Metallic or absorbable implants for ankle fractures

A comparative study of infections in 3,111 cases

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Absorbable fracture fixation has been in clinical use since 1984. Our study compares the infection rates and some infection parameters between metallic (2073 patients) and absorbable fracture fixation devices (1012 patients) in displaced ankle fractures.

The infection rate associated with metallic fixation was 4.1%, compared with 3.2% absorbable fixation (p 0.3). The patients who had a wound infection were older when metallic fixation was used (p 0.01). They also had a bi- or trimalleolar fracture more often than did patients treated with absorbable fracture fixation, but this difference did not have a significant effect on the wound infection rate (p 0.2).

The infections were mostly caused by microorganisms of the Staphylococcus species. Deep infections were equally common with both fixation methods (0.4%), but there was some variation in the bacterial spectrum.

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Totally absorbable internal fixation devices have been in clinical use at our department since 1984 (Rokkanen et al. 1985) and more than 2800 patients have been operated on. In this study we have examined the postoperative infections observed in all 3111 ankle fracture patients treated with metallic or absorbable fracture fixation devices during an 8-year period. In 2073 cases metallic screws and plates were used and in 1012 cases totally absorbable fixation devices were used. In 26 cases, both metallic and absorbable implants were used.

Patients and methods

All patients with displaced ankle fractures admitted to our department between 1985 and 1992 were included. Only during the first couple of years were there certain limitations in the use of absorbable implants, e.g., people over 70 years of age and alcoholics were managed with other methods. Otherwise, the use of implants was optional except in some clinical series.

The absorbable devices were made of polyglycolic acid (PGA), poly-L-lactic acid (PLLA) or polyglycolide/polylactide (PGA/PLA) co-polymers. Until December 1988 the PGA-material used for these devices contained a green aromatic quinone dye, as also do Dexon® sutures. Since then, PGA-implants have been made of material that were not colored. The absorbable implants included cylindrical self-reinforced (SR)-PGA or SR-PLLA rods, pins or screws and SR-PLLA tacks, expansion plugs or wires. All fractures were postoperatively immobilized in a plaster cast, which was removed during the 6th postoperative week after 1–2 weeks of weight bearing. The patients were regularly followed at 3, 6, and 12 weeks, and at 6 and 12 months.

The infections were diagnosed by a surgeon. The wound was defined as infected when pus was observed or there was serous secretion from which the same bacteria were continuously (at least twice) observed or the patient had a wound inflammation associated with fever and a high erythrocyte sedimentation rate, C-reactive protein concentration and leukocyte count. The infection was called deep when it affected bone and could be seen on radiographs. The bacterial cultures were collected by aspirating pus into a syringe or by swabbing the wound. In the metallic fixation group there was one infection that occurred 7 years after the operation. This case was considered to be of secondary origin and was exclud-

Table 1. Operated ankle fractures 1985–1992

Implant material	Cases	Infections	
		n	%
Metal	2073	85	4.1
Metal and absorbable	26	3	12
Absorbable	1012	33	3.2
Total	3111	121	3.9

Table 2. Patients

	Fixation		
	Metallic	Absorbable	P-value
Men / women	995 / 1078	486 / 526	–
Mean age	46 (8–90)	39 (12–84)	0.01
Fracture type [a]	708 / 1365	596 / 416	0.01

[a] unimalleolar / bi- and trimalleoar.

Table 3. Ankle fractures treated with absorbable implants 1985–1992

Implant material	Cases	Infections		P-value
		n	%	
PGA/PLA copolymer	53	2	3.8	0.9
SR-PGA (total)	827	29	3.5	0.6
Rod, stained 375		10	2.7	
Screw, stained 105		2	1.9	
Rod, non-stained 10		0	0	
Screw, non-stained 123		6	4.9	
Several 214		11	5.1	
SR-PLLA	83	0	0	0.2
Several	49	2	4.1	0.8
Total	1012	33	3.2	0.3

P-value when compared to the metallic fixation group.

Table 4. Patients with infections

	Fixation	
	Metallic	Absorbable
Number of cases	85	33
Men / women	43 / 42	21 / 12
Mean age [a]	52 (17–82)	45 (19–77)
Fracture type [b] uni- / bi- and trimall.	24 / 61	18 / 15
Mean trauma-operation interval (h)	24 (3–120)	24 (7–120)
Mean operation time (min)	70 (15–170)	48 (20–125)
Mean operaton-infection interval (day)	33 (1–212)	40 (1–164)
Complicated fractures	8	2

[a] p 0.05, [b] p 0.02

ed from the study. Otherwise, all superficial and deep wound infections were included.

