Minimally invasive tension band wiring for displaced transverse patellar fractures

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Background
Patellar fractures account for ~1% of all fractures. Most are transverse fractures involving the middle third of the patella in patients aged 20–50 years, and affect almost twice as many men as women.
Patients and methods
Percutaneous tension band wiring of 18 fresh transverse fractures of the patella with displacement of more than 3 mm in 18 patients was performed as a prospective study. The mean age was 40 years (range: 27–60 years).
Results
The average follow-up period was 30 months (range: 24–36 months). Radiological evidence of union was apparent in all cases at 8 weeks after surgery, with no hardware migration in 17 cases. Skin problems including superficial abrasions and contusions were encountered in 10 patients, which healed with local care, within the immobilization period. One osteoporotic female patient aged 60 years had proximal migration of one Kirschner wire, which necessitated replacement of the Kirschner wire with a thicker one 3 weeks postoperatively. Two cases had mild postoperative articular step-off but without patellofemoral arthritic changes on radiographs. Two patients encountered hardware irritation of the skin over the knee necessitating implant removal after the fractures were healed.
Discussion and conclusion
Percutaneous tension band wiring technique has many advantages, including minimal dissection of the soft tissues, good cosmesis, early rehabilitation, and shorter hospital stay.

Keywords:
displaced patellar fractures, minimally invasive technique, tension band

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Introduction

Patellar fractures account for ~1% of all fractures [1,2]. Most are transverse fractures involving the middle third of the patella in patients aged 20–50 years [3], and affect almost twice as many men as women [4].

In fractures of the patella, precise reduction of the articular surface and stable fixation of the fragments restore the extensor mechanism of the knee, allowing early mobilization [5].

Tension band wiring is considered the treatment of choice, but it is performed through a large incision, with a higher risk for postoperative complications and prolonged rehabilitation [6].

Displaced transverse patellar fractures are easier for anatomic reduction using closed manipulation and potential candidates for percutaneous osteosynthesis. Less invasive technique with percutaneous fixation may reduce postoperative wound complications and the possibility of delayed operation due to lacerations or abrasions over the skin of the patella [7].

The purpose of this study was to present our experience in using minimally invasive tension band wiring for displaced transverse patellar factures.

Patients and methods

Between the years of 2008 and 2009, 18 patients (13 male and 5 female) were treated. All patients provided informed consent for inclusion in the study. The study was authorized by the local ethical committee and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki. The average age was 40 years (range: 27–60 years). All patients who had closed transverse fractures of the patella with a displacement of more than 3 mm underwent percutaneous tension band wiring. All cases of comminuted fractures of the patella were excluded from our study. Twelve patients had slipped while

