

Prevalence of Surgical Site Infections in Clean Orthopedic Practice With Implants

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ABSTRACT

Objective: To assess the prevalence of surgical site infections in patients undergoing clean orthopedic surgery where metal implants were used.

Methods: A prospective cross-sectional study with aim to calculate the prevalence of Surgical Site Infection SSI where 165 patients undergoing elective and clean orthopedic surgery during the months of March and April 2017.

Results: The surgical site infection was found in 21 patients (12.27%). In data analysis, staphylococcus aureus was found to be the most common organism isolated. The rate of diabetes mellitus in the infected population was found to be 23.81% and rate of nicotine consumption in the infected population was found to be 28.57%.

Conclusion: The occurrence of surgical site infection in orthopedic surgery was higher, with 62% of cases diagnosed after hospital discharge, this result reinforces the need for post-discharge surveillance.

Keywords: Perioperative Nursing; Staphylococcus Aureus; Nursing Research; Surgical Wound Infection; Risk Factors; Orthopedic Procedures; Metal Implants.

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Article History:

Received: 15-06-2017, **Revised:** 03-07-2017, **Accepted:** 25-07-2017

Access this article online

Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2017.3.4.039	

INTRODUCTION

Surgical Site Infections (SSI) are the most common nosocomial infections and a major cause of postoperative morbidity and resource utilization.^{1,2} An infected wound can prolong hospitalization by 5 to 20 days and subsequently increase medical costs.³ The recent English Nosocomial Infection National Surveillance Scheme (NINSS) reported that the overall incidence of SSI's was 4.3% of all surgical operations, of which 25% were serious deep or organ/ space infections.⁴

The CDC healthcare-associated infection (HAI) prevalence survey found that there were an estimated 157,500 surgical site infections associated with inpatient surgeries in 2011.³

Until the 1860s, surgical site infections were so severe that surgeons rarely operated. Erichsen, the Head Surgeon in the University College Hospital in London, in his published work called Hospitalism, had elaborately stated the statistics pertaining to deaths after major amputations which approached to a discouraging figure of 46%.⁵

Joseph Lister's antiseptic technique revolutionized the practice of surgery. It was the genius of the "father of modern surgery" and "the greatest surgical benefactor to mankind" that envisioned the principles of Pasteur in the form of an etiological basis for infections and gangrene.⁶

In 1881 Charles Chamberland⁷ invented the steam sterilizer, known as the autoclave. The autoclave was used to clean surgical tools and kill bacteria by heating water, held within the autoclave, to 140°C. After about 20 minutes the tools would be completely sterilized. Despite Chamberland's ingenuity, the sterilization of surgical equipment was slow to catch on. Only very few surgeons actually used the autoclave or other techniques in the early 1880s.

DEFINING SURGICAL SITE INFECTIONS

Since a range of microorganisms that could cause infection normally colonizes skin, defining a surgical site infection (SSI) requires evidence of clinical signs and symptoms of infection rather than microbiological evidence alone. SSIs frequently only affect the superficial tissues, but some more serious infections affect the deeper tissues or other parts of the body manipulated during the procedure.

The majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th and 10th postoperative days. However, where a prosthetic implant is used, SSIs affecting the deeper tissues may occur several months after the operation.

According to Center for Disease Control guidelines, there are three levels of SSI.^{8,9}

1. SUPERFICIAL INCISIONAL

Infection occurs within 30 days after any operative procedure (where day 1 = the procedure date)

AND

Involves only skin and subcutaneous tissue of the incision

AND

Patient has at least one of the following:

- a. purulent drainage from the superficial incision.
- b. organisms identified from an aseptically obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method, which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST).
- c. superficial incision that is deliberately opened by a surgeon, attending physician or other designee and culture or non-culture based testing is not performed.

AND

patient has at least one of the following signs or symptoms:

- a. pain or tenderness; b. localized swelling, erythema; or heat. c. a culture or non-culture based test that has a negative finding does not meet this criterion. d. diagnosis of a superficial incisional SSI by the surgeon or attending physician or other disease.

