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Original Article

Open Fractures and Incidence of Infection in Tertiary Care Government Hospital

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Abstract

Introduction: Infection still represents one of the most common challenge in the treatment of open fractures. It is well known that most infections in open fractures are of nosocomial origin as causative microorganisms of infection are different to those found in initial smears. This study was aimed to highlight incidence of infection, its microbial trend during treatment.

Materials and Methods: This retrospective observational study was conducted from January 2017 to April 2017 at Department of Orthopedics, B. J. Medical College and Sassoon General Hospital, Pune, Maharashtra. Records of total 60 patients with 64 open fractures treated under our hospital's Orthopedic Department were analyzed.

Results: Among the 60 patients with 64 open fractures, there were 15 (23.43%) cases of infection overall. Road traffic accident predominated 48 (75%) as mode of injury. There was change in wound flora over the period of hospital stay. Mean duration of final wound coverage was 5.66 days. Rate of infection increased with increase in trauma to final wound coverage interval.

Conclusion: Most infections in open fractures are nosocomial in origin and the wound flora changes during the hospitalization period. Chances of infection of wound increases as there is increase in trauma to final wound coverage interval.

Key words: Incidence, Infection, Microbial trend, Open fractures

INTRODUCTION

An open fractures still represent a major challenge for the treating surgeon and frequently demands an array of complex procedures to achieve an undisturbed healing with adequate limb function. The incidence of infection in open fractures varies considerably in the literature. Spencer *et al.*[1] showed overall incidence of infection in open fractures to be about 10.4% whereas Weitz-Marshall and Bosse[2] found infection rates between 0% and 50%.

Radical (repetitive) debridement of the wound and coverage of soft tissue defects along with antibiotic therapy are of utmost importance in the prophylaxis of septic complications. Rates of primary colonization of a contaminated wound have been shown to as high as 70%.[3-6] It is well known that most infections in open fractures are of nosocomial origin as causative microorganisms of infection are different to those found in initial smears.[7,8] If the local wound requires flap coverage, early performed procedures yield a clear decrease of infection rates even in most severe fracture forms.

In the present study, we analyzed the incidence of infection and its microbial trend in cases of open fracture at a tertiary care government hospital.

Aims and Objectives

1. To determine the incidence of infection in open fractures
2. To determine whether there is change in flora of wound due to delayed wound coverage in cases of open fractures.

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MATERIALS AND METHODS

Sixty patients with 64 open fractures aged between 18 and 60 years presenting to our tertiary hospital were considered. Patients having life-threatening head, abdominal or chest injuries, those with mental illness, burns and/or systemic illnesses, and/or immunocompromized status were excluded from the study. Patients who later died because of trauma or who had indication for immediate amputation were also excluded from study.

As per record, wound evaluation and grading of fracture were done according to Gustilo and Anderson Classification.

Gustilo and Anderson[6,9] classified open fractures into three categories (Table 1).

As per record, treatment for management of open fractures as per our departmental protocol was followed as mentioned below:

Wound was irrigated in the emergency department. Wound swab was taken for culture and sensitivity after surface cleaning and was repeated at 1-week interval except when definitive wound closure was done. Intravenous (IV) broad spectrum antibiotics were given in the form of injection amoxicillin + clavulanic acid 1.2 g BD, injection amikacin 500 mg OD, injcetion metronidazole 500 mg TDS for minimum of 5 days after surgical debridement. Intraoperative wound debridement was done within 6 h of presentation to hospital and irrigation with 3 liters of saline per Gustilo grade. Primary wound closure was done if wound permitted so. Secondary wound closure was done in cases of heavily contaminated wound. In case of delayed wound closure or wound coverage because of burden of patients in government hospital, wound dressing was done after every 48 h. For larger defects, either skin grafting or flap coverage for wound was done as early as possible. Fixation comprising of either internal fixation and external fixation or cast immobilization was done. Analgesics and IV fluids were given on as and when required basis.

Infection was documented irrespective of the type of closure or fixation and irrespective of culture results. The spectrum of infection included those wounds with either cellulitis, wound breakdown, stitch abscess, purulent discharge or ooze, established collection or abscess and or those with infected metalware where applicable.

Data were obtained from patient's record with regard to age, sex, mode of injury, and time interval between trauma and presentation to casualty, fracture site, grading of open fracture, associated medical comorbidities, culture, and sensitivity report as well as time interval between trauma and final wound coverage. The data were analyzed.

