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Original Research

"All-Inside" Arthroscopic Treatment of Tillaux-Chaput Fractures: Clinical Experience and Outcomes Analysis

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ABSTRACT

We investigated all-inside ankle arthroscopy for Tillaux-Chaput fractures. We retrospectively evaluated 19 patients (12 males [63.2%] and 7 [36.8%] females; 11 right [57.9%] and 8 left [42.1%] ankles) treated from May 2013 to January 2016. Their mean age was 28.1 (range 10 to 55) years. Sixteen (84.2%) had single Tillaux-Chaput fractures and 3 (15.8%) had combined proximal fibular fractures; 17 (89.5%) were diagnosed radiographically and 2 (10.5%) by computed tomography. Anterolateral and anteromedial ankle arthroscopy was used for closed reduction and internal fixation with 1 or 2 Herbert screws. Joint function was evaluated using the American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale. All 19 patients healed by first intention without nerve, vessel, or tendon injuries. The follow-up was 19.0 (range 12 to 25) months; fracture union was achieved by 23.5 (range 12 to 36) weeks. At the last follow-up, the 19 patients had no restrictions in ankle function and range of motion, with no ankle or walking pain. The AOFAS score changed from 52.8 to 91.7 points, with an excellent/good rate of 100%. These results suggest that anterolateral and anteromedial all-inside ankle arthroscopy is a precise and effective method for closed reduction and internal fixation of Tillaux-Chaput fractures.

Starting at the first point of the anterior lower tibiofibular ligament, an avulsion fracture in the anterolateral aspect of the distal tibia (Tillaux-Chaput tubercle) is called a Tillaux-Chaput fracture. It usually occurs in adolescents aged 12 to 14 years (1). The Tillaux-Chaput fracture can lead to a widening ankle, lower stability, ankle instability, ankle pain, and traumatic arthritis if an improper method has been used or treatment is late or missed (2–4). The presence of a whole anterior lower tibiofibular ligament and a well-reduced fracture are the most effective factors to reduce the rate of ankle complications (5). The major aim of surgical treatment is to restore the normal position and stability. At present, internal fixation is usually performed by open reduction, with evidence lacking on the use of arthroscopically assisted fixation (6). Compared with traditional open surgery, arthroscopic surgery is a more accurate and faster method, with less bleeding, fewer complications, and a shorter recovery time (7–9).

Our department used all-inside arthroscopy to treat Tillaux-Chaput fractures from May 2013 to January 2016. We retrospectively analyzed the data from 19 patients with Tillaux-Chaput fractures who had been followed up after all-inside ankle arthroscopy. We also discuss the treatment of Tillaux-Chaput fractures using all-inside arthroscopy. We present the indications, efficacy, and characteristics of the technique and provide a rationale to extend the all-inside ankle arthroscopy technique to treatment of Tillaux-Chaput fractures.

Patients and Methods

We reviewed the clinical medical data of the patients who had undergone Tillaux-Chaput fracture treatment in our hospital. We identified the potentially eligible patients for inclusion in our retrospective cohort using the International Classification of Diseases, 10 revision (World Health Organization, Geneva, Switzerland) code S82.80.

Patients were included in the study if they met the following criteria: use of all-inside ankle arthroscopy for treatment, >2 mm of displacement of the whole joint between the anterior lower tibiofibular ligament and the fracture, fragments >5 mm in diameter, voluntary agreement for ankle surgery, and neither ankylosis nor joint space narrowing preoperatively. The exclusion criteria were as follows: coagulopathy, soft tissue ankle infection, range of motion restriction with concomitant joint space narrowing, ankle traction not possible during surgery, tearing of the anterior lower tibiofibular ligament, diastasis of the fragment and anterior lower tibiofibular ligament, or consent not provided for arthroscopic surgery.

The data extracted included age, sex, mechanism of injury, interval from injury to surgery, operative time, fracture characteristics, radiographic healing times, follow-up duration, complications, American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot scale score, and visual analog scale (VAS) score.

