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**Dr. Satishkumar A Patil**  
Junior Consultant,  
PIOS Multispecialty Hospital  
Jaysingpur Maharashtra, India

**Dr. Vikrant Magdum**  
Junior Consultant,  
PIOS Multispecialty Hospital  
Jaysingpur Maharashtra, India

**Dr. Girish Shinde**  
Senior Consultant, PIOS  
Multispecialty Hospital  
Jaysingpur Maharashtra, India

**Dr. Nagesh Naik**  
Professor of Orthopaedic,  
B.V.D.U.M.M.C. & H, Sangli,  
Maharashtra, India

**Dr. Amit Jagdale**  
Senior Resident PIOS  
Multispecialty Hospital  
Jaysingpur Maharashtra, India

## Osteomyelitis in adults: A prospective study of 60 cases

**Dr. Satishkumar A Patil, Dr. Vikrant Magdum, Dr. Girish Shinde,  
Dr. Nagesh Naik and Dr. Amit Jagdale**

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### Abstract

**Introduction:** The exact definition of osteomyelitis is inflammation of bone or bone marrow or both, but for all practical purposes this inflammation invariably is the result of infection. Various factors responsible for osteomyelitis include vascular insufficiency due to any cause, hematogenous spread of infection from a distant focus and surgery or trauma. Acute Osteomyelitis usually presents with fever, chills, pain or irritability. The classic signs of inflammation, including swelling, or redness and limited joint movement may also occur. Chronic osteomyelitis may present with bone destruction and sequestrum formation and is a difficult form of osteomyelitis to treat.

**Aims and Objectives:** To study demographic details, organisms involved and outcome of treatment in patients with osteomyelitis.

**Materials and Methods:** After obtaining approval from institutional ethical committee we conducted a prospective study of 60 patients diagnosed with either acute, subacute or chronic osteomyelitis on the basis of imaging and culture and sensitivity. Patients were included in this study on the basis of predefined inclusion criteria and were treated by antibiotics and when necessary surgical intervention was done. In cases of skeletal tuberculosis appropriate antikochoch treatment was given. Outcome of treatment was studied over a follow up period of 1 year. The data was tabulated and analyzed using SPSS 16.0 version software.

**Results:** Out of 60 cases of either acute, subacute or chronic osteomyelitis there were 38 males (63.33%) and 22 females (36.66%) with a M:F ratio of 1:0.57. Most common age group affected was found to be between 51-60 (36.66%) years. Acute, subacute and chronic osteomyelitis was seen in 71.66%, 11.66% and 16.66% patients respectively. Most common bones involved were Tibia (20%) and Femur (18.33%) followed by iliac bones (15%) fibula (11.66%) and vertebrae (11.66%). In most of the cases (36/60) contagious spread or trauma was the mechanism of infection. Comorbidities like hypertension, diabetes, chemotherapeutic agents or steroid intake and immunosuppression was present in 32 (53.33%) patients. S. Aureus (25/60) followed by Pseudomonas (7/60) and enterococci (7/60) were commonly isolated organisms. Atypical mycobacterial infection was seen in 1 patient who was immunocompromised. 40 patients were completely cured while remaining 10 patients had some or the other problem associated with chronic osteomyelitis. Amputations was done in 4 cases and septic arthritis developed in other 2 cases. 4 patients died during study period due to causes unrelated to osteomyelitis.

**Conclusion:** Diagnosis as well as management of osteomyelitis is a challenge for treating orthopaedician. Knowledge of predisposing factors, presenting complaints, possible complications and proper management is essential for successful management of acute as well as chronic osteomyelitis.

**Keywords:** Osteomyelitis, infection, immunosuppression, tuberculosis, management

### Introduction

Osteomyelitis by definition is inflammation of bone or bone marrow or both. The cause of this inflammation is invariably infection <sup>[1]</sup>. The disruption in the bone integrity as caused by trauma, surgery or prosthesis is common cause of osteomyelitis. The other causes include, tubercular infection of bone (specially vertebrae), hematogenous spread from a distant infective focus or contiguous spread from soft tissue infections <sup>[2]</sup>. Osteomyelitis is divided into acute, subacute or chronic osteomyelitis depending upon the duration between the onset of symptoms and the diagnosis. Acute osteomyelitis is defined as an infection where the period between the onset of symptoms and the diagnosis is less than 2 weeks. In subacute and chronic osteomyelitis this period is 2-6 weeks and beyond 6-12 weeks respectively. Bones are relatively resistant to infections but once the infection sets in it is equally difficult to eradicate

### Correspondence

**Dr. Satishkumar A Patil**  
Junior Consultant,  
PIOS Multispecialty Hospital  
Jaysingpur Maharashtra, India

infection and many instances inadequate treatment may lead to chronic osteomyelitis [3].

