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Osteomyelitis of the Jaw: A 10-Year Retrospective Analysis at a Tertiary Health Care Centre in Canada

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Cite this as: *J Can Dent Assoc* 2024;90:o6

ABSTRACT

Background: Osteomyelitis (OM) of the jaw is a rare medical condition. In this review, we provide a descriptive analysis of the experience with this condition at a single tertiary health care centre in Canada over 10 years.

Materials and Methods: We conducted a retrospective chart review of adult patients aged ≥ 18 years presenting with OM of the jaw at the University of Manitoba Health Sciences Centre between January 2009 and May 2019. We included cases with consistent clinical symptoms and radiographic and/or microbiologic evidence of OM of the jaw. Excluded were cases with a previous history of head and neck cancer, radiation therapy in the head and neck regions and use of anti-resorptive medications.

Results: Of the 37 patients who met our criteria, the mean age was 44 years (standard deviation [SD] ± 16 years), 21 (56.8%) were male, 16 (43.2%) were diagnosed with acute OM and 21 (57.8%) with chronic OM. Underlying comorbidities, such as diabetes mellitus and chronic kidney diseases, were reported in 6 (16.2%) and 3 patients (8.1%), respectively. Traumatic injuries to the facial skeleton were the most common predisposing factor (11 patients [29.7%]). The most commonly isolated infective organisms were viridans group streptococci (VGS; 75.8%), followed by *Prevotella* spp. (45.4%). Results showed a higher level of resistance to penicillin of the isolated organisms in chronic OM compared with acute OM.

Conclusions: This description of acute and chronic forms of OM of the jaw will enable clinicians to better understand OM patient profiles, leading to early diagnosis, improved patient care and better outcomes.

Introduction

Osteomyelitis (OM) is an inflammatory process of the bone marrow. OM of the jaw is rare in developed countries, likely as a result of improved dental care and appropriate use of antibiotics.[1] Nevertheless, it remains a diagnostic and management challenge for a treatment team because of the high rate of relapse.[1]

The mandible is much more susceptible than the maxilla and is the most common site in the head and neck region. This is due to its unique anatomy—a dense cortical structure with the main vascular supply running through an intraosseous canal, which heightens the risk of vascular occlusion.[2] Risk factors for OM of the jaw can be classified into systemic and local factors. Systemic conditions include diabetes mellitus, autoimmune disorders, malnutrition, malignancy and a compromised host defense system resulting from AIDS, prolonged corticosteroid use or chemotherapeutic agents. Local factors that compromise the vascular supply, such as fracture, osteoporosis and radiation, can predispose a patient to progression of the disease.[2,3]

In the past, OM of the jaw was more prevalent, but with the advent of antibiotics, it became rare. However, in recent years, there has been a resurgence of this condition because of increased bacterial resistance, bringing about challenges in both diagnosis and therapeutic efficacy. Despite its significance, OM of the jaw remains underreported in epidemiologic studies. The limited research consists, primarily, of case reports and series, with none conducted in Canada. This lack of comprehensive epidemiologic data underscores the need for further research and attention to the emerging challenges associated with this condition.[3]

Published: July, 2024

Several classifications of OM have been described in the literature, based on duration of symptoms, mechanism of infection or being suppurative vs non-suppurative.[4–7] Baltensperger et al.[7] present the most recent classification system for OM of the jaw: it divides chronic OM into primary vs secondary, with types of acute OM mainly related to the underlying factor.

The purpose of this study was to explore demographic features, underlying comorbidities, predisposing factors and isolated pathogens in individuals diagnosed with acute and chronic OM of the jaw at a Canadian health sciences centre. In addition, we aimed to analyze and compare the results of antimicrobial susceptibility testing (AST) between acute and chronic OM cases, aiming to detect any disparities in antibiotic resistance patterns. Furthermore, we juxtaposed our findings with those documented in the literature.

