

Biodegradable fixation of ankle fractures

Complications in a prospective study of 25 cases

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In a prospective study, 25 displaced ankle fractures were treated with one or two biodegradable rods (Biofix), sizes 3.2 or 4.5 mm. In 2 cases the medial malleolus fractured during drilling. At the 1-year follow-up of 22 cases, the following complications had occurred: sinus formation in 1 case and osteolysis corresponding to the fracture line and/or drill channels in 9 cases, 2 of whom had symptoms. 2 patients

had been reoperated on, one for pseudarthrosis and another for secondary fracture displacement.

Because of the high complication rate and the unknown importance of osteolysis formation, we cannot recommend biodegradable fixation with rods of 3.2 or 4.5 mm length as a supplement to the treatment of displaced ankle fractures, particularly of medial fractures.

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Biodegradable rods made of polyglycolide (Dexon, Biofix) have been used experimentally for osteosynthesis of osteochondral fractures (Greve and Holste 1985), and clinically for fixation of fractures in cancellous bone (Rokkanen et al. 1985).

We report our early results with biodegradable osteosynthesis of displaced ankle fractures at a general orthopedic department.

Patients and methods

From March 1988 to November 1989, 27 consecutive patients with a more than 2 mm displaced fracture of the ankle were fixed with biodegradable rods (Biofix). At the time of the study only rods of 3.2 mm or 4.5 mm, length 50 or 70 mm were available. Exclusion criteria were: (1) age above 67 or below 17 years; (2) previous malleolar fracture in the same ankle; (3) other clinically important injuries in the same or the opposite leg; (4) no patient cooperation because of severe mental disorder or alcoholism; (5) severe comminution of the fragments. All fractures were classified according to Lauge Hansen (1942), (Table 1). The mean age was 46 (17-67) years, and the mean hospital stay was 7 (2-15) days (Table 1).

Tourniquet and standard incisions were used. Reduction was maintained by a clamp. After drilling, the fractures were fixed by one or two rods. Pronation-eversion fractures with disruption of the syndesmosis were transfixed with a 4.5 mm, 70 mm long rod, from the lateral side, through all four cortices just above the

syndesmosis. Fractures of the lateral malleolus were secured by a longitudinal rod, supplemented by a second rod into the tibia in cases of continued instability. The medial malleolus was generally fixed with one rod.

Postoperatively the ankle was immobilized in a below-knee plaster for 8 weeks with full weight bearing allowed after 6 weeks. Follow-up was performed after 8 weeks, 6 and 12 months, and included clinical and radiographic examinations with standard anteroposterior, lateral and mortice projections. Only 25 patients were included in this study, as one had a mixed osteosynthesis (cerclage at the lateral malleolus and a biofix rod at the medial malleolus), and another could not be followed, as she moved to another part of the country shortly after surgery.

Results

Of the 18 fractures of the medial malleolus, 16 were operated on; 1 rod was used in 14 cases, and 2 rods in 2 cases. In 2 cases the medial malleolus fractured during drilling. Fixation was achieved by osteosutures in Case 25; the case was considered a failure, and was only followed until fracture-union, which was uneventful. In Case 17 fixation with 1 rod was achieved, and a minor displacement was accepted. Of the 20 fractures of the lateral malleolus 17 were operated on; 1 rod was used in 8 cases, and 2 rods in 9 cases.

12 cases had a fracture of the posterior margin of the tibia, but none needed fixation.

Table 1. 25 patients treated with biodegradable rods

A	B	C	D	E	F	G	H	I	J	K	L
1	M	31	PA-2	2	-	-	-	-	-	-	70
2	M	32	PA-1	1	-	-	-	-	-	-	85
3	M	39	SE-3	-	1	-	-	-	-	-	85
4	M	38	PE-3	-	2	1	-	-	-	-	100
5	M	17	SA-2	1	-	-	-	-	-	-	100
6	F	46	SE-4	1	0	-	-	-	-	+	75
7	F	60	SE-4	1	2	-	-	-	-	-	90
8	M	54	SE-2	-	1	-	-	-	-	+	100
9	M	51	SE-4	1	1	-	-	-	-	-	95
10	F	60	SE-4	1	1	-	-	-	-	-	95
11	F	67	SE-4	1	2	-	-	-	-	-	95
12	M	43	SA-2	1	0	-	-	-	-	-	90
13	F	58	PE-3	-	1	1	-	-	-	-	65
14	F	47	SA-2	1	0	-	-	+	+	+	45
15	F	67	SE-4	1	1	-	-	-	+	+	100
16	M	48	SE-4	1	2	-	-	-	-	-	100
17	M	20	PA-1	1	-	-	+	-	-	-	-
18	M	35	SE-2	-	2	-	-	-	+	-	80
19	F	54	SE-2	-	2	-	-	-	-	-	65
20	F	66	SE-4	0	1	-	-	-	-	-	80
21	F	32	SE-4	1	2	-	+	-	-	-	-
22	M	65	SE-4	2	2	-	-	-	-	+	80
23	M	30	PE-3	1	1	1	-	+	+	+	50
24	M	60	SE-4	0	2	-	-	-	-	+	95
25	M	27	PA-1	0	0	-	-	-	-	-	-

