

Micro-Organisms Isolated from Open Fractures of Extremities

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ABSTRACT

OBJECTIVE: To determine the frequency of micro-organisms from culture reports of open fractures of extremities.

METHODOLOGY: In this descriptive cross-sectional study carried out in the orthopedic surgery department of Lady Reading Hospital in Peshawar, 173 patients with open fractures lasting more than five days were included. The trial lasted for six months. Consecutive non-probability sampling was used. Swabs were collected from the fracture wounds. Swabs were inoculated on Blood agar, MacConkey agar and chocolate agar. Different biochemical tests were used to identify the Micro-organisms.

RESULTS: Analysis of 173 patients' ages revealed that the patients were 18-67 years old, with a mean age of 28.6 ± 3 . Analysis of the gender-wise distribution of the 173 patients showed that 92(53.2%) were men and 81(46.8%) were women. Analysis of the distribution of micro-organisms among 173 patients revealed that 45(26%) and 36(20.8%) of them were *staphylococcus aureus* and Streptococcus. Staphylococcus epidermidis were 32 (18.5%). Pseudomonas aeruginosa were 34(19.7%) and *E Coli* were 26 (15.02%). The Gustilo classification was used to examine the distribution of fractures among 173 patients. Grade 1 consisted of 31, Grade II consisted of 48, Grade III consisted of 80, Grade IIIB consisted of 8, and Grade IIIC consisted of 6.

CONCLUSION: This study concludes that both staphylococcus aureus were the frequent micro-organisms involved in open fracture infections.

KEYWORDS: Micro-organisms, open fractures of extremities, Culture, Infection.

INTRODUCTION

For the treating surgeon, an open fracture still poses a significant difficulty since it often necessitates various intricate operations to promote undisturbed healing and proper limb function. The research shows considerable variation in the frequency of infection in open fractures. While Weitz-Marshall and Bosse discovered infection rates ranging from 0% to 50%, Spencer et al. reported an overall incidence of infection in open fractures of around 10.4%¹.

It is easiest to think of the process for evaluating and treating open fractures as a collection of ideas that have developed throughout time, frequently in connection with improvements in the treatment of military troops during the war. These guidelines cover both preoperative care and after surgery².

Accurately diagnosing and recording the damage mechanism is the first step. With the start of the proper antibiotic medication and tetanus prophylaxis,

the wound is appropriately covered, and the fracture is splinted. Usually, this is followed by an urgent surgical intervention that addresses soft tissue and bone treatment. The treatment of open fractures has progressed and now includes adjuncts such as the local fracture environment supplied with essential nutrients or antibiotics^{3,4}.

In one research, the culture reports showed that 27 (54%) cases were Gram-positive, with Staphylococcus aureus accounting for 32% of the cases and Streptococcus for 18%. Two cases involved MRSA and Staphylococcus epidermidis. Gram-negative organisms were found in twelve instances (24%), with *E. coli* being the most prevalent (12%). Six (12%) of the patients had mixed growth, one of which included *Enterobacter arogenosa* and MRSA. Ten percent (5 instances) show no growth⁵.

Postoperative infection is the primary complication of open fracture wounds, which are contaminated wounds. The fracture's severity increases the risk of bacterial infection, communication of the broken bone fragments to the surrounding environment, patient comorbidities, de-vascularized soft tissue, and treatment delay⁶.

Surgeons find it challenging to repair open fractures because infection from contaminated wounds is a known consequence. For open fractures, preventive antibiotic medication is usually advised to prevent this consequence⁷.

In another research, there were 15 (23.43%) incidences of infection out of 60 patients with 64 open fractures. Traffic accidents accounted for 48 (75%) of all injuries. Throughout the hospital stay, the flora in

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the wounds changed. The ultimate wound covering lasted an average of 5.66 days. From the last wound coverage period to an increase in trauma, the rate of infection rose⁸.

This study aims to find the frequency of organisms from culture reports of open fractures of the extremities.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Orthopedics, Lady Reading Hospital, Peshawar, from August 2020 to February 2021. Using the WHO Sample Size Calculator, a total sample size of 173 was determined, accounting for 12.5 percent of *E. Coli* in open fractures with a 95% confidence interval, 5% significance level, and 5% margin of error. Consecutive non-probability sampling was used.

