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Original Research

Syndesmosis Fixation in Unstable Ankle Fractures Using a Partially Threaded 5.0-mm Cannulated Screw

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ABSTRACT

The present study evaluated the radiographic outcomes of syndesmosis injuries treated with a partially threaded 5.0-mm cannulated screw. The present study included 58 consecutive patients with syndesmosis injuries concurrent with ankle fractures who had undergone operative fixation with a partially threaded 5.0-mm cannulated screw to repair the syndesmosis injury. Radiographic indexes, including the medial clear space, tibiofibular overlap, tibiofibular clear space, and fibular position on the lateral radiograph, were measured on the preoperative, immediate postoperative, and final follow-up radiographs. The measurements were compared between the injured and intact ankles. All preoperative radiographic indexes, including the medial clear space ($p < .001$), tibiofibular overlap ($p < .001$), tibiofibular clear space ($p < .001$), and fibular position on the lateral radiograph ($p = .026$), were significantly different between the injured and intact ankles. The medial clear space of the injured ankle was significantly wider than that of the intact ankle preoperatively ($p < .001$) and had become significantly narrower immediately postoperatively ($p < .001$). Finally, the medial clear space was not significantly different between the injured and intact ankles at the final follow-up examination ($p = .522$). No screw breakage or repeat fractures were observed. A 5.0-mm partially threaded cannulated screw effectively restored and maintained the normal relationship between the tibia and fibula within the ankle mortise with a low risk of complications. This appears to be an effective alternative technique to treat syndesmosis injuries concurrent with ankle fractures.

Syndesmosis injuries are relatively common with athletic activity, accounting for ≤18% of all ankle sprains (1). They often occur concurrently with ankle fractures and aggravate the instability of the fracture. The key to treating this type of injury is anatomic reduction and effective stabilization of the ankle mortise, which permits the healing of the syndesmotic ligaments. When uncorrected, chronic syndesmotic instability can result in pain during walking, the ankle "giving way," and, possibly, early degenerative arthritis (2–6).

Several fixation devices have been used to hold the syndesmosis in position, including syndesmotic screws, bioabsorbable screws, Kirschner wires, and the TightRope system (Arthrex, Naples, FL). Of these, syndesmotic screw fixation is the current standard treatment (7–9). However, no general consensus has been reached regarding the technical aspects of syndesmotic screw fixation. The screw type, screw size, number of cortices engaged, the use of 1 or 2 screws, the position of the ankle during screw fixation, the time required before allowing weightbearing, and the time to screw removal have all been debated.

A survey of orthopedic trauma and foot and ankle fellowship directors and members of the Orthopaedic Trauma Association and the American Orthopaedic Foot and Ankle Society found that the most common method for treating syndesmosis injuries involved using one or two 3.5-mm cortical screws engaging 4 cortices, which are removed at 3 months postoperatively (10). However, screw breakage occasionally

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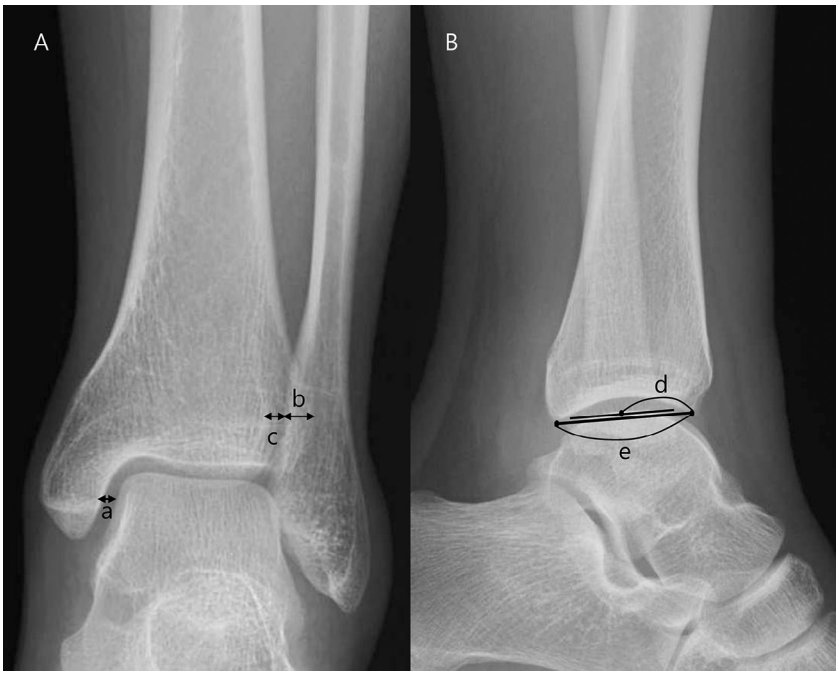

Fig. 1. Radiographic indexes measured on *(A)* anteroposterior and *(B)* lateral view. Medial clear space *(a)* is the distance between the articular surface of the medial malleolus and the medial talar articular surface. Tibiofibular overlap *(b)* is the overlap of the lateral malleolus and the anterior tibial tubercle, measured where the overlap is the largest. The tibiofibular clear space *(c)* is the distance between the medial border of the fibula and the lateral border of the posterior tibia as it extends into the incisura fibularis, measured 1 cm proximal to the plafond. Fibular position on the lateral view *(d/e)* is the relative position of the fibular center *(d)* on a length *(e)* between the anterior and posterior margins of the tibial plafond.

occurs, necessitating removal of the syndesmotic screw before weightbearing (11).

