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ORIGINAL ARTICLE

Surgical site infection in patients undergoing internal fixation for long bone fractures.

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ABSTRACT… Objective: To determine the frequency of surgical site infections in patients undergoing internal fixation for long bone fractures and to identify associated risk factors. **Study Design:** Descriptive Case Series. **Setting:** Ghurki Trust Teaching Hospital, Lahore. **Period:** May 1, 2024, to October 30, 2024. **Methods:** A total of 78 patients meeting inclusion criteria were evaluated. Preoperative prophylaxis with cefazolin and strict aseptic measures were implemented. Patients were followed up at 2 and 4 weeks postoperatively for signs of infection. Data on demographics, implant type, and clinical outcomes were collected and analyzed using SPSS version 22. **Results:** Out of 78 patients, 11 (14.1%) developed SSIs. Females had a higher infection rate (19.4%) compared to males (9.5%), but the difference was not statistically significant ($p=0.209$). Patients with higher BMI showed a significantly increased risk ($p=0.016$). Tibia fractures (9.5%) and trimalleolar ankle fractures (50%) had the highest infection rates. Plate and screw implants were associated with higher SSI rates (18.2% and 71.4%, respectively; $p<0.001$). **Conclusion:** The frequency of SSI following internal fixation for long bone fractures was 14.1%, with higher rates observed in females, patients with elevated BMI, and those treated with plates and screws. Strict aseptic measures, preoperative prophylaxis, and implant selection play crucial roles in reducing infection rates. Further studies are recommended to develop local preventive guidelines.

Key words: Aseptic Techniques, Biofilm, Internal Fixation, Long Bone Fractures, Orthopedic Implants, Surgical Site Infection.

INTRODUCTION

Any surgical procedure starts with the breakage of one of the most important barriers to infection, i.e., skin. Thus, it is very understandable that patients are susceptible to infection following a surgical procedure. Surgical site infection (SSI) has previously been defined as the presence of pain alongside erythema, tenderness, and dis charge from a surgically created wound; discharge can have a positive or negative culture.[1,2] Surgical site infection dates back to 14-37 AD, as far back as the history of surgery. Cornelius Celsus first described the four principal signs of inflammation and warranted the use of antiseptic agents. Around a hundred years after this, the father of surgery: Claudius Galen, defined proper wound management by his practices.[3]

Surgical site infection in the orthopedics population is way more serious than in various other surgical populations. The entity is more challenging because infection in these patients is associated with the development of biofilm over the surgically inserted implant. This film impedes antibiotics' action on infectious agents. This results in more morbidity and, hence, longer hospital stays, worse clinical outcomes, and more exhaustion of resources.[4] This phenomenon leads to higher rates of osteomyelitis, nonunion, implant failure, sepsis, and multi-organ failure. Orthopedic postsurgical infections have been classified in terms of the interval between intervention and diagnosis of infection into early (less than 2 weeks), delayed (2 to 10 weeks), and late (more than 10 weeks. The infectious agent has been studied in orthopedic post-surgical infection cases. The most common pathogens include Staphylococcus aureus (S.

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aureus) and Escherichia coli (E. coli).[2] However, other organisms can be the causative agents; multi-microbial infection patterns have also been witnessed. The management relies on the antibiotic sensitivity of these infectious agents. Generally, vancomycin and ampicillin have been effective against S. aureus. Whereas levofloxacin, gentamicin and amikacin are effective against E. coli. Ceftriaxone, ciprofloxacin, cefoperazone/ sulbactam, tazobactam, and imipenem have been found to be effective against both the aforementioned bugs.[1] Overall rate of SSI has been presented to be 22.7%.[4] On the other hand, a figure as high as 5% following orthopedic implant insertion has been noted as well.[5] Similarly varying figures, mostly ranging from 2-5, have been mentioned in literature generated from different countries.[2]

Since SSI is a complication that can be prevented, good knowledge about the risk factors and possible preventive measures is of utmost importance. Risk factors for these postoperative infections have been categorized into patient-related, equipment-related, and healthcare provider-related. Various patient-related factors like immunocompromised state, comorbid, malnourishment, substance abuse, vascular diseases, etc. have been justified. Equipment-related factors include inadequate sterilization of instruments, improper implants, and inadequate operation theaters. Similarly, healthcare providers' related factors include improper scrubbing, unsterile approach long duration of procedures, etc.[6,7] These factors can be managed to keep a check on infection rates. Use of titanium implant (lowers biofilm formation)/ antibiotic-coated materials, proper surgical technique and OT discipline etc., can decrease post-operative infections.