RESULTS

During the study, after considering the inclusion and exclusion criteria, hospital record of 60 patients with 64 open fractures who were treated under Department of Orthopedics of Sassoon General Hospital, Pune was analyzed.

The mean age of patients was 38.69 years old (range 18-60 years). Of these, 53 (88.33%) were male, and seven (11.67%) were females (Figure 1).

Among the mode of injury (Figure 2), road traffic accident predominated as the cause for open fracture involving 48 (75%) patients. Other modes were crush injury (10.93%), fall from height (6.25%), physical assault (6.25%), and sports injury (1.56%).

Most common site of open fracture (Figure 3) was tibia (40.62%), followed by femur (21.87%), radius/ulna (15.62%), ankle (12.5%), hand (4.68%), and foot (4.68%).

Table 1: Gustilo and Anderson Classification of open fractures

Expanded version of the Gustilo Classification system of open fractures[a]					
Feature	Fracture type				
	I	II	IIIA	IIIB	IIIC
Wound size, cm	<1	>1	>1	>1	>1
Energy	Low	Moderate	High	High	High
Contamination	Minimal	Moderate	Severe	Severe	Severe
Deep soft tissue damage	Minimal	Moderate	Severe	Severe	Severe
Fracture comminution	Minimal	Moderate	Severe/segmental fractures	Severe/segmental fractures	Severe/segmental fractures
Periosteal stripping	No	No	Yes	Yes	Yes
Local coverage	Adequate	Adequate	Adequate	Inadequate	Adequate
Neurovascular injury	No	No	No	No	Yes
Infection rate	0-2%	2-7%	7%	10-50%	25-50%

