Available online at *www.ujpronline.com*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

OSTEOMYELITIS OF THE JAWS: A 5 YEARS RETROSPECTIVE STUDY AT AL-THAWRA HOSPITAL IN SANA'A, YEMEN

Lutf Mohammed Al-Rahbi[1,2], Naif Abdulah Dahan Al-Badani[1], Ahmed Abdulah Al-Ashwal[1,2,3], Hassan Abdulwahab Al-Shamahy[4,5]

[1]*Yemeni Council for Medical Specializations Maxillofacial Surgical Department, Republic of Yemen.*
[2]*Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Sana'a University, Republic of Yemen.*
[3]*Department of Oral and Maxillofacial Surgery, Republican Hospital, Ministry of Health and Population, Yemen.*
[4]*Department of Basic Sciences, Faculty of Dentistry, Sana'a University, Republic of Yemen.*
[5]*Medical Microbiology and Clinical Immunology Department, Faculty of Medicine and Health Sciences, Sana'a University.*

Article Info:

Article History:
Received: 9 April 2025
Reviewed: 14 May 2025
Accepted: 20 June 2025
Published: 15 July 2025

Cite this article:
Al-Rahbi LM, Al-Badani NADA, Al-Ashwal AA, Al-Shamahy HA. Osteomyelitis of the Jaws: A 5 years retrospective study at AL-Thawra Hospital in Sana'a, Yemen. Universal Journal of Pharmaceutical Research 2025; 10(3): 45-51. *http://doi.org/10.22270/ujpr.v10i3.1352*

***Address for Correspondence:**
Dr. Hassan A. Al-Shamahy, Department of Basic Sciences, Faculty of Dentistry, Sana'a University, Republic of Yemen. Tel: +967-1-239551.
E-mail: *hassanalshamahii@gmail.com*

Abstract

Background and aim: Osteomyelitis of the jaws was formerly a terrible condition, but because to increased knowledge, the availability of medications, and improved dental care, its frequency has decreased. The study aimed to determine etiology, clinical features, and results of management and treatment of maxillofacial osteitis patients over a 5 years period in the Oral and Maxillofacial Surgery Department of Al-Thawra Hospital in Sana'a, Yemen.

Methodology: The study was a retrospective case series study that collected data from patients with jaw osteomyelitis at Al-Thawra Hospital in Sana'a, Yemen, over a 5 years period. The majority of patients were male, comprising 12 patients (66.7%), while only 6 patients (33.3%) were female. The data included demographics, medical history, clinical presentation, management methods, treatments, and outcomes.

Result: The majority of patients with maxillofacial osteomyelitis were male, aged 45-54, with a mean age of 40±14.5 years, with only one case involving child under 15 years. Osteomyelitis symptoms include purulent discharge, persistent swelling, truisms, intraoral bone exposure, pain, paresthesia, sinus formation, and pathological fractures, with numbness prevalence at 16.7%. The study found carious lesions (50%), extraction socket infections (16.7%), post-extraction infections (11.1%), pulp devitalization agents (11.1%), and severe periodontitis as the most common causes of maxillofacial osteomyelitis.

Conclusion: The majority of patients with maxillofacial osteomyelitis were male, aged 45 to 54 years, and presented with purulent discharge, persistent swelling, palpable signs, intraoral bone exposure, pain, numbness, and pocket formation. The study found that carious lesions and periapical infections were the most common causes of osteomyelitis, with the right side of the jaw being the most common site.

Keywords: Chronic suppurative osteomyelitis (CSOM), etiology, maxillofacial Osteomyelitis, prevalence, Sana'a, Yemen.

INTRODUCTION

Osteomyelitis of the jaws was formerly a terrible condition, but because of increased knowledge, the availability of medications, and improved dental care, its frequency has decreased[1]. The Latin term "osseous" means bony, the Greek word "osteon" means bone, the word "myelos" means marrow, and the verb "it is" implies inflammation. Osteomyelitis is characterized as an inflammatory bone disease that starts as an infection of the medullary cavity and the cortex's Haversian system and spreads to the periosteum of the afflicted region[2]. It's an inflammatory process that has the potential to get worse. Osteomyelitis is more common in the mandible because of inadequately vascularized cortical plates[2-5].

