Diagnosis and Treatment of Combined Intra-articular Disorders in Acute Distal Fibular Fractures

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Background: **Some patients have residual ankle pain and disability after the treatment of an ankle fracture, despite the fracture site being well aligned. We identified intra-articular disorders in distal fibular fractures and sought to clarify the results of their operative treatment.**

Methods: **This is a prospective, randomized study. Seventy-two patients with Weber type B distal fibular fractures were randomly treated with arthroscopy-assisted open reduction and internal fixation (AORIF) or with open reduction and internal fixation without arthroscopy (ORIF). In the AORIF group, the patients were followed for a mean duration of 3 years 4 months (range, 2 years 4 months–4 years 5 months). There were 27 male patients and 14 female patients. The mean age of the patients at the time of surgery was 36 years (range, 20–64 years). In the ORIF group, the patients were followed for a mean duration of 3 years 5 months (range, 2 years 7 months–4 years 5 months). There were 21 male patients and 10 female patients. The mean age of the patients at the time of surgery was 38 years (range, 20–58 years). We described intra-articular disorders in the AORIF group using ankle arthroscopy and compared their operative results with those of the ORIF group.**

Results: **Including duplication, the arthroscopic findings showed 30 cases with osteochondral lesions of the talar dome (73.2%) and 33 cases with tibiofibular syndesmosis disruptions (80.5%). Six cases (14.6%) had no combined disorders. The mean AOFAS score was 91.0 ± 3.5 (range, 85–100) in the AORIF group, in contrast to 87.6 ± 5.5 (range, 77–97) in the ORIF group ($p = 0.0106$).**

Conclusion: **In the treatment of distal fibular fractures, precisely diagnosing and treating the combined intra-articular disorders is important for gaining satisfactory clinical results.**

Key Words: **Diagnosis and treatment, Combined intra-articular disorders, Acute distal fibular fractures.**

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Controversy surrounds the treatment of distal fibular fractures. Some patients have residual ankle pain and disability after treatment, despite the fracture site being healed and well aligned. Several authors[1,2] have reported that these unsatisfactory results were caused by the fractures being complicated by intra-articular combined disorders, such as ligament disruptions or osteochondral lesions. These combined intra-articular disorders have been shown to affect the clinical results obtained when the distal fibular fractures are treated. It is difficult to diagnose these intra-articular disorders precisely using only physical examination and standard radiography. In addition, the efficacy of treating combined disorders at the same time that the fracture site is being treated has not yet been established.

Since Watanabe[3] developed the Selfoc arthroscope in 1972, ankle arthroscopy has become a standard procedure in the diagnosis and treatment of disorders of the ankle. The advantages of ankle arthroscopy are that clinicians can correctly diagnose and treat the intra-articular lesion with minimal invasion under direct visualization.[4] Therefore, ankle arthroscopy is particularly well suited for clarifying the combined intra-articular disorders in distal fibular fractures. In the current report, we describe intra-articular disorders in distal fibular fractures using ankle arthroscopy and clarify the operative results of these patients when their intra-articular combined disorders were treated operatively at the same time that the fracture site was being treated.

PATIENTS AND METHODS

This is a prospective randomized study, and all subjects provided written informed consent for this study in accordance with the format recommended by our institution's review board for the use of human subjects. Between April 1996 and April 2000, we treated 137 cases of distal fibular fracture. Standard anteroposterior and lateral radiographs and mortise view images were obtained preoperatively to classify the fracture patterns,[5–7] and one of the authors classified the fracture types according to the Weber[8] and Lauge-Hansen classification[9] systems. Seventy-two patients with distal fibular fractures had type B fractures according to the Weber classification system, and all of the subjects in this study were treated operatively. These selected patients were randomly treated with arthroscopy-assisted open reduction and internal fixation (AORIF) or with open reduction and internal fixation without arthroscopy (ORIF). Most patients entered the hos-

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pital on the same day of the initial injury and were treated with limb elevation and cooling to avoid excess inflammatory reactions such as swelling so an early operation could be performed.

AORIF was performed on 41 type B (Weber classification) distal fibular fractures in 41 patients. The patients were followed for a mean duration of 3 years 4 months (range, 2 years 4 months–4 years 5 months). There were 27 male patients and 14 female patients. The mean age of the patients at the time of surgery was 36 years (range, 20–64 years). Thirteen patients had supination external rotation-type fractures and 28 patients had pronation abduction-type fractures according to the Lauge-Hansen classification system. The mean interval between injury and operation was 3 days (range, 1–10 days).