Osteomyelitis caused by hematogenous spread is usually seen in patients who have a distant focus from where organisms disseminate and lodge into bone. The most common bones affected by this mechanism include vertebrae, long bones, clavicle and pelvic bones [4]. Osteomyelitis caused by contiguous spread is usually caused by traumatic injuries, surgical procedures or prosthesis. In all these cases there is direct inoculation of organisms into the bone. Contagious spread from a joint in cases of septic arthritis is also common cause of osteomyelitis of long bones specially in elder individuals [5]. All these mechanisms are more likely to cause severe and chronic osteomyelitis in cases where vascular supply is compromised and hence an inadequate tissue response is expected. In all such cases (peripheral vascular diseases, diabetes mellitus and hypertension) an aggressive treatment on the basis of culture sensitivity at the earliest and surgical interventions if necessary must be done to prevent further complications [6].

The patient usually presents with fever, chills, malaise, generalized weakness, swelling, pain and restricted movements. Common organisms causing osteomyelitis in adults include staphylococcus aureus, *S. epidermidis*, streptococcus pyogenes, gram-negative bacilli, anaerobic organisms and Tuberculosis [7]. Atypical mycobacteria causing osteomyelitis may be seen in immunocompromised individuals such as those having acquired immunodeficiency syndrome, patients on long term immunosuppressive therapy or those receiving long term steroids. Multiple organisms may be involved in patients following extensive trauma. In patients with sickle cell disease the most common organism responsible for osteomyelitis is found to be salmonella [8]. Skeletal tuberculosis is one of the important cause of chronic osteomyelitis in developing countries including India where tuberculosis infection remains one of the rampant infections [9]. It is caused by hematogenous spread of Mycobacterium tuberculosis early in the course of primary infection. Atypical mycobacteria may be responsible for skeletal tuberculosis by atypical mycobacteria including Mycobacterium marinum, Mycobacterium avium intracellulare and Mycobacterium gordonae. Rarely osteomyelitis can be caused by various fungi like Cryptococcus neoformans, coccidioidomycosis and blastomycosis. The diagnosis of osteomyelitis is usually done on the basis of imaging (X-ray, CT or MRI) as well as culture and sensitivity of the infected tissue or pus. The management of osteomyelitis consist of antibiotics in adequate doses for appropriate length of time, analgesics and surgical interventions in some cases (sequestrectomy, debridement, soft tissue reconstruction and bone grafting). Skeletal tuberculosis must be treated by appropriate antitubercular treatment. Managing the co-morbid conditions such as diabetes, immunosuppression and vascular insufficiency which have predisposed an individual for development of osteomyelitis in first place is essential. Failure to treat osteomyelitis aggressively may cause sepsis and multi-organ failure [10].

We conducted this prospective study to know risk factors, common offending organisms, clinical features, management and outcome of adults presenting with osteomyelitis.

### Materials and Methods

We conducted this prospective study of patients having diagnosed with acute, subacute or chronic osteomyelitis on the basis of imaging or culture sensitivity of soft tissue or pus.

The institutional ethical committee approved the study and it was conducted at a tertiary care orthopedic hospital situated in a semi urban area. The patients were included in this study on the basis of pre-defined inclusion and exclusion criteria. Demographic data like gender, age and predisposing factors were noted in all the cases. Etiological organisms, bone involved, signs and symptoms, predisposing factors, co-morbidities and outcome of treatment were studied. A detailed history was taken in all the patients specifically to find out the history of trauma, past surgery or presence of vascular insufficiency and diabetes mellitus. A thorough clinical examination including general, systemic and local examination was done. Imaging studies (X-ray, complete blood count and ESR in all patients; CT scan and MRI if needed) were done. TB PCR of pus was done in cases where patient was suspected to be having skeletal tuberculosis. HIV ELISA and HBSAg was also done in all the cases. The radiographic changes seen were studied. The involved bone, time since first symptom and diagnosis, mechanism of bone infection, specimen for culture (bone, soft tissue or pus), growth of organisms and their sensitivity patterns were all noted down. Broad spectrum antibiotics were started immediately (IV linezolid and ceftriaxone + sulbactam). Later the antibiotics were changed on the basis of culture and sensitivity reports and were continued for 4-6 weeks. In cases where tuberculous osteomyelitis was confirmed antitubercular treatment was started. One immunocompromised patient having fungal osteomyelitis was treated by intravenous amphotericin B to which he didn't respond. Later he was treated by intravenous voriconazole to which he promptly responded. Outcome of the treatment was assessed during follow up visits for at least 1 year. Those patients who didn't come for follow up all possible measures were taken to contact them telephonically and if they were symptom free then such an observation was included in the outcome of study. Data was entered in Microsoft excel and was analyzed using SPSS version 16.0. Categorical variables were analyzed using chi-square test. A p value of less than 0.05 was considered significant level of difference for statistical analysis.

