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IMPORTANCE OF ANATOMICAL REDUCTION FOR SUBJECTIVE RECOVERY AFTER ANKLE FRACTURE

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237 patients with ankle fractures treated during 1977 were evaluated with the object of studying the treatment results and the factors influencing the results. About one half of the patients were treated conservatively and the other half operatively. The type of treatment was determined by the type of injury; hence the milder injuries were usually treated conservatively and the more severe cases operatively. A good radiological primary result was obtained in 82 per cent of the malleoli with operative treatment and in 34 per cent with conservative treatment. The evaluation of the end-result was based on a questionnaire study made 1.5–2.5 years after the accident. All those employed before their injuries had returned to their previous occupations. 27 per cent of the patients responded that they had recovered completely. The subjective end-result was found to correlate with the radiological result at the end of the treatment, but not with the type of injury, the type of treatment, or the patient's age.

Key words: ankle joint injuries; internal fracture fixation; malleolar fractures

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An ankle fracture is one of the most common types of fracture in the working-age population in Finland (Slätis 1972). Because the fracture is most often intra-articular and located in a joint carrying the entire body weight, high demands must be placed on the treatment results. As the operative treatment of severely dislocated and unstable ankle fractures has become common, severely disabling consequences have become rather rare (Klossner 1962, Müller et al. 1978, Hughes et al. 1979, Mitchell et al. 1979).

The previously reported results of ankle fracture treatment vary considerably, apparently at least partly because of differences in the series and the criteria of evaluation. The proportion of those recovered to a nearly or completely asymptomatic state has been in many series about 50–60 per cent (Solonen & Lauttamus 1965, Müller 1975, Sarkisian & Cody 1976, el Banna et al. 1978, Müller et al. 1978).

The object of this study was to clarify the success of fracture reduction achieved by operative and conservative treatment and the influence of various factors on the patients' subjective recovery.

PATIENTS AND METHODS

This retrospective series comprised 237 new ankle fracture patients, aged over 15 years, who had been treated as either inpatients or outpatients in the Tampere Central Hospital in 1977 (239 fractures). These included 128 men and 109 women. The mean age of the patients was 46 years, with ages ranging from 16 to 85 years (Figure 1).

The medical histories of the patients were reviewed and their radiographs checked. In analyzing the data

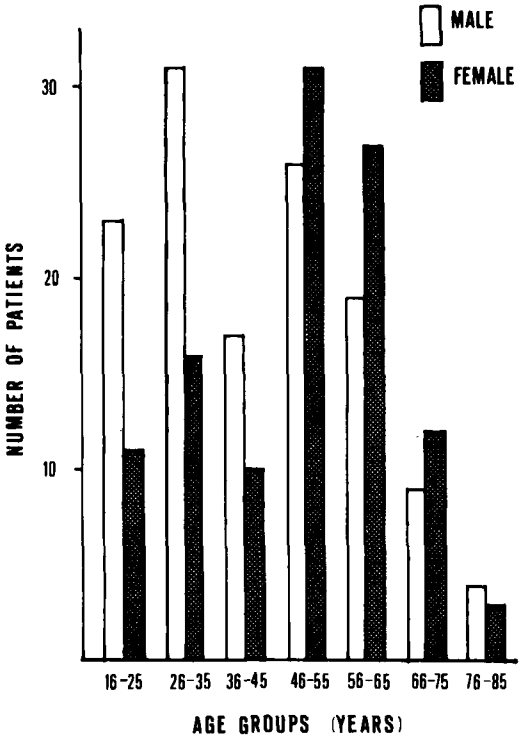

Figure 1. Age distribution of the 237 ankle fracture patients by sex.

and in testing the statistical hypotheses, professional advice was utilized (Univac 1100, the Computer Center, University of Tampere).

Radiographs

The radiological results were estimated from the radiographs taken immediately after the primary treatment and at the end of the treatment (2–3 months after the accident).

The radiological result was considered good when there was no dislocation; fair, if even a minor dislocation was discovered (< 2 mm); and poor, if the dislocation was considerable (≥ 2 mm). The treatment result of a syndesmosis was considered poor if the articular fork had remained wider than normal (≥ 2 mm). The degree of posttraumatic or postoperative osteoarthritis could not be estimated, because late radiographs were not available.

