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ORIGINAL ARTICLE

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Self-locking tension band technique

A new perspective in tension band wiring

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Abstract After experiencing some complications with the AO modified tension band technique, we have made a small modification to prevent proximal migration of the Kirschner wires. In this modification, the proximal ends of the wires are bent to form a loop and the cerclage wire passed through them. In this way, Kirschner wires and cerclage wire lock each other, preventing migration. We have treated 51 patients with this technique, including 22 transverse patellar, 11 olecranon, 3 medial and 5 lateral malleolar fractures, 3 acromioclavicular separations, 4 olecranon chevron osteotomy fixations and 3 trochanter major fixations. Fracture union occurred in 8 weeks (mean). We did not see any postoperative complications or implant failures. Rigid fixation allows early mobilization which quickly restores functional status.

Introduction

The AO modified tension band technique is accepted worldwide in the surgical treatment of many fractures including transverse patellar fractures, olecranon fractures and some of the malleolar fractures [2, 4–6, 8, 9, 12–14, 19]. This technique was introduced to the orthopaedic community by Dr. Weber [6, 15–18]. The method essentially involves placing a wire loop dorsal to the midaxis of the eccentrically loaded fractured bone, such as the patella or olecranon, thereby converting the distractive and shear forces tending to separate the fragments into compressive forces across the fracture site. This tension band will exert a force equal in magnitude but opposite in direction to the bending force. The two Kirschner wires are used to act as an internal splint neutralizing rotational and angular displacement forces [15–17]. The compressive forces promote early fracture healing. This stable fixation also allows early mobilization and rehabilitation.

However, in our clinic we observed that in patients treated with this technique, proximal migration of the Kirschner wires and loss of reduction are not unusual [14]. We decided to examine whether a modification in the K-wires could prevent this complication.

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Patients and methods

In our modification, the proximal ends of the Kirschner wires are bent to form loops with the help of an AO wire twister. The cerclage wire (18–20 Fr. gauge) was then passed through them and tightened in a figure of eight fashion. With this modification, the cerclage wire locks the K-wires and prevents proximal migration. We are now using preformed K-wires manufactured in different lengths, diameters and ring configurations. We prefer horizontal ringed wires for the patella and vertical ringed wires for the olecranon and malleoli because of soft-tissue protection.

The self-locking tension band (SLTB) technique was used in the treatment of 51 patients between September 1992 and March 1997. There were 22 transverse patellar fractures (Fig. 1), 11 olecranon fractures (Fig. 2), 3 medial and 5 lateral malleolar fractures (Fig. 3) and 3 acromioclavicular separations in our trauma group. This technique was also used in the fixation of the trochanter majoris femoris (Fig. 4) in 3 patients and of olecranon chevron osteotomy in 4 patients.

The mean age of the study group was 28.4 years (range 16–53 years). There were 32 men and 19 women. There was no significant difference in age and sex distribution between the different fracture groups. The leading causes of fractures in all groups were motor vehicle accidents followed by falls. All the trauma patients had fresh fractures and were operated on within an average of 3 days (range 1–6 days). They were closed fractures except for one open comminuted patellar fracture. No patient had associated injuries except for the patient with an open patellar fracture who was struck by a car and had an associated head and chest injury. Fixation of trochanter major was achieved with this method in 2 patients during total hip arthroplasty and in another patient with acetabular fracture. Olecranon chevron osteotomies in 4 patients who underwent operation for distal intra-articular humerus fractures were also stabilized with this SLTB method.

