Current Concepts in Oral and Maxillofacial Radiology: Clinical Perspectives

Editor

Hülya ÇAKIR KARABAŞ

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PREFACE

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Chapter 1

HALITOSIS

Taha Emre KÖSE[1]

Halitosis is derived from the Latin term halitus (breath) and the Greek suffix -osis (pathological process), according to the American Dental Association (1). Halitosis, also called as bad mouth odor, bad breath, or fetid halitus is characterized by an unpleasant change in a person's breath, which is extremely uncomfortable for both the affected person and others they come into contact with (2,3). Although halitosis may not pose a direct threat to a patient's life, it significantly reduces their quality of life, particularly in the current era, where social contacts and intricate human relationships are vital. Prior research has shown that the oral cavity is the primary cause of halitosis, with extra-oral causes accounting for 10% of all cases (4).

It may affect all age groups and genders, and it may result from intraoral and extraoral causes (2). The prevalence of halitosis may be underestimated since some people are unaware of their condition, but reported prevalence is 50–65% in the literature (2,3). It is thought to be the third most frequent reason for dental consultations (2). Dental problems, infections, dry mouth, medications, or illnesses affecting other organs can all cause halitosis (5).

As different classification systems exist for halitosis, the most commonly used one is offered by Murata et al. (6). Genuine halitosis, pseudo-halitosis, and halitophobia are the three types of halitosis classified by Murata et al. (7). Genuine halitosis is also subdivided into two other categories as physiological and pathological halitosis (6). Table 1 shows the classification and subdivisions.

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Another alternative found in the literature is that tea tree oil has been shown to help control malodor caused by *Solobacterium moorei* (15).

CONCLUSION

Halitosis is a condition that can arise from various causes, requires thorough investigation and appropriate treatment, and affects individuals' social quality of life.

REFERENCES

1. Khounganian RM, Alasmari ON, Aldosari MM, et al. Causes and management of halitosis: a narrative review. *Cureus*. 2023;15(8):e43742.
2. Silva CR, Silva CC, Rodrigues R. Etiology of halitosis in pediatric dentistry. *Arch Pediatr.* 2022;29(6):467-474.
3. Mento C, Lombardo C, Milazzo M, et al. Adolescence, Adulthood and Self-Perceived Halitosis: A Role of Psychological Factors. *Medicina (Kaunas)*. 2021;57(6):614.
4. Park S, Jo JH, Kim YK, et al. Hematological biomarkers of systemic inflammation in genuine (physiologic and pathologic) halitosis. *J Breath Res.* 2022;16(3):1-14.
5. Li Z, Li J, Fu R, et al. Halitosis: etiology, prevention, and the role of microbiota. *Clin Oral Investig*. 2023;27(11):6383-6393.
6. Poniewierka E, Pleskacz M, Łuc-Pleskacz N, et al. Halitosis as a symptom of gastroenterological diseases. *Prz Gastroenterol*. 2022;17(1):17-20.
7. Murata T, Yamaga T, Iida T, et al. Classification and examination of halitosis. *Int Dent J*. 2002; Suppl 3: 181-186.
8. Kahraman EN, Erensoy Ş, Dikilitaş A, et al. Awareness and knowledge of halitosis among students at two different dental universities in Turkey: a cross-sectional survey. *BMC Oral Health*. 2025;25(1):194.
9. Zürcher A, Laine ML, Filippi A. Diagnosis, prevalence, and treatment of halitosis. *Current Oral Health Reports.* 2014;1: 279-285.
10. Wu J, Cannon RD, Ji P, et al. Halitosis: prevalence, risk factors, sources, measurement and treatment - a review of the literature. *Aust Dent J.* 2020;65(1):4-11.
11. Çoban Z, Sönmez I. Halitosis: a review of current literature. *Meandros Medical and Dental Journal*. 2017;18(3):164-70.
12. Bicak DA. A current approach to halitosis and oral malodor-a mini review. *The open dentistry journal*. 2018;12:322.
13. Madhushankari GS, Yamunadevi A, Selvamani M, et al. Halitosis–an overview: Part-I–Classification, etiology, and pathophysiology of halitosis. *Journal of Pharmacy and Bioallied Sciences*. 2015;7(Suppl 2):339-43.
14. Herman S, Lisowska G, Herman J, et al. Genuine halitosis in patients with dental and laryngological etiologies of mouth odor: severity and role of oral hygiene behaviors. *Eur J Oral Sci*. 2018;126(2):101-109.
15. Tungare S, Zafar N, Paranjpe AG. Halitosis. [Updated 2023 Aug 14]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK534859/
16. Wang N, Hao S, Zhang J et. al. Clinical efficacy of photodynamic therapy on halitosis: a systematic review and meta-analysis. *Lasers Med Sci*. 2022;38(1):29.

Chapter 2

SOFT TISSUE CALCIFICATIONS

Beliz GÜRAY[1]

INTRODUCTION

Soft tissue calcifications (STCs) of the maxillofacial region are relatively rare and are most often detected incidentally on routine radiographic examinations. STCs arise from the deposition of calcium salts and are most often encountered as incidental radiopaque findings on panoramic radiographs obtained during routine dental examinations. STCs are frequently observed in individuals aged 40 and over. In the maxillofacial region, heterotopic calcification or ossification may not cause significant signs or symptoms; instead, it is most often are detected as incidental findings during radiographic examination (1,2). When STCs are detected, their identification, differentiation from normal anatomical variations and pathological conditions, and evaluation of the need for treatment are essential steps. Dentists have a key responsibility in recognizing STCs that may be superimposed on anatomical structures and establishing an accurate differential diagnosis that distinguishes these findings from dental anomalies, osseous lesions, foreign bodies, imaging artifacts, and normal anatomical entities that may present as radiopaque images. These calcifications are commonly classified into three categories: idiopathic, dystrophic, and metastatic (2,3).

Idiopathic calcification refers to the deposition of calcium salts in soft tissues despite normal serum calcium and phosphate levels. In the head and neck region, it may manifest in various forms, including sialoliths, calcifications of the laryngeal cartilages, phleboliths, rhinoliths, antroliths, and dacryoliths and is often detected incidentally during routine radiographic examinations (3,4).

This section focuses on idiopathic calcifications commonly encountered in dental imaging.

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patients undergoing DCR range from approximately 6% to 18%, although their prevalence in the general population remains unknown (23,24).

