ORIGINAL RESEARCH

Culture Analysis Of Wound Debridement And Assessment Of Surgical Site Infection In Open Fracture Cases- A Hospital Based Study

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ABSTRACT

Introduction Open fracture wounds are highly susceptible to contamination and infection, posing a significant challenge for orthopaedics. Identifying the specific bacteria present in the wound is crucial for effective antibiotic treatment and wound management. This study investigates the microbiological profile of open fracture wounds through culture analysis of wound debridement and assesses the incidence of SSIs, aiming to inform strategies for preventing post-operative infections and improving patient outcomes. **Materials and Method:** This study included patients with open fractures admitted to the orthopaedic department with fracture duration less than one week, and fit for anaesthesia and surgery. Patients were consecutively enrolled, and data was collected using a pre-designed proforma, with follow-ups at 1 and 3 months post-operation. The study examined various variables, including surgical wound, clinical examination findings, laboratory results, and complications. **Results:** The majority of subjects were male (80%) and belonged to the 31-40 age group. The study identified various organisms during debridement, with S. Aureus being the most common. The most frequently performed operation was plating (31.4%), followed by Ex Fix F/B Plating (28.57%). Post-operative signs of infection were observed in a few subjects within the first 30 days, but significantly improved after 3 months, with 97.14% showing no signs of infection. The study also tracked TLC and CRP levels pre-operatively and at follow-up, indicating a positive outcome. **Conclusion:** By analyzing the culture results and monitoring patients for signs of infection, the study provided valuable insights into the management of open fracture cases and the prevention of surgical site infections, ultimately informing strategies to improve patient outcomes.

Keywords: Open fracture wounds; Sepsis; Debridement

INTRODUCTION

Open fracture wounds are wounds that have been contaminated, and the most prevalent issue during the period after surgery is the occurrence of infection.[1]The majority of open fractures are a result of high-energy trauma, and the care of open fractures provides a difficult challenge for orthopaedists due to the exposure of the fracture haematoma to contamination caused by the subsequent lesion in the soft tissue envelope.[2]Surgical site infection (SSI) is a serious complication that frequently necessitates surgical revision. Infection is a prevalent factor contributing to nonunion and impaired function after open fractures. [3] At the time of trauma, from 0% to 70% of open fractures are infected with germs. [4]

Several factors influence the probability of bacterial infection, including the pattern of the fracture, the patient's co-morbidities, the presence

of injured soft tissue, and the time elapsed between the injury and therapy. The reported incidence of Surgical site infection (SSI) ranges from 3.6% to 22.5% while the infection rate for implant fixation of closed fractures is between 0.5% and 2%, and increases to 30% for open fractures.[5]As per literature, identifying the specific bacteria present at the location of the fracture would allow for a more rational and efficient use of antibiotics before initiating therapy and making a final decision on how to manage the wound.[6,7] Most standard antibiotics should be effective in treating contaminating bacteria in open fractures, as these germs are obtained in the community. It is generally recommended to use an empirical antibiotic with a wide range of activity against both Gram-positive and Gram-negative bacteria. A delayed wound culture can identify the initial contaminating organism, which could suggest a failure in the debridement process and a significant risk of infection after surgery. According to reports, surgical site infections are attributed to bacteria that are acquired in the hospital setting.[7] This ignited a discussion over the need and rationale for obtaining first wound cultures, with certain authors hypothesizing that these cultures offer limited predictive significance for postoperative infection.[8]Some argue that despite not being very specific, they are highly sensitive in identifying wounds that may get infected following surgery.[9,10]The study investigated the microbiological profile of open fracture wounds through culture analysis of wound debridement and assessed the incidence of surgical site infections. It aimed to identify the types of microorganisms present in the wounds and evaluate the effectiveness of surgical interventions in preventing post-operative infections.

