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## Preventing surgical site infection and safe usage of antibiotics in orthopaedic surgery

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### Abstract

This article displays the current principles in prevention of Surgical Site Infection and therapy of Antibiotics in Orthopaedic and Trauma Surgery. It also explains the various guidelines for safe usage with precise choice of Antibiotics in Orthopaedic and Trauma Surgery

**Keywords:** Antibiotics, Principles, Infection, Orthopaedics, Surgery, Injury

### Introduction

Surgical site infection in orthopaedic implant surgery is a serious complication range from 2% to 22%. It leads to increase morbidity and cost of treatment<sup>[14]</sup>.

The efficacy of prophylactic antibiotics has been well established in Orthopaedic surgery<sup>[1]</sup>. The antibiotic administration is effective at reducing infection when administrated just before the surgical incision is made. Multiple studies had confirmed this fact in joint arthroplasty, fracture surgery and spine surgery<sup>[3]</sup>. Despite that, surgical site infections (SSIs) continue to be a major source of morbidity, mortality and hospital cost<sup>[6, 7]</sup>

The World Health Organisation (WHO) estimates more than 50% of antibiotics in many countries are used inappropriately. Hence in its latest advisory, WHO suggested the adoption of 'Access, Watch and Reserve'; an approach that specifies which antibiotics to use for the most common and serious infections, which ones ought to be available at all times in the healthcare system and those to be used sparingly or reserved or used as last resort. WHO has also urged all countries to adopt these guidelines to reduce the antimicrobial resistance, adverse events and costs of the treatment<sup>[15]</sup>.

The incorrect use of antibiotics and easy access fuels antibiotic resistance which is a growing concern worldwide and in India. The recent Indian study confirmed the overusage of antibiotics in our Country with antibiotic prescription rate is high in private sector and advocated antibiotic stewardship programmes (ASP) in the health care institutions. This study also highlighted that primary care physicians in the private sector of our country can play a key role in reducing antibiotic misuse and overuse<sup>[2, 6, 14, 19]</sup>

The Health Department of Government of India through its Indian Council of Medical Research and National Centre of Disease Control had laid down guidelines in Antimicrobial usage in our country focusing the effectiveness and cost reduction. These guidelines are advocating the precise choice of antibiotics and duration to be used in all specialities including orthopaedic and fracture surgery<sup>[11, 13]</sup>

Today the medical planet is advising antibiotic stewardship programmes in all the clinical establishments. The goals of these programmes are to decrease hospital acquired infections, control costs and prevent complications associated with antibiotic usage (eg., renal damage, Clostridium Difficile infections). The stewardship team consists of surgeons, infectious disease specialists, clinical pharmacists, infection control and prevention practitioners<sup>[6, 10, 15, 23]</sup>

**Micro-organisms Prevalence & Antibiotic therapy in Orthopaedic Surgery**<sup>[4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21]</sup>

As per the 2017 Guidelines from Indian Medical Council Research, Staphylococcus Aureus and Coagulase Negative Staphylococci and Gram Negative Bacilli dominates acute

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osteomyelitis, septic arthritis, surgical site infections of Spine Surgery, Arthroplasties, fracture surgery with internal fixation devices, functional tissue repair and in Trauma. In External fixation the commonest organism causing infection are Staphylococcus aureus, Staphylococcus epidermidis and Escherichia coli especially in children. Chronic osteomyelitis or synovitis there is no empiric therapy and the definitive treatment has to be directed by bone/synovial biopsy culture and will be for minimum six weeks.

Orthopaedic Surgery is a unique speciality where the upmost

care in prevention of Infection is warranted. There are more Bone and Joint surgeries performed today than yesteryears. They are indeed justified well considering the early mobility and improving the quality of life. The overall incidence of Orthopaedic Surgical site Infection ranges from 0.8% - 71%. Also the increasing incidence of Road traffic accidents and traumatic injuries in India contributes more of open fractures demanding antibiotics. The following tabuloid exhibits the specific organisms and their choice of antibiotics in Orthopaedic & Trauma Surgery.

