MANAGEMENT OF OPEN TIBIA FRACTURES

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SYNOPSIS

Seventy-nine patients with 80 open fractures of the tibia were analyzed retrospectively with regard to infections. There was an overall rate of infection of 8.8%. There was no significant difference in the rate of infections between fractures treated with cast immobilization and those treated with internal fixation. There were 11 cases of non-union of the tibia. Only one case of non-union occurring in an infected fracture.

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INTRODUCTION

Infection is the most important complication in the management of open fractures of the tibia. While there is agreement that open fractures should be treated as an emergency, differences of opinion exist with regard to method of closure of the skin and the method of stabilisation of such fractures. This paper reviews the experience of infections in open fractures of the tibia in a general orthopaedics unit.

METHOD

A total of 79 patients with 80 open fractures of the tibia were treated at the Department of Orthopaedics, Singapore General Hospital between October 1981 and June 1986. The data obtained from patient records were analysed retrospectively with regard to severity of fracture, method of skin closure, method of stabilisation of the fracture, incidence of infection and incidence of non-union.

Treatment of open fractures of the tibia during this period included:

1. Adequate wound debridement and irrigation of the wound.
2. Primary closure of the wound whenever possible. Heavily contaminated wounds or those with extensive soft tissue injury were closed secondarily. These methods included secondary suture, skin grafting, pedicle flaps and healing by secondary intention.
3. Internal fixation — both early and delayed — was used at the discretion of the surgeon. Fractures which were not fixed were treated with cast immobilisation or external fixation.
4. Broad spectrum antibiotics were administered routinely.

The severity of the open fractures were graded on a scale of 1 to 3 as described by Gustilo and Anderson (1). A Type I fracture had a puncture wound 1 cm or less in diameter and was relatively clean. Type II had a laceration of more than 2 cm without extensive soft tissue damage. Type III is one with extensive soft tissue damage including skin, muscle and neurovascular structures. Some of the problems included in Type III fractures were open segmental fractures irrespective of size of wound, farm injuries with soil contamination, open fractures with neurovascular injury, traumatic amputation and open fractures over 8 hours old.

Infections were diagnosed when there was cellulitis or inflammation of the wound edges or when the drainage was considered infected or when osteomyelitis was present regardless of culture results.

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RESULTS

Rate of Infection

There were a total of 80 fractures in this analysis. There were 32 Type I fractures, 31 Type II fractures and 17 Type III fractures. One patient with an infected Type III fracture underwent an amputation for vascular compromise. There were 7 causes of infection. The overall infection rate was 8.8%. Six out of the seven infections were in Type III open fractures. The remaining infection was in a Type II open fracture (Table 1).

TABLE 1
INCIDENCE OF INFECTIONS ACCORDING TO FRACTURE SEVERITY

Fracture Severity (Type)	No of Fractures	No of Infections
I	32	0 (0%)
II	31	1 (3.2%)
III	17	6 (35.3%)
Total	80	7 (8.8%)

Fracture Stabilisation

The incidence of infection according to fracture severity and method of treatment is presented in Table 2. One case out of the 49 open fractures treated with cast immobilisation became infected. Two out of the twenty-one cases managed by internal fixation were infected. There was no statistically significant difference in the expected incidence of infection between fractures treated by cast immobilisation and those treated by internal fixation for all grades of severity. Of all those treated by external fixation (10 cases), there was 4 cases of infection. All these occurred in Type III fractures.

Wound Closure

Primary closure was carried out for 58 wounds. No infections were recorded in this group of fractures.