MATERIALS AND METHOD

The present study is a prospective, hospital-based observational study conducted in the Department of Orthopaedics. The source of data was patients with open fractures admitted to the orthopaedic department during the study period. The study population consisted of patients who met the inclusion and exclusion criteria, which were carefully selected to ensure a representative sample. The study aimed to observe and record the characteristics and outcomes of patients with open fractures, providing valuable insights into the management and treatment of this type of injury.The study included patients with open orthopaedic injuries who met specific criteria: that comprised patients over 18 years old, of either sex, and have a fracture duration of less than one week after hemodynamic stabilization. Additionally, patients had to be fit for anaesthesia and surgery to be eligible. On the other hand, patients with soft tissue injury without fracture, open fracture with amputation, or those unwilling to participate in the study were excluded. The sampling method involved consecutively enrolling all eligible patients who presented during the study period, ensuring a representative sample of patients with open orthopaedic injuries.The study examined various variables, including the post-operative surgical wound, clinical examination findings such as fever, pain, and swelling, laboratory results like TLC, DC, CRP, post-operative x-rays, neurovascular involvement, and any other complications. Ethical approval was obtained prior to data collection, and informed written consent was obtained from all patients. Data was collected using a pre-designed proforma, and all open fractures in patients over 18 years old were included in the study. A detailed history, clinical examination, routine blood tests, and radiographs were conducted for each patient. Operated cases were followed up for three months, with assessments using clinical examination, CBC, inflammatory markers like CRP and wound evaluation. Patients were followed up at 1 month and 3 months post-operation, and assessments were done using clinical examination, blood investigations, and radiographs, with results analyzed accordingly.The data collected according to the proforma was analyzed and interpreted using suitable statistical methods. The data underwent statistical analysis using compatible techniques, and all data was entered into Microsoft Excel/SPSS software on a personal computer. Descriptive statistics such as mean, standard deviation, and proportion were employed, and analytical statistics like chi-square or other appropriate methods were applied. A statistical p-value of less than 0.05 was considered significant, indicating a statistically significant result.

RESULTS

Table 1 shows age group wise distribution of study subjects results revealed that total 35 subjects participated in the study out of them 1subjects belonged to <20 years, 7 subjects belonged to 21-30 years,10 subjects belonged to 31-40 years, 8 subjects belonged to 41-50, 6 belonged to 51-60 years each age group and 3 subjects belonged to >60 years of age.Table 2 shows gender wise distribution of study subjects results found that 20% female and 80% male participants participated in the study. Table 3 shows type of organism found during debridement wise distribution of study subjects results revealed that E.Coli was found during debridement in 8.57% subjects, pseudomonas was found during debridement in 5.71% subject, S.Aureus was found during debridement in 17.14% subjects and both S.Aureus and E,Coli was found during debridement in 5.71% subjects.Table 4 shows type of operation done wise distribution of study subjects results revealed that

Ex Fix F/B Plating was performed in 28.57% subjects, Ex-Fix in 5.71%, Ex-Fix With K Wiring, K Wire Fixation With Ligamentotaxis, PFN-A2, Plating With K-Wiring, Fix F/B Nailing and Exfix-F/B Imil Nailing performed in 2.85% subject each; maximum plating was performed in 31.4% subjects, lim Nailing in 8.57% subjects and K – Wiring performed in 5.71% subjects and LRS was performed in 2.85% subject . Table 5 shows distribution of study subjects according to signs of infection present in 1st -30 days follow up results revealed that Erythema, swelling observed in 2 subjects and Pus discharge, swelling found in 4 subjects and after 3 months, 97.14% had no signs of infection. Table 6 shows mean TLC and CRP pre-op and at follow up.

Table 1: Age group wise distribution of study subjects

Years	Frequency	Percent
<20	1	**2.85**
21-30	7	20
31-40	10	28.5
41-50	8	22.85
51-60	6	17.14
>60	3	8.57
Total	35	100.0

Table 2: Gender wise distribution of study subjects

Gender	Frequency	Percent
Female	7	20
Male	28	80

Table 3: Type of organism found during debridement wise distribution of study subjects

Organism	Frequency	Percent
Nil	22	62.85
E Coli	3	8.57
Pseudomonas	2	5.71
Staph Aureus	6	17.14
Staph Aureus, E Coli	2	5.71

Table 4: Type of operation done wise distribution of study subjects

Type of operation	Frequency	Percent
Ex Fix F/B Plating	10	28.57
Ex -Fix F/B Nailing	1	2.85
Ex-Fix	2	5.71
Ex-Fix With K Wiring	1	2.85
Exfix-F/B Imil Nailing	1	2.85
Ilim Nailing	3	8.57
K -Wiring	2	5.71
K Wire Fixation With Ligamentotaxis	1	2.85
LRS	1	2.85
PFN-A2	1	2.85
PLATING	11	31.4
Plating With K-Wiring	1	2.85

Table 5: Distribution of study subjects according to signs of infection present in I month and at 3 months follow up

Sign of Infection	Frequency at 1 month	Percent	Frequency at 30 days	Percent
None	29	82.85	34	97.14
Erythema, swelling	2	5.71	0	0
Pus discharge, swelling	4	11.42	1	2.86

