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Hook plating in patella fractures

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ABSTRACT

Purpose: Tension band wiring is considered the standard treatment for patella fractures. However, it is limited for fractures with marginal involvement, comminution, and osteoporotic bone. Our experience indicates that these limitations can be overcome with the hook plate. We evaluated the radiographic and clinical outcomes in patients with patella fracture treated with hook plating.
Methods: We enrolled 30 patients who underwent hook plating for patella fracture at two institutions between 2013 and 2017. Fracture classification and surgical options were reviewed. Postoperative fracture gap and time to union as radiographic measurements, and complications, range of motion, and functional outcome with the Lysholm score as clinical outcomes, were evaluated retrospectively.
Results: Nine fractures were AO/OTA 34A1, three B1, one B2, two C1, nine C2, and six C3. All were closed fractures. There were 3 cases of revision, 4 with lateral or medial marginal fracture, 9 with isolated inferior pole fracture, and 14 with comminuted fracture. The average postoperative fracture gap was 0.4 (range, 0–2.0) mm, and bone union was achieved without additional intervention. The average time to union was 11.6 (range, 7–24) weeks. There were no complications, and no extension lag except in one case (10°). The average flexion was 138.5° (range, 110–145°). For functional outcomes, the average Lysholm score was 89.5 (range, 74–95), with 13 excellent, 14 good, 3 fair, and no poor cases.
Conclusion: This study suggests that hook plating can result in good bone union and restored knee function in marginal or comminuted fractures of the patella.

Introduction

The goals of treatment for displaced patella fractures are anatomical reduction of the articular surface and restoration of the extensor mechanism of the knee. Tension band wiring (TBW) has long been the standard method for such fractures [1,2]. However, Smith et al. [3] reported that 22% of patella fractures treated with TBW were significantly displaced in the perioperative period. Particularly, comminuted patella fractures in elderly patients are difficult to treat since their osteopenic bone often lacks the strength to support TBW and/or cerclage, resulting in fixation failure prior to bone union [4]. Furthermore, TBW is not suitable in cases with marginal fracture. Therefore, to overcome the limitation of TBW, we hypothesized that a hook plating construct could achieve secure and strong fixation for comminuted or marginal fractures. Thus, we have used hook plating for the treatment of patella fractures with marginal involvement, comminution, or osteoporotic bone. This study aimed to evaluate the radiographic and clinical outcomes of hook plating for patella fractures.

Materials and methods

This was a retrospective observational cohort study, and the present study was approved by the institutional review board. The medical records and radiographs of patients who presented with patella fracture from May 2013 to December 2017 in two institutions were reviewed. The inclusion criteria were as follows: patella fracture, surgical treatment with hook plating, and patient age ≥18 years. The exclusion criteria were patients with less than

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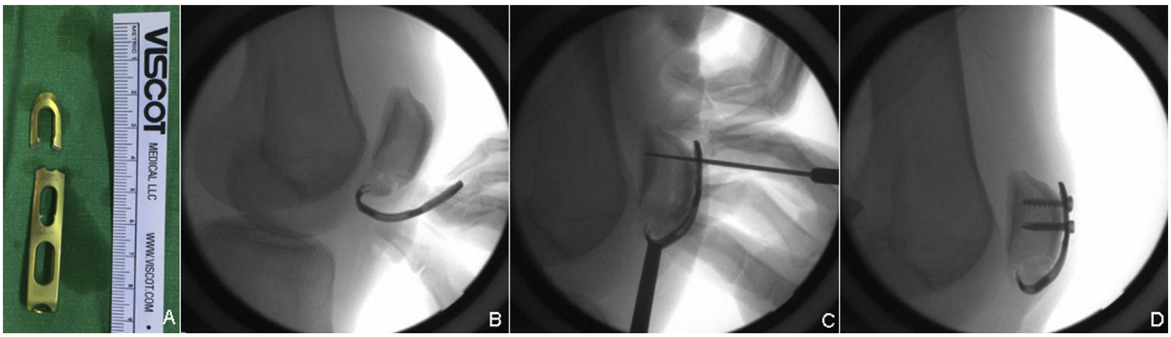

Fig. 1. A Cutting LCP hook plate. B. Hooking inferior pole. C. Provisionary fixation with compression of the inferior pole. D. Final fixation with additional unicortical locking screw.

12 months of follow-up and periprosthetic fracture. Out of the initial 313 patella fractures that were screened during the period, 30 patients (17 male and 13 female) were included in this study with an average age of 52.2 (range, 18–86) years. The average follow up was 14.0 (range, 12–30) months.