### Inclusion Criteria

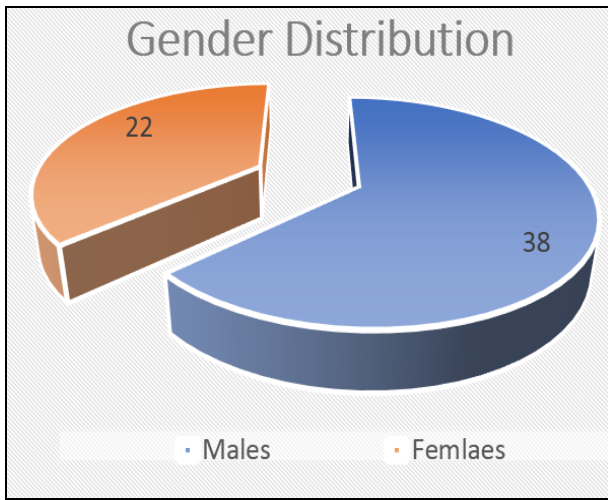
- 1) All the patients who have been diagnosed with acute, subacute or chronic osteomyelitis on the basis of appropriate imaging and culture results.
- 2) Those who have given informed consent to be part of the study.
- 3) Age more than 18 years

### Exclusion Criteria

1. Age less than 18 years.
2. Those who refused informed consent.
3. The patients who didn't remain in follow up (either personally or who couldn't be contacted telephonically to know the outcome) at least for 1 year.

### Results

In this Prospective study of 60 patients with chronic osteomyelitis there were 38 (63.33%) males and 22 (36.66%) females with a M:F ratio of 1:0.57.



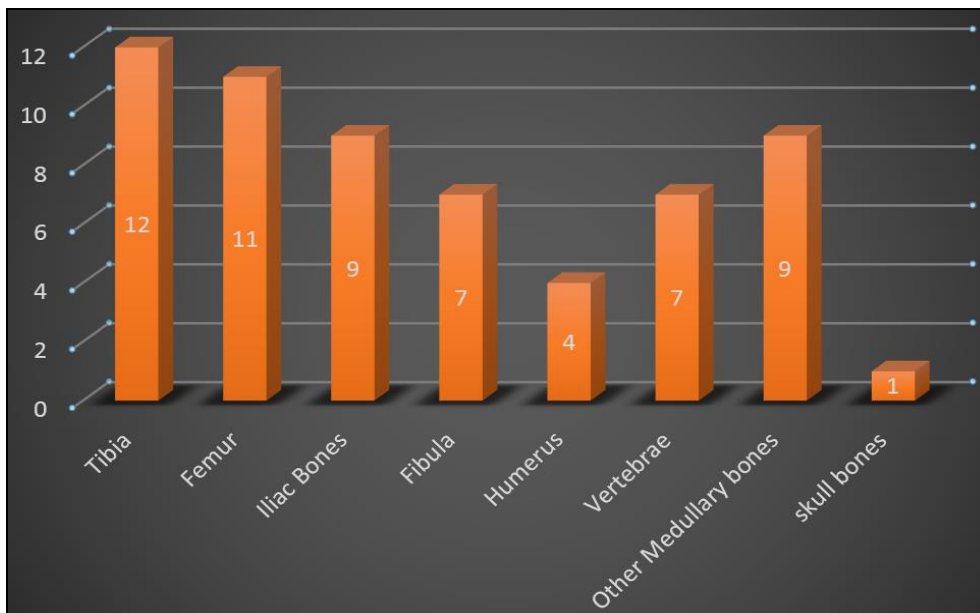
**Fig 1:** Gender Distribution of the studied cases

Study of the age groups of the studied cases showed that the most common age group affected by osteomyelitis was found to be between the age group of 51-60 years (36.66%) followed by 41-50 years (23.33%) and 31-40 years (16.66%).

