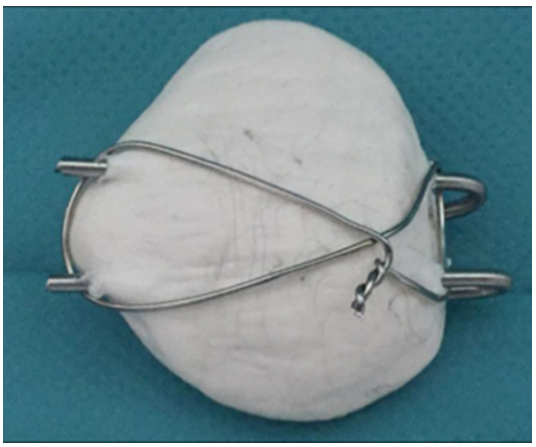

Figure 4. The straight ends of the Kirschner wires are cut with wire clippers at a site 5 mm from the bone.

patella fixation [5]. The most common complication of this treatment is wire migration. Numerous alternative methods have been attempted to prevent this complication. For example, cannulated screws have been used instead of K-wires [6]. In addition, tension band wiring has been used to provide resistance to the displacement of the screws during flexion, but over time, the steel wires can break [2]. Reza *et al.* have developed a method in which K-wires are bent twice to form a 180° angle [7]. Their method is more complicated than ours, and bending the K-wire twice may lead to deformation of the K-wire, which can make it difficult to push the wire up to the superior border of the patella.

In our technique, we created a hooked end in the K-wire protruding from the superior border of the patella. The hook was then pushed into the bone to serve as an anchor and hold the stainless steel wire in place, thus preventing its migration. Our procedure is simple to perform. Furthermore, the tools required for our technique are available in every orthopedic surgical unit. During the past 3 years, we have successfully used this method on over 20 patients, with no adverse events.

In conclusion, our novel method of K-wire bending during tension band wiring for the reduction and fixation of displaced patella fractures was associated with no instances of wire migration and yielded good clinical outcomes. Our technique for the treatment of displaced patella fractures is worthy of clinical application and should be investigated in further large-scale studies with longer follow-up durations.

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Disclosure of conflict of interest

None.

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References

[1] Campbell WC, Canale ST. Campbell's operative orthopaedics. 2008; 1.

[2] Bryant TL, Anderson CL, Stevens CG, Conrad BP, Vincent HK, Sadasivan KK. Vincent, Kalia K. Sadasivan. Comparison of cannulated screws with FiberWire or stainless steel wire for patella fracture fixation: a pilot study. J Orthop 2015; 12: 92-96.

