

# Arthroscopically Assisted Treatment of Ankle Fractures: Arthroscopic Findings and Surgical Outcomes

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**Purpose:** Malleolar fractures have been reported to be associated with a poor prognosis even when the anatomic reduction is complete. Soft tissue injuries such as damage to the cartilage and ligaments, soft tissue impingement, and the existence of free bodies within the intra-articular space account for this poor outcome. In treating fresh malleolar fractures, an arthroscope is used at our institution to confirm anatomic reduction on the articular surface and treat intra-articular injuries. This study evaluated the arthroscopic findings and surgical outcome for fresh malleolar fractures. **Type of Study:** Prospective case study. **Methods:** The subjects were 105 patients (105 joints) who had experienced malleolar fractures and had undergone surgical fixation between January 1996 and May 1999. Arthroscopy was used to confirm the fracture line, cartilaginous damage, presence of detached cartilaginous fragments in the articular space, ligament damage, and diastasis of the distal tibiofibular joint. The cartilaginous damage was treated using shaving, and the free cartilaginous fragments were excised. Diastasis of the distal tibiofibular joint was treated using distal tibiofibular joint fixation, using a screw. Fracture fixation was conducted after anatomic reduction had been confirmed using fluoroscopy and arthroscopy. **Results:** Cartilaginous damage was noted in 21 patients, among whom 13 were treated by shaving and 8 underwent cartilaginous fragment removal. Fixation of the distal tibiofibular joint was conducted in 8 patients. From a postoperative radiographic evaluation, a good result in 100 cases and a fair outcome in 5 were confirmed. The clinical results were good in all, and no postoperative complications or pseudoarthrosis were noted. **Conclusions:** The use of an arthroscope during treatment of malleolar fractures enables diagnosis and treatment of the lesions within the ankle joint, producing a satisfactory surgical outcome. **Level of Evidence:** Level IV, therapeutic study, case series (no control group). **Key Words:** Malleolar fractures—Ankle arthroscopy—Cartilaginous damage—Ligamentous injury.

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**A** malleolar fracture develops when a torsional or rotational force is applied between the leg and foot. The lesion is often accompanied by ligament or cartilaginous damage at the joint. Researchers have reported a poor prognosis for malleolar fracture in some patients even when the anatomic reduction was

sufficient.<sup>1,2</sup> Soft tissue damage (eg, cartilaginous or ligament damage and soft tissue impingement) and the presence of free bodies in the articular space have been cited to explain this discrepancy. To treat this type of fracture, arthroscopy has been recommended for anatomic reduction and confirmation of associated intra-articular injuries.<sup>3-11</sup>

During treatment of a fresh malleolar fracture, arthroscopy has been used at our institution to confirm anatomic reduction of the joint surface and intra-articular injuries. The purpose of this study was to document the incidence and type of articular cartilage and ligamentous injuries associated with malleolar fractures and evaluate the surgical outcome for these conditions prospectively.

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**TABLE 1.** *Fracture Types Classified According to the Method of Lauge-Hansen*

Type	Stage 1	Stage 2	Stage 3	Stage 4	Total
SER	3	41	5	9	58
SAD	9	6	—	—	15
PAB	7	4	4	—	15
PER	9	0	6	2	17

Abbreviations: SER, supination and external rotation; SAD, supination and adduction; PAB, pronation and abduction; PER, pronation and external rotation.

## METHODS

The subjects were 105 patients (105 joints; 52 on the left and 53 on the right; 59 men and 46 women; mean age,  $45.9 \pm 19.3$  years) with fresh malleolar fractures who underwent surgical fixation between January 1996 and May 1999. The mean postoperative observation period was 3 years and 10 months (range 2 years to 6 years and 4 months).

Patients were placed in a supine position and surgery was conducted under general or lumbar spinal anesthesia. Without applying traction to the ankle joint, a direct view with 2.7 mm or a 30° oblique view arthroscope was used. For portals, anteromedial and anterolateral punctures were made to confirm the fracture line, cartilaginous damage, free cartilaginous fragments in the articular space, ligament damage, and diastasis of the distal tibiofibular joint.

Cartilaginous damage was defined as that affecting 50% or more of the thickness of the articular cartilage or separation of cartilaginous fragments. Ligament injuries included complete rupture, ablation fracture of the ligament attachment, and a lack of ligament tension on probing. Diastasis of the distal tibiofibular joint was defined as instability of the joint. This was detected by a squeeze test under fluoroscopy<sup>12</sup> or by residual, arthroscopically seen diastasis of the joint.

