e - ISSN - 2348 - 2168
Print ISSN - 2348 - 215X

Acta Biomedica Scientia

Journal homepage: www.mcmed.us/journal/abs

# BACTERIAL SURGICAL SITE INFECTION IN TRAUMATIC PATIENTS UNDERGOING ORTHOPAEDIC SURGERIES IN SOUTH INDIA

**N.Shivananda Reddy [1], T.G.Dinesh Krishna[2*]**

[1]Associate Professor, Department of Orthopaedics, Bhaarath Medical college and Hospital,Chennai (Affiliated to Bharath University, Chennai), India.
[2]Assistant Professor, Department of General Surgery, Bhaarath Medical college and Hospital, Chennai (Affiliated to Bharath University, Chennai), India.

**Article Info**

*Received 03/12/2020*
*Revised 16/12/2020*
*Accepted 25/12/2020*

**Keywords** :-
Trauma, orthopedic, bacterial infection, antibiotic,Open fracture, Klebsiella

**ABSTRACT**

The rate of infection is high and heterogeneous in developing countries. This study aimed to find the rate and pattern of infection in a tertiary care hospital with a goal to improve the infection control ractices.73 swabs/ pus specimens from various compound fracture sites suspected to be infected were collected and processed, by standard methods. Antibiotic susceptibility testing of all the isolates was done. 64% of patients developed infection at the fracture site. Klebsiella species was the commonest organism isolated 30% followed by others. Unlike previous studies, Klebsiella constituted majority of the cases instead of Staphylococcus. There is an urgent need to adopt basic principles of asepsis and sterilisation and to make judicious use antibiotics.

## INTRODUCTION

Open and multiple injuries often cause infection. Infection is one of the common serious complications in orthopedics. Long treatment cycles, high treatment costs, and poor prognosis bring huge physical and mental harm to patients, as well as huge challenges to doctors and healthcare systems. The total medical cost of infected patients after tibial fracture is 6.5 times that of uninfected patients, antibiotic treatment time is 11 times that of uninfected patients, and the hospital stay is 7.7 times that of uninfected patients [1]. The risk of fracture related infection (FRI) depends on the location of the injury, severity, and the accompanying injury and physiological state of the host. The incidence of infection after closed low-energy fractures is about 1%, and the incidence of infection after complex open fractures is about 15% [2-3].

.

Corresponding Author

**T.G.Dinesh Krishna**
Email: - drpebyreddy@gmail.com

FRI is usually caused by exogenous factors such as initial trauma or surgery [4].

The prevalence of these infections varies widely ranging from 5-16%. In India, based upon the various studies prevalence of SSI varies between 5% and 24%.[5] SSI are defined as an infection occurring within 30 days after a surgical operation (or within 1 year if an implant is left in place after procedure) and affecting either incision or deep tissues at the operation site.[6] Despite advances in SSI control practices, like improved operating room ventilation, sterilization methods, use of barriers, surgical technique there has been an alarming rise in low and middle income countries. Understanding the pathogens implicated in causing the SSIs and their antimicrobial sensitivity place a good role in reducing the mortality and morbidity. Studies have shown an increase in the trend of SSIs attributable to antimicrobial resistant pathogens such as MRSA

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. Road traffic accidents are responsible for a substantial proportion of compound fracture cases and are a growing problem worldwide accounting for around 50 million injuries annually [3]. In developing countries like India, the topic is of great importance since most of the cases of compound fractures end up in fracture site infection because of many risk factors like gross contamination, delayed intervention, multiple surgeries etc. A few studies have been reported in India, though none is comprehensive regarding the bacteriology of openfracture wounds [7-8]. The present study were aimed at determining the trend of causative micro-organisms of fracture site infection in the orthopedic ward of Bhaarath Medical college and Hospital .

**Material and methods:**

A retrospective study was conducted institute of Orthopaedic surgery, Bhaarath Medical college and Hospital,Chennai,India by collecting details of the patients with compound fractures admitted in orthopedic ward.

73 cases of compound fracture with age between 20 and 60, who were admitted in orthopedic ward and included except those who are with associated HIV infection or on immunosuppression therapy. Details collected included patient's basic demographic data, data on underlying disease status, surgical procedures, preoperative preparation and antibiotic prophylaxis. In the operating room, samples were taken after debridement was done using the standard procedure under strict aseptic conditions and were immediately transported to the microbiology department for culture and antibiotic sensitivity testing. Antibiotic therapy was modified based on the sensitivity reports. Repeat cultures were done where signs of clinical infection were noted and patients were switched to appropriate antibiotics based on the culture and sensitivity reports. The microbial flora cultured in the post-debridement samples and the samples sent after infection signs were noted and included in the study.