**Table 1:** Age Group of the patients having osteomyelitis

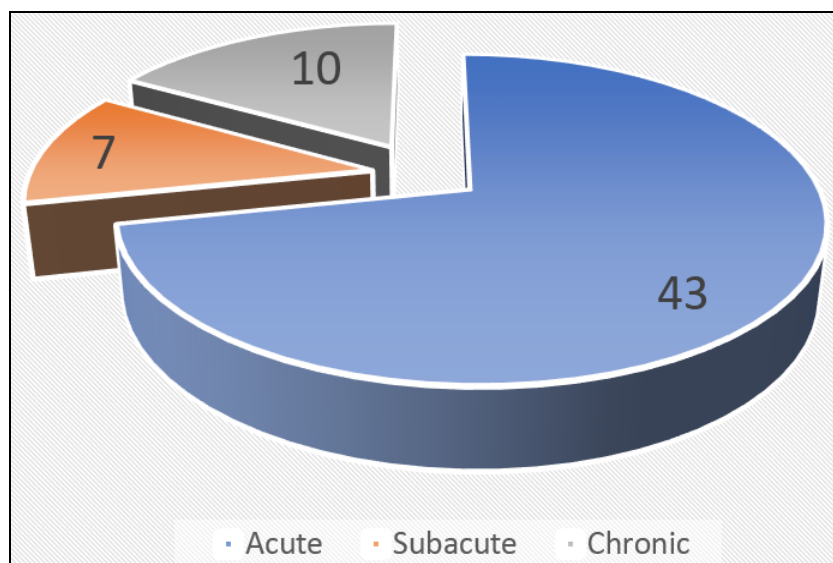
Age Group	No of Patients	Percentage
< 20 years	5	8.33%
18-30 years	9	15%
31-40 years	10	16.66%
41-50 years	14	23.33%
51-60 years	22	36.66%

The most commonly affected bone was tibia (20%) followed by femur (18.33%), iliac bones (15%), fibula (11.66%), vertebrae (11.66%), humerus (6.66%) and skull (1.66%). Other medullary bones were found to be involved in 9 patients (15%).



**Fig 2:** Site of infection in the studied cases

Out of 60 cases Acute Osteomyelitis was seen in 43 patients (71.66%) while subacute and chronic osteomyelitis was seen in 7 (11.66%) and 10 (20%) patients respectively.



**Fig 3:** Types of Osteomyelitis in studied cases

The most common sites for chronic osteomyelitis was found to be vertebrae (3/10) and medullary bones (3/10) while tibia (2/7) was found to be most common site of subacute

osteomyelitis. Femur (10/43) was found to be most commonly affected by acute osteomyelitis.

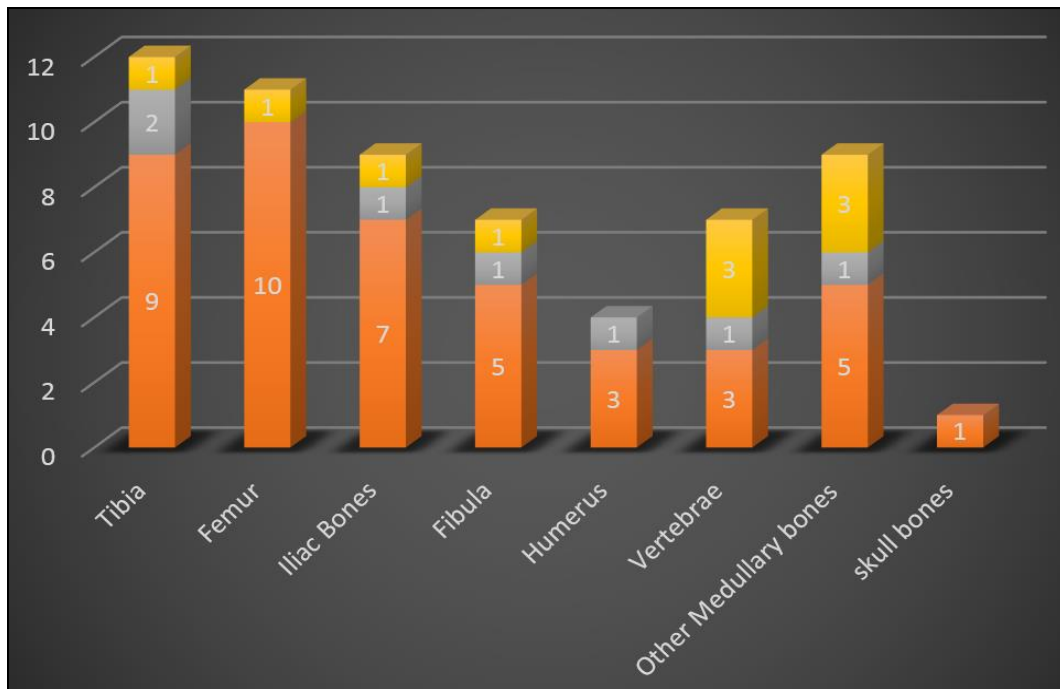


Fig 4: Site and type of Osteomyelitis

Out of 43 cases of acute osteomyelitis majority of the infections (32/43) were caused by local spread of infection from a contagious site. Out of the patients in whom the spread of infection was seen from a local site most of the patients acquired infection following trauma (26/43) while other

causes of local spread included surgical procedures (2/43) and spread of infection from skin (4/43). In remaining 11 patients acute osteomyelitis was seen following hematogenous spread from a distant focus.

