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Shifting Trends in Maxillofacial Infections: The Impact of MRONJ - Overview of the Literature

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Abstract: ***Maxillofacial infections encompass a wide range of conditions historically arising primarily from odontogenic sources and involving deep fascial spaces. In recent years, however, a distinct shift has occurred, marked by the rising prevalence of medication-related osteonecrosis of the jaw (MRONJ). Once considered rare, MRONJ now represents a significant aetiological factor in maxillofacial infections, especially in patients receiving antiresorptive or antiangiogenic therapy. A key dimension in this evolving profile is the role of peri-apical lesions of endodontic origin. Chronic inflammatory foci from inadequately treated root canal infections, apical periodontitis, or persistent radicular cysts may interact unfavourably with medication-compromised bone, increasing the risk of secondary infection and impaired healing. Distinguishing between conventional endodontic pathology and MRONJ-related infection remains a critical diagnostic challenge, as overlapping clinical and radiographic features may lead to delayed or inappropriate management. Thus, precise differential diagnosis is essential to guide effective therapeutic decision-making and prevent unnecessary surgical interventions. Current strategies range from conservative infection control to combined protocols incorporating surgical debridement, systemic antimicrobials, and adjunctive therapies. Preventive measures, including high-quality endodontic treatment and regular follow-up, are fundamental to reducing risk. Overall, the literature highlights MRONJ as both a therapeutic challenge and a driver of change in clinical practice, underscoring the importance of integrating surgical, medical, and endodontic perspectives in managing contemporary maxillofacial infections.***

Keywords: maxillofacial infections, bone lesions, medication-related osteonecrosis of the jaw (*MRONJ*), antimicrobial therapy, surgical management, prevention.

1. Introduction

Historically, acute maxillofacial infections requiring hospitalization have predominantly originated from odontogenic sources, such as advanced dental caries, periodontal disease, or pericoronitis, as well as from traumatic injuries to the facial region. These infections were often associated with rapid progression, significant risk of airway compromise, and the potential for systemic involvement, which necessitated prompt surgical and medical management. Prior to the widespread availability of modern antibiotics and improvements in oral health care, odontogenic and trauma-related infections constituted the leading causes of severe maxillofacial sepsis presenting in hospital settings [1]. The oral cavity and adjacent maxillofacial regions host one of the richest microbial communities in the human body [2]. The majority of these infections arise from pre-existing dental or periodontal disease [3], or from wound contamination following dentoalveolar surgery. Consequently, the microorganisms normally residing in the oral cavity are the primary pathogens involved [4].

These infections typically originate from untreated dental caries, periodontal disease, trauma, or surgical complications, enabling bacteria to penetrate deeper tissues through vascular or fascial pathways [5]. Most dental space infections are therefore of odontogenic origin. Thanks to advances in dental care and the availability of antibiotics this trend is changing [6].

Improved preventive dentistry, earlier intervention, and greater patient awareness have further contributed to reducing the burden of traditional odontogenic infections in many populations [7], [8]. However, the emergence of medication-related osteonecrosis of the jaw (*MRONJ*) - a complication associated with bisphosphonates, denosumab, and other bone-modifying agents - has reshaped this clinical picture [9], [10]. MRONJ is now recognized as a distinct, challenging condition, frequently requiring hospital-based treatment due to its poor response to standard therapies and frequent association with secondary infections [11].

The increasing prescription of antiresorptive and antiangiogenic drugs for osteoporosis, metastatic bone disease, and other systemic conditions has led to a corresponding rise in MRONJ cases worldwide [12]. Consequently, maxillofacial units now encounter a growing proportion of patients with infections not solely attributable to classical odontogenic pathways but instead precipitated or perpetuated by medication-induced bone compromise [9]. This shift has important clinical and public health implications, as the patient population at risk is often elderly, systemically compromised, and less tolerant of aggressive interventions.

In this context, peri-apical lesions of endodontic origin deserve particular attention [13], [14]. Chronic inflammatory processes arising from untreated or inadequately treated root canal infections can act as potential triggers or exacerbating factors in MRONJ development [15], [16]. Where bone metabolism is pharmacologically altered, even low-grade inflammatory foci may contribute to impaired healing and perpetuation of necrotic bone exposure [17]. Hence, the quality of endodontic treatment and long-term follow-up becomes a critical determinant in preventing infectious complications in vulnerable patients [18]. Inadequate disinfection, incomplete obturation, or missed canals may leave residual microbial reservoirs that not only compromise

tooth prognosis but may also interact unfavourably with compromised bone physiology [3], [5], [19].