An inferior alveolar neurovascular bundle supplies blood to the mandible. Because it is heavily vascularized and receives its blood supply from several feeder arteries, the maxilla, which is less thick, has a lower incidence. Compared to the mandibular posterior area, the maxillary posterior region is less damaged[3]. Even in the mandible, the most often seen areas are the body, symphysis, angle, ascending ramus, and condyle. The high frequency and severity of odontogenic infections during normal dental care, together with the

high bacterial load of the oral cavity, are among of the primary reasons why osteomyelitis of the jaw is more common than osteomyelitis of any other skeletal bone [3-5]. *S. aureus* and *Mycobacteria* are the most specific bacteria that cause illness; other causes might include radiation, trauma, or certain drugs[6]. Weakened host defenses, whether local or systemic, have an impact on its growth. Malnutrition, inflammatory diseases, diabetes, and cancer are additional risk factors for osteomyelitis[3]. Osteomyelitis can manifest as mouth inflammation, non-healing exposed bone in the mouth, an extraction socket, a fistula from the mouth to the lower skin, or sequestra development[7,8]. It begins as a medullary cavity infection, moves on to the Haversian system, and then progressively affects the infected area's periosteum, resulting in significant tissue and bone loss[9-11]. Ossification and increasing inflammatory osteoclasia are present[6]. Tooth extraction and implant insertion are similarly contraindicated in the irradiated region, and radiation-related osteomyelitis has a delayed start[12]. Predisposing factors for osteomyelitis include weakened immune systems, decreased blood vessels in the bones, and the virulent nature of microorganisms. It can also be caused by immuno-deficiencies such as diabetes, leukemia, malnutrition, and chronic alcoholism. In the maxilla, it may be caused by sinusitis or facial cellulitis[1,3,13].

Considering the etiology of osteomyelitis of the jaw, the main causes of osteomyelitis are odontogenic infections of the pulp, periapical, or pericoronal tissues, infected cysts, alveolar sockets, and tumors[13,14]. Trauma is the second most common cause, especially compound fractures and any medical surgery. Orofacial infections resulting from periostitis following gingival recession, lymphadenitis resulting from boils, tonsillar abscesses, and lacerations are also common causes. Facial boils, upper respiratory tract infections, mastoiditis, skin wounds, otitis media, and systemic tuberculosis can also cause bloodborne spread of the infection[1,14].

The microbiology of osteomyelitis of the jaws shows that many cases of osteomyelitis are caused by aerobic *streptococci* (alpha-hemolytic *streptococci*, beta *streptococci*), anaerobic *streptococci*, and other anaerobes such *Peptostreptococci*, *Fusobacterium*, and *Bacteroides*. Gram-negative bacteria including *Klebsiella*, *P. aeruginosa*, and *Proteus* are also occasionally detected, along with anaerobic cocci [1,3,14]. A particular kind of osteomyelitis is brought on by *P. aeruginosa*, *T. pallidum*, *M. tuberculosis*, and *Actinomyces* species. *Actinomyces*, *Echinella*, and *Arachnea* were also recognized by Marks *et al.*, as the causes of some refractory osteomyelitis[1,3,14].

Both pharmacological and surgical approaches are necessary for the treatment of osteomyelitis in general or osteomyelitis of the jaw. In rare cases, such as osteomyelitis in children, intravenous antibiotic therapy is required[3]. Empirical antibiotic therapy should be initiated based on histological findings, such as Gram stain results of the exudate or the potential pathogen. Although sensitivity testing and culture may take time, they help the surgeon make the optimal therapeutic decision for the patient[3]. Sensitivity testing of the causative bacteria may even be necessary in Yemen, where several recent studies have indicated high rates of antibiotic resistance in bacteria isolated from disease cases[15-24].

This study aimed to explore the etiology, clinical features, and results of management and treatment of maxillofacial osteomyelitis patients over a 5 year period in the Oral and Maxillofacial Surgery Department of Al-Thawra Hospital in Sana'a city, Yemen.

SUBJECTS AND METHODS

Study design, site of the study: This study was a retrospective case serius study that collected data from the medical records of patients with osteomyelitis of the jaw over a 5 years period; from October 1, 2019 to the end of September 2024, at Al-Thawra Hospital in Sana'a, Yemen.

Data collection: Data were collected from the medical records of the Department of Oral and Maxillofacial Surgery, which included: patient demographics, medical history, clinical presentation, management methods and treatments; and finally outcomes.

Statistical method: The data is accompanied by pertinent descriptive statistics (*p*-value, mean, frequency, and standard deviation). Excel 2010 and the Statistical Package for Social Science (SPSS) version 26 were used for all statistical analyses of the data. Following data collection, the data were recorded and sent to SPSS for analysis.

Ethical Approval: The Medical Ethics Committee of the Ministry of Health and Population granted ethical permission (No.: 66-2024, dated 1-1-2024), and all information, including the patient's identity, was kept private.

