POSTOPERATIVE TREATMENT OF INTERNALLY FIXED ANKLE FRACTURES

A PROSPECTIVE RANDOMISED STUDY

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In a prospective, randomised trial of 81 patients with fractures of the ankle of AO types A, B and C we compared two regimes of postoperative management after internal fixation. The patients were mobilised either non-weight-bearing with crutches or weight-bearing in a below-knee walking plaster.

We found a temporary benefit in subjective evaluation only (65 v 50 points, Mann-Whitney test, cft, $p = 0.02$) for those with a below-knee walking plaster. There were no significant differences between the groups in the loaded dorsal range of movement (25° v 23° , Mann-Whitney test, cft, $p = 0.16$) or in the overall clinical result. Both treatments were considered to be satisfactory and their choice depends on the ability to mobilise non-weight-bearing, wound healing, the type of work and personal preference.

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The standard postoperative management advised by the Association for the Study of Internal Fixation (Müller et al 1969) after the internal fixation of fractures of the ankle is the use of crutches without weight-bearing. It is based on the principle of early active painfree mobilisation of muscles and joints adjacent to the fracture for the prevention of 'fracture disease'.

In several studies using ASIF operative techniques alternative regimes of treatment after operation have been described. Weber (1972) mobilised patients after wound healing with an orthosis in which the weight was partially transmitted to the lower leg with a spring preventing pes equinus. Hanke (1989) used a 'Gehapparat' which is a similar appliance. Lindsjö (1981) applied a below-knee walking plaster.

There have been several prospective randomised trials to compare different types of postoperative treatment. Sonde-naa et al (1986) compared two regimes of plaster immobilisation without weight-bearing. Half of the patients had early active exercises and the use of a removable splint; the other half was not allowed to do exercises. The latter had a temporary increase in pain, swelling and loss of the loaded dorsal range of movement, which appears to justify the ASIF principle of early active exercises.

In 1986 and 1987 Ahl et al reported two studies comparing early and late weight-bearing in plaster for unimalleolar and for bimalleolar and trimalleolar fractures. Operation was by Cedell's (1967) method of adaptive osteosynthesis. All patients were kept in plaster for seven weeks and were randomised either to four weeks of mobilisation without weight-bearing and crutches or to direct weight-bearing. They concluded that early weight-bearing in a below-knee walking plaster was safe, but because of a small risk of superficial wound infection, they advised that weight-bearing should begin after primary wound healing. In 1988 Ahl, Dalén and Selvik presented a further study comparing early weight-bearing in a below-knee walking plaster with an orthosis which was removed five times daily to exercise the ankle. After three months a higher subjective score and a better loaded dorsal range of movement were found in the orthosis group, but as in other studies, the differences were temporary and had disappeared after one year. After a further randomised trial in 1993 they concluded that there were only small differences in the various types of management and as early active weight-bearing in a walking plaster facilitates rehabilitation, this should be preferred. Cimino, Ichtertz and Slabough (1991) found no significant difference in the loaded dorsal range of movement between a group mobilised in a walking plaster and one using a hinged ankle-foot orthosis.

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Table I. Details of 81 patients with ankle fractures

	Plaster (n = 41)	Crutches (n = 40)
Median age in years (range)	35.5 (17 to 77)	37 (15 to 77)
Male:female	24:17	21:19
Right:left	18:23	19:21
Cause of fracture		
Traffic	15	10
Sport	13	16
Domestic	9	9
Work	2	2
Other	2	3
History of fracture	1	
Pre-existing neurological disease	0	1
Soft-tissue injury		
Grade 0	41	39
Grade I	0	1

Table II. Classification of the fractures according to the AO/ASIF system (Olerud and Molander 1984)

AO type A fracture	3
Supination-adduction II (= AO type A2 and A3)	3
AO type B fracture	55
Supination-eversion IV (= AO type B1-B3)	51
Pronation-abduction III (= AO type B3)	1
Not classifiable	3
AO type C fracture	23
Supination-eversion IV (= AO type C1-C3)	8
Pronation-eversion III-IV (= AO type C2)	15
Total	81

We have compared non-weight-bearing 'functional' mobilisation with active exercises and crutches with early weight-bearing using a below-knee walking plaster.