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S.-M.F. and Q.-Q.S. contributed equally to the present study.
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We enrolled 19 patients, 12 (63.2%) males and 7 (36.8%) females. These 19 patients had undergone all-inside ankle arthroscopy for Tillaux-Chaput fractures consecutively from May 2013 to January 2016. The mean age of the patients was 28.1 ± 11.0 (range 10 to 55) years. The mechanism of injury was a sprain in 13 patients (68.4%) and a traffic accident in 6 (31.6%). The right ankle was involved in 11 patients (57.9%) and the left ankle in 8 patients (42.1%). Of the 19 patients, 16 (84.2%) had a single Tillaux-Chaput fracture and 3 patients (15.8%) had combined proximal fibular fractures.

The institutional review boards of our hospital approved the present study. Informed consent and Health Insurance Portability and Accountability Act consent were obtained from each patient. All operations were performed by the same surgical team who were kept unaware of the measurement results during the study period.

Surgical Technique

All the surgeries were performed with the patient under epidural anesthesia aided by pneumatic tourniquet control (applied at the proximal thigh, 45 kPa, for a maximum of 90 minutes) and the arthroscopic system by the same team of 3 surgeons (S.-M.F., Q.-Q.S., A.-G.W.). The ankle puncture was made horizontally on the medial crossing point between the horizontal projection of the ankle and anterior tibial muscle tendon. Next, 20 mL of normal saline was injected to expand the articular cavity, and a 5-mm-long ankle incision using an anteromedial approach was made. A 2.7-mm, 30° arthroscope was placed into the ankle by way of the anteromedial portal to investigate the articular cavity. A 5-mm-long incision using an anterolateral approach was established with arthroscopic guidance. To examine the articular cartilage, we drained any hemarthrosis and removed the episomes, pieces of articular cartilage, synovial proliferation tissue, and so forth. Minimally invasive surgery was used for patients with soft tissue injuries. Blood clots between the fracture ends were created to enhance the integrity of the anterior lower tibiofibular ligament. Above the tibialis anterior lip, a part of the joint capsule was debrided to expose the Tillaux-Chaput tubercle and fracture fragment over tibial anterior lip to clear the operative field and determine the amount of displacement and dislocation. Two guide pins (1.0 mm in diameter) were inserted in the bone block, perpendicular to fracture line, using the arthroscope. With traction and maintaining moderate flexion of the knee, the foot was internally rotated in plantarflexion. A guide pin was inserted after the fragments had been reduced using the ankle arthroscopy, using the guide pin as a holder. C-arm radiographic fluoroscopy was used to confirm fracture reduction and the direction, depth and ideal location of the guide pin. The guide pin was of medium size with 1 or 2 Herbert screws (3.0 mm in diameter). Next, arthroscopy and C-arm radiography were used to confirm joint surface reduction and the length and direction of the Herbert screws. Drainage of the articular cavity occurred as a normal process. The incision was closed with interrupted sutures using an absorbable cone needle and wound compression. Finally, any concomitant tibial proximal fracture was treated (Fig.).

Postoperative Management

The postoperative management protocol included limb lifting and routine antiinflammatory and antiswelling medication. Removal of the drainage tube occurred according to the fluid volume at 24 to 48 hours after surgery. Passive activity was performed on the affected side toes at 24 hours postoperatively and on the ankle and toes after 24 hours postoperatively. Before the 24-hour point, the patients were allowed to ambulate non-weightbearing and perform isometric exercises to strengthen the muscles of the lower limb. The sutures were removed after 2 weeks, and functional practice was provided by ambulating with partial weightbearing after 6 weeks. When radiography had confirmed union of the fractures, the patients were allowed to begin full weightbearing walking. All the patients underwent follow-up radiography at 2, 6, 12, and 24 months after surgery.