The swabs were assayed for the predominant organisms found in culture and the microbial sensitivity/resistance patterns. The pathogens were identified by standard laboratory procedures including Grams staining, motility, colony characters and biochemical reactions. Antibiotic susceptibility testing was done by Disc diffusion method and measuring diameter of zone of inhibition as described by Bauer- Kirby method on Mueller Hinton Agar (MHA). Clinical infection was defined according to the Centers for Disease Control and Prevention criteria which divides infections into superficial and deep based on the extent of skin and tissue involvement. The factors considered for the diagnosis of infection include the presence of local or systemic signs of inflammatory response including fever, local erythema, warmth, purulent discharge, or the invasion of sterile host tissue, leading to necrosis irrespective of whether the bacterial cultures were positive or negative.

Analysis was done on the collected data to determine the incidence of infections in compound fracture cases in orthopedic ward, Prevalence of various microbes at the infected fracture site, and pattern of their drug sensitivity.

**Table 1: Type of organism.**

| Type of organism | n | % |
|---|---|---|
| Gram positive | 8 | 16 |
| Gram negative | 42 | 84 |

**Table2: Type of Microbial Culture**

| Type of Microbial Culture | n | % |
|---|---|---|
| Gram positive | 7 | 14 |
| Gram negative | 43 | 86 |

**Table 3: Cultured organism**

| Cultured organism | n | % |
|---|---|---|
| Klebsiella pneumoniae | 19 | 38 |
| Proteus mirabilis | 10 | 20 |
| Pseudomonas aeruginosa | 9 | 18 |
| Staphylococcus aureus | 7 | 14 |
| Escherichia coli | 1 | 2.0 |
| Acinobacter | 1 | 2.0 |
| Candida | 1 | 2.0 |
| Citrobacter | 1 | 2.0 |
| Enterococci | 1 | 2.0 |

**Discussion:**

Surgical site Infections are a common side effect in orthopedic patients, and despite aseptic precautions during surgery, there is still the possibility of this complication. In our study, the infection rate at the orthopedic surgery site was 4%, which is in the range estimated in other studies. Of course, it should be noted that the incidence of infection at the surgical site, due to differences in the number of the study population, time and place of study, type of hospital, surgical team, type of surgery and several other factors can vary.

Infection after any orthopedic surgery is one of the most serious complications.[9] In recent past years with a better understanding of asepsis and operative conditions, the incidence of infection declines rapidly after any orthopedic surgery. With the increase in the frequency of high-energy trauma globally and going trend toward the early internal fixation of compound fractures of all bone, the incidence of infection related to orthopedic implant is again showing increasing incidence.[10] This increasing incidence also associated with the emergence of multi-drug resistant microorganism prevalent in hospitals.[11] Open injuries expose many tissues like bone, tendon, nerves and vessels which are all tend to at risk when left exposed.[12] Hence it is important to give wound cover as early as possible.[13 ]The bony gap results initially from acute traumatic bone loss at the site of the injury.[14]

Due to the high prevalence of orthopedic surgery site infection, differences in pathogens causing infection, differences in bacterial resistance to antibiotics and consequently the need to start different antibiotics, epidemiologic studies that evaluate the frequency distribution of bacterial infection and related risk factors seem crucial. Previous studies have claimed that the rate of bacterial surgical site infection in traumatic patients are dependent on various factors and vary from 2-9%. The specific organisms responsible for infections should also be determined in specific populations [15-16]. Motor vehicles and road traffic accidents, fall from height and certain risk taking behaviors are more common among men could be the cause of the high prevalence of infection among them.

Having an open wound at the time of admission increases the risk of infection. Patients with open fracture and fracture fixation have a high rate of infection [17]. Possibly open wounds (49.1%) were one of the causes of high infection rate among our patients. Also, repeated surgeries are common among orthopedic patients. many a times, wound debridement is performed as an emergency procedure for severe traumatic wounds. Later, the implant is used for internal fixation of fracture. Covering the wound with skin graft or flap is also a frequently performed surgery. Therefore, repeated exposure of orthopedic patients to operation room is unavoidable.