PATIENTS AND METHODS

Between April 1991 and April 1993, we randomised 81 consecutive patients with ankle fractures treated by internal fixation using an odd or even date of accident, to management with either a below-knee walking plaster or with non-weight-bearing mobilisation with crutches. We excluded those with fractures which were assessed as unstable for early mobilisation after the operation (e.g. because of insufficient fixation in severely osteoporotic bone), grade-II and grade-III open fractures (Müller et al 1990), pilon fractures of the tibia, and open injuries to the physcal plate of the distal tibia, and those who were unable to cope with either of the two post-treatment schemes. The details are given in Table I. The fractures were classified according to the AO/

ASIF system (Olerud and Molander 1984), combined with the Lauge Hansen (1942) system (Table II).

Of the 55 patients with AO type-B fractures, 19 (35%) also had a fracture of the medial malleolus and 26 (47%) had a deltoid ligament rupture. Twenty-six (47%) had associated fractures of the posterior malleolus.

In those with AO type-C fractures there were ten associated fractures of the medial malleolus, 13 ruptures of the deltoid ligament and 11 fractures of the posterior malleolus.

The fibular implants consisted of lag screws (41 patients), a one-third tubular plate (30), a tension band (4), a tibiofibular syndesmotic positioning screw (4) and a combination of implants (2). An additional positioning screw was used in six. Internal fixation of the medial malleolar fracture was performed in 27 of 29 patients and of the posterior malleolar fracture in 15 of 37. All positioning screws were removed after a median period of 58 days (46 to 62).

Postoperative management. After rigid internal fixation all patients were treated in a plaster cast for two to five days. After initial wound healing and exercises to prevent equinus and to increase the range of dorsal movement, 41 were randomly allocated to a below-knee walking plaster (17 unimalleolar fractures and 24 bimalleolar or trimalleolar fractures) and 40 to non-weight-bearing with crutches (16 unimalleolar fractures and 24 bimalleolar or trimalleolar fractures). Four of the patients with a positioning screw were in the walking plaster group and six in the other. The median period of hospital admission was six days (2 to 25).

Twenty-three patients received physiotherapy (28%) in the period between six weeks and one year after the operation. Nine (22%) had been in a walking plaster and 14 (35%) on crutches. Two of the patients had Sudeck's dystrophy and were given active exercises. The remaining 21 patients had walking and stabilising exercises, massage (9), ultrasound (2), traction and translation (1), interference (3) and warm compresses (2).

All patients were reviewed at 10 to 14 days, six weeks, three months and one year after operation. After 10 to 14 days the stitches were removed. At each assessment we performed a physical and radiological examination for which lateral and mortise views were taken.

We evaluated the patients subjectively using a modification of the scoring system proposed by Olerud and Molander (1984) (Table III). Patients were also asked to express their complaints, progress in mobilisation and ability to perform everyday activities using a linear analogue scale of 0 to 100. Clinically, they were classified as 'excellent', 'good', 'fair' and 'poor' (Table IV). The loaded dorsal range of movement was measured according to Lindsjö (1981) and the anatomical and radiological features using the criteria of Cedell (1967).

The loaded dorsal range of movement was measured by standing the patient on a small elevated box with the knee and hip flexed. Both ankles were measured. The width of the medial joint line was assessed. Measurements of supination and pronation were not carried out as these movements

Table III. The modified subjective ankle score of Olerud and Molander (1984)

	Score
Pain	
None	25
Minor (weather-dependent)	20
During sports	15
During walking on smooth surfaces	5
Constant and severe	0
Stiffness	
None	10
In the morning	5
Constant	0
Swelling	
None	10
Only in the evening	5
Constant	0
Star-climbing	
No problems	10
Impaired	5
Impossible	0
Sports	
Normal	10
Impaired	5
Impossible	0
Supports	
None	10
Tape or wrap	5
Stick or crutch	0
Daily activity and work	
Unchanged level	25
Loss of tempo	20
Change to easier job or part-time job	10
Severely impaired work capacity or disability to work	0
Total	100

are mainly located in the subtalar ankle joint and in the middle and forefoot (Zwipp 1989). The Cedell (1967) classification describes the separate results of the lateral, medial and posterior malleoli in terms of dislocation in millimetres. Osteoarthritis was assessed by observation of narrowing of the joint space, osteophyte formation and early ligamentous calcification.