Cartilaginous damage and detached cartilaginous fragments found under arthroscopy were treated by shaving or excision. Screws were used to fix the separated distal tibiofibular joint. Fractures were fixed using tension band wiring or screws and plates after anatomic reduction had been confirmed by fluoroscopy and arthroscopy. For patients whose fractures could be manually reduced after hematoma elimination, both under arthroscopy, arthroscopic fixation was performed using screws.<sup>10,11</sup>

Fractures were classified according to the method of Lauge-Hansen.<sup>13-15</sup> The results of the postoperative

radiographic evaluation and clinical examinations were rated at one of 3 levels (good, fair, or poor), according to the method of Burwell and Charnley.<sup>16</sup>

## RESULTS

The fracture types included 58 cases (55.2%) with supination and external rotation (SER; stage 1, 3 cases; stage 2, 41; stage 3, 5; and stage 4, 9); 15 cases (14.3%) with supination and adduction (SAD; stage 1, 9 cases and stage 2, 6); 15 cases (14.3%) with pronation and abduction (PAB; stage 1, 7 cases; stage 2, 4; and stage 3, 4); and 17 cases (16.2%) with pronation and external rotation (PER; stage 1, 9 cases; stage 2, 0; stage 3, 6; and stage 4, 2). Forty-one patients, 39% of the entire patient population, were classified as SER, stage 2 (Table 1).

Cartilaginous damage was noted in 21 patients (20%). SER dominated the fracture types (22.4%), but the incidence of PAB was relatively rare (13.3%). Among those exhibiting the most common SER type fracture, cartilaginous damage below stage 2 was noted in 25% (Table 2). The sites of cartilaginous damage were tibial plafond in 5 cases, talus in 6, medial malleolus in 3, and lateral malleolus in 7 (Table 3). No correlation was found between fracture type and the sites of cartilaginous damage. Among the 21 patients with cartilaginous damage, 13 were treated by shaving and 8 underwent removal of the cartilaginous fragments.

Ligamentous injury was noted in 54 patients (51.4%), among whom sole injury to the anterior tibiofibular ligament was most common (41 cases). Combined injuries to the anterior and posterior tibiofibular ligaments and those of the anterior tibiofibular ligament and deltoid ligament were found in 5 patients in each respective group, and injuries to the anterior talofibular ligament were found in 3. When the relationship to fracture type was examined, ligament

**TABLE 2.** *Fracture Types and Cartilaginous Damage*

Type	Stage 1	Stage 2	Stage 3	Stage 4	Total
SER	1	10	0	2	13
SAD	1	2	—	—	3
PAB	1	1	0	—	2
PER	1	0	1	1	3

Abbreviations: SER, supination and external rotation; SAD, supination and adduction; PAB, pronation and abduction; PER, pronation and external rotation.

**TABLE 3.** *Fracture Types and the Sites of Cartilaginous Damage*

Type	Tibial Profund	Talus	Medial Malleolus	Lateral Malleolus
SER	3	3	1	6
SAD	1	0	1	1
PAB	0	2	0	0
PER	1	1	1	0
Total	5	6	3	7

Abbreviations: SER, supination and external rotation; SAD, supination and adduction; PAB, pronation and abduction; PER, pronation and external rotation.

damage was frequently found in SER and PER (67.2% and 52.9%, respectively), but it was relatively rare in SAD and PAB (20% each) (Table 4).

Persistent instability of the distal tibiofibular joint, which was detected under fluoroscopy and arthroscopy in 8 patients, was managed by fixation using a screw. The squeeze test was found to be as accurate as arthroscopic techniques in making the diagnosis of diastasis of the distal tibiofibular joint. Arthroscopy was conducted for all patients at the time of hardware removal, and all exhibited cicatricial bonding at the distal tibiofibular joint.

After removal of hematoma under arthroscopy, arthroscopic osteosynthesis was performed in those patients in whom fractures could be reduced manually or arthroscopically.<sup>10</sup> This procedure was conducted in 16 patients. In 9 of these patients, the lesions were located at the medial malleolus and in 7 at the lateral malleolus.

From a postoperative radiographic evaluation, the therapeutic outcome was rated to be good for 100 cases and fair for 5. The clinical results were good for all, and no incidence of postoperative complications, pseudoarthrosis, or post-traumatic osteoarthritis was noted.

## DISCUSSION

The prognosis of some cases of malleolar fractures has been reported to be poor, even when anatomic reduction is sufficient.<sup>1,2</sup> Soft tissue injuries such as cartilaginous and ligament damage, soft tissue impingement, and the presence of free bodies within the articular space are suspected to be the causes for this inconsistency.<sup>1,3,6,17-19</sup> At our institution, arthroscopy is combined with surgical procedures for the treatment of mal-

leolar fractures to confirm the anatomic reduction on the articular surface and the intra-articular injuries.