CONCLUSION

Idiopathic calcifications of the maxillofacial region represent a group of heterotopic mineralization processes that occur in soft tissues without systemic disturbances in calcium or phosphate metabolism. These calcifications are typically asymptomatic and detected incidentally on routine radiographic examinations, their identification is important in clinical practice. Knowledge of their typical locations, radiographic features, and differential diagnostic considerations allows clinicians to distinguish them from pathological lesions that require intervention. A comprehensive radiographic assessment combined with clinical correlation helps prevent misdiagnosis and unnecessary treatment. For this reason, a thorough understanding of idiopathic soft tissue calcifications is essential for accurate radiological interpretation of the maxillofacial region. A thorough understanding of the anatomical distribution, radiographic characteristics, and differential diagnostic features of idiopathic calcifications is essential for their differentiation from pathological conditions requiring treatment.

REFERENCES

1. Bayramov, N., Öztürk, A. Ü., & Yalçinkaya, Ş. E. (2022). Incidental Soft Tissue Calcifications in Cone-Beam Computed Tomography Images: A Retrospective Study. Turkiye Klinikleri Journal of Dental Sciences, 28(2).
2. Çakmak, E. Ş. K., Bayrak, S., & Atakan, C. (2020). Prevalence and characteristics of soft tissue calcifications in Cbct images of mandibular region. Clinical and Experimental Health Sciences, 10(1), 68-71.
3. Duran, M. H., & Baybars, S. C. (2024). Evaluation of soft tissue calcifications in the head and neck region on panoramic radiography of edentulous patients. Necmettin Erbakan Üniversitesi Diş Hekimliği Dergisi, 6(2), 208-215.
4. Celik Ozsoy, S., Zirek, T., Bahrilli, S., Yuksel, I. B., & Altindag, A. (2025). Examination of the Frequency of Soft Tissue Ossification and Calcifications in Panoramic Radiographs: A Retrospective Study. Diagnostics, 15(16), 2013.
5. Parihar, A., Shastri, A., Jain, A., Saxena, A., Rawat, A., & Singh, M. (2020). "CALCIFIC ISLANDS:" A cone-beam computed tomography review of soft-tissue calcifications in head-and-neck region. Journal of Oral and Maxillofacial Radiology, 8(2), 30-35.
6. Ayrancı, F., Ömezli, M. M., Torul, D., Sunar, Ç., & Koc, L. (2020). Sialolith of the submandibular gland: a case report. Middle Black Sea Journal of Health Science, 6(3), 407-411.
7. Duong, L. T., Kakiche, T., Ferré, F., Nawrocki, L., & Bouattour, A. (2019). Management of anterior submandibular sialolithiasis. Journal of Oral Medicine and Oral Surgery, 25(2), 16.
8. Kraaij, S., Karagozoglu, K. H., Forouzanfar, T., Veerman, E. C. I., & Brand, H. S. (2014). Salivary stones: symptoms, aetiology, biochemical composition and treatment. British dental journal, 217(11), E23-E23.

9. Ghom, A. G., & Ghom, S. A. (Eds.). (2014). Textbook of oral medicine. JP Medical Ltd.
10. Mallya, S., & Lam, E. (2018). White and Pharoah's oral radiology: principles and interpretation. Elsevier Health Sciences.
11. Çağırankaya, L. B., Akkaya, N., Akçiçek, G., & Doğru, H. B. (2018). Is the diagnosis of calcified laryngeal cartilages on panoramic radiographs possible?. Imaging science in dentistry, 48(2), 121-125.
12. Carter, L. C. (2000). Discrimination between calcified triticeous cartilage and calcified carotid atheroma on panoramic radiography. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 90(1), 108-110.
13. Mupparapu, M., & Vuppalapati, A. (2005). Ossification of laryngeal cartilages on lateral cephalometric radiographs. The Angle Orthodontist, 75(2), 196-201.
14. BÖLÜKBAŞI, G., & GÜNERİ, P. (2023). Geniş Bir Hemanjiom Kökenli Multipl Flebolitler: Olgu Sunumu. Journal of Ege University School of Dentistry/Ege Üniversitesi Dis Hekimligi Fakültesi Dergisi, 44(3).
15. Duran, M. H., & Baybars, S. C. (2023). Oral Hemangiom with Multiple Phleboliths. Turkiye Klinikleri. Dishekimligi Bilimleri Dergisi, 29(1), 205-208.
16. Chuang, C. C., Lin, H. C., & Huang, C. W. (2005). Submandibular cavernous hemangiomas with multiple phleboliths masquerading as sialolithiasis. Journal of the Chinese Medical Association, 68(9), 441-443.
17. Akkoca, Ö., Tüzüner, A., Demirci, Ş., Ünlü, C., Uzunkulaoğlu, H., Arslan, N., & Aktar, G. (2016). Patient characteristics and frequent localizations of rhinoliths. Turkish Archives of Otorhinolaryngology, 54(4), 154.
18. Günay, M. M., Toptaş, G., Altan, E., Tatar, E. Ç., Saka, C., & Saylam, G. (2024). Rhinolithiasis: Clinical Findings, Treatment Approach, and Associated Pathologies: A Single-Center Experience. Batı Karadeniz Tıp Dergisi, 8(1), 52-57.
19. Üstün, A. O., Taşyapan, S. A., & Alimollaoğlu, N. (2025). Asymptomatic Rhinolith Diagnosis Through MR and CBCT Imaging: A Case Report. Eurasian Dental Research, 3(2), 41-44.
20. Karabaş, Ö. G. D. H. Ç., Göksel, Ö. Ü. S., & Taşyapan, D. S. Antrolitin konik ışınlı bilgisayarlı tomografi ile retrospektif olarak değerlendirilmesi Retrospective.
21. Cho, B. H., Jung, Y. H., & Hwang, J. J. (2019). Maxillary antroliths detected by cone-beam computed tomography in an adult dental population. Imaging science in dentistry, 49(1), 59-63.
22. Naresh, S. R., Gopikrishna, P., Devi, N. H., & Rao, P. S. (2018). Lacrimal sac dacryolith. Journal of Clinical and Scientific Research, 7(4), 184-186.
23. Kominek, P., Červenka, S., Zeleník, K., Doškářová, Š., Lach, K., Švagera, Z., & Matoušek, P. (2014). Lacrimal sac dacryolith: an unusual case of epiphora?. Spektrum der Augenheilkunde, 28(4), 153-159.
24. Özer, S., & Özer, P. A. (2013). Lacrimal sac dacryoliths-pathogenesis and composition. Turkish Journal of Ophthalmology.