ORIF was performed on 31 type B (Weber classification) distal fibular fractures in 31 patients. They were followed for a mean duration of 3 years 5 months (range, 2 years 7 months–4 years 5 months). There were 21 male patients and 10 female patients. The mean age of the patients at the time of surgery was 38 years (range, 20–58 years). Nine patients had supination external rotation-type fractures and 22 patients had pronation abduction-type fractures according to the Lauge-Hansen classification system. The mean interval between injury and operation was 3 days (range, 1–14 days).

In the AORIF group, the arthroscopic procedure was performed with the patient under spinal lumbar anesthesia. The patient was placed in supine position on an operating table. The hip was flexed 45 degrees in a leg holder by means of the bandage distraction technique with a force of 78.4 N.[10] The arthroscope and the motorized shaver were inserted at the anterolateral and the anteromedial portals. A motorized shaver with suction was used to remove the hematomas and granulomas at the fracture site, to make it easier to observe the intra-articular structures. If there was a grade III or IV osteochondral lesion (OCL) of the talar dome according to the modified Pritsch classification,[11] we performed arthroscopic drilling after removing the chondral or osteochondral fragment. Therefore, all lesions had a full-thickness defect with a diameter ranging from 5 to 12 mm (Fig. 1). If the lesion was located at the posteromedial talar dome, arthroscopic drilling was performed according to the procedure of Kumai et al.[12] A Kirschner wire 1.2 mm in diameter was inserted from approximately 3 cm proximal to the tip of the medial malleolus and directed across the medial malleolus into the lesion through the intact cartilage. If the lesion was located anterolateral to the talar dome, drilling was performed via the anterolateral portal. Drill holes were made at approximately 2-mm intervals at a depth of approximately 1 cm. We also diagnosed tibiofibular syndesmosis disruption by means of arthroscopy.[13,14] In this study, we diagnosed the anterior inferior tibiofibular ligament (AITFL) and the posterior inferior tibiofibular ligament (PITFL) disruptions. The interosseous tibiofibular ligament could not be diagnosed under arthroscopy because the ligament was attached approximately 1 cm or more above the joint line, and it was difficult to view it completely via ankle arthroscopy. If there was a disruption (Fig. 2*A*), we performed a stress test of the distal tibiofibular articulation[15] after fixation of the fracture site. This was done by changing the ankle position from relative internal rotation to external rotation under arthroscopy. We considered an