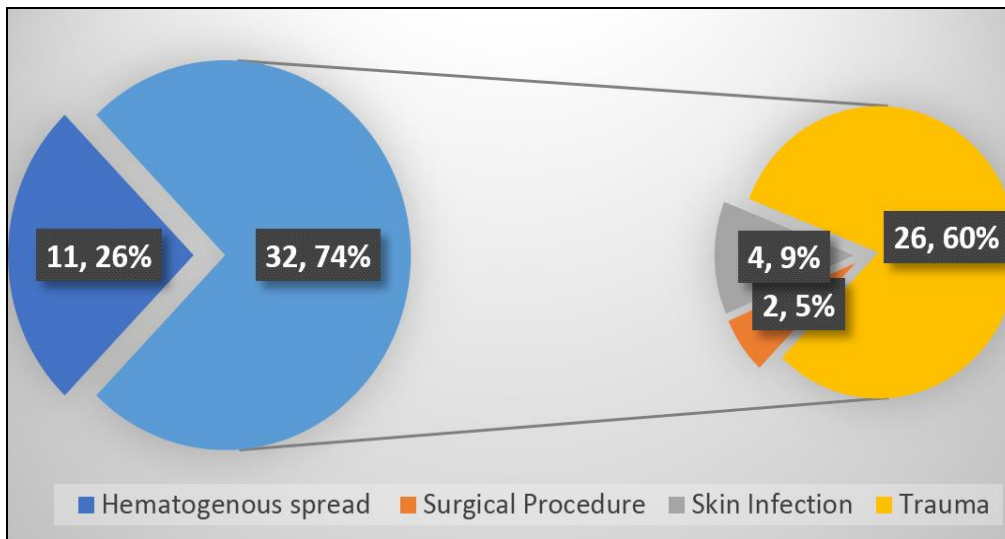
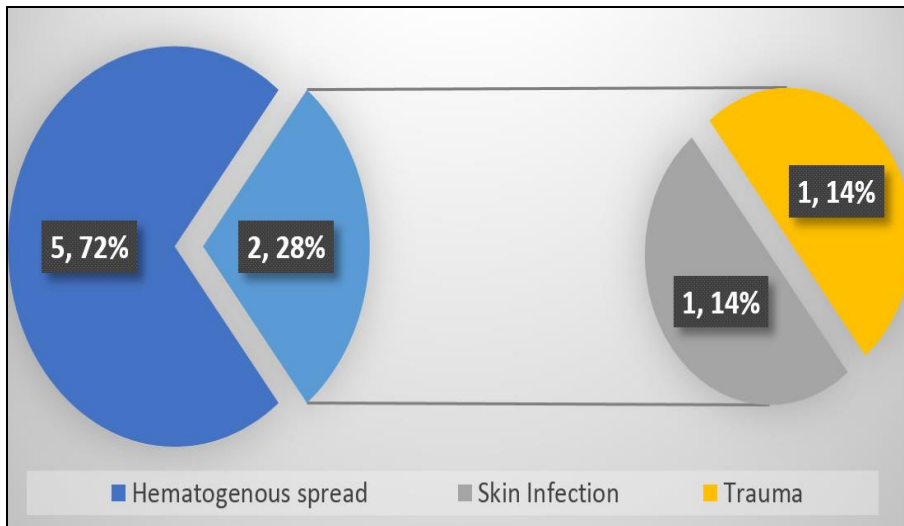


Fig 5: Mechanism of Infection in acute Osteomyelitis

Out of 7 cases of subacute osteomyelitis majority of the infections (5/7) were caused by hematogenous spread. Out of remaining 2 patients 1 patient acquired infection following

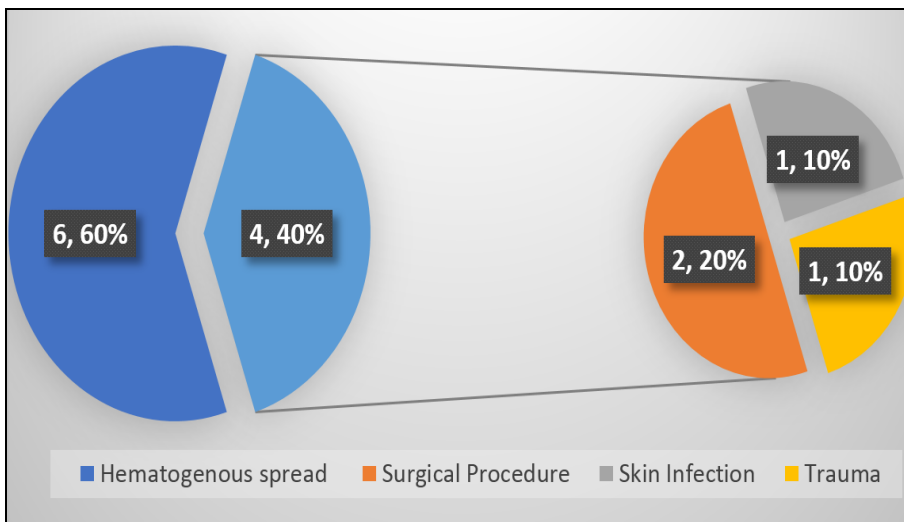
skin infection and another person acquired osteomyelitis following trauma.



