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Arthroscopic findings in acute fractures of the ankle

B. Hintermann, P. Regazzoni, C. Lampert, G. Stutz, A. Gächter

From the University of Basel and the Kantonsspital, St Gallen, Switzerland

We have evaluated prospectively the arthroscopic findings in acute fractures of the ankle in 288 consecutive patients (148 men and 140 women) with a mean age of 45.6 years. According to the AO-Danis-Weber classification there were 14 type-A fractures, 198 type B and 76 type C.

Lesions of the cartilage were found in 228 ankles (79.2%), more often on the talus (69.4%) than on the distal tibia (45.8%), the fibula (45.1%), or the medial malleolus (41.3%). There were more lesions in men than in women and in general they were more severe in men ($p < 0.05$). They also tended to be worse in patients under 30 years and in those over 60 years of age. The frequency and severity of the lesions increased from type-B to type-C fractures ($p < 0.05$). Within each type of fracture the lesions increased from subgroups 1 to 3 ($p < 0.05$). The anterior tibiofibular ligament was injured with increased frequency from type-B.1 to type-C.3 fractures ($p < 0.05$), but it was not torn in all cases. While lateral ligamentous injuries were seen more often in type-B than in type-C fractures ($p < 0.05$), no difference was noted in the frequency of deltoid ligamentous lesions.

Our findings show that arthroscopy is useful in identifying associated intra-articular lesions in acute fractures of the ankle.

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Fractures of the ankle are common and although stability of the joint can be achieved by adequate reduction and internal fixation there is often persistent disabling pain despite the restoration of congruity.[1,2] This may occur on exercise or with changes in the weather, and there may be radiological evidence of osteoarthritis.

These findings are indicative of a lesion of the articular cartilage or damage which occurred at the time of injury and is not detectable on radiographs but may be the cause of the pain. There are no data on the assessment of intra-articular lesions in acute fractures of the ankle. Although arthroscopy is not a new diagnostic tool,[3-8] its role in the evaluation of the injured ankle has not been determined. Our aim was to assess prospectively the arthroscopic findings in such fractures.

Patients and Methods

Between July 1993 and November 1997, we assessed 288 consecutive patients (288 ankles) with acute fractures of the ankle which required surgical treatment. There were 148 men and 140 women with a mean age of 45.6 years (14 to 88) (Table I). There was an almost equal distribution of right (47.6%) and left (52.4%) ankles. Based on radiographs the fractures were categorised according to the AO-Danis-Weber classification;[9] there were 14 type A, 198 type B, and 76 type C (Tables II and III).

We carried out arthroscopy under general or regional anaesthesia followed by open reduction and internal fixation within 72 hours of injury. The patient was supine and the knee was flexed to about 90° using the knee holder

B. Hintermann, MD, Associate Professor
Clinic of Orthopaedic Surgery
P. Regazzoni, MD, Associate Professor
Clinic of General Surgery
Kantonsspital, CH-4031 Basel, Switzerland.

C. Lampert, MD, Assistant Professor
G. Stutz, MD, Registrar
A. Gächter, MD, Full Professor
Clinic of Orthopaedic Surgery, Kantonsspital, CH-9007 St Gallen, Switzerland.

Correspondence should be sent to Dr B. Hintermann.

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Table I. Details of age and gender of the 288 patients

Age (yr)	Male	Female	Total
<20	13	3	16
20 to 29	29	13	42
30 to 39	35	21	56
40 to 49	33	27	60
50 to 59	21	26	47
60 to 69	12	24	36
70 to 79	5	16	21
>79	0	10	10
Total	148	140	288

which allowed the foot to hang free. No distraction device was used for the ankle. To avoid iatrogenic lesions of the articular cartilage and soft tissue, the joint was first inflated with saline, and the portals were created by blunt dissection. A 4.5 mm, 30° arthroscope was introduced into the ankle through a standard central anterior portal. Fluid was aspirated and the cavity filled with CO_2.[10] If necessary, accessory anteromedial and/or anterolateral portals were used for the insertion of instruments.

A systematic examination as described by Ferkel and Fasulo[7] was used to inspect the internal structures.

Table II. Gender of the 288 patients related to the type of the fracture

Type	Male	Female	Total
A.1	2	0	2
A.2	6	3	9
A.3	3	0	3
B.1	42	37	79
B.2	29	38	67
B.3	16	36	52
C.1	20	7	27
C.2	12	11	23
C.3	18	8	26
Total	148	140	288

Lesions of the articular cartilage were graded according to depth as determined by inspection and probing. In grade 1 the lesions were superficial, in grade 2 there was fissuring or degeneration of less than 50% of the thickness of the articular cartilage, in grade 3 these changes involved more than 50% of the thickness and in grade 4 there was erosion of the cartilage was down to the subchondral bone.