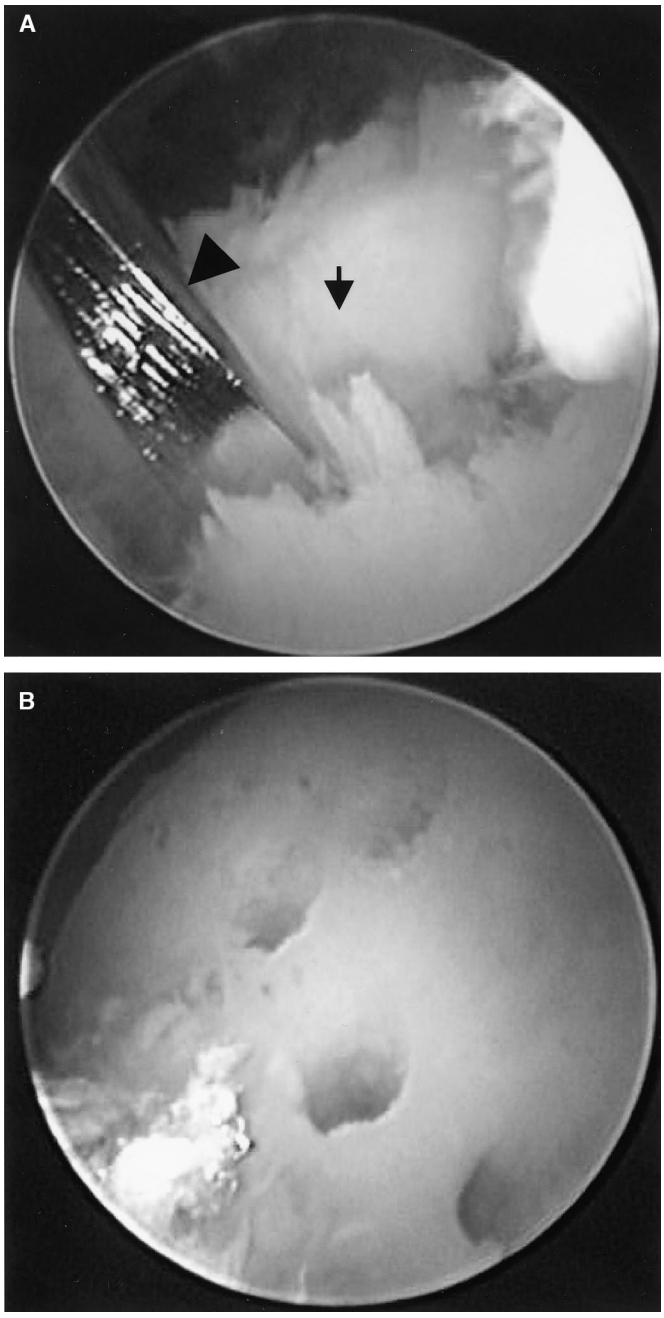

Fig. 1. *(*A*) Arthroscopic finding after arthroscopic drilling for osteochondral lesion of the posteromedial talar dome on the left ankle. The* arrow *indicates the osteochondral lesion. The* arrowhead *indicates the Kirschner wire, with a diameter of 1.2 mm. (*B*) Arthroscopic finding of an osteochondral lesion after arthroscopic drilling.*

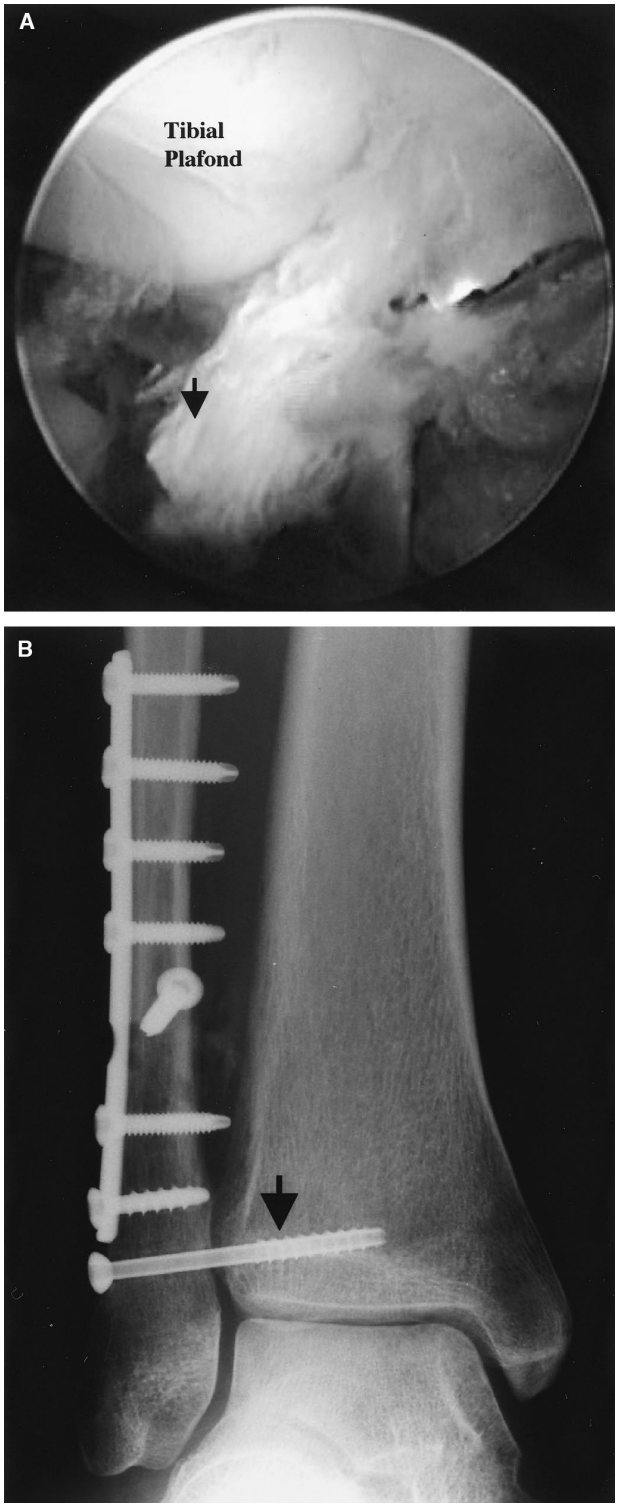

Fig. 2. *(A) Arthroscopic finding of disrupted AITFL on the right ankle. The arthroscope was inserted at the anteromedial portal. The* arrow *indicates that the AITFL was torn at its fibular attachment, found by palpation with a probe. (B) Standard anteroposterior radiograph of the right ankle after syndesmosis screw fixation. The* arrow *indicates a syndesmosis screw penetrating the three cortexes only.*