Materials and Methods

We conducted a retrospective case series study of adult patients with OM of the jaw treated in the Department of Oral and Maxillofacial Surgery or Plastic Surgery at the University of Manitoba Health Sciences Centre—an 800-bed teaching and referral tertiary care centre in Winnipeg, Manitoba—between January 2009 and May 2019. To obtain patient consent, we used the standard surgical treatment consent form at the health sciences centre, which ensured patient confidentiality and complied with the requirements outlined in the Personal Health Information Protection Act (PHIPA). We also used the medical record database to identify all patients with OM of the jaw using the *International Statistical Classification of Diseases and Related Health Problems*, 10th revision (ICD-10-CA) using the code K10.2 to identify potential study candidates. To be included in the study, patients had to be ≥ 18 years of age, and the diagnosis of OM of the jaw was based on the presence of compatible clinical assessment and/or consistent radiographic evidence of OM and/or isolation of a microorganism in samples obtained from bone biopsy or pus aspiration. We excluded cases if patients had: osteoradionecrosis as a concomitant diagnosis; a history of radiation to the head and neck; a history of anti-resorptive medications; and patients who were unable to provide informed consent.

A standardized tool was used to collect data on demographics (age, gender) and baseline characteristics, which included underlying medical comorbidities, presence or absence of sensory loss, presence of cutaneous fistula, duration of symptoms, infection site, local and systemic predisposing factors, alcohol use disorder, underlying psychiatric disorders and substance use disorder. In addition, we collected data on radiographic evidence of OM, antimicrobial exposure before the presentation, microbiological data, AST when available and type of surgical intervention. We classified our cases as acute if symptoms were present for < 4 weeks and chronic if symptoms presented for ≥ 4 weeks.[8]

Statistical Analysis

The extraction of data and statistical analysis were completed using ANOVA in Excel 2015 (Microsoft, Redmond, Wash., USA). Categorical variables were expressed as absolutes and relative frequencies. Continuous variables were expressed as mean and standard deviation (SD).

Ethics approval

Ethics approval was obtained from the University of Manitoba Health Research Ethics Board (no. H2019:077).

Results

An initial search of the medical database revealed 107 cases of OM of the jaw. After removing incorrectly coded, duplicate and missing records and applying exclusion criteria, 37 patients were included in the analysis. Their mean age was 44 years (SD 16 years); 21 patients (56.8%) were male and 16 were female. Underlying comorbidities included diabetes mellitus (6 patients, 16.2%), chronic kidney disease (3 patients, 8.1%), an underlying malignancy not including head and neck (2 patients, 5.4%) and underlying psychiatric disorders (4 patients, 10.8%). Other comorbidities are listed in **Table 1**.

Predisposing factors for OM of the jaw were reported in 26 patients (70.3%). Facial trauma was the most common factor and was documented in 11 patients (29.7%) followed by recent dental extraction in 6 patients (16.2%). The duration of symptoms < 4 weeks (acute) was reported for 16 patients (43.2%) and ≥ 4 weeks (chronic) in 21 patients (56.8%). Associated sensory loss along the inferior alveolar nerve was observed in 5 patients (41.7%) among the 12 who had a neurologic assessment. Cutaneous fistula was noted in 8 patients (21.6%). Antimicrobial exposure before presentation was recorded in 23 patients (62.2%). Mandibular OM was diagnosed in 31 patients (83.8%) and maxillary OM in 6 patients (16.2%). Among patients (*n*=33) who underwent radiographic imaging of the jaw, 31 patients showed evidence of OM (93.9%) (**Table 1**).

Samples for microbiology were obtained from 33 patients (89.2%) either by aspiration of pus or intraoperative bone biopsy (**Table 2**). The most commonly isolated aerobic organisms were VGS (75.7%), and among these isolates, 92% (23/25) were part of a polymicrobial

infection. Other commonly isolated anaerobic organisms included *Prevotella* spp. (45.4%), coagulase-negative staphylococci (CoNS) (30.3%), *Rothia* spp. (21.2%), *Actinomyces* spp. (15.1 %) and *Staphylococcus* aureus (15.1%). One *Actinomyces* case and one *S. aureus* case were related to hardware infection. All fungal OM were part of a polymicrobial infection. Of 80% of VGS (20/25) isolates that had AST, 70% were sensitive to penicillin, while 10% were resistant, 15% had intermediate susceptibility to penicillin and 1 isolate (5%) had intermediate susceptibility to ceftriaxone. Among *Prevotella* species, 66.6% (10/15) that had AST, 70% were resistant to penicillin, and 30% were resistant to clindamycin. A comparison of the antimicrobial susceptibility of VGS and *Prevotella* spp. in both acute and chronic OM is shown in **Table 3**. More resistance to penicillin was associated with chronic OM as opposed to acute OM.