RESULTS

Table 1 shows the distribution of maxillofacial osteomyelitis patients at Al-Thawra Hospital by sex and age over a five-year follow-up period. The majority of patients were male, comprising 12 patients (66.7%), while only 6 patients (33.3%) were female. The mean±standard deviation of age was 40±14.5 years, with ages ranging from 8 to 60 years. Most patients with maxillofacial osteomyelitis were in the 45-54 age group, comprising 9 patients (50%). Child under 15 years of age accounted for only one case (5.6%). Table 2 shows the signs and symptoms of our patients. The most common signs in our patients were purulent discharge (100%) and persistent swelling (100%), followed by truisms symptom, intraoral bone exposed, and pain (33.3%). The prevalence of paresthesia (numbness) was 16.7%, and sinus formation (66.7%) and pathological fractures occurred in one case (5.6%) (Table 2). The most common cause of maxillofacial osteomyelitis in the current study was carious lesions (50%), followed by extraction socket infections (16.7%), post-extraction infections (11.1%), post-surgical infections (mobile plate) (11.1%), pulp devitalization agents (11.1%), and severe periodontitis (5.6%) (Table 3). Consedering the medical history of

patients with maxillofacial osteomyelitis: most patients with maxillofacial osteomyelitis were in good health (44.4%), with the most common comorbidities being diabetes (27.8%), hypertension (16.7%), and breast cancer (11.1%).

Table 1: Gender and age distribution of patients with maxillofacial osteomyelitis.

Characters	Number (%)
Sex	
Male	12 (66.7)
Female	6 (33.3)
Age groups	
Less than 15 years	1 (5.6)
15-24 years	2 (11.1)
25-34 years	2 (11.1)
35-44 years	2 (11.1)
45-54 years	9 (50)
≥55 years	2 (11.1)
Mean±SD	40±14.5 years
Min -Max	8 – 60 years

Table 2: Signs and symptoms in patients with maxillofacial osteomyelitis.

Characters	Number (%)
Pus discharge	18 (100)
Swelling	18 (100)
Truisms	6 (33.3)
Exposed bone interaorally	6 (33.3)
Sinus formation	12 (66.7)
Pain	6 (33.3)
Parethesia	3 (16.7)
Pathological fracture	1 (5.6)

Hepatitis C, hepatitis B, kidney disease, and cerebral atrophy were reported in one case each (Table 4). Table 5 shows the prevalence of predisposing factors for maxillofacial osteomyelitis among our patients. The most common predisposing factors for maxillofacial osteomyelitis were qat chewing (50%) and smoking (44.4%), followed by poor oral hygiene (33.3%) and radiation therapy (11.1%) (Table 5). In view of, the location of maxillofacial osteomyelitis in our patients . The most common site of maxillofacial osteomyelitis in our patients was the right body (33.3%), left body (16.7%), and followed by the right body with angle at 11.1%. Other sites included the left body with angle (5.6%), the left angle (5.6%), the left body with angle-parasymphysis (5.6%), symphysis area (5.6%), anterior maxilla (5.6%), posterior maxilla (5.6%), and right angle (5.6%) (Table 6). The kinds of maxillofacial osteomyelitis among Al-Thawra Hospital patients during a 5 years follow-up; there were no documented occurrences of acute suppurative osteomyelitis (ASOM); all of the cases were 100% chronic suppurative osteomyelitis (CSOM). The treatments given to patients with maxillofacial osteomyelitis at Al-Thawra Hospital over a 5 years follow-up are displayed in Table 7. The most common treatment for our patients with maxillofacial osteomyelitis was sequesterectomy, which accounted for 38.9% of the total cases. Debridement + curettage (DC) was the second most common treatment (27.8%), followed by resection and reconstruction plate (11.1%), removal plate (debridement + curettage) (11.1%), and tooth extraction + antibiotics (11.1%). The results of therapy for maxillofacial osteomyelitis patients at Al-Thawra Hospital throughout a 5 years follow-up period of our maxillofacial osteomyelitis patients treated in our department during the previous five years, 83.3% had a full recovery, while 16.7% required a bone graft.

Table 3: Prevalence of the etiological cause of maxillofacial osteomyelitis among our patients.

Etiology	Number (%)
Carious lesions	8 (44.4)
Infected extraction sockets	3(16.7)
ORN post extraction	2 (11.1)
Pulp devitalizing agents*	2 (11.1)
Post-surgical infection (mobility plate)#	2 (11.1)
Severe periodontitis	1 (11.1)

* These 2 cases were suffering from chemical necrosis of mandublarbone a misuse or/splillage of formaldehyde beyond apical area of the tooth.
# These 2 cases were suffering from mandibular angle fracture treated with miniplates as ORIF.

DISCUSSION

In the current study, the majority of patients were male, comprising 12 patients (66.7%), while only 6 patients (33.3%) were female. This finding differs from that reported by Lukošiūnas *et al.*[25], where the gender distribution of patients with maxillofacial osteomyelitis in Lithuania did not significantly differ by gender. In the current study, most patients with maxillofacial osteomyelitis were in the 45-54 age group, comprising 9 patients (50%). Child younger than 15 years of age accounted for only 1 case (5.6%) (Table 1). This finding differs from that reported by Lukošiūnas *et al.* [25], where the age distribution of patients with maxillofacial osteomyelitis in Lithuania was highest in the 15-45 age group. In the current study, the most common signs in our patients were purulent discharge (100%) and persistent swelling (100%), followed by truisms symptom, intraoral bone exposed, and pain (33.3%).