instability of the distal tibiofibular articulation to be present if a 2-mm or greater opening of the distal tibiofibular articulation was found in reference to the top 2 mm of the probe. In such cases, we performed syndesmosis screw fixation to penetrate three cortices only, the two fibular cortexes and a tibial cortex, with a cannulated titanium screw (Ace Titanium Small Fragment System, 4.5-mm cannulated cancellous screw) (Fig. 2*B*). For that procedure, the ankle joint was kept at 15 degrees of dorsiflexion, and the screw was tightened with a suitable torque. We would like to caution here that the screw should never be tightened with too much force. In the AORIF and ORIF groups, fixation of the fracture site was performed using the posterior antiglide plating technique[16] with a 3.5-mm semitubular plate from the Ace Titanium Small Fragment System. The displacement of the fracture site was reduced fluoroscopically to a distance of less than 2 mm in both the AORIF and ORIF groups. All of the subjects had several degrees of deltoid ligament disruption, but these disruptions were not treated operatively in this study.

In the AORIF and ORIF groups, toe touches and active range-of-motion exercises of the ankle were performed starting 1 day after surgery. Two weeks after the operation, passive range-of-motion exercises were begun. Partial weight bearing was allowed beginning 3 weeks after surgery, and full weight bearing was allowed after 4 postoperative weeks. Physiotherapy, which was supervised by a physical therapist, included range-of-motion exercises of the ankle and strengthening of the anterior tibial muscle, peroneal muscles, and calf muscles. These exercises were performed every day for 2 weeks and then twice daily for 2 weeks. Sports activity was allowed 3 months after the operation in both groups.

At the time of the latest follow-up, all patients were examined by means of the Ankle-Hindfoot Scale score by the American Orthopaedic Foot and Ankle Society (AOFAS).[17] In the AORIF group, we performed ankle arthroscopy at 1 year after the operation with removal of the plate and/or syndesmotic screw to assess the lesion of the cartilage and the tibiofibular syndesmosis. Statistical analysis was performed by means of the unpaired Student's t test. Differences between the two groups were considered to be statistically significant at a value of $p \leq 0.05$.

RESULTS

In the AORIF group, including duplication, the arthroscopic findings showed 30 cases with OCL (73.2%), including 19 cases of posteromedial talar dome and 11 cases of anterolateral talar dome lesions. There were 8 cases with OCL (61.5%) in supination-type fractures and 26 cases (92.9%) in pronation-type fractures according to the Lauge-Hansen classification. There were 33 cases with tibiofibular ligament disruptions (80.5%), including 23 cases (69.7%) with only an AITFL disruption and 10 cases with both an AITFL and a PITFL disruption. There were no cases with only a PITFL disruption. Six cases (14.6%) had no combined disorders. In the AORIF group, there were 12 cases that

Table 1 AOFAS Score at the Latest Follow-Up

	AORIF	ORIF	*p* Value
Total	91.0 ± 3.5	87.6 ± 5.5	0.0106
Supination type	93.0 ± 4.1	89.3 ± 4.9	0.0944
Pronation type	90.1 ± 2.8	86.9 ± 5.7	0.0103

AORIF, arthroscopy-assisted open reduction and internal fixation; ORIF, open reduction and internal fixation without arthroscopy.

showed instability under an arthroscopic stress test after fixation of the fracture site, and they were treated by means of syndesmosis screw fixation.

The mean AOFAS score was 91.0 ± 3.5 (range, 85–100) in the AORIF group and 87.6 ± 5.5 (range, 77–97) in the ORIF group. There were significant differences between the AOFAS scores of the AORIF and ORIF groups ($p = 0.0106$). In the supination-type fractures, the mean AOFAS score was 93.0 ± 4.1 (range, 90–100) in the AORIF group and 89.3 ± 4.9 (range, 85–97) in the ORIF group. We were unable to detect significant differences between the AOFAS scores of the AORIF and ORIF groups ($p = 0.0944$). However, in the pronation-type fractures, there were significant differences between the AOFAS scores of the AORIF and ORIF groups ($p = 0.0103$). The mean AOFAS score was 90.1 ± 2.8 (range, 85–95) in the AORIF group and 86.9 ± 5.7 (range, 77–95) in the ORIF group (Table 1).

In the AORIF group, the mean AOFAS score was 91.1 ± 3.5 (range, 85–100) for those patients with OCL and/or tibiofibular ligament disruptions and 90.8 ± 3.8 (range, 85–95) for those patients who had no associated disruptions. We were unable to detect significant differences ($p = 0.8872$).