Among the patients, 32 (86.4%) received antibiotic therapy (intravenous and oral) for an average of 8 weeks (SD ± 10 weeks). The average length of hospital stay was 11 days (SD ± 19 days). Thirty-five patients (94.7%) underwent surgical intervention **Table 1**. Among 26 patients, postoperative follow-up averaged 19 weeks (SD ± 18 weeks). Nine patients (24.3%) had complete recovery, defined as the absence of symptoms at the time of the final visit.

Discussion

Suppurative OM of the jaw is a rare disease in developed countries. Previously published case series present a combination of suppurative, osteoradionecrosis and primary sclerosing OM[9–16] (**Table 4**). In our cohort, 16.2% of patients had underlying diabetes mellitus and 5.4% had an underlying malignancy, not including head and neck. The association of these comorbidities with OM of the jaw has been noted previously.[12–14]

Smoking and alcohol use disorder were more prevalent in our series than most published series. This association is consistent with what was observed by Koorbusch et al.[10] A possible explanation for alcohol as a risk factor for OM is related to malnutrition among chronic consumers, which leads indirectly to a relatively immunosuppressed state.[10] An underlying psychiatric disorder was observed among 10.8% of our patients. A recent review showed that, patients with underlying psychiatric disorders are more likely to have an unsuccessful outcome compared with those who do not.[9] In our series, the most common local predisposing factor was a recent facial trauma (a third of the cohort) followed by recent dental extraction. This finding is consistent with the observations of Haeffs et al.[9] in the United States.

The diagnosis of acute OM among 16 patients (43.2%) in our study is higher than previously reported. This may be because these cases were related to significant trauma to the face and, therefore, patients presented to the health care facility on an urgent basis. The presence of cutaneous fistula was observed among 8 patients (22.9%), relatively fewer than reported in the recent case series.[9,14,16] This can be explained by the fact that 43% of our cohort presented early with acute OM and, therefore, did not have time for an abscess to progress into a fistula, which is most often encountered in the chronic form of OM.[9,14,16]

The mandible was the most predominantly involved site in our series, in 31 cases (83.8%). This corresponds to observations in most of the published case series and is explained by the anatomical structure of the mandibular bone that increases its risk of developing infection.[9–12,14–16] However, in 1 series in India the maxilla was the most predominant site of OM.[13] That may be because most of the affected cases were associated with poorly controlled diabetes and a third of them had underlying chronic sinusitis. Maxillary OM has been rarely reported in the literature. Only 1 adult patient with *S. aureus* of the maxilla was reported from our institution.[17]

Of the 33 patients who had imaging of the jaw, 31 (93.9%) had radiological evidence of OM. In 2 cases of acute OM the lack of radiographic evidence can be attributed to early presentation and the absence of periosteal reaction on CT scan. This was similar to observations reported by Parsad et al.[3] Other imaging modalities that can help to establish a diagnosis of OM are MRI, which has high sensitivity and specificity even in early presentation, and radionucleotide scintigraphy.[18]

Microbiology results were available for 33 patients (89.2%), and VGS represented the most commonly isolated pathogens (75.8%) followed by Prevotella spp. (45.4%). Twenty-nine of the infections were polymicrobial in nature (87.9%), and this is consistent with most series reported in the literature.[9,12] CoNS were encountered in a third of cases as part of the polymicrobial process. It is not clear whether this represents a true pathogen or a contaminant; therefore, treatment directed against this pathogen should be considered on a case-by-case basis.