The anterior talofibular, calcaneofibular, deltoid and anterior tibiofibular ligaments (ventral syndesmosis) were likewise assessed by inspection and probing. Ligamentous injuries were graded according to the extent of the tears and instability as partial with a tear of less than 50% of the ligament without complete instability, and complete with a tear of the entire ligament or bony avulsion with instability.

We performed statistical analysis using the Cochran-Armitage Trend test. The level of significance was set at $p = 0.05$.

Results

There were no complications as a result of the arthroscopy or the open reduction and internal fixation. Inflation with CO_2 did not give problems or interfere with the open

Table III. Age of the 288 patients related to the type of fracture

Age (yr)	A.1	A.2	A.3	B.1	B.2	B.3	C.1	C.2	C.3	Total
<20	0	1	2	5	1	3	2	0	2	16
20 to 29	0	2	1	11	8	3	6	6	5	42
30 to 39	0	1	0	16	10	11	6	5	7	56
40 to 49	2	3	0	18	15	10	3	3	6	60
50 to 59	0	0	0	12	11	12	5	3	4	47
60 to 69	0	0	0	9	12	10	3	1	1	36
70 to 79	0	2	0	8	5	1	1	3	1	21
>79	0	0	0	0	5	2	1	2	0	10
Total	2	9	3	79	67	52	27	23	26	288

Table IV. Relation between cartilage lesion and fracture type of the 288 patients, by percentage

Cartilage lesion on		A.1 (n = 2)	A.2 (n = 9)	A.3 (n = 3)	B.1 (n = 79)	B.2 (n = 67)	B.3 (n = 52)	C.1 (n = 27)	C.2 (n = 23)	C.3 (n = 26)	Total (n = 288)
Talus											
Grade	0	50.0	55.6	33.3	40.5	31.3	26.9	18.5	8.7	26.9	30.6
	1	0.0	22.2	33.3	40.5	41.8	34.6	51.9	52.2	34.6	40.2
	2	50.0	22.2	0.0	13.9	19.4	21.2	14.8	34.8	23.1	19.5
	3	0.0	0.0	33.3	5.1	7.5	17.3	14.8	4.3	15.4	9.7
Pilon tibiale											
Grade	0	100.0	66.7	66.7	75.9	61.2	26.9	55.6	30.4	34.6	54.2
	1	0.0	22.2	33.3	17.8	20.9	34.7	18.5	43.5	23.1	24.3
	2	0.0	11.1	0.0	6.3	7.5	21.1	11.1	17.4	26.9	12.5
	3	0.0	0.0	0.0	0.0	11.4	17.3	14.8	8.7	15.4	9.0
Medial malleolus											
Grade	0	100.0	44.4	66.7	83.4	49.3	44.2	70.4	34.8	46.2	58.7
	1	0.0	22.2	33.3	12.7	31.3	32.7	18.5	43.5	23.0	25.0
	2	0.0	33.3	0.0	1.3	4.5	5.8	7.4	4.3	15.4	5.9
	3	0.0	0.0	0.0	2.6	14.9	17.3	3.7	17.4	15.4	10.4
Fibula											
Grade	0	50.0	66.7	33.3	49.4	58.3	36.5	74.1	69.6	65.4	54.7
	1	0.0	11.1	33.3	15.1	19.4	23.2	11.1	17.4	11.5	17.1
	2	50.0	11.1	0.0	16.5	10.4	11.5	3.7	4.3	7.7	11.1
	3	0.0	11.1	33.3	19.0	11.9	28.8	11.1	8.7	15.4	17.1