According to arthroscopic findings at 1 year after operation in the AORIF group, all of the lesions of the cartilage were covered with cartilaginous tissue, and there were no patients who showed instability of the tibiofibular articulation under an arthroscopic stress test after removing the plate and/or syndesmotic screw.

There were no complications in the AORIF group. In the ORIF group, two patients each had a superficial wound infection. The scores of the infected cases in the ORIF group at the most recent follow-up were 93 and 96. There were no patients with deep wound infections or lesions of the cutaneous nerve.

DISCUSSION

The ankle mortise actually constitutes a ring of three bones including the tibia, fibula, and talus and their ligamentous attachments including the tibiofibular syndesmosis and the medial and lateral collateral ligaments. A single break in the ring does not lead to instability of the ankle; however, disruption of the ring in two positions by any combination of bone or ligamentous injuries will cause ankle instability[18] and eventually lead to a poor clinical outcome.[19] In this study, we treated Weber type B fractures including supination external rotation-type and pronation abduction-type fractures according to the Lauge-Hansen classification. All of the subjects with the former type of fracture had at least AITFL disruption and distal fibular fractures, and all those with the latter type had tibiofibular syndesmosis disruption and distal fibular fractures. Therefore, we considered all of the subjects in this study to have an unstable fracture and we treated them operatively.

With lateral malleolar fractures of the ankle, patients can have residual ankle pain and disability after treatment, despite the restoration of congruity at the fracture site. Van Dijk et al.[2] performed ankle arthroscopy on 34 consecutive patients with residual complaints after an ankle fracture. They clarified that some patients had an anterior impingement lesion of the distal tibia or anterior border of the talar dome. The authors suggested that these osteophytes may develop because of an excess reaction to damage of the cartilage rim in the majority of severe supination injuries. Loren and Ferkel[20] performed arthroscopic assessment in 48 consecutive patients with acute unstable ankle fractures and reported that 30 of the 48 ankles (63%) showed traumatic articular surface lesions including chondral defects and osteochondral lesions measuring greater than 5 mm in diameter. In addition, 22 of the 48 ankles (45.8%) showed syndesmotic ligament disruptions. Furthermore, Hintermann et al.[1] prospectively evaluated the arthroscopic findings in acute fractures of the ankle in 288 consecutive patients. The authors found several intra-articular combined disorders such as lesions of the cartilage, which occurred in 228 ankles (79.2%), or ligament disruptions, which included 266 cases (92.4%) of anterior tibiofibular ligament rupture, 243 cases (84.4%) of deltoid ligament rupture, and 218 cases (75.7%) of anterior talofibular ligament rupture. They also suggested that these combined intra-articular disorders may affect the clinical results of the treatment of distal fibular fractures.

In our study, arthroscopic evaluation of articular injury showed 30 cases (73.2%) of osteochondral lesions of the talar dome and 33 cases (80.5%) of tibiofibular ligament tears. It is intuitive that correctly diagnosing and treating these combined disorders is fundamental to achieving a favorable clinical outcome. However, the efficacy of treating these combined disorders in the management of distal fibular fractures has not yet been clarified.

In this series, we clarified the efficacy of diagnosing and treating combined disorders of lateral malleolus fractures of the ankle with arthroscopically assisted ORIF. Our clinical results show that better AOFAS scores were achieved when combined intra-articular disorders were diagnosed and treated than when only the fracture site was treated. We believe that ankle arthroscopy should be performed to diagnose combined intra-articular disorders at the same time that the fracture site is being operated on. However, we are fully aware of the limitations of this combined treatment. In this series, osteochondral lesions of the talar dome, which were treated with arthroscopic drilling, were seen to stimulate the synthesis of only fibrous cartilage repair.[21,22] Degenerative posttraumatic

arthrosis is predictable. No long-term follow-up results have been reported for the arthroscopic drilling of osteochondral lesions of the talar dome, and the incidence and degree of posttraumatic arthrosis in association with the combined injury are not clear. A long-term follow-up study of more than 10 years is necessary to clarify the efficacy of arthroscopic drilling. Furthermore, in this study, we did not assess syndesmotic instability in the ORIF group preoperatively, intraoperatively, or at the final follow-up. To clarify the benefit of syndesmotic screw fixation strictly, it is necessary to investigate the rate of cases that had tibiofibular instability in the ORIF group and to compare it with the rate in the AORIF group. In addition, it is possible that subtalar joint or extra-articular disorders may cause residual pain or disability after distal fibular fractures. Clarifying these disorders and treating them precisely may be of some benefit in the treatment of distal fibular fractures.

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