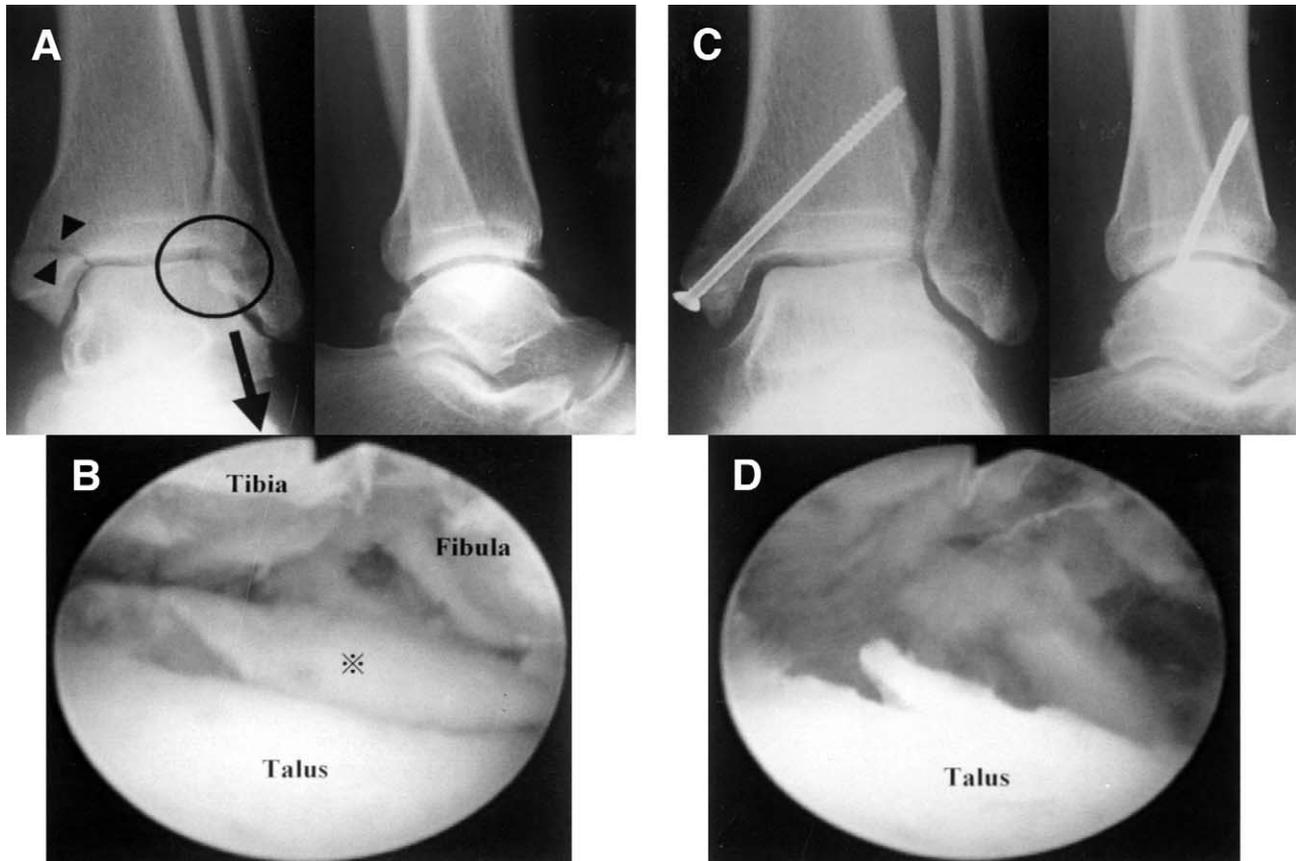
In this study, injuries to the articular cartilage or the presence of free cartilaginous fragments in the articular space were recognized in 20% of the patients. Hintermann et al.<sup>3</sup> reported that cartilaginous damage occurs in 79.2% of patients with fresh malleolus fractures. The cartilaginous damage they described included damage on the surface layer of the cartilage. We assume cartilaginous damage, as defined previously (affecting 50% or more of the thickness of the articular cartilage or the presence of free cartilaginous fragments), is found in 20% to 30% of the patients.

Hintermann et al.<sup>3</sup> also reported that the incidence of cartilage injuries is higher among those classified as type C or its subgroup 3 in the AO-Danis-Weber classification. Although a different classification system was used in this study, cartilaginous damage was noted in 25% of the patients classified as SER stage 2 or lower. The finding indicates that cartilaginous damage may occur regardless of the stage of fracture types, which is worthy of special attention (Fig 1). Diagnosis of cartilage or soft tissue injuries is impossible from plain radiography, and although magnetic resonance imaging (MRI) may be effective in diagnosis, it is costly and not applicable in all cases. We believe that fracture treatment aided by arthroscopy is an outstanding therapeutic modality that allows direct confirmation of intra-articular lesions.