There are two specific types of superficial incisional SSIs:

1. Superficial Incisional Primary (SIP): A superficial incisional SSI that is identified in the primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CAGB)

2. Superficial Incisional Secondary (SIS): A superficial incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site incision for CAGB)

The following does not qualify to fit into the definition of superficial SSI:

Diagnosis/treatment of cellulitis (redness/warmth/swelling), by itself, does not meet criterion d for superficial incisional SSI.

An incision that is draining or that has organisms identified by culture or nonculture based testing is not considered as cellulitis.

A stitch abscess alone (minimal inflammation and discharge confined to the points of suture penetration)

A localized stab wound or pin site infection. While it would be considered either a skin or soft tissue infection, depending on its depth, it is not reportable under this module.

Note:

A laparoscopic trocar site for an NHSN operative procedure is not considered a stab wound.

Circumcision is not an NHSN operative procedure. An infected circumcision site in newborns is and is not reportable under this module.

An infected burn wound is classified as BURN and is not reportable under this module.

2. DEEP INCISIONAL

Must meet the following criteria:

Infection occurs within 30 or 90 days after the operative procedure (where day 1 = the procedure date)

AND

Involves deep soft tissues of the incision (e.g., fascial and muscle layers)

AND

Patient has at least one of the following:

- a. Purulent drainage from the deep incision.
- b. A deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon, attending physician or other designee and organism is identified by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST) or culture or non-culture based microbiologic testing method is not performed

AND

Patient has at least one of the following signs or symptoms: fever (>38°C); localized pain or tenderness. A culture or non-culture based test that has a negative finding does not meet this criterion. c. an abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathology exam, or imaging test

These are the ones affecting the fascial and muscle layers. These infections may be indicated by the presence of pus or an abscess, fever with tenderness of the wound, or a separation of the edges of the incision exposing the deeper tissues.

There are two specific types of deep incisional SSIs:

1. Deep Incisional Primary (DIP): A deep incisional SSI that is identified in a primary incision in a patient that has had an operation with one or more incisions (e.g., C-section incision or chest incision for CBGB)

2. Deep Incisional Secondary (DIS): A deep incisional SSI that is identified in the secondary incision in a patient that has had an operation with more than one incision (e.g., donor site incision for CBGB)

ORGAN OR SPACE INFECTION

Infection within 30 days after operation involves any part of the anatomy (e.g. organs or spaces) other than the incision, which was opened or manipulated during an operation.

AND AT LEAST

1. Purulent drainage from a drain placed through a stab wound into the organ/space.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
3. An abscess or evidence of infection on direct examination during re-operation, or by histological or radiological examination.
4. Diagnosis of an organ/space SSI by a surgeon.

When the infection is such that it involves any part of the anatomy other than the incision that is opened or manipulated during the surgical procedure, for example joint or peritoneum is referred to as organ deep infection. These infections may be indicated by the drainage of pus or the formation of an abscess detected by histopathological or radiological examination or during re-operation. Organ infection is not included within the scope of this guideline.

In addition, there may also be microbiological evidence of wound infection from cultures obtained aseptically from wound fluid or tissue. However, since skin sites are normally colonized by a variety of organisms, positive wound cultures in the absence of clinical signs are rarely indicative of SSI.

Many preventable causes of SSI have been identified, and if proper measures are implemented, the incidence could be reduced. The washing of hands and maintaining basic hygiene,¹⁰ prophylactic antibiotics given at the proper time and at the correct strength,¹¹ surgical clothing,¹² and reducing the flow of staff in the operating room¹³⁻¹⁵ all contribute to lowering the incidence of infection.