**Fig 6:** Mechanism of Infection in subacute Osteomyelitis

Out of 10 cases of chronic osteomyelitis majority of the infections (6/10) were caused by hematogenous spread. Out of remaining 4 patients 2 patients acquired infection following

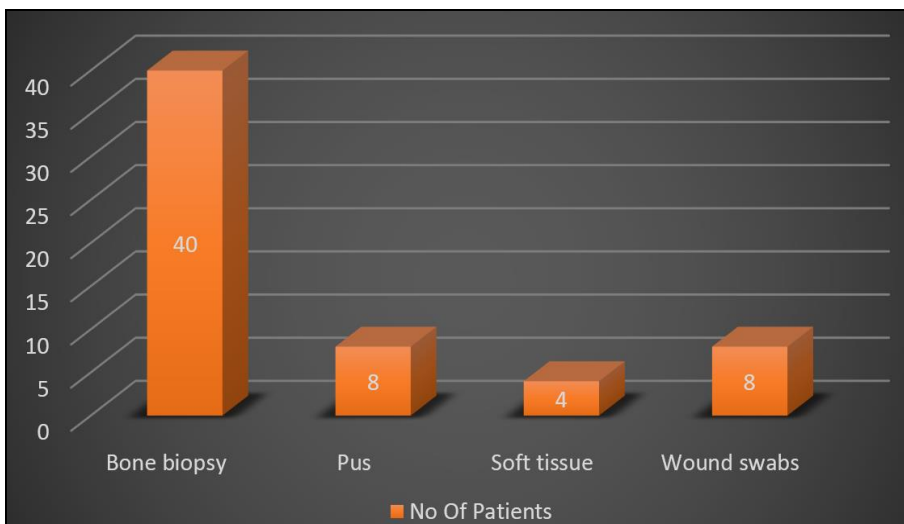
surgical procedure while skin infection and trauma was responsible for osteomyelitis in 1 patient each.



**Fig 7:** Mechanism of Infection in subacute Osteomyelitis

Appropriate tissue was sent for culture and sensitivity in all the patients. Specimens such as bone biopsy (40/60), pus (8/60), affected soft tissue (4/60) and wound swabs (8/60)

were sent for culture sensitivity, TB PCR or fungal culture or microscopy.

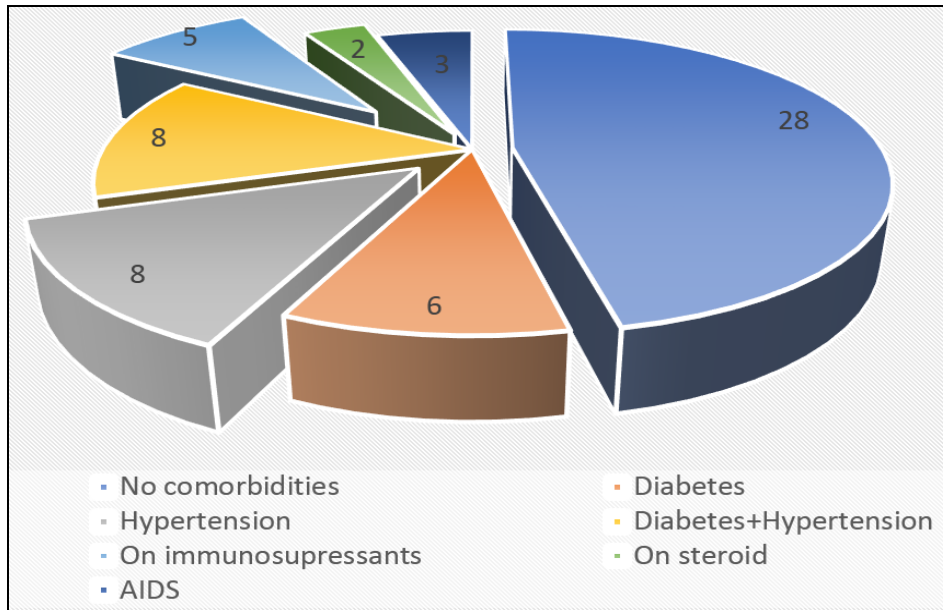


**Fig 8:** Culture specimen for culture and sensitivity tests



The study of associated co-morbid conditions revealed that out of 60 patients 28 (46.66%) patients were not having any kind of associated comorbid condition while 6 patients (10%) had diabetes, 8 patients (13.33%) had hypertension, a combination of diabetes and hypertension was seen in 8