Table 4: The medical history of maxillofacial osteomyelitis patients.

Medical History	Number (%)
Good Health	8 (44.4)
Hepatitis C	1 (5.6)
Breast Cancer	2 (11.1)
Diabetes	5 (27.8)
High BP	3 (16.7)
Hepatitis B	1 (5.6)
Kidney Disease	1 (5.6)
Cerebral Atrophy	1 (5.6)

Table 5: The prevalence of maxillofacial osteomyelitis predisposing factors among patients.

Factors	Number (%)
Smoking	8 (44.4)
Chewing Khat	9 (50)
Bad oral hygiene	6 (33.3)
Radiotherapy	2 (11.1)

The prevalence of paresthesia (numbness) was 16.7%, and sinus formation (66.7%) and pathological fractures occurred in one case (5.6%). Our results of signs and symptoms, are similar to that reported previously where the classical clinical features are pain, swelling, and erythema of the overlying tissues, fever, paresthesia of the inferior alveolar nerve, paresthesia of lower lip, adenopathy, trismus, malaise, fistulas, and sometimes pathologic fracture[1-7].

Table 6: The site of maxillofacial osteomyelitis among patients.

Sites	Number (%)
Right body	6 (33.3)
Left body	3 (16.7)
Right body and angle	2 (11.1)
Left body and angle	1 (5.6)
Left angle	1 (5.6)
Left body and angle-parasyphysis	1 (5.6)
Symphysis area	1 (5.6)
Anterior maxilla	1 (5.6)
Posterior Maxilla	1 (5.6)
Right angle	1 (5.6)

In the current study, pain occurred in 33.3% of our patients[2]. The pain is a generally deep and boring type. Erythema and swelling are frequently observed in cases of acute osteomyelitis, which is a sign of the cellulitic phase of the inflammatory process beneath the bone. Chronic cases include non-healing bony and soft tissue wounds with soft tissue in duration, intraoral or extraoral draining fistulas, thickened or wooden bone, enlargement of the mandible due to deposition of subperiosteal new bone, and the possibility of a pathological fracture[1,2]. In the current study some symptoms were not recorded, fever often accompanies with acute osteomyelitis while fever in the case of chronic osteomyelitis (all of our cases were chronic), it is not seen as reported previously[1-7,25]. In the current study, the prevalence of paresthesia (numbness) was 16.7%. This paresthesia is a due to the inflammatory process, there is continuous pressure on the inferior alveolar nerve, hence, paresthesia of the inferior alveolar nerve is the characteristic feature of osteomyelitis[26]. The truisms symptom was occurred in 33.3% of our patients, this low rate is different from that reported previously were more than 50% of their patients had truisms[25,26]. This truisms is due to that in the case of inflammation in the muscle of mastication of the maxillofacial region, there is trismus[3]. Intraoral bone exposed occurred in 33.3% of our patient. Generally intraoral and extraoral fistulas, and/or intraoral bone exposed are seen in the case of chronic osteomyelitis[3]. In current study, sinus formation occurred in 66.7% and pathological fractures of bone occurred in one case (5.6%). These signs are diagnosed with radiograpy, the radiographic changes can be appreciated after 3 weeks of the onset of osteomyelitis. To indicate any radiographic alterations, there should be at least 40–60% bone loss. Four to eight days following the beginning of acute osteomyelitis, this change is observed. Areas of osteolysis and sclerosis with different levels of periosteal response are seen as mixed radiodensities in the early stages. Volkmann's canals have enlarged and the marrow space has widened, giving the impression of being “mottled”.

Table 7: The types of treatment applied on the maxillofacial osteomyelitis patients.

Types of treatments	Number (%)
Sequesterectomy	7 (38.9)
Resection and Reconstraction plate	2 (11.1)
Debridement +curettage (DC)	5 (27.8)
Removal plate (Debridement +curettage)	2 (11.1)
Tooth extraction +Antibiotics	2 (11.1)
Total	18