Chapter 3

BRUXISM: CLINICAL AND RADIOLOGICAL DIAGNOSTIC CRITERIA

Saliha AKÇAY KÖPRÜCÜ[1]

INTRODUCTION

Bruxism represents a frequent clinical finding in dental practice and is characterized by repetitive activity of the masticatory muscles. Historically regarded as a parafunctional habit, bruxism is now increasingly understood as a complex motor behavior influenced by multiple biological and functional factors. Contemporary international consensus reports emphasize that bruxism should not be considered exclusively as a pathological disorder, but rather as a behavior that may range from physiological to potentially harmful depending on its frequency, intensity, and associated clinical consequences (1–3).

Despite advances in conceptual understanding, the clinical evaluation of bruxism may be challenging. Signs such as tooth wear, masticatory muscle discomfort, and temporomandibular joint–related symptoms are commonly attributed to bruxism in routine practice; however, these findings are not specific and may result from various other conditions. Reliance solely on clinical observation or patient-reported symptoms may therefore contribute to overdiagnosis or misinterpretation of bruxism-related findings (2,4).

An additional challenge arises from the overlap between bruxism and other disorders that may present with similar clinical manifestations. Conditions affecting the temporomandibular joint, masticatory muscles, or orofacial motor control may mimic or coexist with bruxism, complicating diagnostic decision-making. In this context, accurate interpretation of clinical and radiological findings requires a systematic approach that integrates current diagnostic concepts with careful differential diagnosis (5–7).

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9. CONCLUSION

Bruxism is a common parafunctional activity encountered in dental practice and is characterized by a multifactorial etiology. Contemporary classification systems and consensus approaches emphasize that bruxism should not be viewed exclusively as a pathological condition but rather as a motor activity that may remain within physiological limits in some individuals. This perspective underscores the importance of avoiding unnecessary or excessive interventions in diagnosis and treatment planning (1,2).

Clinical evaluation, patient history, and, in selected cases, radiological imaging play important roles in understanding the effects of bruxism. However, no imaging modality is diagnostic in isolation, and findings must always be interpreted within the clinical context (2,14-16).

The primary objective of bruxism management is to eliminate or reduce parafunctional activity whenever possible; when this cannot be achieved, treatment should focus on protecting dental, muscular, and joint structures and controlling symptoms. Optimal clinical outcomes are achieved through individualized, stepwise application of patient education, lifestyle modifications, and appropriate therapeutic interventions. Long-term follow-up and effective patient–clinician collaboration remain fundamental to successful management (1,2,24).

REFERENCES

1. Lobbezoo F, Ahlberg J, Glaros AG, et al. *Bruxism defined and graded: An international consensus.* Journal of Oral Rehabilitation. Wiley; 2013;40(1):2–4. doi:10.1111/joor.12011
2. Lobbezoo F, Ahlberg J, Glaros AG, et al. *International consensus on the assessment of bruxism: Report of a work in progress.* Journal of Oral Rehabilitation. Wiley; 2018;45(11):837–844. doi:10.1111/joor.12663
3. Lavigne GJ, Khoury S, Abe S, Yamaguchi T, Raphael K. *Bruxism physiology and pathology: An overview for clinicians.* Journal of Oral Rehabilitation. Wiley; 2008;35(7):476–494. doi:10.1111/j.1365-2842.2008.01881.x
4. American Academy of Sleep Medicine. *International Classification of Sleep Disorders.* 3rd ed., Text Revision (ICSD-3-TR). Darien (IL): AASM; 2023.
5. Manfredini D, Lombardo L, Siciliani G. *Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era?* J Oral Rehabil. 2017;44(11):908–923. doi:10.1111/joor.12531
6. Balasubramaniam R, Rasmussen J, Carlson LW, Van Sickels JE, Okeson JP. *Oromandibular dystonia revisited: A review and a unique case.* Journal of Oral and Maxillofacial Surgery. Elsevier; 2007;65(2):379–386. doi:10.1016/j.joms.2006.11.028
7. Herrero Babiloni A, Lavigne G, Svensson P, Dal Fabbro C, Carra MC. *Navigating the assessment of sleep-related bruxism: Clinical guidance for applying the 2023 ICSD-3-TR criteria.* Sleep Medicine. Elsevier; 2025;137:106891. doi:10.1016/j.sleep.2025.106891
8. Zieliński G, Pająk A, Wójcicki M. Global prevalence of sleep bruxism and awake bruxism in pediatric and adult populations: A systematic review and meta-analysis. *Journal of Clinical Medicine.* MDPI; 2024;13(14):4259. doi:10.3390/jcm13144259