Questionnaire

The subjective end-result was investigated with a questionnaire sent to the patients 1.5–2.5 years after the injury. Two hundred and six (87 per cent) patients returned the questionnaire. The address of 15 patients (6 per cent) was unknown, and 16 (7 per cent) failed to respond for other reasons. The data acquired about the subjective end-results can thus be considered to cover the whole patient series fairly well. The factors that possibly influenced the subjective end-result and the duration of sick-leave were studied with regression analysis.

Ankle injuries

Home and leisure-time accidents had caused 78 per cent of the fractures, traffic accidents 8 per cent, occupational accidents 7 per cent, and accidents in athletic activities 6 per cent.

Table 1. Combinations of injuries in 230 ankle fractures (number of cases)*

Bone injuries	Associated ruptures of the ligaments				Total
	None	Lateral ligaments	Medial ligaments	Syndesmosis	
Fracture of the lateral malleolus	ⓝ92	–	ⓝ28	–	120
Fractures of the medial malleolus	10	3	–	1	14
Bimalleolar fracture	ⓝ23	–	–	11	34
Fracture of the lateral malleolus and the posterior trigonum	–	–	12	–	12
Trimalleolar fracture	ⓝ31	–	–	ⓝ19	50
Total	156	3	40	31	230

* The material included nine cases of uncommon combinations, which are omitted from this table; in six of those the syndesmosis was ruptured.

ⓝ The five most common combinations.

Table 2. Clinical stability of 226 ankle joints by Weber's groups (number of cases)*

Clinical stability	Weber's groups			Total
	A	B	C	
Stable	42	42	3	87
Uncertain	9	24	5	38
Unstable	3	68	30	101
Total	54	134	38	226

* The material included 13 more cases, but in those the classification was uncertain.

Two patients had fractures in both ankles. Thirteen of the fractures were open (5.4 per cent). There were no nerve or blood vessel injuries requiring treatment.

The most common injury was a plain fracture of the lateral malleolus (39 per cent), and the most common combined injury was a trimalleolar fracture (13 per cent). The most common five combinations covered 81 per cent of the material (Table 1).

Nearly three-fifths of the fractures belonged to Weber's (1966) class B. Six per cent of the class A fractures were unstable and 8 per cent of the class C fractures were stable (Table 2). Weber's class influenced highly significantly the clinical stability of the fracture ($P < 0.001$, chi-square test).

Treatment

Most of the fractures of the medial malleolus, large fractures of the posterior trigonum and ruptured syndesmoses were treated operatively, but most of the plain fractures of the lateral malleolus and the fractures of the posterior trigonum, less than one quarter of the articular surface in size, were treated conservatively (Table 3). Weber's class, dislocation of the fracture, and its stability essentially influenced the choice of treatment, but the patient's age did not (Table 4).

Table 3. Treatment of the ankle injuries

Site of injury	No. of cases	Treatment	
		Operative reduction and fixation	Non-operative reposition
Lateral malleolus	220	97	123
Medial malleolus	103	88	15
Posterior trigonum of tibia	65 (10)	18 (9)	47 (1)
Syndesmosis	37	23	14

( ) Fragment more than 1/4 of the articular surface.

Table 4. Differences between the operatively and conservatively treated groups of patients

Classifications	Treatment		No. of cases*
	Operative ($n=124$)	Conservative ($n=115$)	
Weber's group			
A	11	43	54
B	75	59	134
C	33	5	38
Dislocation			
non-dislocated	5	87	92
dislocated	119	26	145
Stability			
stable	11	82	93
unstable	95	10	105
Age of the patients $\bar{x}\pm SD$ (years)	46±16	46±17	237

* The material is not complete in the classifications because of some uncertain cases.

The regimen in conservative treatment was usually immobilization with a leg plaster cast for 4–6 weeks. During the last 2–3 weeks the patient was usually allowed partial or full weight-bearing on the cast.

If an operation was performed, all the injured malleoli were usually fixed and the ligaments sutured. The use of a screw was the most common operative method; Rush-nailing or tension-band were utilized only exceptionally. Ruptured syndesmosis was usually fixed with a screw. After the operation the ankle was immobilized with a plaster cast generally observing the same principles as in conservative treatment. Syndesmosis screws were removed before full weight-bearing without the cast was allowed. Internal fixation was usually removed if the patient was under 50 years of age.