Granulation tissues between the live and dead bone give the radiolucent uneven lines and zones a “moth-eaten appearance”. Later on, the osteolytic process, which is devitalized and conducive to calcium precipitation, mobilizes an island of cortical bone as the cortical bone eventually becomes involved. Known as a sequestrum, these isolated, devitalized calcified bones with resorbed edges appear like a foreign body and are noticeable on the radiograph. Over the cortex, the subperiosteal new bone is visible as opaque lines known as the involucrum. The area where the new bone is placed on top of the jaw[1] is known as the “fingerprint” or “onion peel” appearance[1-4]. The most common cause of maxillofacial osteomyelitis in the current study was carious lesions (44.4%), followed by extraction cavity infections (16.7%), post-extraction infections (11.1%), post-surgical infections (mobile plate) (11.1%), pulp devitalization agents (11.1%), and severe periodontitis (5.6%). As is well known, dental infections arising from pulpal, periapical, or pericoronal tissues, infected cysts, cavities, or tumors are among the main causes of osteomyelitis. Trauma is the second most common cause, especially compound fractures and any surgical procedure of medical origin[1]. Orofacial infections resulting from periostitis after gingival recession, infected lymph nodes from boils, peritonsillar abscesses, and lacerations are also seen to cause osteomyelitis[1,14]. In our study, pulp devitalization occurred in 11.1% of cases. These two cases presented with chemical necrosis of the mandibular bone, resulting from the misuse and/or leakage of formaldehyde beyond the apical region of the tooth. These two cases accurately describe a serious complication that can arise from the misuse of pulp

devitalization agents, particularly those containing formaldehyde or paraformaldehyde, in endodontic treatment[1,14]. When these agents leak beyond the intended area (usually the root canal), they can cause chemical necrosis of the surrounding bone, including the mandible. This can lead to a range of problems, including osteitis (inflammation of the bone) and alveolar bone loss[14].

In our study, postoperative infection in two cases of mandibular angle fractures treated with miniplates as ORIFs could be attributed to several factors, including prolonged khat use after treatment (as in both our patients), the presence of teeth within the fracture line, soft tissue damage, and poor oral hygiene[26]. Other contributing factors include poor oral hygiene before, during, and after surgery (as in our patients), infections or fractures of teeth within the fracture line, alcoholism, metabolic disorders, tobacco use, a long period between injury and definitive treatment, poor patient adherence to instructions, fracture severity, and inadequate reduction or fixation. Therefore, it is preferable to use a reconstruction plate instead of a microplate to prevent osteomyelitis in this group of patients[26,27].

In the current study, most patients with maxillofacial osteomyelitis were healthy (44.4%), and the most common comorbidities were diabetes mellitus (27.8%), hypertension (16.7%), and breast cancer (11.1%). Hepatitis C, hepatitis B, renal disease, and cerebral atrophy were also reported in one case (Table 4). The predisposing factors for osteomyelitis are known to include: delayed host defense mechanism or any condition affecting host resistance, hypovascularization of host bone at the local or systemic level, and virulence of the microorganism[26]. Any immuno-compromising condition, such as diabetes mellitus, leukemia, malnourishment, agranulocytosis, severe anemia, chronic alcoholism, drug abuse, sickle cell disease, typhoid, chemotherapy, irradiation, steroid use, hepatitis, HIV, glomerulonephritis, systemic lupus erythematosus, etc., can compromise the host defense system[1,3,13,25,26]. Therapeutic radiation, Paget's disease, bone cancer, fibrous dysplasia, osteoporosis, and mercury, arsenic, and bismuth all affect the host bone's vascularity, resulting in metallic bone necrosis. Any pansinusitis or face cellulitis might result in osteomyelitis in the maxilla. There are several species that generate thrombi because of lysosomal action. Pathogen-born bioactive peptides and chemoattracted leukocytic purulence create a protective barrier surrounding the infective foci, causing lysosomal and enzymatic tissue degradation as well as the production of microvascular thrombi. The organisms further proliferate in the host medium but remain protected from the host defense mechanism[25,26]. The most common predisposing factors for maxillofacial osteomyelitis were qat chewing, and smoking , followed by poor oral hygiene and radiation therapy.

The most common factor in the development of maxillofacial osteomyelitis in the current study was khat chewing (50%). Khat (*Catha edulis*) is a natural stimulant from the plant Catha edulis, found in an evergreen flowering tree or large shrub of the Celastraceae family, which grows mainly in Yemen, Ethiopia, Somalia, Kenya, Saudi Arabia, and in the highlands of South Africa and Madagascar[27]. Khat leaves, which are typically placed in the mouth in the distal inferior mucosal fold, are typically chewed during sociocultural gatherings, where the chewing process may last up to 6 hours. Because khat chewing has a drying effect on the oral mucosa, users tend to consume large amounts of fluid. Some khat users also supplement their chewing practice with smoking habits. Side effects believed to be associated with khat chewing include systemic effects such as high blood pressure, tachycardia, fever, increased sweating, muscle weakness, loss of appetite, semen leakage, and some digestive disturbances, and local (oral) effects such as bleeding gums, halitosis, difficulty opening the mouth, and periodontitis leading to osteomyelitis of the face and jaws[27].

Smoking was the second significant predisposing factor for maxillofacial osteomyelitis in current study (44%), due to its negative effects on bone health and healing, as well as its impact on the immune system [28]. It reduces blood flow, decreases oxygen levels, and compromises the body's ability to fight infection and repair damaged tissue, making individuals more vulnerable to developing the condition[28].