Furthermore, inflammatory lesions such as chronic apical periodontitis or persistent radicular cysts can alter the local environment, increasing susceptibility to infection spread in the presence of medication-related bone fragility [20]. These observations underscore the importance of adhering to rigorous endodontic protocols, maintaining meticulous infection control, and implementing structured radiographic follow-up as essential components of MRONJ prevention strategies [21]. In patients receiving antiresorptive therapy, proactive endodontic management may reduce the need for surgical intervention and thereby limit the risk of osteonecrosis [22].

Taken together, these changes highlight an epidemiological transition: while conventional odontogenic infections remain relevant [23], MRONJ-associated infections - frequently linked with peri-apical pathology and the sequelae of suboptimal endodontic care - are redefining diagnostic and therapeutic strategies in maxillofacial practice [16]. Understanding these shifting trends is essential for developing tailored treatment algorithms and preventive measures that integrate both surgical and endodontic considerations, ensuring a comprehensive approach to this evolving clinical framework [4].

The aim of this paper is to review the common causes of maxillofacial infections and to highlight the shifting landscape with the increasing prevalence of MRONJ.

2. Overview

Maxillofacial infections arise from diverse etiologies, which can broadly be divided into odontogenic and non-odontogenic categories. Odontogenic causes account for approximately 63% of cases, while non-odontogenic factors represent around 33% [4]. Among odontogenic sources, periapical inflammation is the most common (59%), followed by pericoronitis (24.8%), periodontitis (8.5%), and post-extraction infections (7.1%). The leading non-odontogenic causes include tonsillitis (20%), malignant tumours and their treatment (17.3%), and lymphadenitis (16%) [8]. The central role of periapical pathology underscores the importance of precise endodontic diagnosis and the implementation of protocols to prevent microbial persistence [3]. Furthermore, complications such as vertical root fractures in previously treated teeth may serve as hidden pathways for infection, aggravating periapical disease and complicating therapeutic outcomes [5]. Within the context of shifting trends in maxillofacial infections, these endodontic challenges acquire greater clinical significance when superimposed on medication-related osteonecrosis of the jaw (MRONJ), where impaired bone healing and secondary infection can further exacerbate disease progression [11]. Alongside this, the leading non-odontogenic causes include tonsillitis (20%), malignant tumours and their treatment (17.3%), and lymphadenitis (16%) [2,6].

Odontogenic infections originate from the teeth or supporting dental structures. They are predominantly bacterial in nature, with anaerobes such as *Streptococcus*, *Peptostreptococcus*, and *Bacteroides* species being most frequently involved [7]. Dental caries often acts as the initial trigger by creating pathways for bacteria to reach the dental pulp. Additional contributing factors include invasive dental procedures, trauma, and periodontal disease [21]. Once bacteria invade the pulp, they can spread into surrounding bone and soft tissues [24], leading to complications such as osteomyelitis, cellulitis, or abscess formation.

Most odontogenic infections are polymicrobial, with mixed aerobic and anaerobic flora. Anaerobic organisms predominate, and only a few studies report mainly aerobic growth [8], [13], [25]. Frequently isolated bacteria include *Streptococcus mitis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, which can enter maxillofacial tissues via trauma, dental interventions, or surgery [26].

Over the past two decades, antiresorptive agents have played an important role in managing bone metastases and osteoporosis. Despite their therapeutic benefits, these drugs are associated with MRONJ, a serious complication characterized by exposed necrotic bone, persistent pain, and chronic inflammation [27], [28], [29]. MRONJ significantly impacts quality of life and is often complicated by secondary soft tissue infections, which may necessitate hospitalization [9], [27].

Although hospitalization rates for MRONJ-related infections are not directly reported in the literature, evidence suggests that they depend on disease severity and treatment modality. Rates are lower in patients with osteoporosis, who typically undergo conservative management, and higher in cancer patients, who receive higher drug doses and require more complex care [1], [12]. However, the exact proportion of acute maxillofacial infections attributable to MRONJ remains unclear.