RESULTS

Radiological results

As revealed by radiographs taken immediately after primary treatment, operative treatment resulted clearly more often in an exact fracture re-

Table 5. Primary radiological results of the operative and conservative treatment of the 220 lateral and 103 medial malleolar fractures

Site of fracture	Treatment					
	Operative*			Conservative		
	No. of patients	Anatomical reduction		No. of patients	Anatomical reduction	
		n	Per cent		*n*	Per cent
Lateral malleolus ($n=220$)	97	80	(83)	123	39	(32)
Medial malleolus $n=103$)	88	72	(82)	15	9	(60)

* All the operative techniques together.

duction than conservative treatment (Table 5), although the operatively treated ankle injuries were considerably more severe (Table 4).

According to radiographs taken at the end of the treatment, screwing the lateral malleolus led to a good result in three-fourths of the cases and Rush-nailing in one quarter of the cases (Table 6). Screwing of the medial malleolus produced a good result in four-fifths of the cases (Table 7). In fractures of the posterior trigonum and in ruptures of the syndesmosis the end-result of operative treatment was nearly always good (16/17 and 17/19, respectively).

Complications

A superficial infection was established in two conservatively and nine operatively treated patients. No deep infections occurred. Local necrosis of the skin was discovered in two operatively treated patients. No deep venous thrombi or pulmonary emboli were revealed.

A total of four patients had late complications; one operatively treated patient encountered a redislocation, and in the conservatively treated patients one delayed union, one non-union, and one refracture were established.

*Table 6. Radiological end-results of the operative treatment of 90 lateral malleolar fractures**

Method of fixation	Radiological end-result (no. of patients)			Total (no. of patients)
	Good	Fair	Poor	
Screwing	55	14	4	73
Rush-nailing	3	7	2	12
Other methods	2	2	1	5
Total	60	23	7	90

* Seven more cases had been operated on, but their radiographs, taken at the end of the treatment, were not available.

*Table 7. Radiological end-results of the operative treatment of 82 medial malleolar fractures**

Method of fixation	Radiological end-result (no. of patients)			Total (no. of patients)
	Good	Fair	Poor	
Screwing	60	10	6	76
Rush-nailing	0	0	1	1
Tension-band	5	0	0	5
Total	65	10	7	82

* Six more cases had been operated on, but their radiographs, taken at the end of the treatment, were not available.

Subjective end-result

As revealed by the questionnaire, 73 per cent of the respondents suffered from some sequelae. The most common symptom was pain (64 per cent), which was most usually felt as exercise-induced pain on the lateral side of the ankle. In almost one half of the patients consequences of the fracture caused some difficulties in physical activities (Table 8), but not serious enough to significantly affect the patients' working capacity (see below).

As shown by the regression analysis, the only significant factor as regards the subjective end-result was the radiological result at the end of treatment: The better the reduction had succeeded, the less sequelae the patient experienced at follow-up ($P < 0.005$). The patient's age, the type of fracture, or the number of injuries had no influence on the subjective result, regardless of whether the treatment had been operative or conservative.

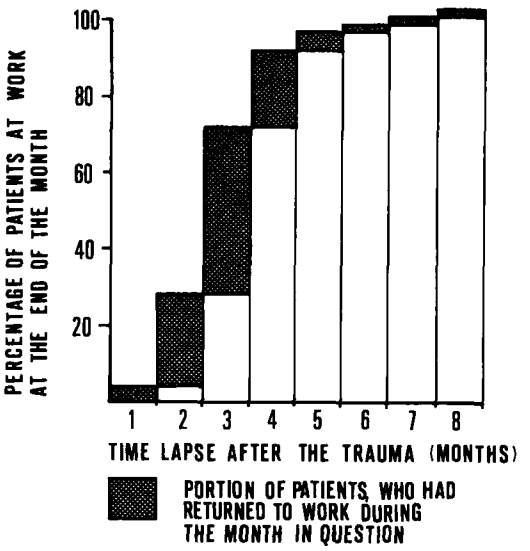

Figure 2. Cumulative monthly return to work of the 135 ankle fracture patients employed before the trauma (12 patients are omitted because the durations of their sick-leaves could not be ascertained).