Also, poor oral hygiene was one of the predisposing factors for maxillofacial osteomyelitis in our study. The oral hygiene status of the involved subjects was determined by using the Simplified Oral Hygiene Index (OHI-S). The Simplified Debris Index (DI-S) and Simplified Calculus Index (CI-S) are components of the OHI-S, which was first presented by Greene and Vermilion[29]. The numerical values that indicate the quantity of calculus or debris on six preselected tooth surfaces form the basis of each of these indexes. Bad oral hygiene is a significant predisposing factor for maxillofacial osteomyelitis because it allows bacteria from the oral cavity to enter the bone. The oral cavity harbors a diverse microbiome, and poor oral hygiene can create conditions where bacteria thrive and spread to bones[25,26].

In the current study, there were no documented occurrences of acute suppurative osteomyelitis (ASOM); all of the cases were 100% chronic suppurative osteomyelitis (CSOM). Generalized symptoms, such as fever, malaise, nausea, vomiting, anorexia, deep-seated boring and continuous pain, intermittent paresthesia or anesthesia of the lower lip, facial cellulitis or moderately indurated swelling, thrombosis of the inferior alveolar vasa nervorum, an increase in pressure due to edema in the inferior alveolar canal, and teeth that are sensitive to percussion and loose and trismus, are characteristics of the early stages of acute osteomyelitis. Deep pain, malaise, fever, dehydration, anorexia, tenderness when the teeth are percussion-tested in that area, loosening of the teeth, purulent discharge via the sinuses, a fetid stench, the possibility of trismus, acidosis, toxemia, and regional lymphadenopathy are all present in established cases[1,2]. Chronic cases include non-healing bony and soft tissue wounds with soft tissue induration, intraoral or extraoral draining fistulas, thickened or wooden

bone, enlargement of the mandible due to deposition of subperiosteal new bone, and the possibility of a pathological fracture[1,2].

Osteomyelitis must be treated with both medicinal and surgical methods. In rare cases, such as infantile osteomyelitis[3], intravenous antibiotic treatment is necessary. The empirical antibiotic therapy should begin based on the histological findings, such as the gram stain results of the exudate or probable pathogen. Sensitive reports and culture may take time, but they help the surgeon treat patient[3]. Sequesterectomy was the most often used therapy for our patients with maxillofacial osteomyelitis in the current investigation, accounting for 38.9% of all cases. The second most prevalent therapy was debridement + curettage (DC) (27.8%), which was followed by tooth extraction + antibiotics (11.1%), resection and reconstruction plate (11.1%), and removal plate (debridement + curettage) (11.1%). Our applied treatments are similar to the classic treatments done elsewhere[3]. Sauterization and sequestrectomy are the traditional methods of therapy. Removing the necrotic or less vascularized bone sequestra and enhancing blood flow are the primary goals. In sequestrectomy, the cortical plates in the affected region are often removed together with avascular and infected bone fragments. Bony cortices are excised up to a good bleeding bone in saucerization nearby, and an open pack is administered for secondary intention healing. Another procedure is decortication, which involves removing the thick, essentially chronically infected, and poorly vascularized bony cortex and placing a vascular periosteum next to the medullary bone to improve blood flow[3]. Of our maxillofacial osteomyelitis patients treated in our department during the previous five years, 83.3% had a full recovery, while 16.7% required a bone graft. Our outcome was roughly similar to that reported elsewhere[25,26].

Limitation of the study

The main limiting factors of this study were the small sample size and lack of details about the operations and post-operative complications.

CONCLUSIONS

The majority of patients with maxillofacial osteomyelitis were male, aged 45 to 54 years, and presented with purulent discharge, persistent swelling, palpable signs, intraoral bone exposure, pain, numbness, and pocket formation. The study found that carious lesions and periapical infections were the most common causes of osteomyelitis, with the right side of the jaw being the most common site. All cases presented with chronic suppurative osteomyelitis (CSOM). Osteomyelectomy was the most common treatment, followed by debridement and curettage. Most patients recovered completely, while a small percentage required bone grafting. A large-scale, multicenter study including all hospitals in Sana'a City should be conducted to evaluate chronic suppurative osteomyelitis. The study should focus on: diagnosis, identification of isolated microbial causes, risk factors, treatment efficacy and antibiotic sensitivity of isolated causative organisms, complications, and long-term treatment outcomes. Similarly, the usage of devitalization as formaldehyde should be minimized or replaced with biocompatible substitutes as Biodentine and MTA (Mineral Trioxide Aggregate). For patients with oral issues or khat users, we also recommend utilizing a dental reconstruction plate rather than a miniplate since, based on our experience, this lowers the likelihood of osteomyelitis in these individuals.

ACKNOWLEDGEMENTS

The authors would like to thank Al-Thawra Hospital in Sana'a, Yemen, for their kind cooperation.

