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Early weight bearing of displaced ankle fractures

Torbjörn Ahl, Nils Dalén, Sven Holmberg and Göran Selvik[1]

A prospective randomized study was performed comparing immediate and late weight bearing in 53 dislocated bimalleolar and trimalleolar fractures. Using cerclage, staples, and pins (Cedell 1967), an exact reconstruction of the ankle mortise was achieved in 41/53 ankles. At follow-up after 3 and 6 months, the two groups were equal regarding clinical results. Evaluation radiographically and by roentgen stereophotogrammetric analysis (Selvik 1974) indicated that the stability of the ankle mortise was sufficient to allow early postoperative weight bearing.

In recent decades open reduction and internal stabilization of dislocated bimalleolar and trimalleolar ankle fractures has become the treatment of choice (Cedell 1967, Hughes et al. 1979, Lindsjö 1985, Pettrone et al. 1983, Roberts 1983, deSouza et al. 1985).

In a previous study of displaced lateral malleolar fractures, we have shown that weight bearing from the first postoperative day was well accepted by the patients and did not cause redisplacement of the fractures (Ahl et al. 1986).

The aim of this study was to compare early and late weight bearing of operated on bimalleolar and trimalleolar fractures.

Patients and methods

From March 1984 through April 1986, 53 displaced bimalleolar and trimalleolar ankle fractures were studied prospectively. After operation, all the fractures were randomly allocated to either early or late weight bearing, i.e., from the first postoperative days (n 25) or the fourth (n 28) postoperative week. A below-the-knee cast was used for 7 weeks in both groups. Excluded from the study were children, patients with open fractures or injuries interfering with the rehabilitation program, and those unable to cooperate, e.g., alcoholics and drug addicts.

The study was approved of by the ethics committee at Karolinska Institute.

The mean age was 57 years and comparable regarding the two groups. The ratio male/female was 10/15 and 6/22 in the early and late weight-bearing groups, respectively. The fractures were classified (Table 1) according to Lauge-Hansen (1942) and Weber (1972). A fracture of the posterior tibial margin was present in 45/53 cases. Postoperative residual displacement was classified according to Cedell (1967).

Table 1. Fracture classification (ankles stereophotogrammetrically analyzed are given in brackets)

		Early weight bearing	Late weight bearing
Weber			
B		12 (6)	15 (7)
C		13 (11)	13 (9)
Total		25 (17)	28 (16)
Lauge-Hansen			
Supination-eversion	IV	13 (7)	14 (6)
Pronation-abduction	III	6 (5)	6 (5)
Pronation-eversion	III	1 (0)	1 (1)
	IV	5 (5)	7 (4)
Total		25 (17)	28 (16)

Karolinska Institute, Department of Orthopedics, Danderyd Hospital, S-182 88 Danderyd, and [1]Department of Anatomy, University of Lund, Lund, Sweden

The operations were performed by all the staff surgeons using cerclage wires, staples, and pins (Cedell 1967). Three fractures of the posterior tibial margin included more than one third of the articular surface and two of these were operated on using a screw.

Roentgen stereophotogrammetric analysis. Radiographic examinations, including roentgen steophotogrammetric analyses (Selvik 1974, 1983, Kärrholm et al. 1984), were performed postoperatively, at 3 and 7 weeks, and after a minimum of 3 months. Peroperatively, we inserted three to five tantalum balls into the medial and lateral malleolus, the distal tibia, and in some cases into the fibula proximal to the fracture site (Figure 1). During roentgen stereophotogrammetric examination, the ankles were placed in a calibration cage with approximately 20 degrees of internal rotation of the foot. Simultaneous exposures of the ankle were performed using two x-ray tubes positioned at a right angle. The three-dimensional coordinates for each tantalum marker were determined. The rigid-body model of the markers in each segment was tested; misplaced or mobile markers were excluded. Further analyses recorded the translation and rotation of each segment.