Postoperative early mobilization was encouraged among the patients. Compressive bandages were applied postoperatively but

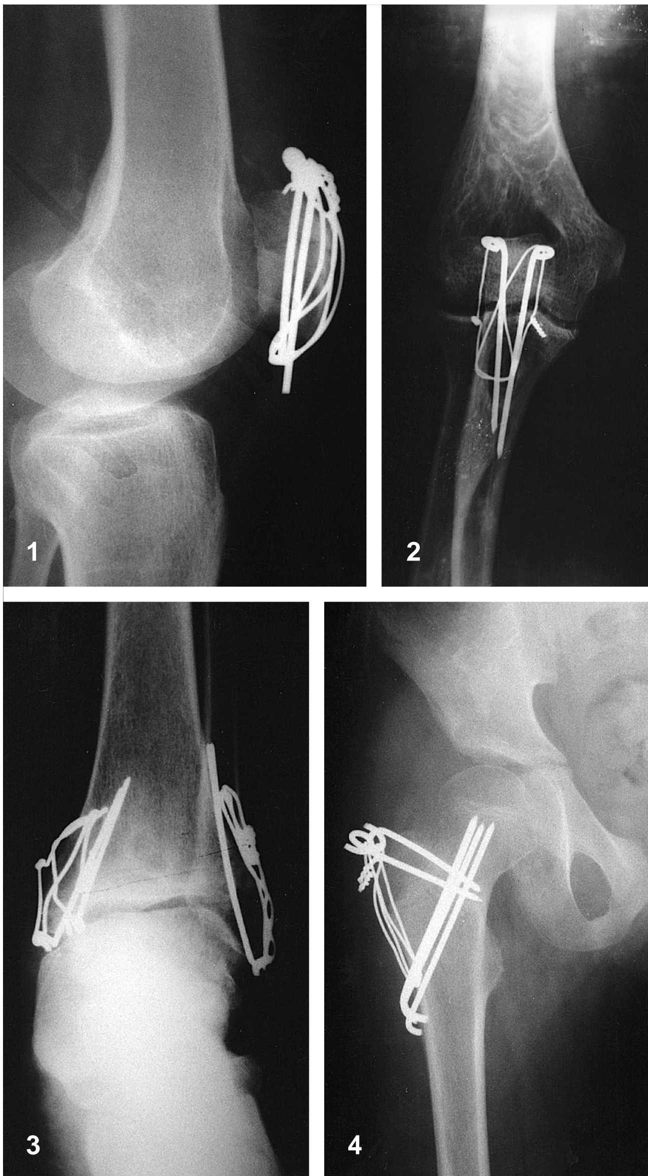

Fig. 1 Postoperative 9th week lateral radiograph of a transverse patellar fracture. Complete fracture healing was seen

Fig. 2 Anteroposterior view of an olecranon fracture treated with self-locking tension band (SLTB) technique

Fig. 3 Bimalleolar fracture fixed with vertical ringed prebend self-locking wires

Fig. 4 Postoperative 3-month radiograph of an 11-year-old boy with ipsilateral collum femoris fracture and Salter-Harris type I fracture of the greater trochanter that was fixed with SLTB technique

no external supports or braces. In the immediate postoperative period passive exercises and from the 3rd day active range of motion (ROM) exercises were done. After 3rd week, protected partial weight-bearing was allowed for patellar and malleolar fractures. With this rehabilitation protocol, all the patients rapidly gained their previous functional physical status.

Results

Our mean follow-up was 33 months (range 7–42 months). We asked the patients to return for follow-ups at 6 weeks, 3, 6 and 12 months postoperatively and then annually. During the follow-ups, physical and radiographic examinations were done. No patient had any sign of fixation failure or K-wire migration. All the fractures united without any problem. Average fracture union occurred in 8 weeks (patellar fractures: 6–8 weeks, olecranon fractures: 8–9 weeks, malleolar fractures: 10 weeks). We did not see any wound infection, joint stiffness or systemic complications in our series. In a patient with a patellar fracture, refracture had occurred after fracture healing as a result of a severe fall. He was treated with the same technique. After fracture healing the implants were removed in 29 patients.