9. Manfredini D, Winocur E, Guarda-Nardini L, Paesani D, Lobbezoo F. Epidemiology of bruxism in adults: a systematic review of the literature. *Journal of Orofacial Pain.* Quintessence; 2013;27(2):99–110. doi: 10.11607/jop.921.
10. Manfredini D, Winocur E, Guarda-Nardini L, Lobbezoo F. Self-reported bruxism and temporomandibular disorders: Findings from two specialized centres. *Journal of Oral Rehabilitation.* Wiley; 2011;38(12):872–880. doi:10.1111/j.1365-2842.2011.02214.x.
11. Garrett AR, Hawley JS. *SSRI-associated bruxism: A systematic review of published case reports.* Neurol Clin Pract. 2018;8(2):135–141. doi:10.1212/CPJ.0000000000000433
12. Alkhatatbeh MJ, Hmoud ZL, Abdul-Razzak KK, Alem EM. *Self-reported sleep bruxism is associated with vitamin D deficiency and low dietary calcium intake: a case–control study.* BMC Oral Health. 2021;21(1):21. doi:10.1186/s12903-020-01349-3
13. Türp JC, Simonek M, Dagassan D. Bone apposition at the mandibular angles as a radiological sign of bruxism: a retrospective study. *BMC Oral Health*. 2021;21(1):537. doi:10.1186/s12903-021-01804-9
14. Zhang J, Yu W, Wang J, et al. A comparative study of temporomandibular joints in adults with definite sleep bruxism on MRI and CBCT. *J Clin Med*. 2023;12(7):2570. doi:10.3390/jcm12072570
15. Emshoff R, Emshoff I, Rudisch A, Bertram S. Reliability and temporal variation of masseter muscle thickness measurements utilizing ultrasonography**.** *Journal of Oral Rehabilitation.* 2003;30(12):1168–1172. doi:10.1111/j.1365-2842.2003.01186.x
16. Arıkan B, Dedeoğlu N, Keskinrüzgar A. Ultrasonographic evaluation of the masseter muscle in patients with temporomandibular joint degeneration. *Imaging Science in Dentistry.* 2023;53(4):355–363. doi:10.5624/isd.20230134
17. Mallya SM, Ahmad M, Cohen JR, Kaspo G, Ramesh A. Recommendations for imaging of the temporomandibular joint: Position statement from the American Academy of Oral and Maxillofacial Radiology and the American Academy of Orofacial Pain. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2022;134(5):639–648. doi:10.1016/j.oooo.2022.06.007
18. Whyte A, Boeddinghaus R, Bartley A, Vijeyaendra R. Imaging of the temporomandibular joint. *Clin Radiol*. 2021;76(1):76.e21–76.e35. doi:10.1016/j.crad.2020.06.020
19. Assiri HA, Almuawi LF, Asiri BA, et al. Bruxism treatment outcomes: A systematic review and meta-analysis. *Medicine (Baltimore).* 2025;104(49):e46247. doi:10.1097/MD.0000000000046247
20. Minakuchi H, Fujisawa M, Abe Y, et al. *Managements of sleep bruxism in adult: A systematic review.* Jpn Dent Sci Rev. 2022;58:124–136. doi:10.1016/j.jdsr.2022.02.004
21. Hardy RS, Bonsor SJ. The efficacy of occlusal splints in the treatment of bruxism: A systematic review. *J Dent.* 2021;108:103621. doi:10.1016/j.jdent.2021.103621
22. Wojtovicz EL, Martinez Alvarez O, Lopez-Davis A, Armijo-Olivo S. Botulinum toxin type A injection into the masticatory muscles and its effects on mandibular bone resorption and density: A systematic review. *Clin Oral Investig.* 2024;28(9):477. doi:10.1007/s00784-024-05838-5
23. Moussa MS, Bachour D, Komarova SV. Adverse effect of botulinum toxin-A injections on mandibular bone: A systematic review and meta-analysis. *Journal of Oral Rehabilitation.* 2024;51(2):404–415. doi:10.1111/joor.13590
24. Vieira MA, Oliveira-Souza AIS, Hahn G, Bähr L, Armijo-Olivo S, Ferreira APL. Effectiveness of biofeedback in individuals with awake bruxism compared to other types of treatment: a systematic review. *Int J Environ Res Public Health*. 2023;20(2):1558. doi:10.3390/ijerph20021558.
25. Jokubauskas L, Baltrušaitytė A. Efficacy of biofeedback therapy on sleep bruxism: A systematic review and meta-analysis. *J Oral Rehabil.* 2018;45(6):485–495. doi:10.1111/joor.12628
26. Macedo CR, Macedo EC, Torloni MR, Silva AB, Prado GF. Pharmacotherapy for sleep bruxism. *Cochrane Database Syst Rev.* 2014;(10):CD005578. doi:10.1002/14651858.CD005578.pub2
27. Venema JAMU, Aarab G, Lobbezoo F, et al. Mandibular advancement device design: A systematic review. *Sleep Medicine Reviews.* 2021;60:101557. doi:10.1016/j.smrv.2021.101557

Chapter 4

DRUG INTERACTIONS IN DENTAL PRACTICE

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INTRODUCTION

Modern dental practice has evolved beyond being limited solely to oral and dental health and has become a discipline closely integrated with systemic medicine. With the increase in life expectancy, a considerable proportion of patients presenting for dental care are observed to be using multiple medications concurrently due to chronic diseases. This condition, defined as polypharmacy, increases the risk of interactions between analgesics and antibiotics prescribed by the dentist or local anesthetics administered during dental procedures and the patient's existing medications (1).

Such interactions may not only reduce the effectiveness of treatment but also lead to adverse effects, toxicity, and, in rare cases, serious clinical complications. Therefore, knowledge of drug interactions is essential for both improving treatment outcomes and ensuring patient safety. Drug interactions are generally classified into two main groups: pharmacokinetic and pharmacodynamic interactions (2).

Types and Mechanisms of Pharmacokinetic Interactions

Pharmacokinetic interactions refer to the influence of another substance on a drug during its journey through the body. These interactions generally occur

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REFERENCES

1. Elkin N. Yaşlılarda Polifarmasi ve Akılcı İlaç Kullanımına Aile Hekimliği Yaklaşımı. İstanbul Gelişim Üniversitesi Sağlık Bilimleri Dergisi. 2020(11):279-90.
2. Mohan S, Govila V, Saini A, Verma SC. Prime drug interplay in dental practice. Journal of Clinical and Diagnostic Research: JCDR. 2016;10(3):ZE07.
3. Vrbanac J, Slauter R. ADME in drug discovery. A comprehensive guide to toxicology in nonclinical drug development: Elsevier; 2017. p. 39-67.
4. Deng J, Zhu X, Chen Z, Fan CH, Kwan HS, Wong CH, et al. A review of food–drug interactions on oral drug absorption. Drugs. 2017;77(17):1833-55.
5. Vuignier K, Schappler J, Veuthey J-L, Carrupt P-A, Martel S. Drug–protein binding: a critical review of analytical tools. Analytical and bioanalytical chemistry. 2010;398(1):53-66.
6. Niu J, Straubinger RM, Mager DE. Pharmacodynamic drug–drug interactions. Clinical Pharmacology & Therapeutics. 2019;105(6):1395-406.
7. Christensen H, Baker M, Tucker GT, Rostami-Hodjegan A. Prediction of plasma protein binding displacement and its implications for quantitative assessment of metabolic drug–drug interactions from in vitro data. Journal of pharmaceutical sciences. 2006;95(12):2778-87.
8. Lee J, Beers JL, Geffert RM, Jackson KD. A review of CYP-mediated drug interactions: mechanisms and in vitro drug-drug interaction assessment. Biomolecules. 2024;14(1):99.
9. Hersh EV, Moore PA. Adverse drug interactions in dentistry. Periodontology 2000. 2008;46(1):109-42.
10. Hersh EV, Moore PA. Drug interactions in dentistry: the importance of knowing your CYPs. The Journal of the American Dental Association. 2004;135(3):298-311.
11. Pichai E, Lakshmanan M. Drug elimination. Introduction to basics of pharmacology and toxicology: Volume 1: General and molecular pharmacology: Principles of drug action: Springer; 2019. p. 117-29.
12. Garza AZ, Park SB, Kocz R. Drug elimination. 2019.
13. Sun L, Mi K, Hou Y, Hui T, Zhang L, Tao Y, et al. Pharmacokinetic and pharmacodynamic drug–drug interactions: research methods and applications. Metabolites. 2023;13(8):897.
14. Algera MH, Kamp J, van der Schrier R, van Velzen M, Niesters M, Aarts L, et al. Opioid-induced respiratory depression in humans: a review of pharmacokinetic–pharmacodynamic modelling of reversal. British Journal of Anaesthesia. 2019;122(6):e168-e79.
15. Haghbin H, Zakirkhodjaev N, Husain FF, Lee-Smith W, Aziz M. Risk of gastrointestinal bleeding with concurrent use of NSAID and SSRI: a systematic review and network meta-analysis. Digestive Diseases and Sciences. 2023;68(5):1975-82.
16. Theriot J, Sabir S, Azadfard M. Opioid Antagonists. StatPearls. Treasure Island (FL). StatPearls Publishing Copyright; 2025.
17. Fournier J-P, Sommet A, Bourrel R, Oustric S, Pathak A, Lapeyre-Mestre M, et al. Non-steroidal anti-inflammatory drugs (NSAIDs) and hypertension treatment intensification: a population-based cohort study. European journal of clinical pharmacology. 2012;68(11):1533-40.
18. Saraga MA, Fotopoulos I, Zisis V, Poulopoulos A, Dabarakis N, Lillis T. Pharmacological Interactions of Epinephrine at Concentrations Used in Dental Anesthesiology: An Updated Narrative Review. Reports. 2025;8(4):224.
19. Poornachitra P, Narayan V, Maragathavalli G. An Update on Common Drug Interactions in Dental Practice. Journal of Indian Academy of Oral Medicine and Radiology. 2023;35(2):284-5.
20. Shionoya Y, Nakamura E, Tsujimoto G, Koyata T, Yasuda A, Nakamura K, et al. Hemodynamic impact of drug interactions with epinephrine and antipsychotics under general anesthesia with propofol. Anesthesia Progress. 2021;68(3):141-5.
21. Hersh EV, Giannakopoulos H. Beta-adrenergic blocking agents and dental vasoconstrictors. Dental Clinics. 2010;54(4):687-96.