Our indications for hook plating for patellar fracture were revision after failed TBW, comminuted fracture, osteoporotic fracture in elderly, marginal fracture involving the medial or lateral border, and inferior pole. The plate used was LCP Hook Plate 3.5® (Synthes, Oberdorf, Switzerland) which was contoured to fit the patella (Fig. 1). When the LCP hook plate was longer than the patella, the plate was cut at the last hole, and the cutting margin was smoothened. The rehabilitation protocol included immediate tolerable weight bearing with the knee brace locked in extension and 90° flexion with passive knee exercise until 4 weeks, followed by 120° flexion over the next 4 weeks. From 8 weeks, tolerable weight bearing without any brace was permitted and full range of flexion was allowed.

Demographic data, including mechanism of injury, body mass index (BMI), comorbidities assessed with the Charlson comorbidity index (CCI), smoking, and diabetes, were reviewed. AO/OTA fracture classification, open fracture and its classification, inferior pole involvement, comminution, and impaction were reviewed with plain radiographs and knee computed tomography. The interval from injury to surgery, surgical option including combined TBW, or screw fixation was recorded. Radiographic measurements included fracture gap after surgery and time to union. All the radiographic observations in the current study were conducted by an orthopaedic surgeon who is one of the authors. Clinical outcomes were also evaluated, considering complications, including infection and nonunion, secondary procedures, and functional outcomes. Range of motion of the injured knee and functional outcome with the Lysholm score were evaluated at postoperative 12 months.

Results

Of the 30 patients, 12 sustained high-energy injury, while 18 had low-energy injury. Their mean BMI and CCI were 22.9 (range, 18.4–28.2) kg/m^2 and 2.5 (range, 0–6), respectively. Seven patients were smokers and three had diabetes. Nine fractures were classified as AO/OTA 34A1, three as B1, one as B2, two as C1, nine as C2, and six as C3. All were closed fractures. There were 3 cases (two C1, one C3) of revision after failed primary TBW (Fig. 2), 4 (three B1, one B2) with lateral or medial marginal fracture (Fig. 3), 9 (nine C1) with isolated inferior pole fracture that was treated with hook plating alone (Fig. 4), and 14 (nine C2, five C3) with comminuted fracture that were underwent hook plate augmentation in addition to other fixation methods including TBW, or screw fixation (Fig. 5). The average interval from injury to surgery was 4.4 (range, 0–13) days. The average postoperative fracture gap was 0.4 (range, 0–2.0) mm, and all cases achieved bone union without any other intervention. The average time to union was 11.6 (range, 7–24) weeks. There were no complications such as mechanical failure, infection, skin irritation, or screw penetration to the articular surface. There were 16 cases (53%) of secondary intervention (implant removal), and all of them were removed by demand not due to any discomfort or irritation. There was no extension lag except in one case (10°) and the average flexion was 138.5° (range, 110–145°). Regarding functional outcomes, the average Lysholm score was 89.5 (range, 74–95); 13 cases were excellent, 14 were good, 3 were fair, and none was poor.

Discussion

The result of the current study demonstrated that hook plating for patella fracture had good results without any complication or secondary intervention. Although TBW is popularly used for displaced patella fracture, it has fundamental pre-requisites: a fracture pattern or bone that is able to withstand compression, an intact cortical buttress opposite the tension band, and a fixation that withstands tensile forces [5]. Although the first two conditions are not met in TBW for comminuted fractures, TBW has been used for such fractures with poor results [4,6]. Böstman et al. [6] reported that the more comminuted the fracture and the older the patient, the worse the surgical outcome with TBW. Matthews et al. [4] also recommended special consideration when treating comminuted patella fractures in elderly patients. Thus, we considered that plating with a locking construct would provide cortical buttress and sufficient fixation in such cases, using it for the augmentation of TBW in cases of revision, and for osteoporotic and/or comminuted fractures. The current study revealed that plating could achieve bony union without secondary reduction loss or mechanical failures, and clinically satisfactory outcomes were obtained. Previous biomechanical studies [7–9] demonstrated that plating in patella fractures provides superior strength compared to TBW, and several plate products for the patella have been introduced and are in use [10–15]. Several authors