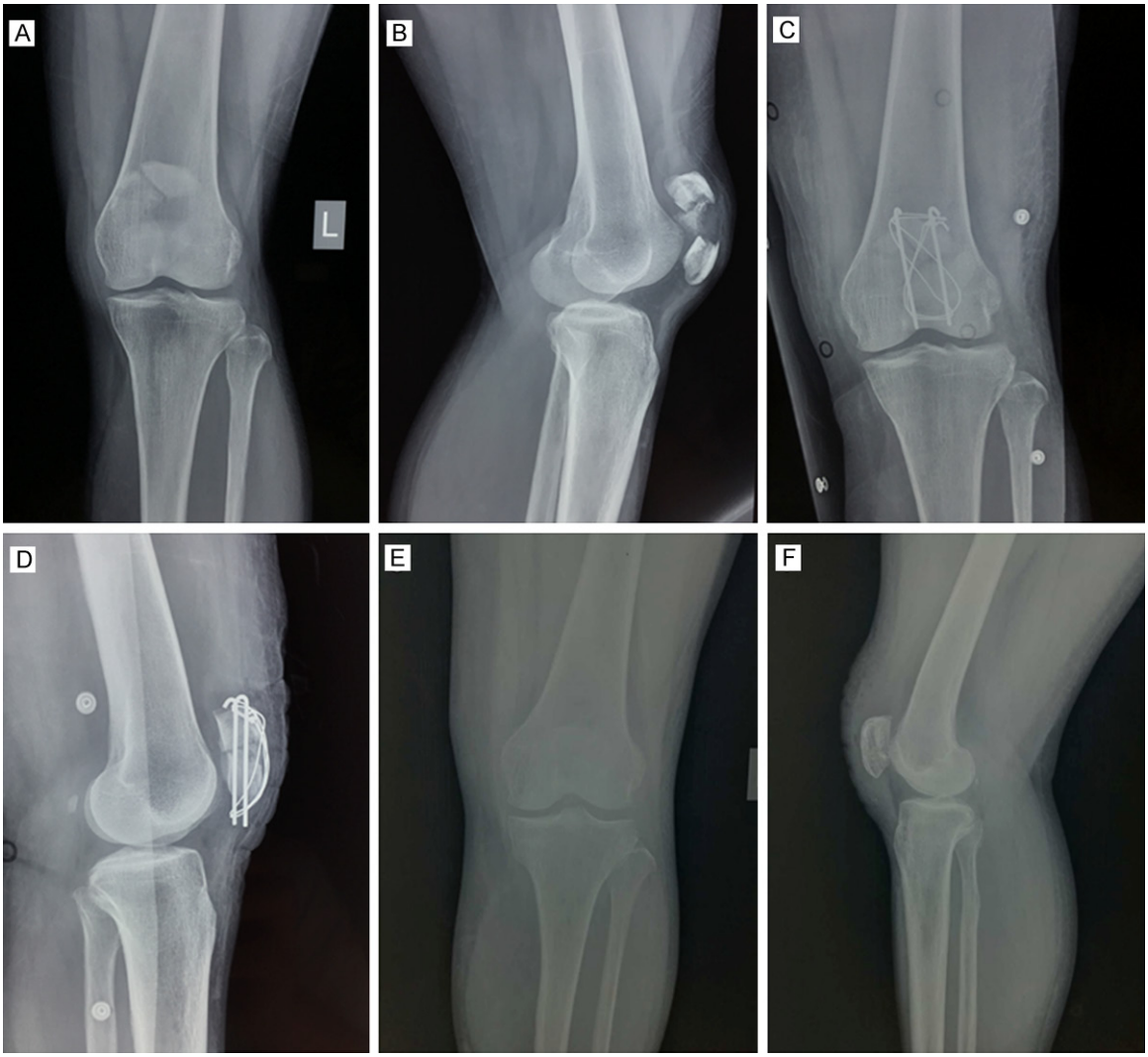

Figure 5. (A) Anteroposterior and (B) lateral radiographs showing a comminuted fracture of the left patella. (C) Anteroposterior and (D) lateral radiographs taken immediately after tension band wiring with our technique show acceptable fraction reduction and fixation. (E) Anteroposterior and (F) lateral radiographs taken after implant removal show good healing of the patella fracture.

[3] Petrie J, Sassoon A, Langford J. Complications of patellar fracture repair: treatment and results. J Knee Surg 2013; 26: 309-312.
[4] Dean G. Lorich, Stephen J. Warner, Matthew R. Garner. Plating of patella fractures: a novel technique using multiplanar fixation. Oper Tech Orthop 2015; 25: 230-234.
[5] John J, Wagner WW, Kuiper JH. Tension-band wiring of transverse fractures of patella. The effect of site of wire twists and orientation of stainless steel wire loop: a biomechanical investigation. Int Orthop 2007; 31: 703-707.
[6] Wang CX, Tan L, Qi BC, Hou XF, Huang YL, Zhang HP, Yu TC. A retrospective comparison of the modified tension band technique and the parallel titanium cannulated lag screw technique in transverse patella fracture. Chin J Traumatol 2014; 17: 208-213.
[7] Firoozabadi R, Kramer PA, Benirschke SK. Benirschke. Kirschner wire bending. J Orthop Trauma 2013; 27: e260-e263.