Actinomyces spp. were isolated in 5 cases (15%), 1 of which was a hardware-related infection. Twenty-three patients had antimicrobial exposure before presentation to the hospital to either beta-lactam alone or in combination with beta-lactamase inhibitor or fluoroquinolone with anaerobic activity. AST for VGS species showed that about a third (31.5%) of the isolates had reduced susceptibility to penicillin, which is comparable to that reported in the recent series by Pigrau et al.[12] All but 1 patient with reduced susceptibility to penicillin had exposure to beta-lactam either alone or in combination with other antibiotics before presentation. Among *Prevotella* spp. isolated in chronic OM, all were resistant to penicillin, as opposed

to 2 isolates (40%) that were resistant in acute OM. With respect to reaction of microorganisms to antibiotics, there were no statistically significant differences in microorganism resistance between acute and chronic OM. The mechanism of beta-lactam resistance among anaerobic Gram-negative bacilli is related to beta-lactamase production.[19] Given the polymicrobial nature of OM of the jaw, an antimicrobial agent with activity against anaerobic Gram-negative bacilli should be considered as part of the regimen if treatment is warranted preoperatively.

A total of 35 patients (94.6%) underwent surgical intervention. Complete recovery was observed in 9 patients (24.3%). This observation was similar to the observation by Andre et al.[15] However, in our series, average follow up was 19 weeks. Therefore, our assessment of the outcome is suboptimal because of lack of long-term follow up.

The strength of our study is the relatively large sample size over 10 years at a tertiary health care centre in Canada. However, our study has several limitations. First, there was heterogeneity in the surgical management of cases, as the facial trauma service is shared between maxillofacial and plastic surgery at our institution. Second, the duration of follow up was not adequate to properly assess the outcome. This limitation is related to the fact that the centre where the study was conducted serves all residents of Manitoba and northwestern Ontario; therefore, follow up is difficult for patients who live outside the city, in remote communities or other regions of Ontario.

Future research directions based on our findings suggest that early intervention and close monitoring, particularly for high-risk individuals, such as those with trauma to the facial skeleton, are warranted as this was identified as the most common predisposing factor. In addition, considering the rising issue of antibiotic resistance, we recommend conducting a similar study to identify the responsible pathogens and their antimicrobial sensitivity.

Conclusions

Dental practitioners must have a clear and informed understanding of IE as a whole. The AHA gives the dental community clear guidelines on what to look for in their patient population, specific dental procedures that may increase the risk of IE and recommendations for AP for patients who would benefit from such treatment. It is likely that the guidelines will change in the future because of ongoing advancements in the study of IE. However, regardless of whether patients are at risk of IE, the dental practitioner should always recommend consistent and effective oral hygiene, as being of utmost importance in advancing oral health and reducing risk of infectious disease.

Table 1: Baseline characteristics of 37 patients with osteomyelitis of the jaw

Variable	Cases, no. (%) except age (*n* = 37, except where noted)
Mean age, years ± standard deviation	44 ± 16
Gender	
Male	21 (56.8)
Female	16 (43.2)
Comorbidities	
Diabetes mellitus	6 (16.2)
Chronic kidney diseases	3 (8.1)
HIV infection	0
Underlying malignancy not including head/neck*	2 (5.4)
Chronic corticosteroid use	0
Smoking	18/30 (60)
Alcohol use disorder	12/26 (46.2)
Substance use disorder	5 (13.5)
Underlying psychiatric disorder	4 (10.8)