In this study, gram negative isolates exhibited maximum degree of resistance to commonly used low generation antibiotics and these findings were in consistent with many other studies globally. The reason is these antibiotics are widely prescribed in empirical treatment of various infections in our setting. So, usage of these drugs in treatment of SSI should be monitored and switched over to other drugs in non-responsive cases. Most of the isolates in the study exhibited greater degree of resistance to Amoxyclavulanic acid than expected and this signifies a gradual shift of organisms towards antibiotic choice. Most of the gram-negative isolates were multi drug resistant and exhibited maximum sensitivity to carbapenems and Piepracillin/tazobactum.

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. 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.[18-19] Lee 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.

Early stabilization of open fractures provides many benefits to the injured patient. It protects the soft tissues around the zone of injury by preventing further damage from mobile fracture fragments. It also restores length, alignment, and rotation all vital principles of fracture fixation. This restoration of length also helps decrease soft tissue dead spaces and has been shown in studies to decrease the rates of infection in open fractures.[20-22]

The wound swab was sent either during or after the surgery and the data was collected from the records. The investigators, therefore, were unable to differentiate community acquired infection and hospital acquired infection. Initial screening of pre-operative patients is not a routine practice in this study setting. We lacked data on antibiotic/ s usage among the study population. Hence, additional research is needed to determine the rate of community acquired and hospital acquired infection and the causes of higher infection rate among the orthopedic cohort.

Infection in orthopaedic trauma patients is a common problem associated with significant financial and psychosocial costs, and increased morbidity. The incidence of infection is high, ranging from 5% to 10% depending on the location and severity of the injury, and the type of fracture. Despite improvements in management, infection still remains a significant problem [23-29]

In a prospective study, Das, Mishra et al13, done at IMS and SUM Hospital, Odisha, India, a total of 621 orthopaedic wound samples were collected among which 468 samples showed bacterial growth. Staphylococcus

aureus (26.89%) was the most commonly isolated organism in that study followed by Pseudomonas aeruginosa (11.35%), Klebsiella Species, (10.76%), Acinetobacter Species, (8.76%), Citrobacter Species (4.98%), Proteus Species, (3.39%) and E. coli (1.79%). Lingarajet al [26] demonstrated that organisms grown in pre-debridement cultures did not correlate with postoperative wound infection. Lee showed that post-debridement cultures could predict infection in only 42% of the cases. However, another study by D'Souza et al. showed that both preand postdebridement cultures play a role in predicting postoperative infection.

The choice of antibiotic must depend on the severity of fracture: Type I and II injuries most commonly grow Staphylococcus aureus, hence a second generation cephalosporin is recommended and more severe Type III injuries predominantly grow Gram negative aerobes, for which Gentamycin is to be added.

**Conclusion:**

By evaluating the frequency distribution of bacterial infection and related risk factors in traumatic patients undergoing orthopedic surgeries, we showed that the incidence rate of infection was 4% and the most common bacteria was Staphylococcus aureus. 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. Hence, frequent hospitalization or visit to an out-patient department is directly proportional to the rate of infection. Though we cannot avoid some of these events, we certainly can reduce the infection rates in the present setting. Early debridement and wound coverage is the most important factor of the fracture outcome. increasing incidence pattern. Amidst varied results regarding the pathogenic organism, in recent period there is a changing trend from gram positive like, Staphyloccocus aureus towards gram negative organisms like Klebsiella, Proteus, Pseudomonas. There is an urgent need to adopt basic principles of asepsis and sterilization and to make judicious use antibiotics in these patients to reduce the incidence of fracture site infections.

Infection among the orthopedic surgery patients can have devastating consequences and hence newer measures are needed to combat this. Many hospitals in India have infection control committees which are working very hard to bring down the infection rates. Yet, the infection rate in several hospitals is high.