Similarly effective use of antibiotics as three doses of any broad-spectrum cephalosporin lowers the incidence of SSI in the field of orthopedics.[8] Combination of effective use of antibiotics and aseptic measures alone can reduce SSI to a huge extent. Similarly, proper wound care postoperatively is beneficial. Treatment relies on culture-based use of antibiotics alongside local wound care. However, if the conservative management fails; then removal of the implant stays the mainstay.[9]

Shah MQ et al. studied surgical site infections in patients undergoing open reduction and internal fixation of long bones. They reported that 5.30% of cases developed SSI when followed till 4 weeks postoperatively.[10]

Thus, the rationale of this study is to monitor SSI following internal fixation cases. This will result in the collection of fresh local data that will not only help alarm surgeons regarding the complication, if needed but also will help generate local guidelines for the prevention of this grave complication. So, the study aimed to determine the frequency of surgical site infractions in cases of long bone fractures undergoing internal fixation.

METHODS

This descriptive case series study was conducted in Ghurki Trust Teaching Hospital Lahore, which aimed to assess for surgical site infection in patients who underwent internal fixation for long bones. After duly signed approval (Ref. No.2023/11R-20) (Dated: 01-11-23) from the institutional review board of Ghurki Trust Teaching Hospital, a total of 78 patients who fulfilled the criteria for inclusion in the study were assessed from May 01, 2024, to October 30, 2024. A sample size of 78 was calculated using a 95% confidence level, 5% margin of error, and taking the frequency of SSI as 5.3%.[10]

The inclusion criteria consisted of both male and female genders of age 18 years and above who underwent internel fixation for long bones. The exclusion criteria of the study were patients with Open fractures and fractures with associated neurovascular injuries and comorbid conditions that result in immunocompromise, inc. diabetes. Patients with multiple fractures and associated injury of any other boy organ or system are treated surgically. The assessment started after taking informed consent from the study individuals. All these cases, whether admitted through the outpatient department (OPD) or Emergency room (ER), were thoroughly assessed at first presentation in terms of history and clinical exam. Then, appropriate radiological exams were advised. These patients were then prepared for internal fixation and, after anesthesia assessment, underwent surgical fixation. Every patient got a preoperative dose of broad-spectrum cephalosporin (cefazolin) one hour before the incision. Strict aseptic measures, including proper scrubbing, growing/gloving, and surgical site preparation as per WHO guidelines, were followed. All these cases were given postoperative intra-venous antibiotics as per hospital guidelines for 3 days, and daily dressing was advised till 2 weeks postoperatively. At two weeks postop, the patients came back to the out-patient, where wounds were assessed for any sign of infection. Second follow-up was done at the end of 4th postoperative week to assess the surgical site infection. During these visits, if any sign of wound infection was seen, appropriate management in terms of culture-based antibiotics was commenced. Samples were collected as non-probability consecutive sampling, and All the data, including patients' demographic variables, procedure details as well as wound status, were recorded by the researcher on the 4th postoperative week on a performed proforma.

All the data collected from the study group were entered into SPSS version 22. Then both descriptive and inferential analysis will be done. Categorical variables will be presented in terms of frequencies and percentages, whereas quantitative variables will be assessed in terms of measures of central tendencies, i.e., mean and standard deviation. Then, each of these variables will be stratified against the outcome variable, i-e surgical site infection, by use of chi-square and t-test.