Statistical analysis. The results are expressed as the median and the range with, if appropriate, the 95% confidence interval (CI) estimated according to Day (1988) and Gardner and Altman (1989). It was not possible to undertake blind assessment of the treatment groups. As a normal distribution cannot be assumed only non-parametric tests were used. For qualitative data we used Fisher's exact test (two samples, two-tailed) and for quantitative data the Mann-Whitney test (two samples, with correction for ties). A significance level =0.05 was assumed.

RESULTS

Complications. Complications occurred in 13 patients (16%). These were superficial wound infection (6), osteitis (1), secondary dislocation after operation (3), delayed union (1) and Sudeck's dystrophy (2). Further operation was needed in two patients. The cases of infection were equally divided between the walking plaster group with four superficial wound infections and the non-weight-bearing group with two superficial wound infections and one case of osteitis. There was one case of wound dehiscence in each group.

Postoperative management. One patient was lost to follow-up after three months. Another developed haemorrhagic pancreatitis two months after the ankle fracture and the data were therefore incomplete, but assessment was possible at 20 months.

The median subjective ankle score at the final review (median 12 months) was 95 points (35 to 100). Comparison of the AO type-B and type-C groups showed no difference in the median scores: 95 points and 100 points, respectively

Table IV. Classification of the clinical results

Score	I Poor*	II Fair†	III Good	IV Excellent
Complaints	Pain at work/rest	Pain at sports	Minor	None
Activity/work	Unable to work	Changed	Unchanged	Unchanged
Loss of loaded dorsal range of motion (degrees)	>20	11 to 20	4 to 10	0 to 3
Cedell's classification	<Poor/./.	≥Poor/./.	≥Good/G/G‡	Anatomical/A/A‡
Medial clear space widening (mm)	>2	=2	≤1	=0
Osteoarthritis	Narrowing >1/2	Sclerosis/cysts Narrowing <1/2	Osteophytes	No signs

*result is poor when three 'air' items are present or one of the 'poor' items (<poor/./.) is worse than one 'poor' result; ≥poor/./. is no more than one 'poor' result

†no more than two items are present

‡≥Good/G/G means at least a 'good' result for each malleolus; Anatomical/A/A means an anatomical result for each malleolus

Table V. Results and differences in the median loss of loaded dorsal range of movement, the median linear analogue scale and the median subjective ankle score at each follow-up (Mann-Whitney test, cft*)

Follow-up	Loss of loaded dorsal range of movement (degrees)		Linear analogue scale		Subjective ankle score	
	Plaster	Crutches	Plaster	Crutches	Plaster	Crutches
10 days	28	33	40	30	45	40
	p = 0.22		p = 0.05		p = 0.47	
6 weeks	25	23	70	60	65	50
	p = 0.16		p = 0.03		p = 0.02	
3 months	14	12	80	80	85	80
	p = 0.72		p = 0.82		p = 0.84	
1 year	8	7	90	90	95	95
	p = 0.97		p = 0.83		p = 0.90	

*correction for ties

(Mann-Whitney test, cft, $p = 0.36$). There was also no difference between the walking plaster and the non-weight-bearing groups (Mann-Whitney test, cft, $p = 0.90$). Inclusion of the patient who was lost to follow-up also produced no difference between the walking plaster (median 95 points, range 0 to 100) and the non-weight-bearing groups (median 95, range 35 to 100; Mann-Whitney test, cft, $p = 0.94$).