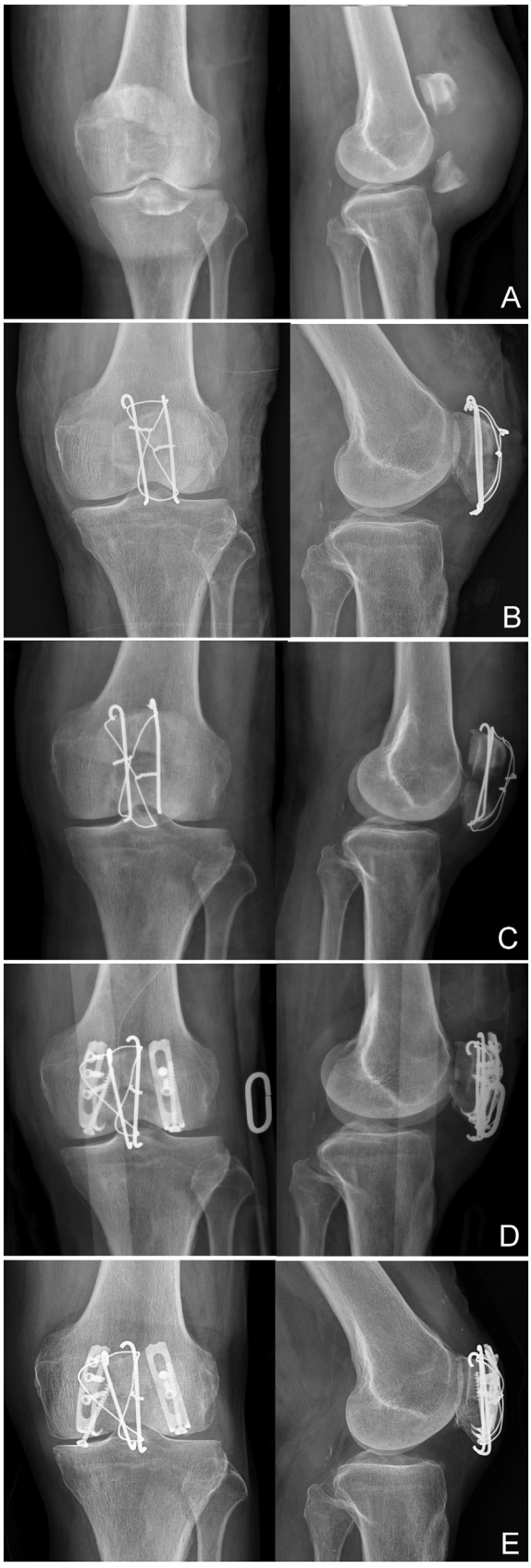

Fig. 2. Eighty-four-year-old male patient. A. Initial radiography. B. Fixation with tension band wiring (TBW). C. Reduction loss at postoperative 4 weeks. D. Revision with TBW augmented with hook plates. E. Three-year postoperative radiograph.

reported satisfactory outcomes in treating simple and comminuted fractures using the locking patella plate [13–16], comminuted fracture using mesh plate [10,12,13], and inferior pole fracture using basket plate and rim plate augmentation [11,17].

However, we used hook plating because of several advantages. Fixed angle plates alone cannot generate compressive forces across fracture fragments. Therefore, fragment reduction and compression of major fragments was achieved with clamp application in hook plating. This was followed by additional compression with the eccentric position of a cortical screw at the most proximal combi-hole of the hook plate, with the anterior screws locking into the plate, allowing the contouring of the plate in situ. Thereafter, angular stability was acquired with locking screws (Fig. 1). Finally, unicortical locking screws were placed from the anterior to the posterior portions for augmentation, with fixed angle stability. Given that patella plating is commonly performed on the anterior cortex, opposite the articular surface, bicortical screw placement is infeasible as hardware cannot violate the patellofemoral joint. For this reason, fixed angle locking plates, with unicortical locking screws, are better suited for fixation when placed on the anterior cortex. Furthermore, this construct can be in anticipation of the tension band effect working as an anterior cortical buttress.

Another important issue is 'hook' plating. Marginal fractures with small and comminuted fragments, which are common in inferior pole fracture in the elderly, are difficult to appropriately address with TBW or screw. In particular, inferior pole fracture is frequently associated with comminution and requires technical expertise for surgical treatment [11,17,18]. To overcome this difficulty, Matejcic et al. [11] used the so-called basket plate and Cho et al. [17] proposed rim plate augmentation in addition to a separate vertical wiring technique [19]. We used a hook plate to fix the fracture to reinforce the inferior pole comminution with the hook system through the patella tendon that was tied through the plate. The hook can be easily and quickly installed by inserting it into the patella tendon beneath the apex without any technical difficulty (Fig. 1B). The hook plate is easily available, in the contrast with other plates. Furthermore, it is suitable for marginal fractures including the medial, lateral, or inferior pole through the hook. It may also be applied in addition to other fixation methods such as TBW and screw for augmentation due to its characteristic low profile.