22. Becker DE. Psychotropic drugs: implications for dental practice. Anesthesia progress. 2008;55(3):89-99.
23. Hersh EV, Moore PA. Three serious drug interactions that every dentist should know about. Compendium. 2015;36(6):739-44.
24. Meechan JG. Plasma potassium changes in hypertensive patients undergoing oral surgery with local anesthetics containing epinephrine. Anesthesia Progress. 1997;44(3):106.
25. Deol N, Alvarez G, Elrabi O, Chen G, Ferraro N. A comparative review of epinephrine and phenylephrine as vasoconstrictors in dental anesthesia: exploring the factors behind epinephrine's prevalence in the US. Journal of Dental Anesthesia and Pain Medicine. 2023;23(6):293.
26. Seminario-Amez M, González-Navarro B, Ayuso-Montero R, Jané-Salas E, López-López J. Use of local anesthetics with a vasoconstrictor agent during dental treatment in hypertensive and coronary disease patients. A systematic review. Journal of Evidence Based Dental Practice. 2021;21(2):101569.
27. Figallo MAS, Cayón RTV, Lagares DT, Flores JRC, Portillo GM. Use of anesthetics associated to vasoconstrictors for dentistry in patients with cardiopathies. Review of the literature published in the last decade. Journal of Clinical and Experimental Dentistry. 2012;4(2):e107.
28. Niwa H, Sugimura M, Satoh Y, Tanimoto A. Cardiovascular response to epinephrine-containing local anesthesia in patients with cardiovascular disease. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2001;92(6):610-6.
29. Rowe S, Patel N, Dave M. The clinical implications of cocaine use in dentistry. British Dental Journal Team. 2025;12(5):237-8.
30. Whyte K, Whitesmith R, Reid J. The effect of diuretic therapy on adrenaline-induced hypokalaemia and hypomagnesaemia. European journal of clinical pharmacology. 1988;34(4):333-7.
31. Edinoff AN, Swinford CR, Odisho AS, Burroughs CR, Stark CW, Raslan WA, et al. Clinically relevant drug interactions with monoamine oxidase inhibitors. Health psychology research. 2022;10(4):39576.
32. Saraghi M, Golden LR, Hersh EV. Anesthetic considerations for patients on antidepressant therapy—part I. Anesthesia progress. 2017;64(4):253-61.
33. Harbell MW, Dumitrascu C, Bettini L, Yu S, Thiele CM, Koyyalamudi V. Anesthetic considerations for patients on psychotropic drug therapies. Neurology International. 2021;13(4):640-58.
34. Moraczewski J, Awosika AO, Aedma KK. Tricyclic antidepressants. StatPearls [Internet]: StatPearls Publishing; 2023.
35. Dunbar D, Ouanounou A. An update on drug interactions involving anti-inflammatory and analgesic medications in oral and maxillofacial medicine: a narrative review. Frontiers of Oral and Maxillofacial Medicine. 2025;7.
36. Mendell J, Lee F, Chen S, Worland V, Shi M, Samama MM. The effects of the antiplatelet agents, aspirin and naproxen, on pharmacokinetics and pharmacodynamics of the anticoagulant edoxaban, a direct factor Xa inhibitor. Journal of cardiovascular pharmacology. 2013;62(2):212-21.
37. Bakhriansyah M, Souverein PC, de Boer A, Klungel OH. Gastrointestinal toxicity among patients taking selective COX-2 inhibitors or conventional NSAIDs, alone or combined with proton pump inhibitors: a case–control study. pharmacoepidemiology and drug safety. 2017;26(10):1141-8.
38. Vazquez SR. Drug-drug interactions in an era of multiple anticoagulants: a focus on clinically relevant drug interactions. Blood, The Journal of the American Society of Hematology. 2018;132(21):2230-9.
39. Kim G-H. Renal effects of prostaglandins and cyclooxygenase-2 inhibitors. Electrolytes & Blood Pressure: E & BP. 2008;6(1):35-41.
40. Prieto-García L, Pericacho M, Sancho-Martínez SM, Sánchez Á, Martínez-Salgado C, López-Novoa JM, et al. Mechanisms of triple whammy acute kidney injury. Pharmacology & therapeutics. 2016;167:132-45.