Working capacity and sick-leaves

At the end of the follow-up period the working capacity of 199 patients (84 per cent) was established. Eleven of these were students, 53 were retired people already on pension before the trauma, and the rest (135 patients) had returned to their previous occupations. The duration of the sick-leave ranged from 2 to 30 weeks with a mean of 11 weeks (Figure 2).

As shown by the regression analysis, the radiological end-result, the patient's age, the type of fracture, the number of injuries, or the form of treatment (operative *vs.* conservative) had no statistically significant influence on the duration of the sick-leave.

*Table 8. Subjective end-results of 206 ankle fracture patients according to the questionnaires 1.5–2.5 years after the trauma**

No sequela		27%
Pain in the ankle		64%
– on the lateral side	42%	
– on the medial side	29%	
– at rest	21%	
– at start of walking	24%	
– at exercise	46%	
Decreased capacity		38%
– powerlessness	24%	
– fatigue	34%	
Stiffness of the ankle		47%
Difficulty of motion		47%
– trouble in walking	27%	
– trouble in running	42%	
– trouble in squatting	31%	
– need for auxillary devices	4%	

* The series included 31 more patients (13 per cent), who did not return the questionnaires.

DISCUSSION

In the present study, evaluation of the radiological end-result was based on the latest available radiographs which had usually been taken far too early as regards development of any arthrotic changes. So, no idea of the prevalence of post-traumatic osteoarthritis in the series was acquired. Yet, in view of the literature, our follow-up period on subjective results may be considered sufficient (Kristensen 1956, Klossner

1962, Solonen & Lauttamus 1965, Wilson & Skilbred 1966, Müller et al. 1971). Still, it has been observed that the subjective late symptoms correlate clearly with the objective findings and occurrence of osteoarthritis (Klossner 1962, Müller et al. 1971, Cedell 1975, Sarkisian & Cody 1976, Henkemeyer et al. 1976, Wheelhouse & Rosenthal 1980) or are less prominent than what might be expected on the basis of the objective status (Klossner 1962, Solonen & Lauttamus 1965). Thus, a follow-up based on questionnaires seemed adequate.

The primary radiological result and the frequency of complications as well as the duration of the sick-leave agreed with several corresponding reports (Klossner 1962, Solonen & Lauttamus 1968, Müller et al. 1971, Sarkisian & Cody 1976, el Banna et al. 1978, Müller et al. 1978, Hughes et al. 1979, Mitchell et al. 1979, Wheelhouse & Rosenthal 1980). The proportion of those who had recovered to be asymptomatic was of the same order, 30 per cent, as in earlier reports (e.g. Klossner 1962, Solonen & Lauttamus 1965, Weiger et al. 1973, Müller 1975, McDaniel & Wilson 1977). Our end-result correlated clearly only with the acquired radiological reduction and not significantly with the type of injury or the form of treatment. The same observation has been made in many other studies (e.g. Klossner 1962, Sarkisian & Cody 1976, Wheelhouse & Rosenthal 1980).

In treating ankle fractures, the importance of anatomical reduction has been increasingly emphasized in recent years (Solonen & Lauttamus 1968, Ramsey & Hamilton 1976, Yablon et al. 1977, Mitchell et al. 1979). In the present series, as in most others, the more severe fractures were usually treated operatively and the milder cases conservatively. Yet, a good radiological result was clearly more often obtained with operative than with conservative treatment. This was particularly so in fractures of the lateral malleolus. On the other hand, the radiological result was the only factor that significantly influenced the subjective recovery. On the basis of these observations operative treatment of dislocated ankle fractures can be recommended.

Although conservative treatment in our material did not result nearly as often in an exact reduction as operative treatment, there was no significant difference between the subjective end-results of the groups. This is probably partly explained by the fact that the group of conservative treatment included selectively milder injuries; but it also supports the observations that a false position left after conservative treatment causes less sequelae than an equally false position after an operation, and that if the reduction is equally good after the two types of treatment, the one treated operatively will have more sequelae (Müller et al. 1971, Weigert et al. 1973, Sarkisian & Cody 1976, McDaniel & Wilson 1977, Müller et al. 1978).

On the basis of our observations and the review of literature we conclude: The most central requirement in the treatment of ankle fractures is the anatomical correction. If this can be securely achieved conservatively, the operation may be avoided. Otherwise, the operative reduction and fixation is necessary.

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