The quantitative results were analyzed with the Student's t-test and the qualitative results with the chi-square test using Yates' correction.

Results

A total of 85 infections were detected in 2073 (4.1%) patients operated on with metallic implants. With absorbable fixation, wound infection occurred in 33 of 1012 (3.2%) patients (Table 1). Patients treated with metallic fixation were older and had bi- and trimalleolar fractures more often (Table 2). SR-PGA implants were used in 827 patients (Table 3). 6 of the 123 (5%) patients treated with nonstained PGA screws had a postoperative infection. SR-PLLA implants were used in 83 cases without infections. None of the differences is significant.

There were significant differences in the types of fractures and the mean ages of the patients suffering from a postoperative infection (Table 4). Of 1304 unimalleolar fractures, 42 (3.2%) were infected, of 1781 bi- or trimalleolar fractures, 76 (4.3%) had wound infectionts (p 0.2). The mean age of the patients suffering from a postoperative infection was 50 years, compared to one of 43 years in patients without an infection (p 0.02).

Staphylococcus aureus and Staphylococcus epidermidis were the most commonly observed species in both groups (Table 5). In the metallic fixation group, 38 of 85 infections, and in the absorbable fixation group, 11 of 33 infections were due to one species of bacteria. The cultures were negative in 8 cases in the metallic group, and in 5 cases in the absorbable group.

There was no difference between the deep infection rates: 8 (0.4%) were found in the metallic group, and 4 (0.4%) in the absorbable group. 3 of these were fixed with PGA screws and 1 by PGA/PLA rods. There were no particular species associated with deep infections in patients treated with metallic implants. Staphylococcus aureus, together with some other Staphylococcus species, were cultured from all deep infections in patients treated with absorbable implants (Table 5).

When absorbable fixation is used, fracture healing is sometimes associated with sinus formation. In this study (33 infections) there were 3 cases (superficial infections) of secondarily infected sinuses.

Table 5. Microorganisms in infected ankle fractures. Microorganisms in deep infections are given in brackets

Species	Fixation			
	Metallic [a]		Absorbable [b]	
	n	%	n	%
Staphylococcus aureus	40 (6)	47	12 (4)	36
Staphylococcus epidermidis	22 (1)	26	13 (2)	39
Diphteroid	17	20	4	12
Enterobacter cloacae	10 (4)	12	6 (1)	18
Beta-hemolytic Streptococcus	9	11	3	9
Streptococcus agalactiae	1	1	3	9
Staphylococcus species (indefinite)	2	2	4	12
Other	28	33	19	57
Total	129		64	

[a] 85 (8 deep) infections occurred after metallic fixation.
[b] 33 (4 deep) infections occurred after absorbable fixation.

Discussion

In the literature, the infection rate associated with metallic fracture fixation of ankle fractures varies from under 2% (Lindsjö 1985) to around 10% (Mak et al. 1985, Carragee et al. 1991) compared to 4.1% in our study. The infection rates were similar (3.2%) after absorbable osteofixation. In an earlier study the infection rates of metallic and absorbable fixation were also the same, 1 infection in 28 cases, in both groups (Böstman et al. 1987).

It has been shown that there are fewer wound infections associated with absorbable sutures than with biostable sutures (Wetter et al. 1991). The mechanism by which the absorbable materials could affect the wound infection risk is not yet known. However, PGA can activate inflammatory cells (Devereux et al. 1991).

There were differences between patients treated with metallic or with absorbable implants. However, only the age difference between the groups may have had an effect on the outcome of the study.

The age differences may have been due to limited use of absorbable fracture fixation during the first couple of years. The differences in the fracture types in each group may may have arisen because no absorbable plate fixation devices were available and metallic plate fixation was often the only possible method in comminuted fractures. However, the infection rates in various fracture types werenot statistically different.

Deep infections were equally common in the metallic and absorbable groups. This was surprising, since bacteria tend to colonize inert surfaces more readily than the less stable ones (Gristina et al. 1976). However, there were only 12 patients with osteomyelitis, so perhaps our material is still too small to demonstrate any possible difference in this context.

Our findings suggest that the implant material does not have a significant effect on the wound infection rate.

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