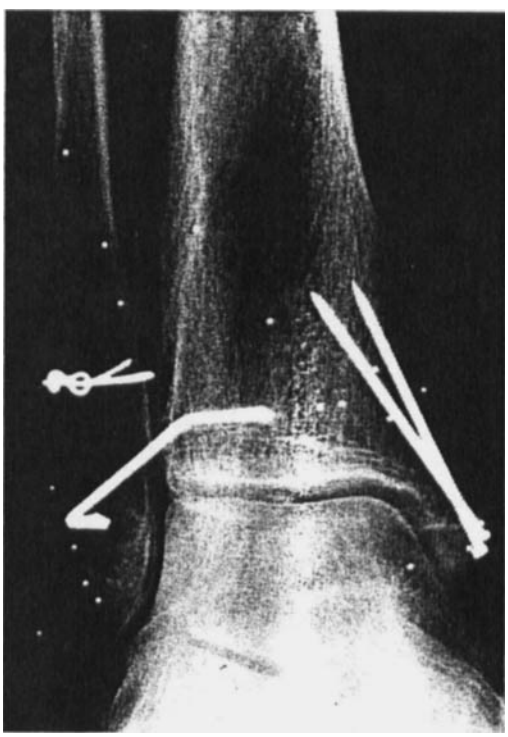

Figure 1. Tantalum bone markers and osteosynthesis devices.

The error of the method is about 50 micrometers and 0.2 degrees (1 SD) for translations and rotations, respectively (Selvik 1974).

Forty-four patients agreed to participate in the roentgen stereophotogrammetric examination (Tables 1 and 4), but due to technical failures when inserting the tantalum markers, 11 cases were not possible to analyze. In 31 of the remaining 33 cases, complete analysis of both translation and rotation movements of the lateral maleolus was performed. Because of the close position of the tantalum markers in the medial malleolus, only translation movements of the medial malleolus have been analyzed.

Follow-up. At follow-up, 3 and 6 months postoperatively (Table 2), we recorded the ankle and calf circumferences and the range of loaded dorsal and plantar ankle flexion, expressed as a percentage of the uninjured ankle (Lindsjö 1981). The precision was determined by repeated measurements of 30 individuals. The measurement error (1 SD) expressed as a percentage of the maximal flexion capacity was 6 and 5 per cent, respectively, for dorsal and plantar ankle flexion.

The patients filled in a questionnaire answering questions about pain at rest and at weight bearing, stiffness, swelling, stair climbing, walking, and running capacity, and the use of supports. Walking capacity and capacity for sports and activities during leisure time were also evaluated. A linear analogue scale with the extreme "perfectly normal ankle" set at 100 per cent and the other extreme "totally disabling ankle" set at zero per cent was also used (Olerud & Molander 1984).

Of 53 patients included in this study, 2 patients, both belonging to the late weight-bearing group, were lost to follow-up; 1 preferred not to participate further and 1 died.

Table 2. Comparison of early and late weight bearing after operative treatment of ankle fractures. Mean values (SD) in percentage of uninjured side

	3 months		6 months	
	Early n 24	Late n 23	Early n 24	Late n 25
Ankle circumference	108 (5)	107 (7)	105 (4)	105 (4)
Calf circumference	97 (3)	96 (2)	98 (2)	97 (3)
Loaded dorsal flexion	59 (17)	52 (24)	77 (16)	69 (13)
Loaded plantar flexion	73 (19)	76 (14)	85 (12)	87 (11)

The Student's t-test and the chi-square test were used for statistical analysis. $P < 0.05$ was considered significant.

Results

Superficial wound infection or skin irritation occurred in 6 cases in the early weight bearing group and in 2 cases in the late weight bearing group. The difference was not significant. No deep infection occurred. All the fractures healed and no reoperation was performed. Time spent in the hospital averaged 4 days in both groups.