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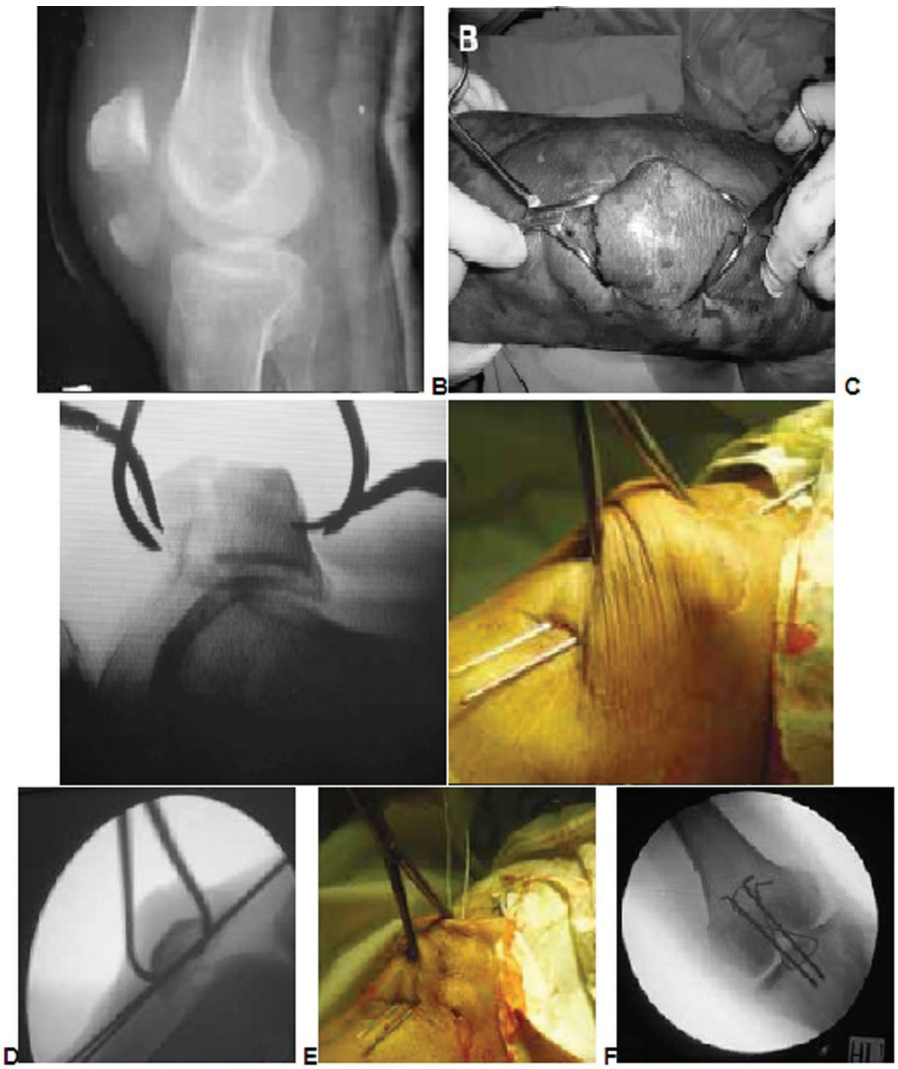
walking, three were involved in road traffic accidents, and three fell from a height. Abrasions and hemarthrosis were not contraindications. Most operations were performed on the day of injury, but three were operated on the following day.

Surgical technique

The patient was prepared in supine position and a tourniquet was applied after aspiration of intra-articular hematoma (Fig. 1a). Two stab incisions were made about 2 cm at the middle of the superior border and the inferior pole of the patella. Thereafter, reduction of fracture was attempted first at full extension. One pointed reduction forceps was applied at the far end of the two fragments percutaneously and the reduction was checked with fluoroscopy. If the joint congruity was not achieved, further manipulation was performed. Each fragment was manipulated with an individual pointed reduction forceps until satisfactory congruity was achieved. The reduction was maintained with another pointed reduction forceps across the fragments (Fig. 1b). Provided the articular congruence was considered satisfactory, the knee was placed in 40 flexion and two parallel 1.5 mm Kirschner wires were inserted from the proximal end of the patella through the superior stab incision to the distal fragment under image intensifier guidance to appear through the distal stab incision. These two Kirschner wires were separated by 1.5–2 cm (Figs. 1c and d). The wire was then placed using a wire passer with the knee in extension in a figure-of-8 manner by introducing an 18-G stainless steel wire through a lower incision from inferolateral to inferomedial under the Kirschner wires.

Figure 1



(a) A displaced transverse fracture of the patella. (b) Fragments manipulated with two towel clamps percutaneously under the control of an image intensifier. (c) Passing of two parallel Kirschner wires percutaneously. (d) Checking of reduction and wire position using an image intensifier. (e) Percutaneous passing of a stainless steel wire in a figure-of-8 manner using a wire passer. (f) Confirmation of reduction and positions of Kirschner wires and stainless steel wire using an image intensifier.

The wire was then reintroduced from inferomedial diagonally toward the superolateral corner of the superior incision of the patella subcutaneously. The other end of the wire was introduced from inferolateral toward the superomedial corner of the superior incision under the skin and over the patella. This wire was reintroduced toward the superolateral under the Kirschner wires so as to meet the other end of the wires, and a knot was applied (Fig. 1e). The Kirschner wires were bent proximally and interiorized by means of distal traction until the hooks touched the bone surface. The Kirschner wires were then cut at their distal ends, with the knee in maximum flexion (Fig. 1f). The retinaculum was not repaired. The two incisions were then closed. A Jones dressing was applied, and the tourniquet was deflated.