Patients with open fractures, defined as those with a duration of more than five days and any gender who presented with the fracture, were included in the study. Patients with potentially fatal head, abdominal, or chest injuries, mental illness, burns, systemic illnesses, or immune-compromised status were excluded, as were patients who later experienced trauma or showed signs of immediate amputation.

All patients who met the inclusion criteria and were hospitalized as emergency patients were included in the research after receiving clearance from the hospital's ethical committee. Written informed consent was obtained from all patients before the study implementation. After surface cleaning, wound swabs were obtained for sensitivity and culture. For a minimum of five days following surgical debridement, intravenous (IV) broad-spectrum antibiotics were administered as injections of amoxicillin + clavulanic acid (1.2 g BD), amikacin (500 mg OD), and metronidazole (500 mg TDS). Wound debridement and irrigation with three litres of saline were performed.

If the wound allowed, primary wound closure was completed. If a wound was highly polluted, secondary wound closure was done. Wound dressings were applied every 48 hours when patient load caused a delay in wound closure or covering. Skin grafting or flap covering for wounds was done as soon as feasible for bigger deformities. Additionally, cast immobilization or external and internal fixation were performed. Analgesics and intravenous fluids were administered as needed.

Data analysis was done using SPSS version 22. Age and other numerical factors were determined as mean + SD. The study computed frequencies and percentages for categorical variables, including micro-organisms, gender, injury location, and open fracture grade.

RESULTS

A total of 173 patients presented with open fractures as per operational definition, having duration of

fracture > 5 days.

The results were analyzed as follows: Age distribution among 173 patients was analyzed: 18-24 Years was 26 (15.03%) 25-32 Years was 34(19.7%) and 33-40 Years was 24(13.9%) 41-47 Years was 21(12.1%) 48-54 Years was 22(12.7%) 55-61 Years was 20(11.6%) and 62-67 Years was 26(15.03%). The mean age was 28.6±3. (**Table I**)

Gender Wise Distribution among 173 patients was analyzed as 92(53.2%) were male and 81(46.8%) were Female.

The distribution of compound fractures according to anatomic location among 173 Patients. (**Table II**) Micro-organism distribution among 173 patients was analyzed: 45(26%) and 36(20.8%) were *staphylococcus aureus* and *Streptococcus*, respectively. *Staphylococcus epidermidis* were 32 (18.5%). *Pseudomonas aeruginosa* were 34(19.7%), and *E. coli* were 26 (15.02%) (**Table III**).

Distribution of compound fractures according to Gustilo classification was analyzed as Grade 1 comprised 31, Grade II consisted of 48, Grade III comprised 80, Grade IIIB comprised 8, and Grade IIIC consisted of 6. The association of micro-organisms and gustilo classification is shown in (**Table IV**).

Table I:
Age-wise distribution of sample size (n=173)

Age ranges	Frequency	Percent
18-24	26	15.03
25-32	34	19.7
33-40	24	13.9
41-47	21	12.1
48-54	22	12.7
55-61	20	11.6
62 -67	26	15.03
Total	173	100

Table II: Distribution of compound fractures according to anatomic location (n=173)

Site	Frequency	Percentage
Femur	32	18.5
Tibia	58	33.5
Ankle	25	14.6
Radius and Ulna	16	9.25
Humerous	11	6.36
Radius	13	7.5
Ulna	8	4.6
Fibula	4	2.3
Patella	3	1.7
Calcaneus	1	0.05
Pelvis	2	1.2

Table III: Micro-organism distribution (n=173)

Micro-organism	Frequency	Percent
Staphylococcus aureus	45	26
Streptococcus	36	20.8
Staphylococcus epidermidis	32	18.5
E Coli	26	15.02
Pseudomonas aeruginosa	34	19.7
Total	173	100%

Table No IV: Association between Micro-organism and Gustilo classification (n=173)