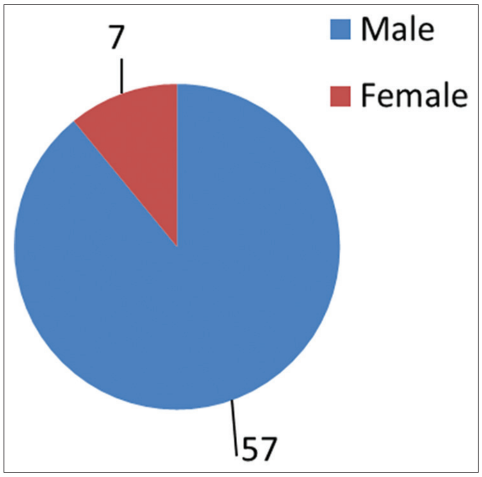

Figure 1: Distribution of 64 open fractures according to gender

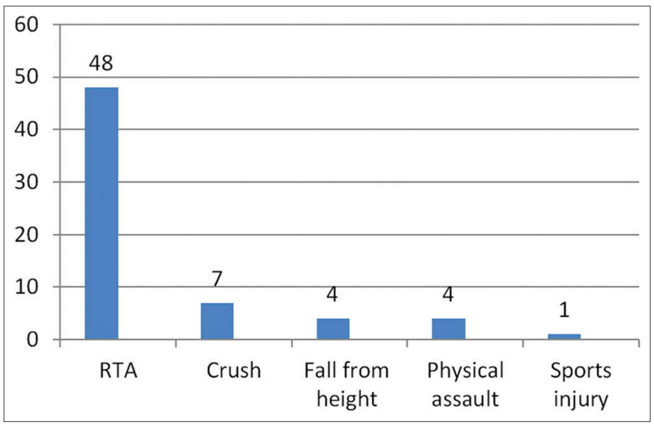

Figure 2: Distribution of open fractures according to mode of injury

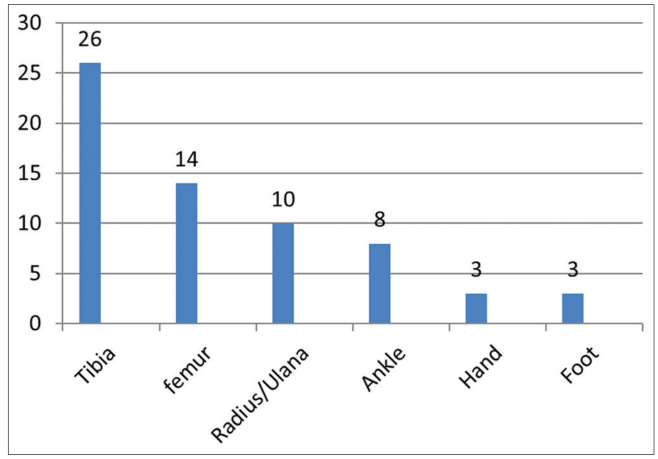

Figure 3: Distribution of open fractures according to bone involved

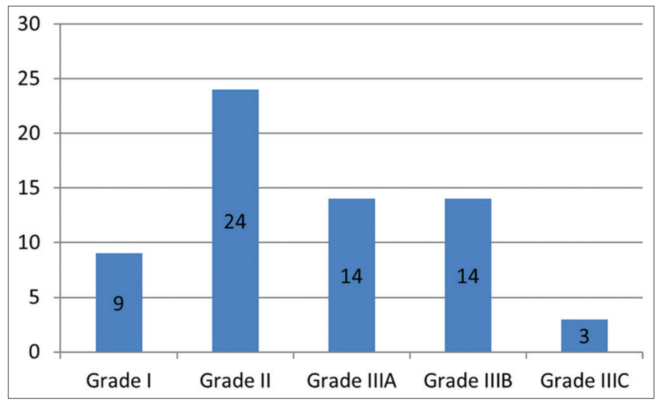

Figure 4: Distribution of open fractures according to Gustilo Anderson Classification

Distributing the fractures according to Gustilo and Anderson Classification (Figure 4), nine fractures (14.06%) were Grade I, 24 fractures (37.5%) were Grade II, and 31 fractures (48.43%) were Grade III.

There were 15 (23.43%) cases of infection overall. Among them, one fracture (6.66%) was Grade I, two (13.33%) were Grade II, and 12 (80%) were Grade III. Analysing the proportion of infected open fractures, Grade III B fractures predominated with 46.66%. This shows that the incidence of infection in open fracture increased with increase in Gustilo and Anderson grade of the fracture (Figure 5).

Analysing the culture and sensitivity report of the wound swabs (Table 2), *Acinetobacter* species (nine samples positive - 14.06%) and *Enterobacter* species (nine samples positive - 14.06%) were the most common bacteria detected in wound swabs taken in casualty.

Methicillin-resistant *Staphylococcus aureus* (MRSA) (three samples positive - 8.33%) and methicillin-sensitive *S. aureus* (three samples positive - 8.33%) were the most common overall organism detected in wound swabs taken at 1 week after trauma.

Table 2: Distribution of infecting organism in open wound fractures before final wound coverage

Organism	Casualty	1 week	2 weeks	3 weeks
No growth	34	19	3	-
Enterobacter spp.	9	-	-	-
Acinetobacter spp.	9	1	1	-
Enterococcus spp.	3	2	2	-
Citrobacter spp.	5	2	-	1
Streptococcus spp.	1	-	-	-
E. coli	3	1	-	-
MRSA	-	3	4	1
MSSA	-	3	-	-
Pseudomonas spp.	-	2	-	-
P. vulgaris	-	1	1	-
P. mirabilis	-	1	-	-
K. pneumoniae	-	-	-	-

E. coli: Escherichia coli, K. pneumoniae: Klebsiella pneumoniae, P. vulgaris: Proteus vulgaris, P. mirabilis: Proteus mirabilis, MRSA: Methicillin-resistant *Staphylococcus aureus*, MSSA: Methicillin-sensitive *Staphylococcus aureus*

All the wounds which developed infection before final wound coverage showed change in wound flora during hospitalization.

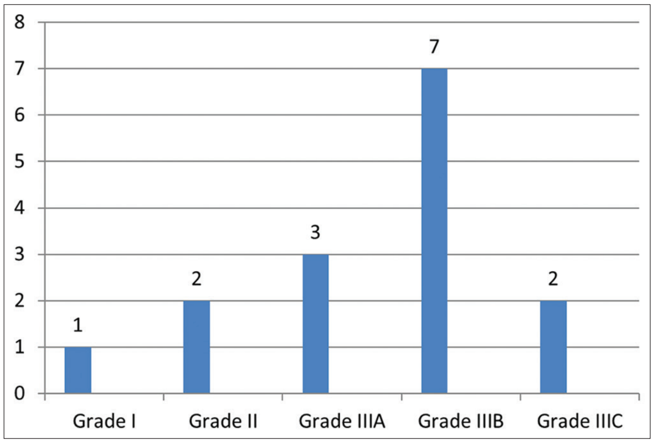

Figure 5: Distribution of infected open fractures according to Gustilo and Anderson Classification