**Table 1:** The display of organisms and Choice of antibiotics in Orthopaedic Surgery

Disease/Challenge	Microorganisms	First Choice	Second Choice	Route/Duration
Cellulitis/Soft Tissue Infection/Lymphagitis	Group A Streptococci Pyogenes, Staphylococcus Aureus	Cloxacillin (50-100mg/kg/day) in 3-4 divided doses or Co- Amoxyclav (1.2 Gms) BD or Inj Cefazolin (50mg/kg/d in BD)	Clindamycin 600mg 8 <sup>th</sup> hourly- in Pencillin allergic patients	IV /5-7 Days
Acute Osteomyelitis/Septic Arthritis	Staphylococcus aureus/ Group A Streptococci Pyogenes,	Co- Amoxyclav (1.2 Gms) BD and Gentamycin 80 mg	Inj Ceftriaxone 1 gm / Inj Cefotaxime 1gm with or without Inj Vancomycin 1 gm	IV/ 4-6 weeks
Chronic Osteomyelitis	Multiple Organisms including Gram negative Bacilli, Anaerobes	Pathogen specific antibiotics after Culture and Bone Biopsy	--	Longer duration than 6 weeks
Surgical Site Infection/Implant Surgery Infection	Staphylococcus Aureus and Coagulase Negative Staphylococci and Gram Negative Bacilli	Ceftriaxone 2 gm IV OD with Inj Vancomycin 1gm IV BD	Inj Teicoplanin 800 mg three doses/12 hrs followed by 400mg once daily	IV/ 4 weeks
Open Fractures	Staphylococcus Aureus and Coagulase Negative Staphylococci and Gram Negative Bacilli	Co- Amoxyclav (1.2 Gms) BD / Cefuroxime (1.5 gms) 8 <sup>th</sup> hourly	Clindamycin 600mg 8 <sup>th</sup> hourly- in Pencillin allergic patients	IV/ Continued until wound debridement

### Antibiotic Prophylaxis in Orthopaedic & Trauma Surgery <sup>[1, 3, 9, 11, 13, 14, 16, 18]</sup>

The value of prophylactic antibiotics in Orthopaedic surgery has been well recognized today. It had been proved that the antibiotic administration is valuable at reducing infection and sepsis after Orthopaedic surgery. It is advised to give antibiotic infusion 15-30 minutes by intravenous route before starting surgery. However there is evidence suggesting that there is no antibiotics needed for orthopaedic surgery without implants and the same applies to soft tissue surgery in orthopaedics. For open fractures, Antibiotic prophylaxis and antitetanus measures to be provided in the emergency room itself. The antibiotics are recommended and continued until wound debridement (excision).

**Table 2:** The display of Choice of Prophylactic antibiotics in Orthopaedic & Trauma Surgery

Orthopaedic Surgery & Closed Fracture Surgery	Inj Cefuroxime 1.5 gm IV Stat and BD for 24 hrs (maximum) or Inj Cefazolin 2 gm IV Stat and BD for 24 hrs
Trauma Surgery & Open Fracture Surgery	Inj Cefuroxime 1.5 gm IV Stat and BD for 24 hrs (maximum) or Inj Cefazolin 2 gm IV Stat and BD for 24 hrs - The antibiotics are recommended and continued until wound debridement (excision)

### Preventing Surgical Site Infection (SSI) in Orthopaedic Surgery <sup>[9, 10, 12, 17, 22, 23]</sup>

- The incidence of SSI in Orthopaedic surgery as quoted earlier Surgical site infection in orthopaedic implant surgery is a serious complication range from 2% to 22% and spine surgery is 9%. Staphylococcus aureus is the commonest

organism involved. The risk may be due to Patients factors like Obesity, Co-morbid diseases like, Diabetes Melitus, Immunosuppression, Steroid usage, Extremes of age or procedural factors like more operating time, more bleeding, more tissue trauma and more staff movements while operating.