41. Nunes RP. Lithium interactions with non-steroidal anti-inflammatory drugs and diuretics–A review. Archives of Clinical Psychiatry (São Paulo). 2018;45:38-40.
42. Malhi GS, Bell E, Outhred T, Berk M. Lithium therapy and its interactions. Australian prescriber. 2020;43(3):91.
43. Murphy N, Redahan L, Lally J. Management of lithium intoxication. British Journal of Psychiatry Advances. 2023;29(2):82-91.
44. Svanström H, Lund M, Melbye M, Pasternak B. Concomitant use of low-dose methotrexate and NSAIDs and the risk of serious adverse events among patients with rheumatoid arthritis. Pharmacoepidemiology and drug safety. 2018;27(8):885-93.
45. Maeda A, Tsuruoka S, Kanai Y, Endou H, Saito K, Miyamoto E, et al. Evaluation of the interaction between nonsteroidal anti-inflammatory drugs and methotrexate using human organic anion transporter 3-transfected cells. European journal of pharmacology. 2008;596(1-3):166-72.
46. MacLeod-Glover N, Mink M, Yarema M, Chuang R. Digoxin toxicity: Case for retiring its use in elderly patients? Canadian Family Physician. 2016;62(3):223-8.
47. Anglin R, Yuan Y, Moayyedi P, Tse F, Armstrong D, Leontiadis GI. Risk of upper gastrointestinal bleeding with selective serotonin reuptake inhibitors with or without concurrent nonsteroidal anti-inflammatory use: a systematic review and meta-analysis. Official journal of the American College of Gastroenterology| ACG. 2014;109(6):811-9.
48. Bahuva R, Yee J, Gupta S, Atreja A. SSRI and the risk of gastrointestinal bleed: more than what meets the eye. Official journal of the American College of Gastroenterology| ACG. 2015;110(2):346.
49. Blough ER, Wu M. Acetaminophen: beyond pain and fever-relieving. Frontiers in pharmacology. 2011;2:72.
50. Ndetan H, Evans Jr MW, Singal AK, Brunner LJ, Calhoun K, Singh KP. Light to moderate drinking and therapeutic doses of acetaminophen: An assessment of risks for renal dysfunction. Preventive medicine reports. 2018;12:253-8.
51. Caldeira D, Costa J, Barra M, Pinto FJ, Ferreira JJ. How safe is acetaminophen use in patients treated with vitamin K antagonists? A systematic review and meta-analysis. Thrombosis Research. 2015;135(1):58-61.
52. Kim S-J, Seo JT. Selection of analgesics for the management of acute and postoperative dental pain: a mini-review. Journal of Periodontal & Implant Science. 2020;50(2):68.
53. Kotlinska-Lemieszek A, Klepstad P, Haugen DF. Clinically significant drug–drug interactions involving opioid analgesics used for pain treatment in patients with cancer: a systematic review. Drug design, development and therapy. 2015:5255-67.
54. Baldo BA, Rose MA. The anaesthetist, opioid analgesic drugs, and serotonin toxicity: a mechanistic and clinical review. British journal of anaesthesia. 2020;124(1):44-62.
55. Witkiewitz K, Vowles KE. Alcohol and opioid use, co-use, and chronic pain in the context of the opioid epidemic: A critical review. Alcoholism: clinical and experimental research. 2018;42(3):478-88.
56. Hassamal S, Miotto K, Dale W, Danovitch I. Tramadol: understanding the risk of serotonin syndrome and seizures. The American journal of medicine. 2018;131(11):1382. e1-. e6.
57. Teal L, Sheller B, Susarla HK. Pediatric Odontogenic Infections. Oral and Maxillofacial Surgery Clinics. 2024;36(3):391-9.
58. Cirkel LL, Herrmann JM, Ringel C, Wöstmann B, Kostev K. Antibiotic prescription in dentistry: Trends, patient demographics, and drug preferences in Germany. Antibiotics. 2025;14(7):676.
59. Jafari F, Arasteh O, Hosseinjani H, Allahyari A, Ataei Azimi S, Askari VR. A critical review of methotrexate clinical interactions: role of transporters. Expert Opinion on Drug Metabolism & Toxicology. 2023;19(2):91-107.

60. Huang X, He F, Deng Y, Shi S. Severe hematologic toxicity after low-dose methotrexate in ectopic pregnancy: role of MTHFR polymorphism and drug interaction-a case report and literature review. Frontiers in Pharmacology. 2025;16:1671369.
61. Hall JJ, Bolina M, Chatterley T, Jamali F. Interaction between low-dose methotrexate and nonsteroidal anti-inflammatory drugs, penicillins, and proton pump inhibitors: a narrative review of the literature. Annals of Pharmacotherapy. 2017;51(2):163-78.
62. Sathi N, Dawson J. Methotrexate-induced pancytopenia associated with co-prescription of penicillin and trimethoprim. Clinical rheumatology. 2007;26(1):134-5.
63. Vega AJ, Smith C, Matejowsky HG, Thornhill KJ, Borne GE, Mosieri CN, et al. Warfarin and antibiotics: drug interactions and clinical considerations. Life. 2023;13(8):1661.
64. Davydov L, Yermolnik M, Cuni LJ. Warfarin and amoxicillin/clavulanate drug interaction. Annals of Pharmacotherapy. 2003;37(3):367-70.
65. Elkhoury D, Reddy N, Venkatraman D, Patel P, Montalbano M. Exploring Antibiotic-Mediated Disruption of Enterohepatic Circulation and Combined Oral Contraceptive Efficacy: A Systematic Review. Women's Health Reports. 2025;6(1):599-604.
66. Curtis KM. US medical eligibility criteria for contraceptive use, 2016. MMWR Recommendations and Reports. 2016;65.
67. Simmons KB, Haddad LB, Nanda K, Curtis KM. Drug interactions between non-rifamycin antibiotics and hormonal contraception: a systematic review. American journal of obstetrics and gynecology. 2018;218(1):88-97. e14.
68. Wishart DS, Feunang YD, Guo AC, Lo EJ, Marcu A, Grant JR, et al. DrugBank 5.0: a major update to the DrugBank database for 2018. Nucleic acids research. 2018;46(D1):D1074-D82.
69. Boddepalli R, Keerthana B, Vidyasagar B, Pasala A. Drug alcohol interactions-a review. Asian Journal of Hospital Pharmacy. 2022:62-4.
70. Tao RE, Prajapati S, Pixley JN, Grada A, Feldman SR. Oral tetracycline-class drugs in dermatology: Impact of food intake on absorption and efficacy. Antibiotics. 2023;12(7):1152.
71. Rodríguez AT, i Barceló AF, González MB, Esnal DE, Muner DS, Martínez JA, et al. Clinically important pharmacokinetic drug-drug interactions with antibacterial agents. Revista Española de Quimioterapia. 2024;37(4):299.
72. Li DQ, Kim R, McArthur E, Fleet JL, Bailey DG, Juurlink D, et al. Risk of adverse events among older adults following co-prescription of clarithromycin and statins not metabolized by cytochrome P450 3A4. Cmaj. 2015;187(3):174-80.
73. Sparkes T, Lemonovich TL, Practice AIDCo. Interactions between anti-infective agents and immunosuppressants—guidelines from the American Society of Transplantation Infectious Diseases Community of Practice. Clinical transplantation. 2019;33(9):e13510.

