Nonunion and Infected Nonunion of Long Bones : A Review of Management

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ABSTRACT: From January 1982 to December 1985, 33 cases of infected nonunion and 26 cases of uninfected nonunion of long bones were reviewed retrospectively. The average age was 33.9 years. Tibia was the most common site and right side was more common than the left. Duration of hospitalization in infected group and uninfected group was 92 days and 22 days respectively. Road traffic accident was the most common mechanism in both groups. Fourty-four patients (74.5%) were innitially treated at other institutes. Only 15 patients (25.4%) were primarily treated in our hospital. Of the 59 nonunions, there were thirty open fractures (50.8%). Twenty five cases of infected open fracture and 7 cases of postoperative infected nonunion were categorized into two groups. The principle of management for uninfected group was appropriate stabilization in 23 cases for hypertrophic type and rigid internal fixation with bone graft in 3 cases for atrophic type. Union occurred in all cases. The principle of management in infected group consisted of adequate debridement, skin coverage, fracture stabilization and bone graft. Bone healing occurred in 84.8 per cent of the infected group. The average time for bony union in infected and uninfected group was 6.2 months and 4.5 months respectively.

Nonunion and infected nonunion of long bones are more common in developing countries due to the increase in incidence of traffic accidents and inadequate immediate treatment from various medical centers. The traditional way of management of fracture and dislocation under the hand of bone setters or monks in this country is still widely accepted by majority of the population. The result of such treatment was poor in most patients. Sometime, the delay in proper management especially in open fractures led to severe complications. It is the purpose of this report to present our experiences in the treatment of infected and noninfected nonunion.

MATERIALS AND METHODS

From January 1982 to December 1985, thirty-three cases of infected non-union and twenty-six cases of noninfected nonunion were seen and treated at Lerdsin Hospital. Forty four patients (74.6%) were not initially treated by us. Thirty-five patients (59.3%) were treated previously from some other institutes such as private hospital and provincial hospital, nine patients (15.3%) were treated from other hospitals in Bangkok and fifteen patients (25.4%) were treated by us (Table 1). Patients' chart and x-rays were reviewed retrospectively using the following criteria[1-3] this study.

1. Duration of nonunion The fracture line should exist for a period longer than 6 months. Clinically false movement should be demonstrated in all cases.

2. Roentgenograms The diagnosis of nonunion was made from serial roetgenograms. Nonunion existed when all signs of healing had ceased and showed no progression of healing over a period of 3-month interval.

TABLE 1
Places of Initial Treatment

	Group I	Group II
Private hospital	1	10
Provincial hospital	17	7
Hospital in Bangkok	7	2
Lerdsin hospital	8	7

TABLE 2
Incidence Age, Sex, Duration of Nonunion, Hospitalization

	Infected Group	Non Infected Group
Age (yrs)	8 – 71 (31.1)	13 – 66 (37.3)
Sex (male : female)	28 : 5	18 : 8
Duration of nounion (months)	3 – 60 (13.8)	3 – 48 (9.5)
Hospitalization (days)	24 – 706 (92)	7 – 114 (22)

3. Infection The diagnosis of chronic osteomyelitis was based on the demonstration of bone abnormality by radiograph, the finding of redness swelling of the tissue around the wound, and the evidence of pathologic organisms from the culture of drainage.

4. Intra articular fractures were excluded from the study.

5. The minimum follow up was 2 years.

These 59 patients were divided into 2 groups:– Group I (infected nonunion) and group II (uninfected nonunion). The age, sex, duration of nonunion from the time of the original fracture to the time of definite treatment and duration of hospitalization were demonstrated in Table 2. Traffic accident was the most common mechanism of injury, and tibia was the most common site of fractures in both groups (Tables 3, 4). There were 25 open fractures (75.8%) in group I and 5 open fractures (19.2%) in group II (Table 5). In group I, there were 17 positive cultures and pseudomonas was the most common organism found in the infected nonunion sites (Table 6).