The median linear analogue scale score at the final review was 90 in both groups (range 35 to 100; Mann-Whitney test, cft, $p = 0.83$). The difference between the clinical scores of the walking plaster (29/40, 72.5%) and the non-weight-bearing groups (26/40, 65%) was not significant (95% CI of the difference was 12.5% to 27.5%, chi-squared test, $p = 0.47$).

Table V gives the differences in the loss of loaded dorsal range of movement, the linear analogue scale and the subjective ankle score at each follow-up. Mobilisation in a walking plaster during the first six weeks after operation did not diminish the loaded dorsal range of movement in the ankle. This supports the concept of the 'functional' treatment of operated ankle fractures in a walking plaster; it allows some movement in the joint.

Both the subjective ankle score and the linear analogue score, which are based on the subjective experiences of the patients, had a small difference in favour of the walking plaster group at six weeks ($p = 0.03$ and $p = 0.02$). At ten days, however, this group already had a nearly significantly better linear analogue score. Considering also the small differences of the median values and the p values, which are just below 0.05, these subjective results indicate that no important difference is to be expected at six weeks (95% CI of differences of median linear analogue score at six weeks 0 to 15; 95% CI of differences of median subjective ankle scores at six weeks 0% to 15%). At three months and at one year the differences between the median subjective ankle scores and the analogue scores had disappeared.

Return to work. The median period of return to full-time work was 78 days (9 to 244) for the walking plaster group and 79 days (9 days to 1 year) for the non-weight-bearing patients (Mann-Whitney test, cft, $p = 0.54$).

Disregarding the type of job, return to work on a part-time basis took a median of 24 days (7 to 183) for those in a walking plaster and 44 days (4 to 216) for the non-weight-bearing group. This difference was not significant (Mann-Whitney test, cft, $p = 0.19$). Patients with a standing job required a median period of 20 days in the walking plaster group and 40 days in the non-weight-bearing group (difference not significant, Mann-Whitney test, cft, $p = 0.13$).

Secondary dislocation and radiological appearance. Secondary dislocation due to injury in the unprotected non-weight-bearing group or to breakage of the implants in those in plaster may influence the radiological appearance, the morbidity and the end result. The three cases of secondary dislocation occurred within the first ten days before mobilisation with crutches or weight-bearing in a walking plaster was begun. The type of treatment after operation did not affect the anatomical result. The final review showed a 'good or anatomical' radiological appearance (Cedell group I or II) in all cases, with medial clear space widening of 1 mm or less in all patients. Although no definite conclusion can be drawn from observations of only one year, 85% (95% CI 71% to 93%) of the walking plaster group and 98% (95% CI 87% to 100%) of the non-weight-bearing group had no signs of osteoarthritis (osteoarthritis scale IV; 95% CI of the difference 1% to 25%; Fisher's exact test, two-tailed, $p = 0.11$).

The effect of physiotherapy on the loaded dorsal range of movement. The median loss of loaded dorsal range of movement decreased from 34° to 22° in the group with physiotherapy and from 28° to 6° in those without physiotherapy. No conclusion can be drawn from these results as these are selected groups, but clinical observations suggest that physiotherapy had a positive effect on recovery of movement at the ankle.

DISCUSSION

Although the patients with a walking plaster had a significantly higher linear analogue score and a higher subjective

ankle score at six weeks, there was no difference afterwards. The loaded dorsal range of movement, as a direct measurement of the effect of immobilisation of the ankle by plaster, showed no difference at any time. The difference in ability to return to work was not significant, although the walking plaster group needed a median of 24 days and the non-weight-bearing group 44 days to restart their work on a part-time basis. The complication rate was equally divided in both groups.

No evidence was found for the general assumption that the mobilisation of patients with an operatively treated ankle fracture in a walking plaster is 'a combination of disadvantages of two treatments'. Our results show that the early application of a walking plaster did not result in an increased rate of complications such as wound dehiscence, superficial wound infection, arthritis, osteitis or secondary dislocation.

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