Table 1 continued ▶

Variable	Cases, no. (%) except age (*n* = 37, except where noted)
Predisposing factors	
Recent trauma to the face	11(29.7)
Recent dental extraction	6 (16.2)
Recent dental implant	1 (2.7)
Combinations	2 (5.4)
Orthognathic surgery	3 (8.1)
Odontogenic infection	3 (8.1)
Unknown	11(29.7)
Duration of symptoms†	
< 4 weeks	16 (43.2)
≥ 4 weeks	21 (56.8)
IAN sensory change	5/12 (41.7)
Presence of cutaneous fistula	8/35 (22.9)
Antimicrobial exposure 6 months prior to presentation	23 (62.2)
Site of OM	
Anterior mandible	11 (29.7)
Posterior mandible	20 (54.1)
Anterior maxilla	5 (13.5)
Posterior maxilla	1 (2.7)
Radiographic evidence of OM‡	31/33 (93.9)
Surgical intervention	
Curettage and decortication	13 (35.1)
Marginal resection	4 (10.8)
Segmental resection	1 (2.7)
Sequesterecomy and debridement	9 (24.3)
Other §	8 (21.6)
Intra-operative pathological fracture	10 (27.0)
Outcome, complete recovery	9 (24.3)

**Leukemeia, lymphoma.*

†Pain, swelling, fever.

‡Computed tomography, panoramic x-ray.

§Hardware removal, fistulectomy, ethmoidectomy, maxillary antrostomy, hemi-mandibulectomy.

Table 2: Microorganisms isolated from 33 patients with osteomyelitis of the jaw.

Microorganism	No. (%) *n* = 33
Aerobic Gram-positive	
Viridians group streptococci	25 (75.8)
Group A,B,C streptococci	1 (3.0)
Staphylococcus aureus	5 (15.2)
Coagulase negative staphylococcus	10 (30.3)
Enterococcus spp.	1 (3.0)
Gemella spp.	1 (3.0)
Other streptococci*	1 (3.0)
Large bacilli†	3 (9.1)
Aerobic Gram-negative	
Eikenella spp.	4 (12.1)
Kingella spp.	1 (3.0)
Haemophilus spp.	4 (12.1)
Neisseria spp.	4 (12.1)
Enterobacteriaceae sp.	0
Anaerobic Gram-positive	
Actinomyces spp.	5 (15.2)
Micrococcus spp.	1 (3.0)
Parvimonas micra	4 (12.1)
Propionibacterium spp.	1 (3.0)
Peptostreptococci	1 (3.0)
Rothia spp.	7 (21.2)
Peptinophilus spp.	2 (6.0)
Anaerobic Gram-negative	
Prevotella spp.	15 (45.5)
Fusobacterium spp.	2 (6.0)
Veillonella spp.	3 (9.1)
Clostridium spp.	1 (3.0)
Fungi	4 (12.1)
None	1 (3.0)

**Abiotrophia defectiva, Granulicatella spp..*
†Diphtheroid spp., Arcanobacterium haemolyticum..

Table 3: Comparison of antibiotic resistance of VGS and Prevotella spp. in acute and chronic OM of the jaw.

Microorganism	Reaction of microorganisms to antibiotics	
	Acute OM	Chronic OM
Viridans group streptococci	1 resistant to penicillin 1 intermediate to ceftriaxone 1 intermediate to penicillin 6 susceptible to penicillin, ceftriaxone and vancomycin.	1 resistant to penicillin 2 intermediate to penicillin 8 susceptible to penicillin, ceftriaxone and vancomycin. 10 (30.3)
Prevotella spp.	2 susceptible to penicillin 2 resistant to penicillin 1 intermediate to penicillin	5 resistant to penicillin

Table 4: Published case series on osteomyelitis of the jaw, since 1990.

Authors	Year	No. of cases	Mandible	Maxillary	Head and neck cancer	ORN	ART
Koorbusch et al.[10]	1992	35	33	2	2	6	0
Taher[11]	1993	88	88	0	8	8	0
Pigrau et al.[12]	2009	46	45	1	—*	6	4
Peravali et al.[13]	2012	31	15	16	—	—	—
Baur et al.[14]	2015	24	24	0	0	0	0
Andre et al.[15]	2017	40	35	5	0	0	0
Bertrand et al.[16]	2018	56	48	8	19	—	3
Haeffs et al.[9]	2018	42	41	1	0	0	0
Almuzzayen *et al* (this study)	2024	37	31	6	0	0	0

Note: ORN = osteoradionecrosis, ART = anti-resorptive therapy.

**Not specified.*

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This article has been peer reviewed.

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