Treatment of infected nonunion consisted of the following procedures 1) Debridement of soft tissue and necrotic bone (18 operations). 2). Removal of metalic implant at the time of debridement (18 operations). 3). Reconstruction of skin coverage as soon as possible (4 cases for cross leg flap and 3 cases for split thickness skin graft). 4). Stabilization of bony fragments by mean of plaster cast (9 cases) or external fixation. (9 cases) in case with active infection. Internal fixation (22 plates, 1 nail) was accomplished after the wound was clear of infection 5). Bone grafting was performed in all cases (36 operations) there were 23 cases of hypertrophic type and 3 cases of atrophic type of nonunon.[4] All were treated by mean of internal fixation alone for hypertrophic type and by mean of internal fixation supplemented with bone graft for atrophic type.

TABLE 3
Causes of Fracture

	Group I	Group II
Motorcycle accident	14	13
Car accident	8	4
Pedestrian	7	6
Fall	2	2
Gunshot	2	–
Direct blow	–	1

TABLE 4
Sites of Nonunion

	Group I		Group II	
	R /	L	R /	L
Tibia	12	9	7	2
Femur	5	4	5	3
Humerus	1	2	2	5
Forearm	–	–	–	2
Total	18	15	14	12

TABLE 5
Types of Fracture

	Group I	Group II
Closed fracture	8	21
Open fracture		
(Gustilo's classification)		
Type I	1	2
Type II	4	3
Type III	5	–
Type ?	15	–

TABLE 6
Pathogenic Organisms

Pseudomonas	10	Specimens
S. aureus	8	Specimens
Proteus sp.	3	Specimens
Klebsiella sp.	2	Specimens
Staph. coag neg	2	Specimens
Acinatobactor	1	Specimens
Alpha-streptococcus	1	Specimens
Enterobactor	1	Specimens

Culture positive	17
Culture negative	5
No report	11
Total	33

RESULTS

The minimum period of follow up was 24 months, and the maximum period was 58 months. Of the 33 long bone nonunion in group I, 28 patients (84.8%) healed with solid union which could be demonstrated by serial x-rays and clinical examination. The average time for bony union was 6.16 months (3-13 months). On an average, 2.4 operations were required to accomplished union. There were 23 complications (7 ankle joint stiffness, 7 bone shortening, 5 knee joint stiffness, 2 persistent sinus drainage, 1 malunion, 1 broken plate). The metallic implants were removed in 8 patients when the bone was completely healed. All nonunion in group II healed after one operation with the average time of 4.5 months (3-11 months). There were 6 complications (2 shortening, 1 ankle joint stiffness, 1 knee joint stiffness, 1 shoulder joint stiffness, 1 limitation of forearm rotation).

DISCUSSION

The findings of main predominant traffic accident was the most common mechanism of injury, and tibia being the most common site of nonunion in this study is similar to other reports elsewhere.[5,6] Most nonunions are associated either with open fractures, infection or poor reduction and poor immobilization.[7] More than half (59.3%) of the patients received primary treatment from private sector. There were thirty open fractures (25 in infected group and 5 in noninfected group). Thirty-two patients in infected group and only six patients in noninfected group demonstrated a relatively high risk of nonunion were seen at the time of operation.[8] Treatment of nonunion in noninfected cases was simple. The bone united after only one operation. In infected nonunion the treatments were more complicated and extensive. The period of hospitalization of patients in infected group was 4 times longer than in noninfected group. More complications were encountered in infected group. Infected ununited fractures have a good chance of proceeding into union after sequestrectomy and the use of compression stabilization and bone grafting.[8] In Rosen's report,[9] 83 per cent of 24 infected pseudarthrosis healed after the first operation. In this study, union was achieved after 2.4 operations for infected nonunion group. Repeated debridement with or without removal of metalic implants previously fixed together with soft tissue coverage either with skin graft or myocutaenous flap were the essential parts in the management of infected nonunion. When the wound nealed, bony stabilization with internal fixation and bone graft are an essential procedures. Stable internal fixation is necessary to achieve bony union and good functional result. The average time for union in infected and noninfected group was 6.2 months and 4.5 months respectively. The conventional method[10] of managing this problem is safe but usually results in stiffness of adjacent joints. The development of rigid internal fixation, modern antibiotics therapy and a relevent method and adequate reconstructive procedure allowing us to deal with this complicated problem.

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