**TABLE 4.** *Fracture Types and Ligamentous Injuries*

	Stage	ATiF	A + PTiF	ATiF + Del	ATF	Total
SER	1	2	0	0	0	2
	2	25	1	0	0	26
	3	4	2	0	0	6
	4	3	0	2	0	5
SAD	1	0	0	0	1	1
	2	0	0	0	2	2
PAB	1	0	0	0	0	0
	2	0	1	0	0	1
PER	3	1	0	1	0	2
	1	0	0	0	0	0
	2	1	0	0	0	1
	3	4	0	2	0	6
	4	1	1	0	0	2
Total		41	5	5	3	54

Abbreviations: SER, supination and external rotation; SAD, supination and adduction; PAB, pronation and abduction; PER, pronation and external rotation; ATiF, anterior tibiofibular ligament injury; A + PTiF, anterior and posterior tibiofibular ligament injuries; ATiF + Del, anterior tibiofibular ligament and deltoid ligament injuries; ATF, anterior talofibular ligament injury.



**FIGURE 1.** A 62-year-old man experienced a fracture of the medial malleolus, rated PAB stage 1 (A), from a fall. An arthroscopic examination revealed cartilaginous damage to the talus (B), which was surgically corrected (D). The fracture of the medial malleolus could be transcutaneously reduced. Arthroscopic osteosynthesis was conducted using a screw (C). The postoperative course has been satisfactory. The arrow indicates the fracture of the medial malleolus; the dot pattern indicates the free cartilaginous fragment.

When the entire fracture line can be examined under arthroscopy and can be reduced transcutaneously or arthroscopically after elimination of the hematoma at the fracture site, the malleolar fracture can be arthroscopically reduced and fixed with a satisfactory result. Arthroscopic reduction and fixation is minimally invasive and an effective therapeutic approach for malleolar fractures that are reducible transcutaneously or arthroscopically.<sup>10,11</sup>

Ligamentous injuries were noted in 54 cases, among which 41 (75.9%) were isolated injuries involving the anterior tibiofibular ligament. The dominance of isolated injuries of this type may be explained by the fact that more than half of the malleolar fractures in this study were the SER type.

Except for injuries of the deltoid ligament that may result in instability of the ankle joint, suturing the

ligament was avoided as a rule for the repair of ligament injuries. Treatment was limited to shaving so that the disrupted ends of the injured ligaments were not impinged.

When diastasis of the distal tibiofibular joint is detected under fluoroscopy or by arthroscopy, the affected joint is subject to fixation using a screw. This procedure was applied in 8 cases in this study, and all were examined under arthroscopy when the instruments were removed. Cicatricial bonding was found at the distal tibiofibular joint in all.

When diastasis of the distal tibiofibular joint is complicated with injuries to the deltoid ligament, the ruptured ligament may be impacted, and the talus may remain deviated laterally even after fixation of the distal tibiofibular joint. At our institution, the ruptured ends of the deltoid ligament are shaved first to correct

the lateral deviation of the talus. If the deviation persists, it is necessary to correct the impacted deltoid ligament and suture it via surgical means.

In the present study using arthroscopy for treatment of fresh malleolar fracture, the clinical results were good for all. Burwell and Charnley<sup>16</sup> treated these fractures with standard open techniques without any arthroscopic assistance and reported that the clinical results were good in 81.8%, fair in 14.4%, and poor in 3.8%. These results show that by including arthroscopy in the therapeutic procedures for fresh malleolar fractures, a reliable surgical result can be produced. However, the present study was not a comparative study between arthroscopic techniques and standard open techniques. To determine if early arthroscopic intervention will minimize poor outcomes after malleolar fractures, a prospective randomized comparative study is necessary. Thordarson et al.<sup>20</sup> performed a prospective randomized comparative study for surgical treatment of malleolar fractures with or without ankle arthroscopy. They reported no significant difference between arthroscopic techniques and standard open techniques. Their study consisted of a small group of patients (19 patients), and the average follow-up time was short (21 months). Thordarson et al. stated that a larger group of patients and long-term follow-up times may be necessary to show the usefulness of arthroscopic intervention.

We believe that including arthroscopy in the therapeutic procedures for fresh malleolar fractures is useful to achieve a reliable surgical outcome, because a number of intra-articular injuries are associated with fresh malleolar fractures and the prognosis is poor in some cases with malleolar fractures even when anatomic reduction is sufficient.

Arthroscopy of the ankle joint is also effective in confirming the presence of complicated injuries within the joint that may be a cause for poor prognosis after osteosynthesis. Arthroscopy enables direct confirmation of the presence of cartilaginous injuries or free bodies in the articular space that cannot be detected through preoperative plain radiography, and the lesions within the ankle joint can be effectively treated at the same time. We concluded that including arthros-

copy in the therapeutic procedures for fresh malleolar fractures produces a reliable surgical result.

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