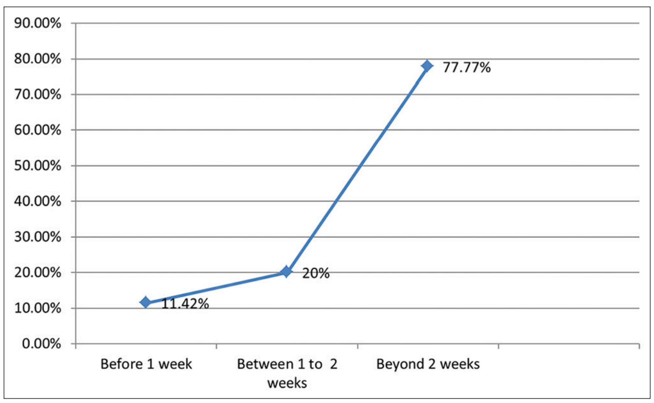

Figure 6: Incidence of infection in open fracture wounds in comparison with time interval from trauma to final wound coverage

The mean duration from time of trauma to final wound coverage was 5.66 days (range 2 h to 21 days).

Time interval between trauma and final wound coverage affected the incidence of infection in the wound. The incidence of infection increased with increase in this interval. Among the 35 fractures which had final wound coverage within 1 week of trauma, only four (11.42%) developed infection. Of the 20 fractures which received final wound coverage between 1 and 2 weeks of trauma, four (20%) developed infection in the wound. Nine fractures which received final wound coverage beyond 2 weeks of trauma, seven (77.77%) developed infection. This shows that those fractures which received final wound coverage within 2 weeks after trauma had less chance of developing infection (Figure 6).

DISCUSSION

Infection still represents one of the most common challenge in treatment of open fractures. Breakdown of tissue barrier between the fracture and environment creates portal for contaminating agents. The incidence of infection in open fractures varies considerably in the literature. Spencer *et al.*[1] showed overall incidence of infection in open fractures to be about 10.4%. Muhr and Ostermann[10] reported the risk of infection between 0% and 25% whereas Weitz-Marshall and Bosse[2] found infection rates between 0% and 50%. In our study, we found overall incidence of infection of 23.43%.

As a result of improved aseptic precautions and operative techniques, outcomes in open fracture patients have improved but loss of injured extremity because of wound complications still remains a major concern. Open fractures are more prone to complications of wound infection despite improved patient survival and limb salvage.

Rates of primary colonization of a contaminated wound have been shown to as high as 70%.[3-6] Smears reveal most often Gram-positive *S. aureus* and *Epidermidis* and in Gram-negative species *Bacilli*, *Pseudomonas*, *Acinetobacter,* or *Enterobacteriae*.[7-9,11-14] In our study, rate of primary colonization was 46.87%. The most common primary colonizing agent was *Enterobacter* species and *Enterococcus* species. Whereas MRSA was the most common bacteria causing infection in open fractures. By showing similar findings, our study further strengthens those international studies.

Although the microbiological pattern at the wound site may be influenced by environmental factors (agricultural injury, gunshot injury, and water injury…) which have to be considered in the antibiotic management.[4,15,16] It is well known that most infections in open fractures are of nosocomial origin as causative microorganisms of infection are different to those found in initial smears.[7,8] Lee[7] evaluated that only 8% of microorganisms on pre-debridement cultures were to be the infectious agents. Our study also showed that all the infected wounds showed change in flora during hospitalization. This further strengthens the fact that most infections in open fractures are nosocomial in origin.

Our study supported the importance of early wound coverage as those fractures which received wound coverage after 2 weeks of trauma, 77.77% developed infection before final wound coverage.

Limitations of our study are those inherent to all designs that use data collected from medical records, such as reliability and incompleteness of information.

CONCLUSION

Most of the open fracture wounds show change in wound flora during hospitalization and the infection in open fracture wounds is most often nosocomial in origin. The rate of infection in wound increases with increase in trauma to final wound coverage interval. We recommend final wound coverage as early as possible. We would like to conduct further study to access whether change in the dressing material and current practice of dressing will affect the outcome of these difficult to treat compound fracture.

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