AUTHOR'S CONTRIBUTION

Al-Badani NADA: Writing the original draft, methodology and research. **Al-Rahbi LM:** formal analysis, data curation. **Al-Ashwal AA:** formal analysis, conceptualization. **Al-Shamahy HA:** writing, review and editing, methodology. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The accompanying author can provide the empirical data that were utilized to support the study's conclusions upon request.

CONFLICT OF INTEREST

None to declare.

REFERENCES

1. Neelima Mallick – Textbook of oral and maxillofacial surgery 4th Edn Jaypee Brothers Medical Publishers. New Delhi: 2016.
2. Gudmundsson T, Torkov P, Thygesen TH. Diagnosis and Treatment of Osteomyelitis of the Jaw – A Systematic Review (2002-2015) of the Literature. J Dent Oral Disord 2017; 3(4): 1066.
3. Miloro M, Peterson LJPeterson's Principles of oral and maxillofacial surgery. PMPH-USA, 2012
4. Shin JW, Kim JE, Huh KH, Yi WJ, Heo MS, Lee SS, Choi SC. Clinical and panoramic radiographic features of osteomyelitis of the jaw: A comparison between antiresorptive medication-related and medication-unrelated conditions. Imaging Sci Dent 2019 Dec; 49(4):287-294. *http://doi.org/10.5624/isd.2019.49.4.287*
5. Park MS, Eo MY, Myoung H, Kim SM, Lee JH. Early diagnosis of jaw osteomyelitis by easy digitalized panoramic analysis. Maxillofac Plast Reconstr Surg 2019 Feb 1;41(1):6. *http://doi.org/10.1186/s40902-019-0188-2* PMID: 30800645; PMCID: PMC6358629.
6. Goldblatt LI, Adams WR, Spolnik KJ, Deardorf KA, Parks ET. Chronic fibrosing osteomyelitis of the jaws: An important cause of recalcitrant facial pain. A clinicopathologic study of 331 cases in 227 patients. Oral Surg Oral Med Oral Pathol Oral Radiol 2017 Oct;124(4):403-412.e3. PMID: 28754378 *http://doi.org/10.1016/j.oooo.2017.05.512*
7. Nezafati S, Ghavimi MA, Yavari AS. Localized osteomyelitis of the mandible secondary to dental treatment: Report of a case. J Dent Res Dent Clin Dent Prospects 2009 Spring; 3(2):67-9.