Micro-organisms	Gustilo classification			Total		
	Grade 1	Grade 2	Grade 3			
			a	b	c	
Staphylococcus aureus	9	15	19	1	1	45
Streptococcus	6	11	17	1	1	36
Staphylococcus epidermidis	5	8	15	2	2	32
E Coli	6	4	14	2	0	26
Pseudomonas aeruginosa	5	10	15	2	2	34
Total	31	48	80	8	6	173

DISCUSSION

A total of 173 patients were included in our study. Male patients were 53.2%, and females were 46.8%. This finding agrees with the previous study, which documented more males than females⁹; this may be explained by the fact that men have traditionally dominated several occupations in Pakistan, including building, operating machinery, and transportation. For various reasons, surgical debridement cannot usually be completed in the first six hours. Sometimes the surgery is done at the wrong time by overworked and exhausted anesthetists and surgeons.^{10, 11} A waiting period of six to twenty-four hours before beginning surgical treatment for complex fractures can help with preoperative planning of the fractures that require final treatment, better identification of the extent of related injuries, and therefore, appropriate clinical stabilization. There is currently no scientific evidence in the literature suggesting that delaying surgical debridement affects the risk of infection. According to Gustilo and Anderson's categorization^{11,12}, observational studies have demonstrated a correlation between infection and severe fractures, particularly those affecting leg bones. This investigation confirmed these findings. Notably, four infections were found in less significant fractures (Grade I and II), although no infections were found in those who underwent surgery six hours later; this indicates that the severity of injuries should always be considered and that time was not the only determining factor. Thus, we advise that more serious

fractures should be operated on immediately.

Our attention was drawn to the high infection rate in ankle fractures; out of 18 fractures, 27.7% developed infection; this is a significant percentage compared to leg bone fractures, where 16.9% of the 65 fractures acquired infection. Further studies are necessary to determine the exact reason for this discovery, given this group was not studied in isolation¹³.

Research hasn't shown much evidence to link infection to postponed surgical debridement^{13,14}. Similar studies have not demonstrated a correlation between the infection rate, the time needed for surgical debridement, and IV antibiotics¹⁵⁻¹⁹. There is a chance of a type II error in this study because of the small sample size. Still, there is no statistically significant correlation between the infection incidence and the debridement time. After all fractures, 40.4% had surgery within 6 hours after the trauma; however, the causes of this delay in surgical debridement were not the focus of this investigation.

The research shows significant variation in the infection rates for complex fractures. In a nationwide investigation, Muller et al.²⁰ discovered acute infectious consequences in 20.5% of the fractures. Comparable infection rates were also seen in other foreign investigations²¹⁻²³, with an overall frequency of 13.24%.

We think a multicenter randomized trial would be required to more accurately analyze the relationship between the time and the occurrence of infection; however, this kind of analysis is hampered by ethical considerations. Other factors that affect the risk of infection should not be overlooked. These include patient-related factors (such as diabetes, smoking, and other co-morbidities), fracture type (including lesion location and severity), and surgical technique (including the surgeon's experience and the degree of aggressive debridement of devitalized tissues).

CONCLUSION

This study concludes that Gram-positive and Gram-negative bacteria are involved in infections of open fractures of extremities. Gram-positive bacteria were more frequent than Gram-negative. The results highlight the need for regular microbiological examination of open fracture injuries.

Ethical permission: Lady Reading Hospital, Medical Teaching Institute, Peshawar, Pakistan, IRB letter No. 475/LRH/MTI.