Table 6: Mean TLC and CRP pre-op and at follow up

	Mean TLC	Mean CRP
Pre-op	10.1±1.2	1.82±1.5
At 3 months	16.4±1.4	26.3±8.5

DISCUSSION

The study consisted of 35 subjects, with the majority (80%) being male and 20% female. The age distribution showed a range from under 20 to over 60 years old, with the highest number of subjects in the 31-40 age group. In a comparable study by **Dish et al**,[11] the majority of participants (26.15%) fell within the 21-30 years age group, while 14 participants were between 41-50 years old.The present study found various organisms during debridement, with S. Aureus being the most common (17.14%), followed by E. Coli (8.57%) and both S.Aureus and E,Coli was found during debridement in 5.71% subjects.. The anterior nares and palms serve as significant reservoirs for Staphylococcus aureus, with approximately 10-20% of healthy persons harboring this pathogen. Bed sheets, instruments, and dressings have been identified as reservoirs.[5] In the study by **Dish et al[11]** In terms of pre-debridement culture results, Staphylococcus aureus was the most commonly isolated organism, followed by Acinetobacter, Enterobacter, and Pseudomonas species. Klebsiella species were only found in six patients. After debridement and treatment for bacterial infection, subsequent culture examinations revealed no growth in 61 patients. Similarly, Staphylococcus aureus, accounting for 40.90% of all isolates in the study by **Lakshminarayana S et al.[5] However, in the study by Agarwal AC et al[12],** Gram negative (E. coli and Pseudomonas spp.) infections have emerged as the major threat (74.37%) in orthopaedic cases in contrast to Staphylococcus aureus (23.31%). These bacteria infected patients with open fractures (34.3%), spinal instrumentation with bedsores (23.31%), osteomyelitis of bone (24.42%) and guillotine amputation stumps (14.43%). **Lindeque B et al[13]**and another study by **Rajaduraipandi K et al[14]** has shown the presence of MRSA in varying proportions, ranging from 5.6% to 37.9% This suggests that the prevalence of MRSA throughout the study period was on the lower end of this range.The most common operation performed was plating (31.4%), followed by Ex Fix F/B Plating (28.57%). Post-operative signs of infection were observed in 6 subjects within the first 30 days, but after 3 months, 97.14% of subjects showed no signs of infection. The study also tracked mean TLC (Total Leukocyte Count) and CRP (C-Reactive Protein) levels pre-operatively and at follow-up, although the specific values are not mentionedThe current study investigates and characterizes the occurrence of surgical site infection following surgical therapy in cases involving open fractures.In the first 30 days of the follow-up period, symptoms of infection were detected in 17.15% of patients. The most prevalent signs were pus discharge and swelling, followed by erythema and swelling among patients. During the 31st to 90th day of follow-up, the incidence of infection decreased to 2.86% among all patients, who had symptoms such as pus discharge and edema. **Shao J et al[15]** documented a surgical site infection rate of 7.19%. In this study, the incidence of surgical site infection (SSI) was reported by many authors. **Hu Q et al[16]** conducted a study that found the occurrence rate of surgical site infections (SSI) after open fracture surgery to be 18.6%. In their study, they found that out of 2445 participants in the Fluid Lavage of Open Wounds trial, 325 individuals (13.3%) had an SSI. A study conducted by **Hu Q et al[16]** revealed a substantial association between seven risk factors and surgical site infections (SSI). These factors encompass the type of fracture, the duration of the surgery, the duration of anesthesia, the body temperature during the operation, the level of blood glucose, and the count of platelets and leukocytes. Among the seven predictors given, six were found to be potentially modifiable and have a significant effect in preventing postoperative wound infection in patients. The literature widely recognizes CRP as a dependable early indicator for postoperative infection. It is essential to comprehend the usual pattern of CRP levels in instances of tissue damage

and uncomplicated surgery to identify any atypical fluctuations that could suggest an infection.[17] Our study found that the average level of CRP increased from the pre-operative period (16.4±1.4) to the first 90 days (1.82±1.5). The surgical procedure triggers an immunological response that is regulated by cytokines. An high C-reactive protein (CRP) level is a well-established marker of negative outcomes in elderly individuals who are undergoing surgery. The usual pattern of CRP elevation halts after the third day post-surgery, indicating that it rises until the third day and then goes back to the normal range.[18] In their study, **Ayo HO et al[17]** observed that the average levels of C-reactive protein (CRP) reached their highest point on the third day after surgery for both groups of patients.However, patients who developed postoperative surgical site infections (SSI) had a higher CRP value of 52.2 mg/l compared to 47.7 mg/l for those without SSI. This difference was statistically significant (p = 0.015). A study conducted by Shetty S et al[18], those who did not encounter postoperative wound infection exhibited a similar pattern. The study revealed that patients who had postoperative wound infections exhibited notably elevated average CRP levels on the third and seventh days following surgery, in contrast to those who did not encounter any postoperative infections.