http://doi.org/10.5681/joddd.2009.016. PMID: 23230486; PMCID: PMC3517289.
8. Grecchi F, Zollino I, Candotto V, *et al*. A case of mandible osteonecrosis after a severe periimplant infection. Dent Res J (Isfahan). 2012 Dec; 9(Suppl 2):S233-6. *http://doi.org/10.4103/1735-3327.109768*. PMID: 23814591; PMCID: PMC3692181.
9. Agarwal A, Kumar N, Tyagi A, De N. Primary chronic osteomyelitis in the mandible: A conservative approach. BMJ Case Rep 2014 Apr 3;2014:bcr2013202448. PMID: 24700038; PMCID: PMC3987517. *http://doi.org/10.1136/bcr-2013-202448*.
10. Sasaki H, Furusho H, Rider DB, *et al*. Endodontic Infection-induced Inflammation Resembling Osteomyelitis of the Jaws in Toll-like Receptor 2/Interleukin 10 Double-knockout Mice. J Endod. 2019 Feb;45(2):181-188. *http://doi.org/10.1016/j.joen.2018.10.007*. PMID: 30711175; PMCID: PMC6364571.
11. Mehra H, Gupta S, Gupta H, Sinha V, Singh J. Chronic suppurative osteomyelitis of mandible: A case report. Craniomaxillofac Trauma Reconstr 2013 Sep;6(3):197-200. *http://doi.org/10.1055/s-0033-1343781*. Epub 2013 May 31. PMID: 24436759; PMCID: PMC3773067.
12. Shibahara T. Imaging modalities for drug-related osteonecrosis of the jaw (2), Overview of the position paper on medication-related osteonecrosis of the jaw and the current status of the MRONJ in Japan. Jpn Dent Sci Rev 2019 Nov;55(1):71-75. *http://doi.org/10.1016/j.jdsr.2018.11.003*. Epub 2019 Mar 18. PMID: 30949254; PMCID: PMC6430737.
13. Gill GS, Pulcini M. Maxillary Osteomyelitis in a Patient with Pansinusitis and Recently Diagnosed Focal Segmental Glomerulosclerosis. Cureus. 2019 Aug 8;11(8):e5347. *http://doi.org/10.7759/cureus.5347*. PMID: 31523584; PMCID: PMC6721898.
14. Tellez-Rodriguez J, Lopez-Fernandez R, Rodriguez-Jurado R, *et al*. Mycobacterium tuberculosis as a cause of mandibular osteomyelitis in a young woman: A case report. J Med Case Rep. 2016 Dec 20;10(1):366. *http://doi.org/10.1186/s13256-016-1118-x*. PMID: 27998317; PMCID: PMC5175378.
15. Al-Yosaffi EA, Al-Shamahy HA, Othman AM, Al-Haddad AM, Al-Moyed KA. Antibiotic sensitivity of bacterial bloodstream infections in the intensive care unit patients of university hospitals in Sana'a city, Yemen. Universal J Pharm Res 2023; 8(5):1-8. *http://doi.org/10.22270/ujpr.v8i5.1004*
16. Al-Yousafi EA, Al-Shamahy HA, Othman AM, AlShawkany AARM. Bloodstream infections in intensive care unit patients in tertiary hospitals in Sana'a city, Yemen. Universal J Pharm Res 2023; 8(4):1-8, *http://doi.org/10.22270/ujpr.v8i4.977*
17. Al-Khamesy KSA, Al-Shamahy HA. Assessment of the present bacteriological profile and antibiotic sensitivity pattern in chronic suppurative otitis media in Sana'a, Yemen. Universal J Pharm Res 2023; 8(5):1-8. *http://doi.org/10.22270/ujpr.v8i5.1010*
18. Al-Shehari MM, Al-Khamesy KSA, Al-Shamahy HA, *et al*. Distribution and antibacterial resistance of wound pathogenic bacteria in patients of Sana'a hospitals, Yemen. Universal J Pharm Res 2023; 8(3):1-8. *http://doi.org/10.22270/ujpr.v8i3.942*
19. Alhadi YAA, Al-Kibsi TAM, Al-Shamahy HA, Aldeen YAAS. Surgical site infections: Prevalence, associated factors and antimicrobial susceptibility patterns of the bacterial isolates among postoperative patients in Sana'a, Yemen. Universal J Pharm Res 2022; 7(3):1-8. *http://doi.org/10.22270/ujpr.v7i3.777*
20. Al-Arosi SAH, Al-shamahi EY, Al-Shamahy HA, *et al*. Neonatal bacterial conjunctivitis in tertiary hospitals in Sana'a city, Yemen. Universal J Pharm Res 2022; 6(6):1-8. *http://doi.org/10.22270/ujpr.v6i6.697*
21. Al-Shami HZ, Al-Haimi MA, Al-Shamahy HA, *et al*. Patterns of antimicrobial resistance among major bacterial pathogens isolated from clinical samples in two tertiary's hospitals, in Sana'a, Yemen. Universal J Pharm Res 2021; 6(5):1-8, *http://doi.org/10.22270/ujpr.v6i5.674*
22. Alyahawi A, Alkaf A, Alnosary T. Current trend of resistant for the commonly prescribed new fluoroquinolones among hospitalised patients in Sana'a, Yemen. Universal J Pharm Res 3 (5):1-8. *http://doi.org/10.22270/ujpr.v3i5.197*
23. Al-Tahish GAA, Measar MAH, Al-Shamahy HA, *et al*. Antimicrobial resistance patterns among bacterial pathogens isolated from clinical samples in Sana'a hospitals. Universal J Pharm Res 2024; 9 (3):1-8. *http://doi.org/10.22270/ujpr.v9i3.1112*
24. Al-Hammadi MA, Al-Shamahy HA, Ali AQ. The prevalence and phenotypic characterization of extended-spectrum β-lactamases-producing escherichia coli strains isolates recovered from tertiary hospitals in Sana'a city, Yemen. Universal J Pharm Res 2019; 3(6):1-8. *http://doi.org/10.22270/ujpr.v3i6.220*
25. Lukošiūnas A, Kubilius R, Sabalys G, *et al*. An analysis of etiological factors for traumatic mandibular osteomyelitis. Medicina (Kaunas) 2011; 47(7):380-5.
26. Ronisa Swain.Osteomyelitis of Jaw: A Review. Indian J Forensic Medicine & Toxicology, October-December 2020, Vol. 14, No. 4
27. Al-Kholani AI. Influence of khat chewing on periodontal tissues and oral hygiene status among Yemenis. Dent Res J (Isfahan) 2010 Winter;7(1):1-6. PMID: 21448439; PMCID: PMC3065335.
28. Kuhlefelt M, Laine P, Suominen AL, Lindqvist C, Thorén H. Smoking as a significant risk factor for infections after orthognathic surgery. J Oral Maxillofac Surg 2012 Jul;70(7):1643-7. PMID: 21958665. *http://doi.org/10.1016/j.joms.2011.06.224*..
29. Peter S. Essentials of Preventive Community Dentistry. In: Peter S, editor. Indices in dental epidemiology. New Delhi: Arya (Medi) Publishing House; 2004 127–240.