Chapter 5

HUMAN HERPESVIRUS INFECTIONS: ORAL AND MAXILLOFACIAL MANIFESTATIONS

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INTRODUCTION

Viruses are obligate intracellular parasites that lack the enzymatic machinery required for independent protein and nucleic acid synthesis. Following attachment to susceptible host cells and entry into the intracellular environment, they replicate and may cause cellular injury and tissue damage. The clinical impact of a viral infection varies according to the biological characteristics of the virus, the host immune response, and the nature of the host–virus interaction. In addition, factors such as the size of the viral inoculum and the general health status of the patient play an important role in determining disease severity (1).

Viruses may be transmitted through direct contact, respiratory routes, the fecal–oral route, contaminated fluids or blood injections, and tissue transplantation procedures. The route of transmission depends on the source of the virus, its environmental stability, surrounding conditions, and its ability to reach target tissues (2). Following entry into the body, viruses replicate in cells that possess appropriate biosynthetic machinery and specific viral receptors. Many viral infections initially involve the oral mucosa or the upper respiratory tract. Viruses may remain localized at the site of entry or disseminate to other tissues via mononuclear phagocytes, the bloodstream, the lymphatic system, or neuronal pathways (2).

A variety of laboratory techniques have been developed for the detection, isolation, and identification of viruses in clinical specimens. These include microscopic examination, cell culture, serological assays, and nucleic acid amplification techniques (3).

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differential diagnosis, timely referral to appropriate medical specialties when necessary, and meticulous application of infection control measures—particularly in immunocompromised patients, in whom herpesvirus-related diseases may present with atypical, severe, or rapidly progressive manifestations.

REFERENCES

1. Knipe DM, Howley PM, eds. Fields Virology. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
2. Whitley RJ, Roizman B. Herpes simplex viruses. In: Knipe DM, Howley PM, eds. Fields Virology. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2013. p. 1823–1897.
3. Flint SJ, Racaniello VR, Rall GF, Skalka AM. Principles of Virology. 4th ed. Washington, DC: ASM Press; 2015.
4. Roizman B, Knipe DM, Whitley RJ. Herpes simplex viruses. In: Knipe DM, Howley PM, eds. Fields Virology. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
5. Neville BW, Damm DD, Allen CM, Chi AC. Oral and Maxillofacial Pathology. 4th ed. St. Louis: Elsevier; 2016.
6. Arduino PG, Porter SR. Herpes simplex virus type 1 infection: Overview on relevant clinico-pathological features. Journal of Oral Pathology and Medicine. Wiley-Blackwell; 2008;37(2): 107–121. doi:10.1111/j.1600-0714.2007.00586.x
7. James WD, Berger TG, Elston DM. Andrews' Diseases of the Skin: Clinical Dermatology. 13th ed. Philadelphia: Elsevier; 2020.
8. Johnston C, Corey L. Current concepts for genital herpes simplex virus infection: Diagnostics and pathogenesis. Infectious Disease Clinics of North America. Elsevier; 2016;30(2): 347–364. doi:10.1016/j.idc.2016.02.006
9. Kimberlin DW, Whitley RJ. Neonatal herpes: What have we learned. Seminars in Pediatric Infectious Diseases. Elsevier; 2005;16(1): 7–16. doi:10.1053/j.spid.2005.01.005
10. Gershon AA, Breuer J, Cohen JI, et al. Varicella zoster virus infection. Nature Reviews Disease Primers. Nature Publishing Group; 2015;1: 15016. doi:10.1038/nrdp.2015.16
11. Young LS, Rickinson AB. Epstein–Barr virus: 40 years on. Nature Reviews Cancer. Nature Publishing Group; 2004;4(10): 757–768.
12. Rickinson AB, Kieff E. Epstein–Barr virus. In: Knipe DM, Howley PM, eds. Fields Virology. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
13. Greenspan JS, Greenspan D. Oral hairy leukoplakia: diagnosis and management. Oral Surgery Oral Medicine Oral Pathology. 1989;67(4): 396–403.
14. Rawlinson WD, Boppana SB, Fowler KB, et al. Congenital cytomegalovirus infection in pregnancy and the neonate: consensus recommendations for prevention, diagnosis, and therapy. Lancet Infectious Diseases. 2017;17(6): e177–e188.
15. Kotton CN, Kumar D, Caliendo AM, et al. The Third International Consensus Guidelines on the Management of Cytomegalovirus in Solid-Organ Transplantation. Transplantation. 2018;102(6): 900–931.
16. Griffiths P, Reeves M. Pathogenesis of human cytomegalovirus in the immunocompromised host. Nature Reviews Microbiology. 2021;19(12): 759–773.
17. Ljungman P, Boeckh M, Hirsch HH, et al. Definitions of cytomegalovirus infection and disease in transplant patients for use in clinical trials. Clinical Infectious Diseases. 2017;64(1): 87–91.
18. Boeckh M, Ljungman P. How we treat cytomegalovirus in hematopoietic cell transplant recipients. Blood. 2009;113(23): 5711–5719.
19. Scully C, Porter SR. Oral manifestations of cytomegalovirus infection. Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontology. 2001;92(5): 443–448.

Bölüm 6

ORAL LEUKOPLAKIA

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INTRODUCTION

Leukoplakia is considered as a whitish gray lesion found on the mucosa of various tissues. Oral leukoplakia is a lesion that can be found on the oral mucosa and within the oral cavity. Other than the oral tissues this lesion may be encountered on gastrointestinal track, perianal mucosa also. This condition is primarily characterized by white lesions that manifest on the oral mucosa, typically presenting asymptomatically (1). The term "leukoplakia" originates from the ancient Greek words "leuko" and "plakos," meaning "white" and "plaque" respectively, thus literally translating to "white spot" or "white plaque-form" (2). These patches, which cannot be scraped off by simple means, are frequently rough, thick, or hardened in texture and can appear on the tongue, cheeks, gingiva, or floor of the mouth (3). Oral leukoplakia can be located on the lip, vermillion border, gingiva, tongue, and floor of mouth. This white plaque is defined by the World Health Organization (WHO) as a diagnosis reached after excluding other known diseases or disorders that do not present an increased cancer risk (4). Oral leukoplakia is categorized as an oral potentially malignant disorder (OPMD) due to its significant propensity for malignant transformation into squamous cell carcinoma, necessitating careful diagnostic and management approaches (5,6). In 2005, the World Health Organization (WHO) classified oral leukoplakia as an oral potential malignant disorder. This classification was made to recognize the ability of the condition to progress through different histopathological stages, eventually leading to invasive squamous cell carcinoma (7).