CONCLUSION

In conclusion, this study examined the demographic and clinical characteristics of 35 subjects who underwent surgical interventions. The majority of subjects were male (80%) and belonged to the 31-40 age group. The study identified various organisms during debridement, with S. Aureus being the most common. The most frequently performed operation was plating (31.4%), followed by Ex Fix F/B Plating (28.57%). Post-operative signs of infection were observed in a few subjects within the first 30 days, but significantly improved after 3 months, with 97.14% showing no signs of infection. The study also tracked TLC and CRP levels pre-operatively and at follow-up, indicating a positive outcome. Overall, the study provides valuable insights into the demographic and clinical characteristics of subjects undergoing surgical interventions, which can inform future treatment strategies and improve patient outcomes.

REFERENCES

1. Lee J: Efficacy of cultures in the management of open fractures . Clin Orthop. 1997, 339:71-5
2. Diwan A, Eberlin KR, Smith RM. The principles and practice of open fracture care, 2018. Chinese Journal of Traumatology. 2018 Aug 1;21(04):187-92.
3. Dellinger EP, Miller SD, Wertz MJ, Grypma M, Droppert B, Anderson PA. Risk of infection after open fracture of the arm or leg. Archives of surgery. 1988 Nov 1;123(11):1320-7.
4. Ojo OD, Oluwadiya KS, Ikem IC, Oginni LM, Ako-Nai AK, Daniel FV. Superficial swab cultures in open fracture management: insights from a resource-poor setting. journal of wound care. 2010 Oct;19(10):432-8.
5. Lakshminarayana S, Chavan S, Prakash R, Sangeetha S. Bacteriological profile of orthopedic patients in a tertiary care hospital, Bengaluru. Int J Sci Res. 2013;4(6):2319-7064.
6. Heitmann C, Patzakis MJ, Tetsworth KD, et al.: Musculoskeletal sepsis: principles of treatment. Instr Course Lect. 2003, 52:733-43. 10. Seekamp A, Köntopp H, Schandelmaier P, et al.: Bacterial cultures and bacterial infection in open fractures . Eur J Trauma. 2000, 26:131-8
7. Faisham WI, Nordin S, Aidura M: Bacteriological study and its role in the management of open tibial fracture. Med J Malaysia. 2001, 56:201-6
8. Kreder HJ, Armstrong P: The significance of perioperative cultures in open pediatric lower-extremity fractures. Clin Orthop. 1994, 302:206-12.
9. D'Souza A, Rajagopalan N, Amaravati RS: The use of qualitative cultures for detecting infection in open tibial fractures. J Orthop Surg (Hong Kong). 2008, 16:175-8. 10.1177/230949900801600209
10. Naique SB, Pearse M, Nanchahal J: Management of severe open tibial fractures: the need for combined orthopaedic and plastic surgical treatment in specialist centres. J Bone Joint Surg Br. 2006, 88:351-7. 10.1302/0301-620X.88B3.17120
11. Dish J, Shanthappa AH, Natarajan A. A Prospective Comparative Study of Pre-debridement and Post-debridement Cultures in Open Fractures of the Extremities. Cureus. 2024 Feb 23;16(2):e54778.
12. Agrawal AC, Jain S, Jain RK, Raza HT. Pathogenic bacteria in an orthopaedic hospital in India. The Journal of Infection in Developing Countries. 2008 Apr 1;2(02):120-3.
13. Lindeque B, Rutiqliano J, Williams A, Mc Connell J. Prevalence of Methicillin – Resistant Staphylococcus aureus among orthopaedic patients at alarge academic hospital. Orthopaedics 2008 Apr; 31(4):363.
14. Rajaduraipandi K, Mani KR, Pannerselvam K, Mani M, Bhaskar M, Manikandan P. Prevalence and antimicrobial susceptibility pattern of methicillin resistant

Staphylococcus aureus, A multicentre study. Indian J Med Micrbiol 2006 Jan; 24(1):34-8
15. Shao J, Zhang H, Yin B, Li J, Zhu Y, Zhang Y. Risk factors for surgical site infection following operative treatment of ankle fractures: A systematic review and meta-analysis. Int J Surg. 2018 Aug;56:124-132. doi:
16. Hu Q, Zhao Y, Sun B, Qi W, Shi P. Surgical site infection following operative treatment of open fracture: Incidence and prognostic risk factors. Int Wound J. 2020 Jun;17(3):708-715.
17. Ayo HO, Mcharo CN. C-reactive protein response in open fractures of the tibia. SA Orthopaedic Journal. 2010 Jan;9(1):24-9.
18. Shetty S, Ethiraj P, Shanthappa AH. C-reactive Protein Is a Diagnostic Tool for Postoperative Infection in Orthopaedics. Cureus. 2022 Feb 16;14(2):e22270.