TABLE 2
INCIDENCE OF INFECTION ACCORDING TO FRACTURE SEVERITY AND METHOD OF TREATMENT

Treatment	Fracture Severity (Type)	Infections (No)
Cast Immobilisation	I[1]	0/25 (0%)
	II[2]	0/19 (0%)
	III[3]	0/5 (20%)
Internal Fixation	I[1]	0/6 (0%)
	II[2]	1/10 (10%)
	III[3]	1/5 (20%)
External Fixation	I	0/1 (0%)
	II	0/2 (0%)
	III	4/7 (57.1%)

[1] p 0.05
[2] p 0.05
[3] p 0.05

TABLE 3
INCIDENCE OF INFECTION ACCORDING TO FRACTURE SEVERITY AND METHOD OF CLOSURE

Method of Closure	Fracture Severity (Type)	Infections (No)
Primary Closure	I	0/28
	II	0/15
	III	0/5
Secondary	I	0/4
	II	1/6 (16.7%)
	III	6/12 (50.0%)

Secondary closure was carried out in 22 wounds. All 7 infections occurred in this group of fractures. The incidence of infection according to fracture severity and method of closure is presented in Table 3.

Non-Union

There were 11 cases of non-union among the 80 open fractures (13.8%). Only one case of non-union occurred in an infected fracture. The other 10 cases of non-union occurred in non-infected fractures. The presence of infection did not appear to influence the incidence of non-union significantly in this series (Table 4). The incidence of non-union according to fracture severity and method of fracture stabilization is presented in Table 5. There is a higher incidence of non-union in Type I fractures treated by cast immobilisation. There was a higher incidence of non-union occurring in Type III open fractures treated by internal fixation. Thirty percent of fractures treated by external fixation developed non-union.

DISCUSSION

The overall rate of infection of open tibial fracture in this series was 8.7%. The literature reports infection rates in open fractures between 3% to 40% (1–9). Often in these series it is not certain whether the figures refer to all wound infections or only deep infections involving bone. The definition used in the present series includes both superficial and deep infections. Also, in some reports, the severity of injury was not taken into account. In this series, the severity was found to be an important prognostic indicator of infection. Six out of the seven infections occurred in Type III open fractures. The rate of infection of Type III open fractures in this study was 35.3%. Type III open fractures are a difficult problem (10) with reported rates of infection of between 10% and 50% (1,2,4,10–4). No universally accepted method of treatment has been devised for the treatment of Type III open fractures.

There were no infections in wounds closed primarily in this series. All wound infections occurred in wounds closed secondarily. As there was no control group in this study, the absence of infection in the group closed primarily may be due to the tendency to close wounds with less severe soft tissue damage. It has also been noted that leaving a wound open for long intervals renders it susceptible to secondary infection (1). The main objection to primary closure of wounds in open fractures is the dreaded complication of infection with anaerobic or gas-forming organisms (15). This did not occur in this series. From these observations, primary closure may be performed in carefully selected wounds that have been adequately treated and debrided.

TABLE 4
INFECTION AND THE INCIDENCE OF NON-UNION

	Infected	Non-Infected
Union	6	63
Non-Union	1	10

TABLE 5
INCIDENCE OF NON UNION ACCORDING TO FRACTURE SEVERITY AND METHOD OF FRACTURE STABILISATION

Method of Stabilisation	Fracture Severity	Non-union (No)
Cast Immobilisation	I	4/25 (16.0%)
	II	1/19 (5.3%)
	III	0/5 (0%)
Internal Fixation	I	0/6 (0%)
	II	1/10 (10%)
	III	2/5 (40%)
External Fixation	I	1/1 (100%)
	II	1/2 (50%)
	III	1/7 (14.2%)

The wound must be closed without tension. Broad-spectrum antibiotics should be used in all wounds closed primarily (1,3).

Immobilisation is an important adjunct to healing of soft tissue wounds in open fractures (17–19). The method of stabilisation, however, remains a controversial issue, (8,13,17–22). The results in this series show no statistically significant difference between cast immobilisation and internal fixation for each grade or fracture severity with regard to wound infection. There was a high rate of infection in Type III open fractures treated by external fixation. This was because these patients had severe soft tissue damage and unstable fractures.

Factors affecting the non-union of tibia are severity of injury, infection, bone loss, stability, bone opposition and age of the patient (2). In this study, infection did not contribute significantly to non-union of open fractures of the tibia. It was noted that there was a higher rate of non-union in Type I open fractures treated by cast immobilisation and Type III fractures treated by internal fixation. External fixation is associated with a high incidence of non-union. This has been the experience with other authors (3,17).

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