Therefore, we modified the syndesmotic screw fixation technique to minimize the risks of breakage. The aim of the present study was to evaluate the radiographic outcomes of syndesmosis injuries treated with a partially threaded 5.0-mm cannulated screw. We hypothesized that the screw could effectively restore and maintain the normal relationship between the tibia and fibula within the ankle mortise.

Patients and Methods

The institutional review board of our institute approved the present study. Consecutive patients who had undergone operative treatment with a partially threaded 5.0-mm cannulated screw for syndesmosis injuries concurrent with ankle fractures from May 2009 to December 2013 were enrolled in the present study. All the patients underwent preoperative ankle radiographs, including anteroposterior, lateral, and mortise views. The demographic data, including age, sex, height, and weight, were recorded. The exclusion criteria were as follows: (1) ankle fractures from a direct blow; and (2) abnormal ankle anatomy from a congenital anomaly, previous surgery, trauma, infection, or tumor.

Operative Technique and Postoperative Management

All operations were performed by 2 of us (M.S.P., K.M.L.) with the same treatment policy. The patients underwent operative reduction and internal fixation using a one-third tubular plate and screws for the lateral malleolus and one or two 5.0-mm cannulated screws or tension band wiring for the medial malleolus. The posterior malleolus was fixed using a 5.0-mm cannulated screw if surgical fixation was indicated. Unstable syndesmosis injuries were evaluated using a lateral stress test intraoperatively (12) after all fractures had been internally fixed. Unstable injuries were defined as those with a ≥5 mm tibiofibular clear space on the fluoroscopic lateral stress test (5,13). The syndesmosis was held in place with a large reduction clamp to compress the tibia and fibula. To avoid oblique malreduction, the clamp tips were placed on the lateral malleolar ridge of the fibula, which is the insertion of the peroneal retinaculum, and the center of the anteroposterior width of the medial tibial cortex 10 mm above the ankle joint line. Next, a partially threaded 5.0-mm cannulated screw was placed through the plate hole across the syndesmosis, engaging 4 cortices, 1 to 1.5 cm above the tibia plafond with the ankle in 5° of dorsiflexion. The guide pin facilitated the placement of the screw in the correct position. The deltoid ligament was left unrepaired.

Postoperatively, the patients were placed in a well-padded short-leg cast with the ankle in neutral dorsiflexion and instructed to maintain non-weightbearing status for the first 6 weeks. The patients were then placed in a removable short-leg splint, and ankle movement throughout the entire range of motion was encouraged from 2 weeks postoperatively onward. Tolerable and progressive weightbearing was allowed from 6 weeks postoperatively, and then patients were allowed to walk without any limitations.

Radiographic Examinations and Measurements

Ankle radiographs of the anteroposterior, mortise, and lateral views were obtained using a UT 2000 x-ray machine (Philips Research, Eindhoven, The Netherlands) at a source-to-image distance of ~100 cm with the patient in the supine position. The radiograph setting depended on the patient's body size, with a range of 46 to 50 kVp and 4.5 to 5 mA.

Radiographic images were retrieved using a picture archiving and communication system, and measurements were subsequently performed using picture archiving and communication system software (IMPAX; Agfa Healthcare, Mortsel, Belgium).

Radiographic indexes, including the medial clear space, tibiofibular overlap, tibiofibular clear space, and fibular position on the lateral view (Fig. 1), were measured on the preoperative, immediate postoperative, and final follow-up radiographs for the injured ankle. Those indexes were also measured once for the intact ankle.

Statistical Analysis

Descriptive statistics, including the mean, standard deviation, and proportion, were calculated. A Kolmogorov-Smirnov test was used to verify the normality of the distribution of the continuous variables. Comparisons between the injured and intact ankles were conducted using a *t* test, paired *t* test, or Mann-Whitney *U* test according to the data characteristics. Statistical analyses were conducted using SPSS, version 20.0 (IBM, Armonk, NY) and R, version 2.15.1 (R Foundation, Vienna, Austria). p Values $< .05$ were considered statistically significant.

Results

A total of 58 patients were included in the present study. The mean age of the patients at surgery was 39.9 ± 14.4 years. Of the 58 patients,