Although our patients demonstrated no complications, we performed additional surgery for the removal of implants in 16 patients. Since the plate and screw heads are close to the skin, but have a smooth margin and low-profile with minimal soft tissue irritation, this removal might not have been caused by discomfort or irritation from the implant, but rather by the patients' desire not to retain metals in their body, which is particularly common in Asians. Similar tendencies have been recorded in other study of Asians. Suh et al. [20] reported that among 13 patients who underwent surgical fixation with headless screws and wiring, 6 (46.2%) underwent removal surgery, and half of the removals (23.1%) was due to social and psychological factors present in oriental cultures, as opposed to irritation.

This study presented a new technique for treating patella fractures for which TBW is not suitable. However, there are some limitations to this study such as its retrospective nature, small sample, and the fact that the surgeries were performed by two surgeons in two institutions. Although the two surgeons were experts, a potential for bias exists because the surgeries were performed at different centers. However, we performed a standard surgical procedure based on basic fracture principles; therefore, the potential for bias should be minimized.

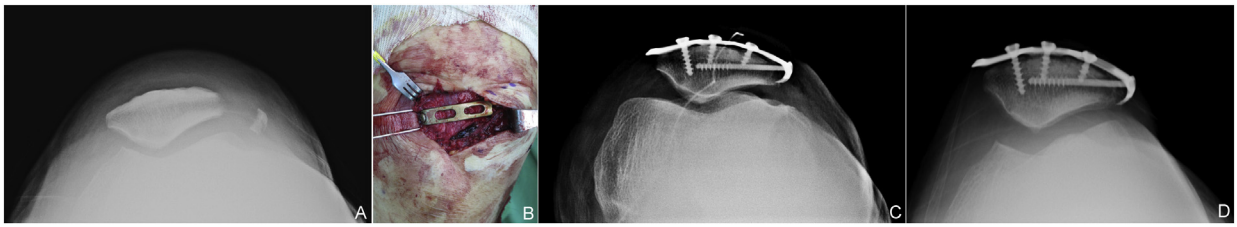

Fig. 3. Forty-eight-year-old male patient. A. Lateral marginal fracture in the skyline view. B. Hook plating. C. Postoperative radiograph. D. Eight-week postoperative radiograph.

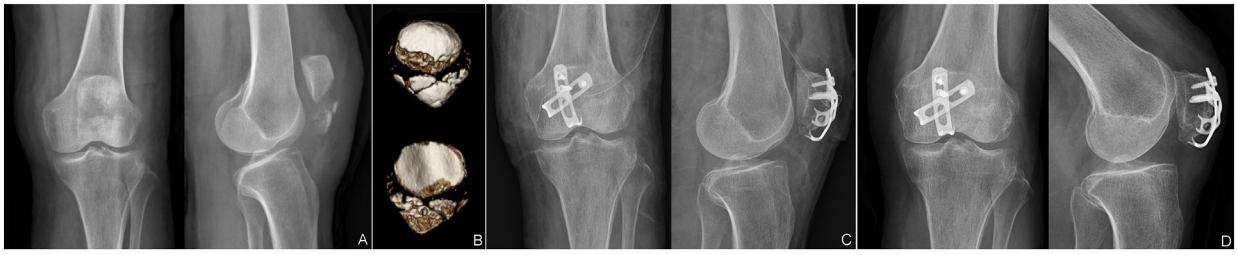

Fig. 4. Seventy-four-year-old female patient. A. Initial radiograph. B. Three-dimensional reconstruction computed tomography image. C. Fixation with two hook plates. D. One-year postoperative radiograph.

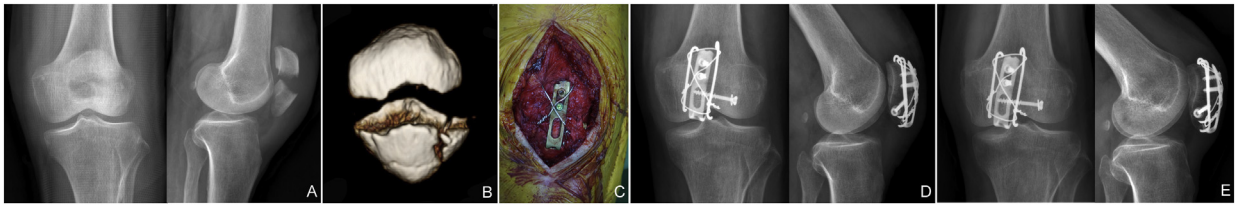

Fig. 5. Eighty-year-old female patient. A. Initial radiograph. B. Three-dimensional reconstruction computed tomography image. C. Fixation with tension band wiring augmented with a hook plate. D. Postoperative radiograph. E. One-year postoperative radiograph.

Conclusion

This study showed that hook plating for displaced patella fractures had good clinical outcomes. Therefore, hook plating could serve as a treatment option for marginal or comminuted fractures of the patella.

Declaration of Competing Interest

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