Fig. 1a

Fig. 1b

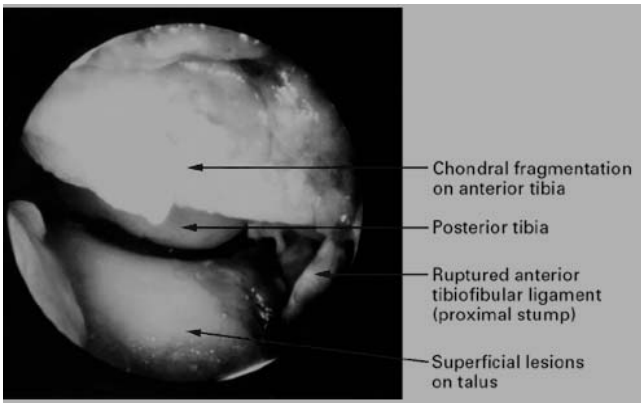

Fig. 1c

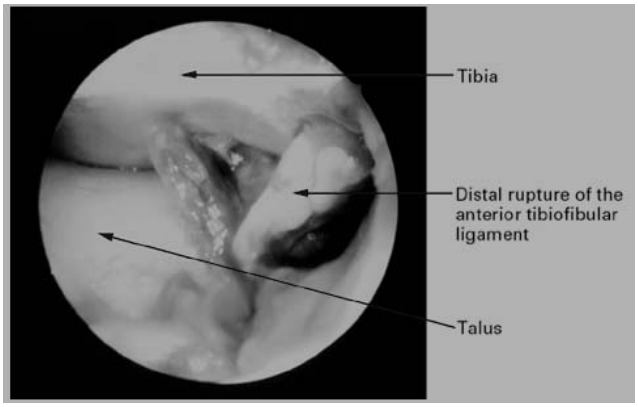

Fig. 1d

Type B.1 fracture in a 57-year-old man (a,b). Arthroscopy revealed deep chondral fragmentation on the anterior tibia (grade 4) and superficial lesions on the talus (grade 1) (c). There was a distal rupture of the anterior tibiofibular ligament in this highly unstable ankle (d).

reduction and internal fixation which followed.

Lesions of the cartilage (Figs 1 and 2) were found in 228 ankles (79.2%), more often on the talus (200, 69.4%) than on the distal tibia (132, 45.8%), the fibula (130, 45.1%) or the medial malleolus (119, 41.3%) (Table IV). The frequency and severity of the lesions increased from type-B to type-C fractures ($p < 0.05$). Within each type of fracture the lesions increased from subgroups 1 to 3 ($p < 0.05$) (Table IV).

More lesions were found in men than in women ($p < 0.05$) and in general they were more severe in men ($p < 0.05$). There were also more lesions in the age groups of between 20 and 40 years and over 70 years in men (Table V), whereas in women they were more common between 30 to 39 years and over 60 years (Table V). They also tended to be worse in patients under 30 years and in those over 60.

The ligaments could not always be identified by arthroscopy and there were significant differences between the four. The anterior tibiofibular ligament (Figs 1 and 3) was seen in 266 patients (92.4%), the deltoid ligament (Fig. 3) in 243 (84.4%) and the anterior talofibular ligament in 218 (75.7%). Injuries to the lateral ligament were seen more often in type-B than in type-C fractures ($p < 0.05$), but there was no difference in the frequency of injuries of the deltoid ligament with the exception of type-B.1 fractures (Table VI). Damage to the anterior tibiofibular ligament occurred with increasing frequency from type-B.1 to type-C.3 fractures ($p < 0.05$), although it was not ruptured in all cases.

Fig. 2a

Fig. 2b

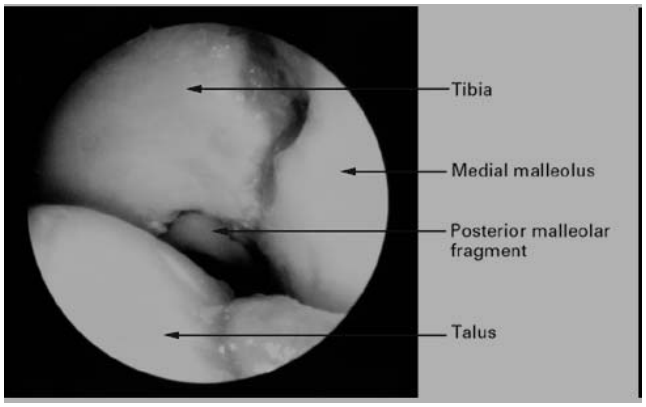

Fig. 2c

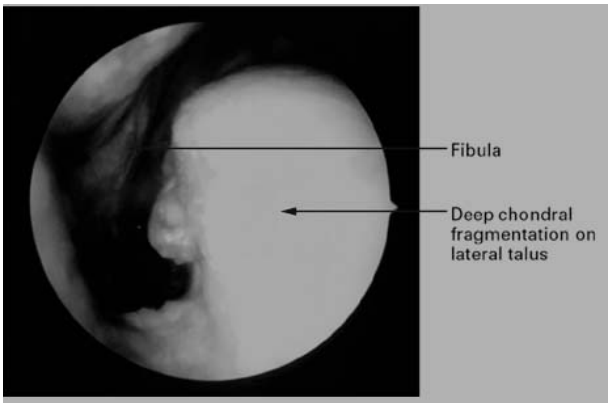

Fig. 2d

Type B.3 fracture in a 52-year-old man (a,b). Using arthroscopy, the fragment of the posterior malleolus was localised posteromedially. The y-shape fracture of the distal tibia was found to be combined with a subluxation of the posterior tibial tendon (c). In addition, there was deep chondral fragmentation on the lateral talus (grade 3) (d).