The interplay between odontogenic pathology and medication-induced alterations in bone metabolism warrants particular emphasis in current clinical research. Chronic apical periodontitis, for instance, represents not only a frequent endpoint of untreated pulp disease but also a critical factor in the onset and perpetuation of MRONJ when combined with systemic risk factors [15], [16]. In vivo and imaging-based studies have demonstrated that structural changes in the apical zone, such as cortical thinning and trabecular rarefaction, create favourable conditions for bacterial colonisation and impaired healing [14], [19]. These findings highlight the necessity of early, accurate diagnosis through advanced imaging modalities like cone-beam computed tomography, as conventional radiographs often underestimate lesion dimensions and associated risks.

Preventive and therapeutic strategies must therefore integrate both endodontic and systemic considerations. Rigorous root canal disinfection and three-dimensional obturation protocols are pivotal in eliminating microbial reservoirs that could compromise bone physiology [3], while structured radiographic follow-up ensures the timely detection of recurrent or persistent disease [21]. Furthermore, clinical evidence supports that patients on antiresorptive therapy benefit from conservative dental approaches aimed at retaining natural teeth whenever possible, as extractions in

these individuals are strongly correlated with a higher incidence of MRONJ [12], [20].

From a public health perspective, this evolving interplay underscores the importance of interdisciplinary collaboration. Oral and maxillofacial surgeons, endodontists, oncologists, and general dental practitioners must coordinate to stratify risk and customise treatment planning [4]. Such an approach not only mitigates infectious complications but also reduces the need for invasive surgical procedures, ultimately improving patient outcomes and quality of life [9]. The integration of preventive endodontic management into MRONJ risk-reduction strategies therefore represents a vital step in addressing the challenges posed by shifting epidemiological patterns of maxillofacial infections.

3. Conclusion

Maxillofacial infections are primarily odontogenic, yet the emergence of MRONJ has introduced a new and complex challenge in clinical practice. While precise hospitalization rates for MRONJ-related acute infections are not well established, available data indicate that admissions are more frequent among cancer patients receiving high-dose antiresorptive therapy compared to those treated for osteoporosis. Further research is needed to quantify these rates and optimize management strategies for this growing patient population.