Surgical Site Infection (SSI) for orthopedic surgery is a clinical problem that occurs in orthopedic wards for patients undergoing orthopedic surgery.¹⁶ Although orthopedic surgery is categorized as clean and strict measures of aseptic techniques and antibiotic prophylaxis are commonly employed, SSIs continue to be present as important complications to be addressed.¹⁷ Globally, SSI was reported in 1% to 3% of patients who had orthopedic surgery.¹⁸ Orthopedic SSIs prolong patient hospital stay to about two weeks, double the rate of rehospitalization, and triple the overall healthcare costs¹⁹, in addition to the physical limitations imposed on the patient, such as prosthesis removal or loss of limb function.⁹ Identifying patients at high risk of orthopedic SSI would enable providing both patient and healthcare provider with information that helps in improving preoperative assessment of the risk of developing orthopedic SSI, and make healthcare providers raise the index of suspicion for orthopedic SSI in high-risk individuals.²⁰ The risk factors of orthopedic SSI have been identified in the literature as preoperative risk factors, intraoperative risk factors, and postoperative risk factors.^{21,22} To our knowledge, this is the first study to be conducted in India to explore the risk factors of orthopedic SSI and to set the strategies required to prevent orthopedic SSI. The purpose of this review paper is to explore the risk factors that contribute to the incidence of orthopedic SSI in addition to exploring the causative microorganisms for orthopedic SSI.

METHODS

The data gathered arose from a prospective observation of 165 patients who underwent orthopedic surgical intervention with a metal implant on elective basis during march and April 2017 at Dr. R.N. Cooper Hospital and Hinduhrdaysamrat Balasaheb Thackeray Medical College a 650-bed tertiary care center in Mumbai India. Our main aim was to detect the occurrence of SSI within 30 days of the surgical procedure.

Inclusion Criterion

- Patients in whom operative Orthopedic intervention was done with a metal implant
- Surgical procedure between the month of march & April 2017
- SSI as per CDC criteria
- There should not be a pre-existing infection in the bone clinically
- Patient should not be undergoing a revision surgery
- Signs of infection should be visible in first 3 months only.

Exclusion Criterion

- Patients who were operated on emergency basis
- All open fractures
- Patients those were operated without metal implants
- Patient who did not consent to be a part of this study
- Patients not operated at this center.

The data was collected from the wards and OPD (out-patient department) of Dr. R.N. Cooper Hospital. It included age, sex, date of admission, diagnosis, classification of fractures

(open/closed), type of operative procedure (ORIF/CRIF), whether the first signs of SSI were found in the ward or OPD, CDC grade of SSI, nicotine consumption, pre-existing Diabetes mellitus, duration of surgery, organism Isolated and drug sensitivity.

As a standard practice prophylactic, intravenous antibiotics were given in the operating room before the anaesthesia. Patient was kept admitted for 5 days in the ward with 3 days of postoperative antibiotics. During this time 2 check dressings were done to pick up any signs of infection. Patient was then discharged and first follow-up is at day 15 of surgery for suture removal, followed by 2 weekly follow-ups till 3 months. During this duration surgical site infections were picked up. The infection was assessed by the infective organism, sensitivity of the antibiotics, and recovery. The prevalence of SSI was calculated.

The data was analysed using SPSS version. The data was summarized as frequency and percentage for continuous data, the bivariate comparisons were done using unpaired t test p values above 0.05 was considered statistically significant

RESULTS

This study was performed at Dr. R.N. Cooper hospital where 165 operated patients were followed up. Out of which 21 patients had surgical site infection as per CDC criterion, of the total of 165 patients 12.72% had SSI. Average age of the total study population was 37 years and that of infected patients was 45.2 years. Average male: female ratio of the whole population is 68.5 : 31.5 and that of the infected patients was 66 : 33. Of the total infected patients; closed reduction internal fixation was done in 28.57% and open reduction internal fixation was done in 71.43%. Of the total 21 SSI patients 61.9% were picked up from the OPD. As per the CDC grade 38.9% had 'Superficial incisional SSI', 33.33% have 'Deep incisional SSI', and 28.57 % had 'Organ or Space SSI'. Nicotine consumption was seen in 28.57% of the total infected patients and pre-existing diabetes mellitus was seen in 23.81% of the total infected patients.