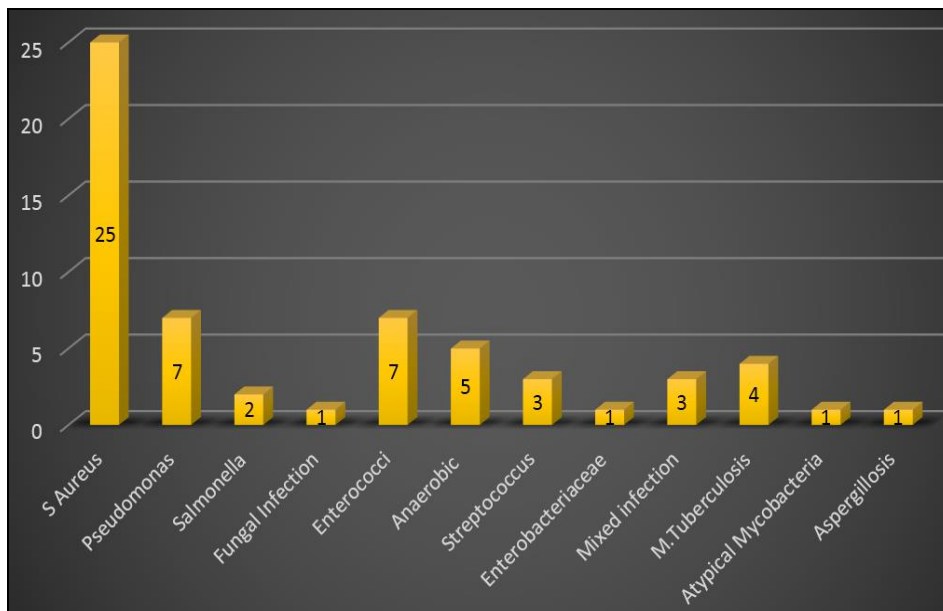
patients (13.33%). 5 patients (8.33%) were on immunosuppressants, while 2 patients (3.33%) were on long term steroid treatment. 3 patients (5%) were diagnosed to be having HIV infection.



**Fig 9:** Presence of Associated comorbidities in studied cases

The analysis of organisms found in culture sensitivity of the studied cases showed that the most common offending organism was Staphylococcus Aureus (25/60) followed by Pseudomonas (7/60), enterococcus (7/60), Anaerobic bacteria

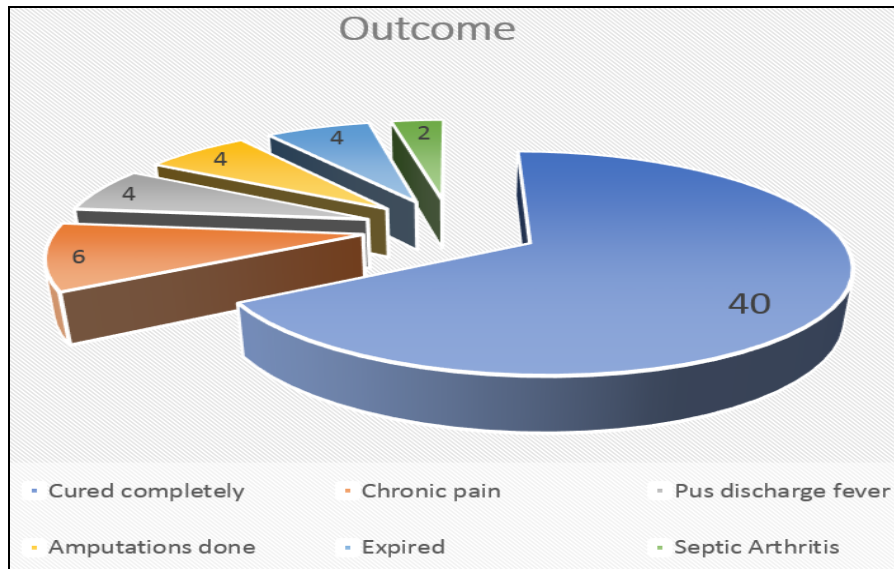
(5/60) and M tuberculosis (4/60). Other less common organisms isolated were mixed infections (3/60), streptococcus (3/60), atypical mycobacteria (1/60 and aspergillosis (1/60).