Discussion

Tension-band wiring is a very effective and easy method for the treatment of some fractures. In the classic AO technique, after fracture reduction and fixation by two parallel K-wires, the proximal ends of the wires are bent 180 deg, cut sharply and hammered into the bone [4]. Many comparative biomechanical studies for the treatment of different fractures have shown us that this method provides dependable primary stability [1, 3, 11]. Sometimes, however, given the enormous forces acting on the implants during motion, K-wires become loosened and migrate proximally. This can lead to loss of reduction. In the literature, we have met surprisingly many reports about this complication [1–3, 5, 7, 8, 10, 12, 14]. Some authors did not agree with the frequency of this complication and reported that with proper surgical technique, wire migration was not a problem [18]. On the other hand, some modifications were tried to prevent this complication, such as Larsen's "non-sliding pins" [7].

In our modification, while preserving the spirit of the AO tension band technique, safe early mobilization is possible without wire migration. This results in early fracture healing and less joint stiffness. We did not see any wire migrations in the study group. We think complications related to wire migration like loss of fixation or skin breakdown can be eliminated, and early aggressive rehabilitation is possible with this technique.

References

1. Curtis MJ (1990) Internal fixation for fractures of the patella. A comparison of two methods. J Bone Joint Surg [Br] 72:280–282
2. Doursounian L, Prevot O, Touzard RC (1994) Osteosynthesis by tension band wiring of displaced fractures of the olecranon. Ann Chir 48:169–177
3. Fan GF, Wu CC, Shin CH (1993) Olecranon fractures treated with tension band wiring techniques – comparisons among three different configurations. Chang Gung Med J 16:231–238

4. Heim U (1991) Forearm and hand/mini implants. In: Müller ME, Allgöwer M, Schneider R, Willenegger H (eds) Manual of internal fixation, 3rd edn. Springer, Berlin Heidelberg New York, pp 460–463
5. Hung LK, Chan KM, Chow YN, Leung PC (1985) Fractured patella: operative treatment using tension band principle. Injury 16 : 343–347
6. Kouwenhoven GC, Weber BG (1969) Zuggurtungs-Osteosynthesen bei Olekranonfrakturen. Arch Orthop Unfall Chir 65 : 244–250
7. Larsen E, Jensen EM (1991) Tension band wiring of olecranon fractures with non-sliding pins. Acta Orthop Scand 62 : 360–362
8. Levack B, Flannagan JP, Hobbs S (1985) Results of surgical treatment of patellar fractures. J Bone Joint Surg [Br] 67 : 416–419
9. Lotke PA, Ecker ML (1981) Transverse fractures of the patella. Clin Orthop 158 : 180–184
10. Macko D, Szabo RM (1985) Complications of tension band wiring of olecranon fractures. J Bone Joint Surg [Am] 67 : 1936–1941
11. Murphy DF, Green WB, Gilbert JA, Dameron TB (1987) Displaced olecranon fractures in adults. Biomechanical analysis of fixation methods. Clin Orthop 224 : 210–214
12. Murphy DF, Green WB, Gilbert JA, Dameron TB (1987) Displaced olecranon fractures in adults, clinical evaluations. Clin Orthop 224 : 215–223
13. Rink PC, Scott F (1991) The operative repair of displaced patellar fractures. Orthop Rev 20 : 157–165
14. Us AK, Kinik H (1996) Self locking tension band technique in transverse patellar fractures. Int Orthop (SICOT) 20 : 357–358
15. Weber BG (1964) Grundlagen und Möglichkeiten der Zuggurtungsosteosynthese. Der Chirurg 35 : 81-86
16. Weber BG (1973) Olekranonfrakturen. Z Unfallmed Berufskr 2 : 66–70
17. Weber BG (1975) Zuggurtungosteosynthesen mit Draht. Chirurg 46 : 102–105
18. Weber BG, Vasey H (1963) Osteosynthese bei Olekranonfraktur. Z Unfallmed Berufskr 2 : 90–96
19. Wolfgang G, Burke WB, Bush D, Parenti J (1987) Surgical treatment of displaced olecranon fractures by tension band wiring technique. Clin Orthop 224 : 192–204