No differences between the two groups regarding objective (Table 2) or subjective results were found. At 6 months 28/49 patients were completely free of pain during walking. All the patients had a capacity of dorsal and plantar flexion exceeding 10 and 25 degrees, respectively, and only 3/49 patients expressed a feeling of severe ankle stiffness. Constant ankle swelling was present in 13/49 and swelling in the evenings only in 19/49 patients.

Postoperative residual displacement of the lateral or medial malleolus was present in 12/53 ankles (Table 3). A redislocation occurred in 1 case belonging to the early weight bearing group. This redislocation was caused by a new trauma during the second postoperative week when the patient was treated a short time without a cast because of a superficial wound infection. Roentgen stereophotogrammetric analysis revealed a total translation of 4.5 mm of both the lateral and the medial malleolus.

Roentgen stereophotogrammetric analyses showed only minimal movements in the ankle mortise (Table 4) without differences between the groups being found.

Table 3. Residual displacement after operative treatment of ankle fractures. Cedell classification (1967)

	Early weight bearing n 25	Late weight bearing n 28
Lateral malleolus		
anatomic	23	26
good	0	1
poor	2	1
Medial malleolus		
anatomic	22	23
good	2	4
poor	1	1
Posterior tibial fragment		
anatomic	3	4
good	13	10
poor	6	9

Table 4. Roentgen stereophotogrammetric analysis at 3 months compared with the postoperative analysis. Mean values in mm or degrees (SD)

	Early weight bearing n 16	Late weight bearing n 16
Movements of the lateral malleolus in relation to the tibia		
Widening of the ankle mortise (mm)	0.3 (0.6)	0.3 (0.6)
Proximal translation (mm)	−0.1 (0.7)	0.3 (0.7)
Ventral translation (mm)	−0.6 (0.9)	−0.6 (0.9)
Varus angulation (degrees)	0.7 (2.0)	0.6 (1.3)
Dorsal angulation (degrees)	1.2 (2.0)	1.3 (1.6)
Outward rotation (degrees)	1.6 (2.3)	1.4 (1.8)
Movements of the medial malleolus in relation to the tibia		
Medial translation (mm)	0.1 (0.3)	0.0 (0.3)
Proximal translation (mm)	0.0 (0.5)	0.0 (0.3)
Ventral translation (mm)	0.0 (0.2)	0.1 (0.4)
Movements of the lateral malleolus in relation to the proximal fibula		
Compression of the lateral malleolar fracture (mm)	0.2 (0.6)	0.7 (0.6)

Discussion

Early postoperative weight bearing facilitates rehabilitation. After operations on ankle fractures performed according to the AO principles, Lindsjö (1985) allowed weight bearing in a walking cast after a few days of active movements, whereas others, using the same operative technique, have not allowed weight bearing until several weeks after operation (Bauer et al. 1985, Leeds & Ehrlich 1984, deSouza et al. 1985). In our study a minimum of osteosynthesis devices, such as wires, small staples, and pins, have been used. To our knowledge, when using this technique, only late weight bearing has been advocated when dealing with bimalleolar fractures (Cedell 1967, Olerud & Molander 1986).

Compared with isolated lateral malleolar fractures, bimalleolar and trimalleolar fractures have become more common among older patients, especially in females with osteoporosis (Bengnér et al. 1986). Nevertheless, an anatomic reconstruction of the ankle mortise could be achieved in 41/53 ankles, and in 7/12 displaced ankles the residual displacement was minimal, never exceeding 1 mm (Table 3). These results are comparable to results presented by Lindsjö (1985). Unacceptable results, with remaining displacement in 67/134 operated on ankles, when using an operative technique similar to ours, have been presented in a retrospective study (Olerud & Molander 1986). Their results and conclusions are not in agreement with our experience.

The total range of ankle motion during normal gait has been estimated at approximately 25 degrees, including 10 degrees of dorsal and 15 degrees of plantar flexion (Stauffer et al. 1977, Wright & Desai 1964). At 6 months' follow-up, all our ankles had a capacity of motion exceeding these values. Both in our earlier study concerning isolated lateral malleolar fractures (Ahl et al. 1986) and in the present study, we have found a tendency to better loaded dorsal ankle flexion in the early weight bearing group.