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AUTHOR CONTRIBUTION

Zaman R: Literature search, data collection, manuscript writing, final approval

Deeba F: Data analysis, final approval

Roghani AS: Data interpretation, drafting

Roghani FS: Data analysis, final approval

Inam M: Study design, concept, questionnaire design, final approval

REFERENCES

1. Kale AR, Sonawane CS, Waghmare VU, Kalambe H. Open fractures and incidence of infection in tertiary care government hospital. *Int J Sci Stud*. 2017; 5(5): 24-28.
2. Bucholz RW, Heckman JD, Court-Brown C, editors. *Rockwood and Green's Fractures in Adults*. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.
3. Beaty JH, Kasser JR, editors. *Rockwood and Wilkins' Fractures in Children*. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2005.
4. Ruedi T, Buckley R, Moran C eds. *AO Principles of Fracture Management*. New York: Thieme; 2007.
5. Naeem U, Habibullah S, Amer HK. Common organisms and their sensitivity in open fractures of the Extremities. *Pak J Surg*. 2012; 28(3): 186-92.
6. Reddy L, John AS, Sheela D, Syed N, James J. Predebridement wound culture in open fractures does not predict postoperative wound infection: a pilot study. *J Nat Sci Biol Med*. 2015; 6: S63-S68.
7. Hasan O, Rahim Khan HA, Mustafa SF, Muhammad ZA, Ahmad T. Use of bacterial cultures in open wound fractures: a prospective cohort study. *IJS Short Rept*. 2018; 3: 52-7.
8. Amit RK, Chandrashekar SS, Vijay UW, Harshal K. Open fractures and incidence of infection in tertiary care government hospital. *Int J Sc Study*. 2017; 5(5): 24-29.
9. Zeb A, Ullah Z, Ullah F, Safder A, Khan Y, Naseem U. Bacterial Spectrum and Antibiotic Sensitivity in open Fractures of the Extremities. *Pak J Med Health Sci*. 2022; 16(05): 1192.
10. Carmont MR. The Advanced Trauma Life Support course: a history of its development and review of related literature. *Postgrad Med J*. 2005; 81(952): 87-91.
11. Carley S, Driscoll P. Trauma education. *Resuscitation*. 2001; 48(1): 47-56.
12. Collicott PE. Advanced Trauma Life Support (ATLS): past, present, future-16th Stone Lecture, American Trauma Society. *J Trauma*. 1992; 33(5): 749-753.
13. Bosch F, Rosich L. The contributions of Paul Ehrlich to pharmacology: a tribute on the occasion of the centenary of his Nobel Prize. *Pharmacology*. 2008; 82(3): 171-179.
14. Kindsfater K, Jonassen EA. Osteomyelitis in grade II and III open tibia fractures with late debridement. *J Orthop Trauma*. 1995; 9(2): 121-127.
15. Bednar DA, Parikh J. Effect of time delay from injury to primary management on the incidence of deep infection after open fractures of the lower extremities caused by blunt trauma in adults. *J Orthop Trauma*. 1993; 7(6): 532-5.
16. Spencer J, Smith A, Woods D. The effect of time delay on infection in open long-bone fractures: a 5-year prospective audit from a district general hospital. *Ann R Coll Surg Engl*. 2004; 86(2): 108-112.
17. Noumi T, Yokoyama K, Ohtsuka H, Nakamura K, Itoman M. Intramedullary nailing for open fractures of the femoral shaft: evaluation of contributing factors on deep infection and nonunion using multivariate analysis. *Injury*. 2005; 36(9): 1085-1093.
18. Skaggs DL, Friend L, Alman B, Chambers HG, Schmitz M, Leake B, Kay RM et al. The effect of surgical delay on acute infection following 554 open fractures in children. *J Bone Joint Surg Am*. 2005; 87(1): 8-12.
19. Arruda LRP, Silva MAC, Malerba FG, Fernandes MC, Turíbio FM, Matsumoto MH. Fraturas expostas: estudo epidemiológico e prospectivo. *Acta Ortop Bras*. 2009; 17(6): 326-330.
20. Müller SS, Sadenberg T, Pereira GJC, Sadatsune T, Kimura EE, Novelli JLV. Filho Estudo epidemiológico, clínico e microbiológico prospectivo de pacientes portadores de fraturas expostas atendidos em hospital universitário. *Acta Ortop Bras*. 2003; 11(3): 158-169.
21. Swanson TV, Szabo RM, Anderson DD. Open hand fractures: prognosis and classification. *J Hand Surg Am*. 1991; 16(1): 101-107.
22. Taffinder NJ, McManus IC, Gul Y, Russell RC, Darzi A. Effect of sleep deprivation on surgeons' dexterity on laparoscopy simulator. *Lancet*. 1998; 352(9135): 1191-1191.
23. Arnedt JT, Owens J, Crouch M, Stahl J, Carskadon MA. Neurobehavioral performance of residents after heavy night call vs after alcohol ingestion. *JAMA*. 2005; 294(9): 1025-1033.

