Injury, Int. J. Care Injured 47 (2016) 1574–1580

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Anterior-inferior tibiofibular ligament anatomical repair and augmentation versus trans-syndesmosis screw fixation for the syndesmotic instability in external-rotation type ankle fracture with posterior malleolus involvement: A prospective and comparative study☆

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ARTICLE INFO

Article history:
Accepted 12 April 2016

Keywords:
Ankle joint
Bone fractures
Ankle injuries
Internal fixation
Syndesmotic injuries
Tibiofibular syndesmosis

ABSTRACT

Purpose: Syndesmosis injury is common in external-rotation type ankle fractures (ERAF). Trans-syndesmosis screw fixation, the gold-standard treatment, is currently controversial for its complications and biomechanical disadvantages. The purpose of this study was to introduce a new method of anatomically repairing the anterior-inferior tibiofibular ligament (AITFL) and augmentation with anchor rope system to treat the syndesmotic instability in ERAF with posterior malleolus involvement and to compare its clinical outcomes with that of trans-syndesmosis screw fixation.

Methods: 53 ERAFs with posterior malleolus involvement received surgery, and the syndesmosis was still unstable after fracture fixation. They were randomised into screw fixation group and AITFL anatomical repair with augmentation group. Reduction quality, syndesmosis diastasis recurrence, pain (VAS score), time back to work, Olerud–Molander ankle score and range of motion (ROM) of ankle were investigated.

Results: Olerud–Molander score in AITFL repair group and screw group was 90.4 and 85.8 at 12-month follow-up ($P > 0.05$). Plantar flexion was 31.2° and 34.3° in repair and screw groups ($P = 0.04$). Mal-reduction happened in 5 cases (19.2%) in screw group while 2 cases (7.4%) in repair group. Postoperative syndesmosis re-diastasis occurred in 3 cases in screw group while zero in repair group ($P > 0.05$). Pain score was similar between the two groups ($P > 0.05$). Overall complication rate and back to work time were 26.9% and 3.7% ($P = 0.04$), 7.15 months and 5.26 months ($P = 0.02$) in screw group and repair group, respectively.

Conclusions: For syndesmotic instability in ERAF with posterior malleolus involvement, the method of AITFL anatomical repair and augmentation with anchor rope system had an equivalent functional outcome and reduction, earlier rehabilitation and less complication compared with screw fixation. It can be selected as an alternative.

Introduction

Distal syndesmosis injury is quite common in Lauge–Hansen external-rotation type ankle fractures (ERAF) [1,2]. The injured syndesmosis may remain unstable even the fractures are well reduced and fixed [3–5]. The gold-standard treatment for syndesmotic instability is trans-syndesmosis screw fixation [2]. However, this method is a static fixation and becomes controversial currently because it has a high complication concern [6] and could lead to biomechanics alteration and micro-motion restriction of syndesmosis [7,8], which may increase posttraumatic arthritis rate [2,7,9,10]. Therefore, flexible/dynamic fixation has been advocated in more recent literatures [11,12], and more effective treatment methods with less complication are expected in the future [13–15].

The distal syndesmosis is mainly stabilised by syndesmotic ligament complex, in which anterior-inferior tibiofibular ligament

☆ The study was launched at Shanghai Jiaotong University Affiliated Shanghai Sixth People's Hospital, a level-one trauma centre.

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http://dx.doi.org/10.1016/j.injury.2016.04.014
0020–1383/

(AITFL) and posterior-inferior tibiofibular ligament (PITFL) play the most important roles [2]. In most ERAF, syndesmosis becomes unstable due to the rupture or dysfunction of AITFL and PITFL. Nevertheless, PITFL is rarely ruptured when posterior malleolus is avulsed, and fixation of posterior malleolus fracture will restore the normal function of PITFL [16,17]. Once the posterior fracture is well fixed, the residual syndesmotic instability in those ERAF mainly results from the AITFL rupture [16–19]. Therefore, we speculated that syndesmotic instability in ERAF with posterior malleolus involvement could be treated by AITFL reconstruction alone, while rigid fixation with regular syndesmotic screws would be unnecessary.

In this study, we introduced a new method to treat the residual syndesmosis instability and compared its clinical outcomes with that of regular trans-syndesmosis screw fixation. To stabilise the injured syndesmosis after posterior malleolus fracture fixation, AITFL was anatomically repaired and augmented by flexible syndesmosis fixation with absorbable anchor rope system. We hypothesised that this method could achieve an equivalent satisfying functional outcome, good syndesmosis reduction and adequate syndesmosis stability as screw fixation did.

Patients and methods

Between February 2013 and January 2014, 158 ERAFs with posterior malleolus involvement admitted to Shanghai Sixth People's Hospital were prospectively assessed. All patients underwent physical examination, serial trauma radiographs, CT scans and MRI. To evaluate the role of AITFL repair and augmentation, fractures with deltoid ligaments and PITFL injuries were excluded (Fig. 1). Other exclusion criteria included: poly-trauma or multiple fractures; open fractures or poor condition of soft tissues; poor medical condition limiting the rehabilitation or participation to the study tests; refuse to give informed consent.