**References**

1. Metsemakers W-J, Smeets B, Nijs S, Hoekstra H. Infection after fracture fixation of the tibia: analysis of healthcare utilization and related costs. Injury. 2017;48(6):1204–10.
2. Papakostidis C, Kanakaris NK, Pretel J, Faour O, Giannoudis PV. Prevalence of complications of open tibial shaft fractures stratified as per the Gustilo- Anderson classification. Injury. 2011;42(12):1408–15.
3. Cook GE, Markel DC, Ren W, Webb LX, Mckee MD, Schemitsch EH. Infection in orthopaedics. J Orthop Trauma. 2015;29:S19–23.
4. Trampuz A, Zimmerli W. Diagnosis and treatment of infections associated with fracture-fixation devices. Injury. 2006;37(Suppl 2(2)):S59-66.
5. Pathak A, Saliba EA, Sharma S, Mahadik VK, Shah H, Lundborg CS. Incidence and factors associated with surgical site infections in a teaching hospital in Ujjain, India. Am J Infect Control. 2014;42e11-5.
6. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection. Centers for disease control and prevention (CDC) hospital infection control practices advisory committee. Am J Infect Control. 1999;27:97-132.
7. Lee J. Efficacy of cultures in the management of open fractures. Clin Orthop Relat Res 1997;339:71-5.
8. Merritt K. Factors increasing the risk of infection in patients with open fractures. J Trauma 1988;28:823-7.
9. Goel SC. Infection following implant surgery. Indian J Orthop 2006;40:133-7.
10. An YH, Friedman RJ. Concise review of mechanisms of bacterial adhesion to biomaterial surfaces. J Biomed Mater Res 1998;43:338-48.
11. Moussa FW, Anglen JO, Gehrke JC, Christensen G, Simpson WA. The significance of positive cultures from orthopedic fixation devices in the absence of clinical infection. Am J Orthop (Belle Mead NJ) 1997;26:617-20.
12. Charles C. Edwards M.D., Shelton C. Simmone M.D., Bruce Du Browner, M.D. and Mahstry C. weigel M.A. Severe open Tibial fractures Results treating 202 injuries with external fixation. Clinical Orthopedics and related research No: 230 May 1988.
13. Isreal Ziv M.D, F.R.C.S. (C) and David Segal M.D, Immediate Care of crush injuries and compartment syndrome with the split thickness skin excision. Clinical orthopaedics and related research No: 256 July, 1990.
14. Keating JF, Simpson AH, Robinson CM. The management of fractures with bone loss. J Bone Joint Surg Br. 2005 Feb;87(2):142–50.

15. Badia JM, Casey AL, Petrosillo N, Hudson PM, Mitchell SA and Crosby C. Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries. J Hosp Infect 2017; 96: 1-5.
16. Bebko SP, Green DM and Awad SS. Effect of a preoperative decontamination protocol on surgical site infections in patients undergoing elective orthopedic surgery with hardware implantation. JAMA Surg 2015; 150: 390-395.
17. Willey M, Karam M. Impact of Infection on Fracture Fixation. Orthop Clin North Am. *Orthop Clin N Am*. 47 (2016) 357–4.
18. Lee J. Efficacy of cultures in the management of open fractures. Clin Orthop Relat Res 1997;339:71-5.
19. Merritt K. Factors increasing the risk of infection in patients with open fractures. J Trauma 1988;28:823-7.
20. Worlock P, Slack R, Harvey L, Mawhinney R. The prevention of infection in open fractures: An experimental study of the effect of fracture stability. Injury. 1994; 25:31– 8.
21. Merritt K, Dowd JD. Role of internal fixation in infection of open fractures: Studies with Staphylococcus aureus and Proteus mirabilis. J Orthop Res. 1987; 5:23–8.
22. Merritt K. Factors increasing the risk of infection in patients with open fractures. J Trauma. 1988; 28:823–7.
23. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. J Bone Joint Surg Am 1976;58:453-8.
24. Neubauer T, Bayer GS, Wagner M. Open fractures and infection. ActaChir Orthop Traumatol Cech 2006;73:301-12.
25. Blease R, Kanlic E. Management of open fracture. Bosn J Basic Med Sci 2005;5 (4):14-21.
26. Lingaraj R, Santoshi JA, Devi S, Najimudeen S, Gnanadoss JJ, Kanagasabai R, et al. Predebridement wound culture in open fractures does not predict postoperative wound infection: A pilot study. J Nat SciBiol Med 2015;6:S63-8.
27. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: A modification of CDC definitions of surgical wound infections. Am J Infect Control 1992;20:271-4.
28. Monson TP, Nelson CL. Microbiology for orthopaedic surgeons, selected aspects. ClinOrthopRelat Res. 1984;190:14-22.
29. Zalavras CG, Marcus RE, Levin LS, Patzakis MJ. Management of open fractures and subsequent complications. J Bone Joint Surg Am 2007;89:884-95