Passive range of motion was started postoperatively according to the maximum pain the patient could tolerate. Protected weight-bearing with two crutches was allowed on the first day following the surgery. Two days after the operation, patients were discharged. Active range of motion was instructed since 3 weeks postoperatively. Full weight-bearing without walking assistance was started after the fracture was healed radiologically. This time varied from 7 to 8 weeks.

All patients were followed up clinically and radiologically every 2 weeks until healing of fractures, and then monthly until 6 months and every 6 months thereafter. In each follow-up, knee pain score was recorded [8]. Good fellow's grading [9] of range of motion was carried out, thigh circumference was measured, and check radiography was taken to assess fracture union and position of the hardware. The maximum score of knee pain score is 50.

Results

The mean operating time was 45 min (range: 30–60 min). The mean follow-up period was 30 months (range 24–36 months). No early postoperative complications were observed. Skin problems including superficial abrasions and contusions were encountered in ten patients, which healed with local care, within the immobilization period.

Radiographic examination showed solid union of all fractures at 8 weeks, with no hardware migration in 17 cases. One osteoporotic female patient aged 60 years had proximal migration of one Kirschner wire, which necessitated replacement of the Kirschner wire with a thicker one 3 weeks postoperatively. Two cases had mild postoperative articular steps but without patellofemoral arthritic changes on radiographs. Two patients encountered hardware irritation of the skin over the knee, necessitating implant removal after the fractures were healed.

At the latest follow-up, all patients regained full extension with no quadriceps wasting. The objective score according to the Good fellow grading was excellent in 15, good in two, and fair in one case. The subjective evaluation according to the knee pain score was 50 among 15 and more than 40 in three cases.

Discussion

Fractures of the patella require anatomic reduction and stable fixation to begin early mobilization. This is facilitated by early fixation and keeping the soft tissue damage to a minimum. According to Benli *et al.* [10], the most important factor adversely affecting the long-term results is the delay of the operation. Stabilization of patellar fractures can be delayed because of the status of the skin, which is vulnerable to injury, especially in direct trauma. Excessive abrasions and bruised or edematous skin may necessitate waiting until the skin heals, to reduce the risk for wound complications, especially to avoid the danger of contaminating the operative wound [11]. However, a delay in surgery retards convalescence and to some extent unfavorably affects the results [10].

Percutaneous fixation seems to overcome these problems because the operation was performed through only stab incisions that may be placed on intact skin. Another advantage of the percutaneous technique is keeping the soft tissue damage to a minimum, which also is an important factor for early rehabilitation [12].

Arthroscopic-assisted fixation has achieved excellent results in patients with minor displaced patellar fractures [5,13–15]. In a randomized controlled trial comparing percutaneous with open surgery in patients with major separation of patellar fragments, percutaneous surgery required shorter operating time and achieved less pain and better knee function [16].

In our study, we used percutaneous tension band wiring for the fixation of displaced transverse patellar fractures with excellent radiological and clinical results. Aspiration of the hemarthrosis was carried out routinely in all cases as it reduces the fracture gap, lessens pain, and allows early movement. The major problem of this technique is that the retinacular tears cannot be repaired simultaneously as in an open

technique. Ma *et al*. [17] suggested that a ruptured quadriceps expansion need not be repaired, because the wire that is used provides sufficient strength to fix the fracture. This also maintains any fibrous union of a ruptured quadriceps expansion at either pole of the patella. None of our patients had any extensor lag despite having no retinacular repair.Moreover, some limitations should be considered; our technique is indicated for displaced transverse patellar fractures but not recommended for more comminuted fractures with multiple displaced and stepped fragments. For these complicated fractures, precarious reduction using the closed method is expected and needs further research.

In this study, although we had 10 cases with superficial abrasions and contusions, out of 18 cases included in that study, no early postoperative complications were observed and the skin problems improved with local care during immobilization period in relation to other studies using the same technique [12] and there was no delay in the time of operative fixation.

Conclusion

Percutaneous tension band wiring is a viable option for transverse fractures of the patella, especially with skin problems. The advantages of the technique include minimal dissection of the soft tissues, good cosmesis, early rehabilitation, and shorter hospital stay.

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Conflicts of interest

There are no conflicts of interest.

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