Postoperative Follow-Up Data and Outcome Measures

Each patient was examined at follow-up visits at 6 weeks, 12 weeks, and 6 months postoperatively. The follow-up duration was decided by clinical examination and the imaging test results obtained by review. Follow-up examinations were continued until the patients were satisfied with the result or were lost to follow-up. A 10-cm-line VAS, divided into mild (0 to 3 cm), moderate (4 to 6 cm), and severe (7 to 10 cm), was used to evaluate pain. The outcome and time required to achieve union were recorded, and the patients completed a VAS at 6 months postoperatively. The AOFAS ankle-hindfoot scale was completed by the last follow-up visit. The symptoms of pain were analyzed on a scale of 40 points, with none, mild, moderate, and serious pain. The joint function was assessed using a scale of 50 points. The questionnaire included the ability to move, the longest walking distance, walking attitude, activity of the forefoot and hindfoot, and stability of the foot and ankle. The alignment assessment, with a total of 10 points, was divided into good, fair, and poor. Good was described as plantarflexion and an aligned foot and ankle; fair as plantarflexion, with some degree of lesser toe malalignment and asymptomatic; and poor as severe malalignment with symptoms present. The treatment outcome was also assessed, with 90 to 100 points considered excellent, 80 to 89 good, 70 to 79 fair, and <70 poor. These standard tests were performed by an experienced surgeon (Wei-Wei Chang, MD, Xuzhou Central Hospital, Xuzhou, China), who was not a part of the surgical team that performed all the surgeries.

Statistical Analysis

Statistical analysis was performed by an experienced surgeon (C.-K.L.). All calculations were made using SPSS, version 17.0, software (IBM Corp., Armonk, NY). Quantitative variables are expressed as the mean ± standard deviation. The pre- and postoperative VAS and AOFAS ankle-hindfoot scale scores were compared using the

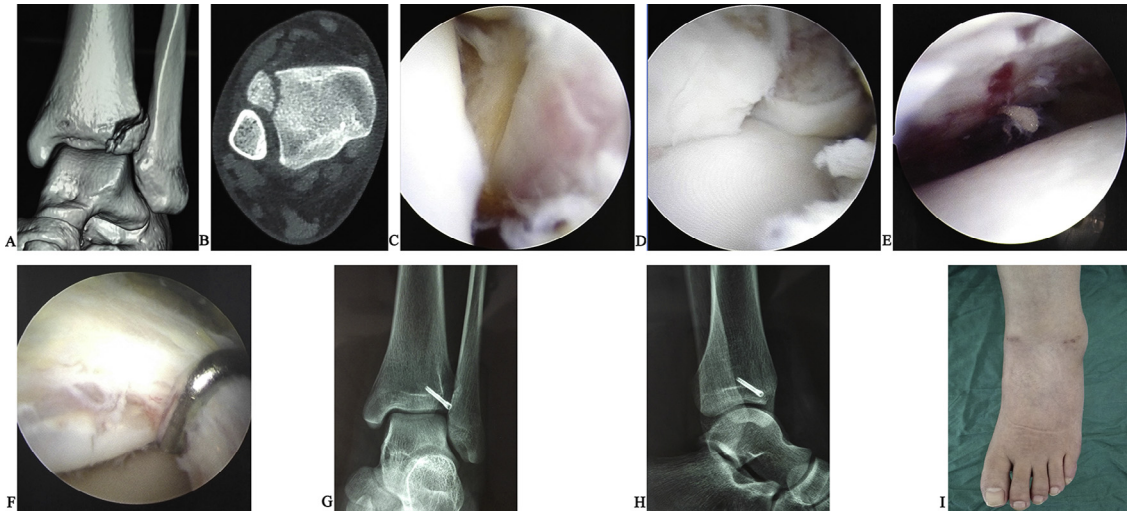

Fig. A 26-year-old female patient (case 4) presented to the hospital 20 hours after experiencing what was thought to be an ankle sprain. She could not weight bear owing to the intense pain, and the ankle was swollen. On physical examination, the soft tissues were intact with no contusion. *(A,B)* Computed tomography assessment revealed a simple Tillaux-Chaput fracture of the left ankle. Under lower nerve block anesthesia, ankle arthroscopy was used to complete closed reduction and internal fixation of the fracture within 37 hours after the injury. *(C)* At surgery, the anterior tibiofibular ligament was found to be intact. *(D)* It was also determined that the fracture fragment had displaced and the articular surface was uneven. One 3.0-mm bidirectional compression hollow screw was used to fix the fragment. *(E,F)* Arthroscopic exploration revealed satisfactory fracture reduction and fixation placement. *(G,H)* Radiographs revealed well-healed incisions, a smooth ankle articular surface, normal articular space, and correct inferior tibiofibular position. *(I)* At the follow-up examination, the incision had an excellent aesthetic appearance.