A	Case number	<i>Number of rods used</i>	<i>1-year follow-up</i>
B	Age	E Medial malleolus	H Reoperation
C	Sex	- no fracture	I Pseudarthrosis
D	Lauge-Hansen type	F Lateral malleolus	J Osteolysis at the fracture site
	SA supination-adduction	- no fracture	K Osteolysis in the drilling channel
	SE supination-eversion	G Syndesmosis	L Functional score
	PE pronation-eversion	- no rupture	
	PA pronation-abduction		

No deep infections occurred. 3 patients developed a superficial skin necrosis. All healed without complications but one of these patients presented with a sinus-formation 2 months postoperatively; spontaneous perforation occurred and healing was achieved without further complications.

2 patients needed reoperation. Case 21 had a supination-eversion fracture, Stage 4, fixed with 1 rod medially and 2 rods laterally. The plaster was changed because of pressure. A control radiograph showed a dislocation of the medial fracture. Reoperation was performed with 2 Palmer pins. The biodegradable rod was found to be partly dissolved and impossible to remove. Subsequently the fracture healed in good position and with an excellent clinical result.

The other patient (Case 17) had a pronation-abduction fracture, Stage 1. Minor fragmentation of the medial malleolus occurred during the operation, but was accepted. However, small bony fragments, impinged on the talus, caused pain. Surgical removal of the bony prominence was attempted, but without pain relief.

Function using Olerud and Molander's method

(1984) gave a mean score of 84 (45-100) points with 9 excellent, 11 good, 2 fair and none poor.

Radiographs after 1 year showed that all fractures except two had healed without incongruity in the ankle joint. No degenerative changes were seen. Osteolysis corresponding to the drilling channel was observed in 7 cases (Figure 1), and osteolysis corresponding to the fracture line in 5 cases. Of these, 3 had both osteolysis at the drilling channel and at the previous fracture. Among the 5 cases with osteolysis of the fracture line, radiographs revealed a pseudarthrosis at the medial malleolus in 2, both classified as fair while the remaining 3 cases rated excellent or good.

Discussion

So far results of the fixation of ankle fractures, with the use of the biodegradable fixation device have only been presented from one center (Rokkanen et al. 1985, Böstman et al. 1987, 1989, Hirvensalo 1989), where a few surgeons have developed and performed this par-



Figure 1. Case 15. A 67-year-old woman with a supination-eversion fracture, Stage 4. Radiographs at one year show union in good position but an osteolytic zone at the fracture site and at the drilling channel in the medial malleolus. She had no symptoms.

ticular technique. In this study, the method was introduced at a middle-sized hospital, where several surgeons performed the operations.

The principle of fixing fractures with rods, gives rise to specific problems. Only bone fragments of a certain size could be fixed with the rods available in this study. If drilling was attempted, the distal fragment broke further as was seen in 2 cases. Rods with a smaller diameter and different lengths would probably solve this problem and allow fixation with more rods, to improve the stability.

Drilling must be done carefully to avoid widening of the most distal part of the channel; if the channel is too wide the fixation of the bone fragment is insufficient, and fracture-slipping may be the consequence. This in combination with intraosseous sinus formation is the most likely explanation of the fracture dislocation that required reoperation of Case 21. The non-rigid fixation may also be the explanation of the 2 cases of pseudarthrosis, found at the 1-year follow-up. As fixation was not considered sufficiently stable with 1 rod, a second rod was needed for fixation of 11 cases. Thus the fixation technique described by Rokkanen et al. (1985) was found insufficient, and the periosteal suture for reinforcement of the fixation was not sufficiently stable.

A well-known complication is subcutaneous sinus formation, described earlier by Böstman et al. (1987), who found an incidence of 7 percent. Hirvensalo (1989) reported an incidence of 15 percent after fixation of severely displaced ankle fractures. This complication occurred in one of our cases but it did not affect the results.

Development of a radiolucent zone corresponding to the drilling channel, was described by Böstman et al. (1990). This was seen in 7 of our cases. Contrary to Böstman (1991) we found osteolysis at the drilling channel to be present even after one year. The im-

portance of this phenomenon remains unknown. It might represent a foreign body reaction (Böstman et al. 1992). We plan to review our cases after 3 years to further study the significance, if any, of the radiolucency phenomenon. Meanwhile we shall not use polyglycolide fixation material.

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