87 of 158 patients met the criteria and received operation. A single curved postero-lateral approach was used. Care was taken to avoid sural nerve injury. The distal fibula, posterior malleolus, AITFL and distal tibiofibular joint were exposed and explored. Lateral, posterior and medial fractures were reduced and fixed with plates and screws sequentially. Then syndesmotic instability was assessed with external rotation stress test (ERST) and lateral stress test under direct visualisation according to previous studies [6,9,10,20–22]. Finally, 19 ankles with stable syndesmosis were ruled out, and 68 unstable syndesmosis with ruptured AITFL were enrolled in the study. They were divided randomly into two groups: (1) anatomical AITFL repair and augmentation with absorbable anchor group, and (2) trans-syndesmosis screw fixation group. They were alternately assigned into the two groups by sequence of their hospital admission. All the operations were performed by the same surgeon (Dr. Xiaoyu Yan) throughout the study. The study was approved by our institutional ethic review board.

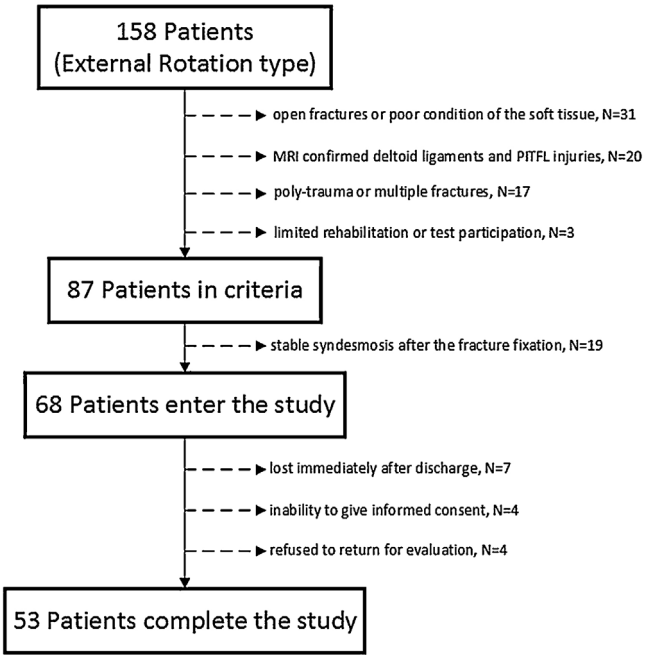

Fig. 1. The inclusion and exclusion flowchart.

AITFL anatomical repair and augmentation group

After bony fixation, an absorbable anchor (LUPINE®, Depuy Mitek) with partially absorbable anchor rope (Orthocord®, Depuy Mitek) was inserted into anterolateral aspect of distal tibia at level of 1.5–2 cm above tibia plafond. Fig. 2a shows the anchor insertion on distal tibia. Its inserting direction was angled with the pulling direction of anchor rope to avoid anchor loosening or escape, which was showed in Fig. 2b. Pull the anchor rope to make sure the anchor was purchasing solidly in the bone. Then the syndesmosis was anatomically reduced under direct vision and maintained with a clamp. Intraoperative fluoroscopy was applied to check the reduction. Afterward, anchor ropes were tied to the fibular plate or distal fibula with proper tension. The knot was properly positioned to avoid potential irritation to the skin. Fig. 2c and d show the augmentation with anchor rope from lateral view and on transvers plane. Then the clamp was removed and ERST was performed again to check the syndesmosis stability achieved by the anchor rope system. After the reduction and reliable fixation of syndesmosis, the ruptured AITFL was anatomically sutured in a tension-free circumstance. Fig. 3a and b show the ruptured AITFL and its repair with absorbable sutures after augmentation, and a sketch shows the repaired AITFL and its augmentation on transvers plane in Fig. 3c. Finally, saline irrigation and wound closure were performed. Fig. 3d shows the incision and closure after repair operation.

Regular screw fixation group

Under fluoroscopic guidance and direct vision, syndesmosis was reduced and maintained with a clamp. Two 2.5-mm drill holes were performed approximately 2 cm above and parallel to distal tibia joint line (through a plate hole if present) from posterior-lateral to anterior-medial direction. 3 cortices were drilled, and then two 3.5-mm cortical screws were inserted. Then the ruptured AITFL was only explored but not repaired.

Postoperative rehabilitation

After operation, limbs were kept elevated to prevent oedema and avoid early wound healing problems. In absence of any wound problems, sutures were removed at 14 days postoperatively. In both groups, no ankle cast or brace was used. Initiate active, active-assisted, and passive ROM with no weight bearing started as early as possible. Weight bearing was not allowed within 6 weeks. Afterward, progressive weight bearing was instructed according to the radiographic manifestations.

Outcome measures

Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, and 12 months postoperatively. X-ray and CT scan were performed in 3 days after surgery (Fig. 4). Loss of reduction and mal-reduction were evaluated mainly by CT scan using the uninjured