Superficial wound infections and skin irritations were, although not significantly, more common in the early weight bearing group and might justify weight bearing to be postponed a few days to allow preliminary wound healing.

We conclude that with the operative technique of Cedell (1967) the stability of the ankle mortise is usually sufficient to allow early postoperative weight bearing in a walking cast.

References

Ahl T, Dalén N, Holmberg S, Selvik G. Early weight bearing of malleolar fractures. Acta Orthop Scand 1986;57(6):526–9.

Bauer M, Bergström B, Hemborg A, Sandegård J. Malleolar fractures: nonoperative versus operative treatment. A controlled study. Clin Orthop 1985;(199):17–27.

Bengnér U, Johnell O, Redlund-Johnell I. Epidemiology of ankle fracture 1950 and 1980. Increasing incidence in elderly women. Acta Orthop Scand 1986;57(1):35–7.

Cedell C A. Supination outward rotation injuries of the ankle. A clinical and roentgenological study with special reference to the operative treatment. Acta Orthop Scand 1967;(Suppl 110).

Hughes J L, Weber H, Willenegger H, Kuner E H. Evaluation of ankle fractures: non operative and operative treatment. Clin Orthop 1979;(138):111–9.

Kärrholm J, Hansson L I, Selvik G. Changes in tibiofibular relationships due to growth disturbances after ankle fractures in children. J Bone Joint Surg (Am) 1984;66(8):1198–210.

Lauge-Hansen N. Ankelbrud 1. Genetisk diagnose og reposition. Thesis, Copenhagen, 1942.

Leeds H C, Ehrlich M G. Instability of the distal tibiofibular syndesmosis after bimalleolar and trimalleolar ankle fractures. J Bone Joint Surg (Am) 1984;66(4):490–503.

Lindsjö U. Operative treatment of ankle fractures. Acta Orthop Scand 1981; (Suppl 189):1–131.

Lindsjö U. Operative treatment of ankle fracture dislocations. A follow-up study of 306/321 consecutive cases. Clin Orthop 1985;(199):28–38.

Olerud C, Molander H. A scoring scale for symptom evaluation after ankle fracture. Arch Orthop Trauma Surg 1984;103(3):190–4.

Olerud C, Molander H. Bi and trimalleolar ankle fractures operated with nonrigid internal fixation. Clin Orthop 1986;(206):253–60.

Pettrone F A, Gail M, Pee D, Fitzpatrick T, Van Herpe L B. Quantitative criteria for prediction of the results after displaced fracture of the ankle. J Bone Joint Surg (Am) 1983;65(5):667–77.

Roberts R S. Surgical treatment of displaced ankle fractures. Clin Orthop 1983;(172):164–70.

Selvik G. A roentgen stereophotogrammetric method for the study of the kinematics of the skeletal system. Thesis, University of Lund, Sweden 1974.

Selvik G. Roentgen stereophotogrammetry in orthopaedics. In: Biostereometrics '82 (Ed. Herron R E). Proceedings of the Society of Photo-optical Instrumentation Engineers. Bellingham, WA, 1983;361: 178–85.

de Souza L J, Gustilo R B, Meyer T J. Results of operative treatment of displaced external rotation abduction fractures of the ankle. J Bone Joint Surg (Am) 1985;67(7):1066–74.

Stauffer R N, Chao E Y, Brewster R C. Force and motion analysis of the normal, diseased, and prosthetic ankle joint. Clin Orthop 1977;(127):189–96.

Weber B G. Die Verletzungen des oberen Sprunggelenkes. Aktuelle Probleme in der Chirurgie, 2. Aufl. Verlag Hans Huber, Bern 1972;3.

Wright D G, Desai S M. Action of the subtalar and ankle joint complex during the stance phase of walking. J Bone Joint Surg (Am) 1964;46(2):361–82.