Of the patients suffering from SSI in 6 patients (28.57%) no organism was isolated, 4 patients (19.05%) had Staphylococcus aureus infection, 3 patients (14.29%) had Acenatobacter infection, 2 patients (9.52%) each of pseudomonas infection, Methicillin resistant Staphylococcus Aureus infection and E.coli infection were detected and 1 patient (4.76%) each of Klebsiella infection and Methicillin resistant Coagulase negative Staphylococcus Aureus infection were detected. Out of all the infected patients 38.09% patients were infected with gram negative organism and 33.33% patients had gram positive infections.

DISCUSSION

Surgical site infection (SSI) is a complication causing excessive morbidity to the patient, high chance of re-operations, use of antibiotics for longer duration with its side effects, pain and increased economic burden to the patient as well as health care system.²³ Majority of surgical site infections are said to be happened at the time of surgical procedure.²⁴ This fact was very well reinforced by decreased rate of infection by execution of infection prevention strategies focused towards practices during surgery inside operation theatre. However, there is no study which will depict actual infection rate acquired at the time of surgical procedure in the operating theatre versus during post-operative period in the ward.²⁵

In our study we found that the incidence of post-operative SSI after clean elective orthopedic surgical procedure was 12.72%, this is in contrast to incidence of surgical site infection of 2% in developed countries.²⁶ The higher incidence of surgical site infection in our study may be due to the lack of economic assets, obsolescent instruments and improper ventilation in our operating theater, as well as incomplete solicitation of infection prevention strategies.

Our data was comparable to other studies conducted in developing countries like India and Brazil.²⁷⁻³⁰ (Table 1)

In our study we have found that the organism most commonly responsible for SSI was Staphylococcus Aureus at 33.33% including MRSA and MRCONS followed by acenatobacter sp at 14.29%. This finding is in tone with the works done by Al-Mulhim et al.²⁹

Table 1: Showing comparison between our studies and other workers

	Prevalence of infection
Our Study	12.27%
Ali Mohammed P²⁷	17.2%
Ribeiro Julio Cesar et al²⁸	11.6%
Thu et al³⁰	12.5%

In our study we found the average age of individuals with SSI was 45.2 years which was higher than the average age of total study population (37 years), similar results were seen in study done by Ribeiro Julio Cesar et al.²⁸

We found that the majority of the SSIs were picked up from the follow-up in the OPD after the patient was discharged i.e. 61.2%, as seen in the study done by Ribeiro Julio Cesar et al.²⁸ This makes post discharge follow-ups very important and we should not miss the early signs of SSI during post discharge follow-up.

Our study highlights that the rate of SSI was much higher in open procedures as compared to closed procedure, as 71.47% of the total SSI occurred in the open procedures and the rest in the closed procedures.

We have found that the rate of nicotine consumption in infected patients was 28.57% and 23.81% of the infected patients had preexisting diabetes mellitus.

In our study average duration of anaesthesia for the study population was 138 mins which was comparatively very high in the infected patients i.e. 191.9 min. As the duration of surgery is an important risk factor for the occurrence of SSI

CONCLUSION

The study was done with the intention to detect the rate of SSI occurring in the Department of the orthopedics in a setup with sub-par operation theatre setup in a developing country in a tertiary care centre. We have found that the rate of infection is much higher than western countries where the rate of infection is much lower. Risk Factors for SSIs are duration of Surgery, Nicotine consumption and diabetes mellitus. Our study has certain limitations as there is no clear cut protocol for surveillance and follows up of patients who are getting discharged from our institute. Because of this, patients developed SSI after discharge may not be included in our study. Secondly our study comprises a small sample size, so further randomized trials with larger sample size are recommended.

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Source of Support: Nil. **Conflict of Interest:** None Declared.

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Cite this article as: Jairam D. Jagiasi, Ali Saify, Prakash Chandra, Ganesh Yeotiwad, Amit Yadav. Prevalence of Surgical Site Infections in Clean Orthopedic Practice With Implants. *Int J Med Res Prof.* 2017; 3(4):184-88. DOI:10.21276/ijmrrp.2017.3.4.039