References

[1] R. Rastenienė et al. “Determinants of length of hospitalization due to acute odontogenic maxillofacial infections: a 2009-2013 retrospective analysis”. Med Princ Pract. 24(2), pp.129-35, 2015.
[2] B. Kamiński, et al. ‘Oral and Maxillofacial Infections - A Bacterial and Clinical Cross-Section’. Journal of clinical medicine, 11(10), pp.2731, 2022.
[3] A. Gusiyska, E. Dyulgerova. “Clinical Approaches to the Three-Dimensional Endodontic Obturation Protocol for Teeth with Periapical Bone Lesions”. Appl. Sci. 13: 9755, 2023.
[4] T. Kuriyama, B. Lund, D. Williams et al. “Bacterial Infections of the Oral and Maxillofacial Region”. In Oral and Maxillofacial Surgery, eds L. Andersson, D.G. Krishnan and Z.S. Peacock, 2025.
[5] A. Gusiyska, E. Gyulbenkiyan. “Vertical root fractures in teeth with endodontic treatment - literature review”. Journal of Medical and Dental Practice 9: pp.1550-1558, 2022.
[6] S. Gadicherla, K. Manglani, K. Pentapati, et al. “Profile of Patients with Maxillofacial Space Infections and Associated Risk Factors”. The Scientific World Journal, 9304671, 2024.
[7] G. Dipalma, A. Laforgia, D. Ciccarese, et al. Odontogenic Infections: Updated Recommendations and Best Practices. International Journal of Infection, 8(1), pp. 3-13, 2024.
[8] D. Taub D. et al. “Controversies in the Management of Oral and Maxillofacial Infections”. Oral and maxillofacial surgery clinics of North America, 29(4), pp.465-473, 2017.
[9] A. Inchingolo, G. Malcangi, I. Ferrara, et al. “MRONJ Treatment Strategies: A Systematic Review and Two Case Reports”. Applied Sciences, 13(7), pp. 4370, 2023.
[10] M. Ohnuma, M. Otsuru, K. Omori, et al. “A retrospective study on odontogenic and non-odontogenic medication-related osteonecrosis of the jaw: Potential differences in clinical features and treatment outcomes”. J Dent Sci, 20(2), pp.1035-1042, 2025.
[11] K. Iwasaki, A. Okazaki. “Medication-related osteonecrosis of the jaw leading to sepsis in a patient with rheumatoid arthritis: A case report and clinical implications”. Clinical case reports, 11(6), e7588, 2023.
[12] E. Kostares, G. Kostare, M. Kostares, et al. “Prevalence of Osteonecrosis of the Jaw Following Tooth Extraction in Patients with Osteoporosis: A Systematic Review and Meta-Analysis”. Journal of Clinical Medicine, 14(17), p.5988, 2025.
[13] A. Gusiyska, N. Gateva, R. Kabaktchieva, et al. “Retrospective study of the healing processes of endodontically treated teeth characterized by osteolytic defects of the periapical area: four-year follow-up” Biotechnology & Biotechnological Equipment 31:1, pp. 187-192, 2017.
[14] A. Gusiyska. “In vivo analysis of some key characteristics of the apical zone in teeth with chronic apical periodontitis”. J IMAB Ann Proc 20, pp.638-641, 2014.
[15] M. Marques-Ferreira, A. Abrantes, A. Paula, et al. “The Role of Apical Periodontitis Disease in the Development of Bisphosphonate-Related Osteonecrosis of the Jaw: An Animal Study”. Dent J (Basel), 11(7), p.168, 2023.
[16] N. Rao, J. Wang, R. Yu, et. al. Role of Periapical Diseases in Medication-Related Osteonecrosis of the Jaws. Biomed Res Int, 2017:1560175, 2017.
[17] R, Yan, R. Jiang, L. Hu, et al. Establishment and assessment of rodent models of medication-related osteonecrosis of the jaw (MRONJ). Int J Oral Sci; 14(1), p.41, 2022.
[18] A. Gusiyska.” Factors Affecting the Prognosis of Endodontic Retreatment of Teeth with Bone Lesions”. International Journal of Science and Research. 11(12): SR221110134645, 2023.
[19] A. Gusiyska. Cone Beam Computed Tomography in the Diagnosis of Chronic Apical Periodontitis and Clinical Decisions. – International Journal of Science and research, 20215, 4(2): 1655-1659.
[20] N. Nakamura, M. Otsuru, T. Miyoshi et al. Risk factors for the development of medication-related osteonecrosis of the jaw and effects of tooth extraction with local infection. J Dent Sci. 19(3), pp.1770-1782, 2024.
[21] A. Gusiyska. Orthograde treatment of chronic apical periodontitis – biological approaches. PhD Thesis, Sofia, 2012, pp.254
[22] C. Moreno-Rabié, L. Lapauw, H. Gaêta-Araujo, et al. “Radiographic predictors for MRONJ in oncologic patients undergoing tooth extraction”. Sci Rep, 12(1):11280, 2022.
[23] Y. Qian, Q. Ge, W. Zuo, et al. “Maxillofacial space infection experience and risk factors: a retrospective

study of 222 cases". Ir J Med Sci, 190(3), pp.1045-1053, 2021.
[24] D. Fritsch, D. Klein. "Ludwig's angina. Heart & lung: the journal of critical care", 21(1), pp.39–46, 1992.
[25] S. R. Caruso, et al. "Update on Antimicrobial Therapy in Management of Acute Odontogenic Infection in Oral and Maxillofacial Surgery." Oral and maxillofacial surgery clinics of North America,34,1, pp.169-177, 2022.
[26] B. Kamiński, K. Błochowiak, K. Kołomański, et al. "Oral and Maxillofacial Infections-A Bacterial and Clinical Cross-Section". J Clin Med. May 12;11(10), pp.2731, 2022.
[27] M. Taskov, S. Dzhenkov, K. Stamatov. "Perceived quality of life among patients with medication related osteonecrosis of the jaw in the Bulgarian population". ONLINE JOURNAL OF THE BULGARIAN DENTAL ASSOCIATION, 1, pp.3033-1846, 2025.
[28] M. Taskov, S. Dzhenkov, K. Stamatov. "Management of Patients on Antiresorptive Therapy and Patients with Medication-Related Osteonecrosis of the Jaw˙: An Analysis of Attitudes Among Dental Medicine Practitioners, Oral Surgery/Maxillofacial Surgery Specialists, and Dental Medicine Students". ONLINE JOURNAL OF THE BULGARIAN DENTAL ASSOCIATION, 1, pp. 3033-1846, 2025.
[29] M. Taskov, S. Dzhenkov, K. Stamatov. Patient awareness of the risks and prevention of medication-related osteonecrosis of the jaws prior to antiresorptive therapy. ONLINE JOURNAL OF THE BULGARIAN DENTAL ASSOCIATION, 1, pp.3033-1846, 2025.