Table-I summarizes the demographic and clinical characteristics of the 78 patients included in the study. The majority of the patients were male (53.8%), with a slightly smaller proportion being female (46.2%). The mean age of the patients was 41.45 years (SD = 19.92), with a wide age range (19–90 years). The average Body Mass Index (BMI) was 22.87 kg/m^2 (SD = 3.34), within the normal weight range, with BMI values ranging from 18.0 to 30.0 kg/m^2.

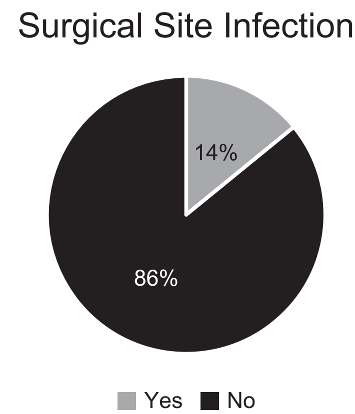

Figure 1. Surgical site infection in patients for long bone fractures

RESULTS

Variables	N(%)	M(SD) Range
Gender		
Male	42(53.8)	
Female	36(46.2)	
Age(years)		41.45(19.92) (19.0-90.0)
BMI (kg/m2)		22.87(3.34) (18.0-30.0)
Bone Fractured		
Humerus	3(3.8)	
Ulna	1(1.3)	
Tibia	21(26.9)	
Radius	6(7.7)	
Femur	15(19.2)	
Fibula	1(1.3)	
Ankle (trimal)	10(12.8)	
Femur, DHS	12(15.4)	
Femur, Hip	2(2.6)	
Femur, Hip DHS	1(1.3)	
Femur, Long plate DHS	1(1.3)	
Hip	2(2.6)	
Radius, Hand	1(1.3)	
Radius, Ulna	2(2.6)	
Type of Implants		
Nail	28(35.9)	
Screw	18(23.1)	
Plates	22(28.2)	
Nail, Plates	2(2.6)	
Plates, K wire	1(1.3)	
Plates, Screw	7(9.0)	

Table-I. Demographic and Clinical characteristics of patients (n=78)

	Surgical Site Infection		
	Yes	No	P-Value
Gender			
Male	4(9.5)	38(90.5)	.209
Female	7(19.4)	29(80.6)	
Age(years)	40.18±13.37	41.66±20.87	.760
BMI (kg/m2)	21.09±2.21	23.16±3.41	.016
Bone Fractured			
Humerus	-	3(100.0)	
Ulna	-	1(100.0)	.305
Tibia	2(9.5)	19(90.5)	
Radius	-	6(100.0)	
Femur	3(20.0)	12(80.0)	
Fibula	-	1(100.0)	
Ankle (trimal)	5(50.0)	5(50.0)	
Femur, DHS	1(8.3)	11(91.7)	
Femur, Hip	-	2(100.0)	
Femur, Hip DHS	-	1(100.0)	
Femur, Long plate DHS	-	1(100.0)	
Hip	-	2(100.0)	
Radius, Hand	-	1(100.0)	
Radius, Ulna	-	2(100.0)	
Type of Implants			
Nail	1(3.6)	27(96.4)	<.001
Screw	1(5.6)	17(94.4)	
Plates	4(18.2)	18(81.8)	
Nail, Plates	-	2(100.0)	
Plates, K wire	-	1(100.0)	
Plates, Screw	5(71.4)	2(28.6)	

Table-II. Stratification of different predictors affecting the surgical site infection

The most common bone fracture was the tibia (26.9%), then femur fractures (19.2%), while humerus and ulna fractures were less common (3.8% and 1.3%, respectively). Regarding the type of implants used for fracture fixation, nails were the most frequently used implant (35.9%), followed by plates (28.2%) and screws (23.1%).

14% of patients were found with surgical site infection, while 86% did not have any infection after surgical intervention, as shown in Figure-1.