Arthroscopy was used successfully to assist in the removal of haematoma, debris and frayed cartilage and bone in 41 patients (14.2%), in the reduction of interposed stumps of ruptured ligaments in nine (3.2%), in the reduction of interposed periosteum in four (1.4%), in pinning back a loose osteochondral fragment into place in six (2.1%) and in closed reduction of a fracture and fixation in 21 (7.3%).

There were 18 minor complications. In 13 patients there was transient impaired function of the superficial peroneal nerve which settled uneventfully. Persistent irritation of a scar was found in four patients and local pain in one. One synovial cyst which developed at the central portal healed after excision. There were no arterial injuries or infections.

Discussion

Injuries to the ankle result from abnormal movement of the talus within the ankle mortise. Fractures of the malleoli are caused by the impact of the talus on the malleoli, either by rotational or translational forces. They can also occur in tension, and the malleoli can be avulsed because of the pull exerted by the intact collateral ligaments on the talus.[9,11,12]

The treatment of fractures of the ankle is still determined

Fig. 3a

Fig. 3b

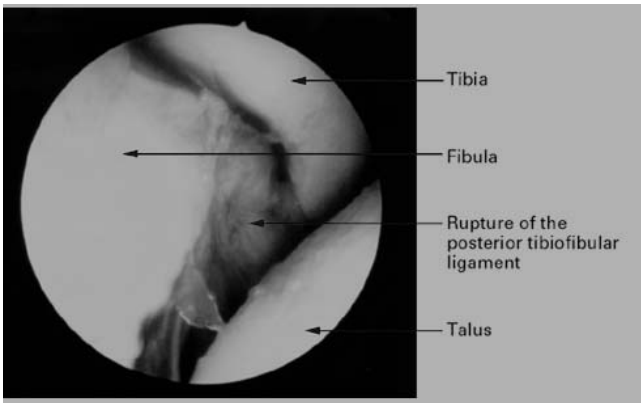

Fig. 3c

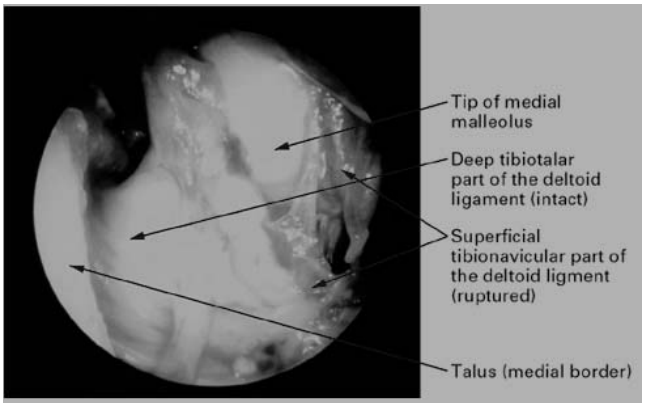

Fig. 3d

Type B.1 fracture in a 47-year-old man (a,b). Arthroscopy revealed an extended rupture of the posterior tibiofibular ligament which resulted in significant instability of the distal fibula (c). The superficial tibionavicular part of the deltoid ligament was completely ruptured while the deep tibiotalar part remained intact (d).

by classifications of injury which were derived at a time when the ankle was thought to be a simple hinge and were based only on plain radiographs. This may explain why the final results do not always correlate with the extent of bony damage, and the reduction and stability achieved. It also suggests the need for studies to determine how and to what extent accompanying injuries can predict the outcome of such fractures.

Independent of the type of fracture, lesions of cartilage were found most often on the talus, and to a less extent on the tibia, fibula and medial malleolus. The frequency and severity of these lesions increased from type-B to type-C fractures, and there was also an increase from subgroups 1 to 3 in both type-B and type-C fractures. These findings support the general belief that the severity of injury depends on the height of the fibular fracture. The fact that there was an unexpected high incidence of lesions of cartilage in all types of fracture may explain the common observation that the final results do not always correlate with the reduction and stability achieved. The prognosis is determined at the time of the accident.

Lesions of cartilage occur when the talus is rotated or translated in the loaded ankle mortise until the fracture occurs. This may be especially true for type-C fractures, but also to a less extent for type-B fractures as long as the underlying mechanism is pronation and/or rotation. Trauma in supination, as is the cause of type-A fractures, may stress the medial half of the joint, but the forces may not be as

high as in pronation/rotation. In nine patients Taga et al[13] found lesions of the cartilage in the medial joint after an acute ankle sprain in 89% and in 95% of 22 patients with chronic sprains. They found more cartilage lesions on the distal tibia than on the medial talus. They concluded that these injuries were caused by local stress concentration. They found no correlation between the severity of the lesion and the degree of instability. This may support our belief that such lesions occur at the time of the acute injury.