**Fig 10:** Offending organisms isolated in culture and sensitivity

Management of the patient was done on the basis of affected bone site, severity of infection, type of osteomyelitis and associated co-morbid conditions. All patients diagnosed to be having pyogenic osteomyelitis received antibiotics at least for 4 weeks in addition to appropriate surgical management like debridement, pus drainage, skin and bone grafting. Patients with skeletal tuberculosis received proper antitubercular treatment. 1 patient with fungal osteomyelitis received amphoteric B and voriconazole. Majority of patients

responded well to the treatment. 40 patients were completely cured and were not having any complaints during follow up period of 1 year 6 had chronic pain 4 patients still had manifestation of chronic osteomyelitis in the form of pus discharge, recurrent fever or continued pain and 4 patients had to undergo some form of amputation due to chronic osteomyelitis, 2 patients acquired septic arthritis and lastly 4 patients were expired during follow up due to reasons not related to osteomyelitis.



**Fig 11:** Outcome of patients with chronic osteomyelitis

### Discussion

This was a prospective study of 60 adult patients who were diagnosed with either acute, subacute or chronic osteomyelitis. Out of the studied cases males were predominantly affected with a M:F ratio of 1:0.57. Various studies conducted on the topic of osteomyelitis have found that Males are more commonly affected than females. This might have to do with the fact that males are more likely to be affected by trauma, fractures and road traffic accidents making them vulnerable for development of osteomyelitis [11]. In a large study of management of osteomyelitis at universities of Michigan and Toledo, Caitlin Helm *et al.* found that out of 133 studied cases males were more commonly affected than females (53.4% to 46.6%) [12]. Similar male preponderance was reported by Kremers H.M *et al.* [13] who found that males were affected by osteomyelitis statistically significantly more commonly than females ( $P < 0.001$ ) and Nan Jiang *et al.* who conducted a study of 394 patients in which there were 307 males and 87 females with a M:F ratio of 3.53:1 [14].

In our study the most common bone to be involved in acute osteomyelitis was found to be femur while subacute osteomyelitis was most commonly seen in tibia. Chronic osteomyelitis was most commonly seen in vertebrae. In the review of studies on osteomyelitis conducted by Harik NS *et al.* it was found that found that approximately two-thirds of all cases involved either the femur, tibia or humerus. Bone involved in chronic osteomyelitis depends upon etiology. For instance, chronic osteomyelitis after trauma may be seen in long bones while in case of hematogenous spread the chronic osteomyelitis commonly affect vertebral bodies of the lumbosacral spine and is commonly associated with inflammation of the adjacent soft tissue and intervertebral discs [15].

The diagnosis of osteomyelitis is usually done by imaging (X-RAY, CT or MRI) and culture sensitivity of dead bone, inflamed surrounding tissue or pus. In cases where chronic osteomyelitis is suspected to be due to M. tuberculosis, TB-PCR for diagnosis of skeletal tuberculosis can be done [16]. Alternative tissue can be sent for mycobacterial cultures for confirmation of diagnosis. Also, investigations to find out presence of Kochs focus somewhere else in the body should be done. One of the important aspects of treatment of patients with skeletal tuberculosis is that there is usually delay in the

diagnosis and management of these patients because of the indolent course of the disease. Broderick C in a retrospective observational study of all adults with positive TB cultures found that Patients waited a median of seven months (IQR 3 to 13.5) between the onset of symptoms and referral to the tertiary center and 2.3 months (IQR 1.6 to 3.4.) between referral and starting treatment. The authors concluded that Patients with bone and joint TB experience delays in diagnosis and treatment, some of which are avoidable. Maintaining a high index of clinical suspicion and sending specimens for mycobacterial culture are crucial to avoid missing cases. Rapid diagnostic tests reduce delays and should be performed on patients with radiological features of tuberculosis [17].

Finally, the diagnosis of osteomyelitis depends upon etiology, pyogenic infections are usually treated by prolonged course of antibiotics on the basis of culture sensitivity. Skeletal tuberculosis is treated by appropriate anti-kochs treatment [18]. Rare cases of fungal osteomyelitis must be aggressively treated by IV anti-fungal agents including Amphotericin B, voriconazole or itraconazole depending upon the response to treatment [19]. Surgical treatment is necessary in complicated and may consist of drainage of pus, sequestrectomy, decompression, curettage and bone grafting and in intractable cases amputation may be required. Delayed and inadequate treatment is fraught with the danger of morbidity and even mortality [20].

### Conclusion

Osteomyelitis is usually seen in patients after trauma, following surgery or in the event of presence of risk factors like diabetes, immunosuppression and vascular insufficiency. Chronic osteomyelitis usually runs an indolent course and patients usually present late in the course of disease making the treatment difficult. Appropriate antibiotics, antitubercular drugs in cases of skeletal tuberculosis and surgical management in complicated cases is essence of management.

**Conflict Of Interest:** None

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