Table-II stratifies various predictors for surgical site infection (SSI) and compares the presence or absence of infection in relation to these predictors. Of the 42 male patients, 4 (9.5%) had an SSI, while 38 (90.5%) did not. Among the 36 female patients, 7 (19.4%) had an SSI, and 29 (80.6%) did not. The p-value of 0.209 indicates that gender was not significantly associated with SSI in this sample. The mean age of patients with SSI was 40.18 years (SD = 13.37), while those without SSI had a mean age of 41.66 years (SD = 20.87). The p-value of 0.760 suggests no significant difference in age between the two groups in relation to SSI. Patients with an SSI had a lower average BMI (21.09 kg/m^2, SD = 2.21) compared to those without SSI (23.16 kg/m^2, SD = 3.41). The p-value of 0.016 indicates a significant difference in BMI between the two groups, suggesting that lower BMI may be associated with a higher risk of SSI.

The presence of SSI stratified the fracture types. For example, 50% of patients with ankle (trimal) fractures had an SSI, while 9.5% of patients with tibia fractures did. A p-value of 0.305 indicates no significant association between bone fracture type and SSI occurrence, although the presence of infection was higher in some fracture types, like the ankle (trimal). The type of implant used was significantly associated with SSI ($p < 0.001$). Plate implants had the highest rate of infection, with 18.2% of patients with plate implants developing an SSI. In contrast, only 3.6% of patients with nail implants and 5.6% of patients with screw implants experienced SSIs. Additionally, plates combined with screws had a strikingly higher infection rate of 71.4%.

DISCUSSION

One of the purposes of this study was to know the rate of surgical site Infection following Internal fixation fractures of long bones. The outcomes of the 14% Incidence of SSI we found In this study are within the range which has been reported in other studies.[11]

Another target of the study was to determine the predictive value of selected risk factors for Surgical site infection. There has been a reported male predominance for infection among injured patients with fractures in previous studies.[12] This is not true for this series, as our results show evidence regarding the justification of body mass index and female predominance to be positively predictive of surgical site infection after long bone fractures internal fixation.

In orthopedics, Surgical site infection remains a significant concern for doctors as well as patients, especially after internal fixation of long bones. The results of SSI rates found in our study align with the findings from various other studies that report SSI rates ranging from 2 to 25% in orthopedic procedures.[13-15] The slight variation in the reported rates can be attributed to differences in patient populations, surgical techniques, and the definitions used for SSIs across studies.

Lower body mass index was found in our study to be another notable risk factor for SSI, with a significant difference between those who had an infection and those without it. This matches with previous data, which show malnutrition and obesity to be marked risk factors for surgical site infections. A multicenter study by Ribeiro et al.[14] has shown a 2.23% Surgical site infection, highlighting a correlation between prolonged surgery and advanced age, which may also correlate with our findings regarding lower Body mass index and infection rates.

The demographic characteristic of patients influences our results. These differences in the results might be due to variations in hospital setups and operating rooms in developed and developing countries and personal differences. These further studies are also needed to support our findings and to evaluate the risk factors more precisely. Although the incidence of postoperative infection depends on the presence of uncontrollable factors such as patient demographics, risk factors, and injury patterns, compliance with care protocols before, during, and after surgery helps to avoid the incidence of even worst possible infections. Our study supports the multifactorial nature of SSI in orthopedic surgery, emphasizing the need for targeted prevention protocols that bring into account patient-related factors such as BMI, the type of surgical implant used, and the implementation of effective antibiotics prophylaxis. Future research should focus on developing standardized protocols for SSI prevention tailored to the unique challenges presented by orthopedic surgeries.

LIMITATION

This is a limited and short cohort study of lesser duration and does not take into account other riskfactors for SSI such as immunocompromised state and comorbids like diabetes.

CONCLUSION

This study marks the importance of identifying the risk factors for surgical site infections after long bone fixations showing malnutrition (lower BMI) and use of specific implants such as plates for fixation of long bones as significant risk factors.

This can improve patients outcomes ,guide decision making and decrease the economic burden of surgical site infection.Future studies should focus on developing strategies to mitigate these risks and develop effective prevention protocols.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Bilal Zaib:** Conceptualization, data collection.
2	**Awais Nawaz Khan:** Frame work of study.
3	**Usman Mushtaq:** Draft of study.
4	**Haseeb Elahi:** Data collection, draft of study.
5	**Muhammad Rizwan:** Data collection.
6	**Atiq uz Zaman:** Critical review.