- It is highly recommended to implement antibiotic stewardship programme in all the health establishments to prevent and manage the SSI. Tetanus Prophylaxis to be given 48 hours before surgery. Proper education regard to surgery and postoperative period. Antibiotic prophylaxis 15 - 30 minutes before surgery to be given. Either Inj. Cefuroxime 1.5 gm IV BD for 24 hrs or Inj. Cefazolin 2 gm IV BD for 24 hrs and in Implant Surgery for 48 hours. Surgical site hair removal just before surgery (using clippers not razors) and Chlorhexidine skin preparation. Iodophor-impregnated drape, less tissue injury and less diathermy usage.
- The Anaesthesiologist's role is also a key factor in preventing SSI and the following Bundles with Phase of Care will help in producing the good results. Mitigating Risk Factors, Glycemic Control, Maintaining Normothermia, Antibiotic Prophylaxis, Patient Education. The duration of surgery correlates with the bacterial load. More than 10<sup>5</sup> organisms can be found in surgical wounds after 5.7 hours and operations longer than 3 hours increase the risk of infections. Good surgical technique is fundamental for reducing infection. This includes meticulous dissection within avascular planes, potential dead spaces.

### Antibiotic Stewardship Programme (ASP) in Orthopaedic Surgery <sup>[6, 16, 20, 21]</sup>

At present the medical society is recommending antibiotic

stewardship programmes in all the clinical establishments in order to manage surgical site infections with judicious use of antibiotics. Their efficacy had been shown with good results in challenging the micro-organisms. A multidisciplinary team approach to antibiotic stewardship can lead to improved patient outcomes and cost-effective medical care. Following principles play a crucial part in the ASP in providing high-quality orthopaedic surgical care:

- a. Determining appropriate indications of antibiotic administration
- b. Choosing the correct antibiotic based on known or expected pathogens
- c. Determining the correct dosage and
- d. Determining the appropriate duration of treatment

These Programmes direct and provide expert guidance on judicious usage of antibiotics.

### Discussion

Microbiological diagnosis is very important in diseases caused by spectrum of bacterial species. Antibiotic use for non-bacterial infections lead to risk of development of bacterial antibiotic resistance. Correct diagnosis of specific bacterial infection is the key to limiting unnecessary prescribing. Bacterial eradication should be the primary goal of antibiotic therapy. Antibiotic choices must reflect local resistance prevalence. We have to think of pharmacokinetics and pharmacodynamics to choose most effective agent and dosage. Consider local resistance, efficacy and maximise cost-effectiveness while prescribing antibiotic therapy. We have to prescribe antibiotics empirically but intelligently. We have to encourage patient compliance. For patients with recurrent infections, consider taking microbiological samples and review the antimicrobial prescription when the results are available. Avoid treatment for colonisation without evidence of infection unless there is a clear indication in the guidelines<sup>[11, 13]</sup>

Certain factors contribute infection in surgery. It may be patient factor or procedural factor. The patient factors are extremes of age, immunosuppression, diabetes mellitus, anaemia, smoking, prolonged hospital stay, co-existing infections at other sites, Obesity, malnourishment and carriage of resistant organisms. The procedural factors are surgical technique, longer surgical duration, inadequate haemostasis, variations of body temperature, skin antisepsis, operating theatre ventilation and air changes, the presence of foreign body, tissue trauma and preoperative shaving of hair<sup>[12, 17]</sup>.

### Conclusion

The National guidelines are to be followed for the antibiotic prescription in orthopaedic and fracture surgery with the shortest effective course, most appropriate dose with right route of administration. With regard to Infection, we have to have the high Index of suspicion for three months following Orthopaedic Surgery. The Choice of antibiotics depends on antibiotic susceptibility of the causative organism. The most effective, least toxic and least expensive antibiotic for the precise duration of time is needed to cure or prevent infection. The antibiotic chosen must cover the main contaminant flora present in the skin or mucosa disrupted by the incision.

It is highly recommended to implement antibiotic stewardship programme in the health establishments providing Orthopaedic Surgical care and also implementations of safety bundles in all the health establishments to prevent and manage the Surgical Site Infection.

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