The higher incidence of cartilage lesions in female patients can be explained by various factors. First, the cartilage may be less resistant to mechanical stress.[14] Secondly, it may have become more vulnerable with increasing age since the age of our female patients was significantly higher. Thirdly, the overall muscular and bony strength is lower so that the fracture probably occurs at an earlier phase of the injury, and with a higher incidence, thus exposing the articular surfaces to a higher risk of damage. This may be especially true in the elderly patient.

Table V. The frequency and severity of cartilage lesions in the talus in 148 male and 140 female patients depending on age

Age (yr)	Grade 0	1	2	3	Total
Male					
<20	7	5	0	1	13
20 to 29	7	10	7	5	29
30 to 39	16	7	9	3	35
40 to 49	12	16	5	0	33
50 to 59	8	9	1	3	21
60 to 69	5	4	2	1	12
70 to 79	0	2	2	1	5
>79	0	0	0	0	0
Total	55	53	26	14	148
Female					
<20	1	2	0	0	3
20 to 29	5	6	1	1	13
30 to 39	3	9	6	3	21
40 to 49	9	11	4	3	27
50 to 59	9	10	4	3	26
60 to 69	5	11	8	0	24
70 to 79	3	10	2	1	16
>79	0	5	3	2	10
Total	35	64	28	13	140

Ligamentous injuries with fractures are a controversial topic.[11,12] It is generally accepted that the higher the fracture is in the fibula, the more extensive is the damage to the anterior tibiofibular ligament and the greater the likelihood that the ankle mortise will be unstable. Our study has shown that the anterior tibiofibular ligament ruptured in most, but not all type-C fractures, and, to a less extent, in type-B fractures. There were also injuries to other ligaments, especially the deltoid and anterior talofibular.[9,15]

Associated lesions of cartilage and injuries to the soft tissues remain a diagnostic challenge in acute injuries to the ankle. The diagnosis cannot be made by plain radiography. MRI may be helpful in detecting these lesions, but its routine use would be extremely expensive and not yet justifiable. In our study, arthroscopy was shown to be reliable in identifying these lesions and to a less extent ligamentous injuries. The data revealed by this prospective study of consecutive ankle fractures give the first systematic assessment of intra-articular lesions in acute fractures of the ankle and may increase our knowledge and understanding of the mechanisms of such injuries. A longer follow-up is necessary to determine the predictive value of these intra-articular lesions.

Arthroscopy through a singular anterocentral portal allowed excellent views within the fractured ankle. The use of CO_2 did avoid swelling of the soft tissues and no complications were noted. The CO_2 was not combined with nitrous oxide, and a tourniquet was used. The overall complication rate of 6.3% was extremely low, and most complications healed uneventfully.

Arthroscopy has been shown to be valuable for a detailed knowledge of the fractured ankle (Fig. 2).

The added time and morbidity are minimal and the examination can be done by manual distraction. It allows the surgeon to minimise the open approach and avoid secondary damage to the surrounding tissues. Although not

Table VI. Ligament lesion and fracture type in the 288 patients

Ligament lesion	A.1 (n = 2)	A.2 (n = 9)	A.3 (n = 3)	B.1 (n = 79)	B.2 (n = 67)	B.3 (n = 52)	C.1 (n = 27)	C.2 (n = 23)	C.3 (n = 26)	Total (n = 288)
Anterior talofibular										
Intact	0	2	1	21	22	20	7	8	6	87
Partially ruptured	0	3	1	21	24	12	4	4	5	74
Ruptured	1	2	0	17	9	12	4	4	8	57
Not seen	1	2	1	20	12	8	12	7	7	70
Deltoid ligament										
Intact	1	1	1	50	30	22	7	9	8	129
Partially ruptured	0	2	0	16	9	9	5	2	7	50
Ruptured	0	1	0	4	20	17	9	5	8	64
Not seen	1	5	2	9	8	4	6	7	3	45
Anterior tibiofibular										
Intact	1	4	1	31	22	9	3	2	3	76
Partially ruptured	0	3	0	20	17	16	9	2	5	72
Ruptured	0	0	0	27	23	23	11	17	17	118
Not seen	1	2	2	1	5	4	4	2	1	22

yet proven, it is likely that after lavage and debridement of an acute fracture of the ankle, the postoperative range of movement improves more quickly.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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