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REFERENCES

1. Ferrari E, Antonelli R, Gallo M, Meleti M, Setti G, Mucci A, et al. Salivary Metabolomics Discloses Metabolite Signatures of Oral Leukoplakia with and Without Dysplasia. International Journal of Molecular Sciences [Internet]. 2025 Jul 7 [cited 2025 Jul];26(13):6519. Available from: https://doi.org/10.3390/ijms26136519
2. Constantin M, Forna DA, Budacu CC, Caraiane A, Raftu G, Forna NC. Oral Tumors Having the Origins in Multiple Tissues, Non-differentiated or Differentiated. Revista de Chimie [Internet]. 2018 Nov 15 [cited 2025 Oct];69(10):2895. Available from: https://doi.org/10.37358/rc.18.10.6648
3. Abdul NS, Rashdan Y, Alenezi N, Alenezi M, Mohsin L, Hassan A. Association Between Oral Microbiota and Oral Leukoplakia: A Systematic Review. Cureus [Internet]. Cureus, Inc.; 2024 Jan 11 [cited 2025 Jul]; Available from: https://doi.org/10.7759/cureus.52095
4. Rodríguez-Archilla A, FUENTES-PEREZ C. Clinicopathological Parameters Related to Malignant Transformation of Oral Leukoplakia: A Meta-Analysis. Cumhuriyet Dental Journal [Internet]. 2021 Apr 21 [cited 2025 Mar];24(2):197. Available from: https://doi.org/10.7126/cumudj.853865
5. Venkat A, Sathyakumar M, Aravindhan R, Magesh KT, Sivachandran A. Analysis of Oral Leukoplakia and Tobacco-Related Habits in Population of Chengalpattu District- An Institution-Based Retrospective Study. Cureus [Internet]. 2022 Jun 14 [cited 2025 Sep]; Available from: https://doi.org/10.7759/cureus.25936
6. Contreras A, Mahmood M, Montilla H, Enciso R, Han PP, Suarez-Durall P. Oral potentially malignant disorders in older adults: A review. Dentistry Review [Internet]. Elsevier BV; 2023 Jul 22 [cited 2025 Jul];3(3):100071. Available from: https://doi.org/10.1016/j.dentre.2023.100071
7. Aittiwarapoj A, Juengsomjit R, Kitkumthorn N, Lapthanasupkul P. Oral Potentially Malignant Disorders and Squamous Cell Carcinoma at the Tongue: Clinicopathological Analysis in a Thai Population. European Journal of Dentistry [Internet]. 2019 Jul 1 [cited 2025 Sep];13(3):376. Available from: https://doi.org/10.1055/s-0039-1698368
8. Lee JJ, Hong WK, Hittelman WN, Mao L, Lotan R, Shin DM, et al. Predicting cancer development in oral leukoplakia: ten years of translational research. PubMed [Internet]. 2000 May 1 [cited 2025 Jun];6(5):1702. Available from: https://pubmed.ncbi.nlm.nih.gov/10815888
9. Chaturvedi AK, Udaltsova N, Engels EA, Katzel JA, Yanik EL, Katki HA, et al. Oral Leukoplakia and Risk of Progression to Oral Cancer: A Population- Based Cohort Study.
10. SEDCYDO - SEGER - SEMO CONGRESS MADRID 2025, 8-10 MAY. Proceedings and Abstract. Medicina oral, patología oral y cirugía bucal [Internet]. 2025 Jan 1 [cited 2025 Sep];1. Available from: https://doi.org/10.4317/medoral.1122335667805
11. Shetty P, Hegde S, Vinod K, Kalra S, Goyal P, Patel M. Oral Leukoplakia: Clinicopathological Correlation and Its Relevance to Regional Tobacco-related Habit Index. The Journal of Contemporary Dental Practice [Internet]. 2016 Jan 1 [cited 2025 Sep];17(7):601. Available from: https://doi.org/10.5005/jp-journals-10024-1897
12. Urízar JMA. Oral leukoplakia: still an enigmatic disorder. Medicina oral, patología oral y cirugía bucal [Internet]. Medicina Oral S.L.; 2020 Jan 1 [cited 2025 Sep];0. Available from: https://doi.org/10.4317/medoral.27214
13. Rich AM, Hussaini HM, Nizar MAM, Gavidi RO, Tauati-Williams E, Yakin M, et al. Diagnosis of oral potentially malignant disorders: Overview and experience in Oceania. Frontiers in Oral Health [Internet]. Frontiers Media; 2023 Apr 6 [cited 2025 Oct];4. Available from: https://doi.org/10.3389/froh.2023.1122497
14. Vazquez-Alvarez R, Fernandez-Gonzalez F, Vila PG, Reboiras-Lopez D, García AG, Gandara-Rey JM. Correlation between clinical and pathologic diagnosis in oral leukoplakia in 54 patients. Medicina oral, patología oral y cirugía bucal [Internet]. 2010 Jan 1 [cited 2025 Oct]; Available from: https://doi.org/10.4317/medoral.15.e832

15. Carrard VC, Waal I van der. A clinical diagnosis of oral leukoplakia; A guide for dentists. Medicina oral, patología oral y cirugía bucal [Internet]. 2017 Jan 1 [cited 2025 Sep];0. Available from: https://doi.org/10.4317/medoral.22292
16. Bielecka-Kowalska NP, Bielicka S, Lewkowicz N. Effects of tobacco smoking and electronic nicotine delivery systems on oral health – a narrative review. Journal of Pre-Clinical and Clinical Research [Internet]. Institute of Rural Health; 2022 Sep 30 [cited 2025 Sep];16(3):118. Available from: https://doi.org/10.26444/jpccr/154648
17. Pandita V, Ajıla V, Babu S, Hegde S. Oral leukoplakia: A review of clinical features and trends in management. Acta stomatologica Naissi [Internet]. Medicinski fakultet i Klinika za stomatologiju, Niš; 2022 Jan 1 [cited 2025 Aug];38(85):2417. Available from: https://doi.org/10.5937/asn2285417p
18. Cabrera OFG, Gerber-Mora R, Tapia ROC. Leucoplasia oral como lesión potencialmente maligna a cáncer. Presentación de un caso clínico y revisión de la literatura. Odontología [Internet]. 2025 Oct 2 [cited 2025 Oct];27:58. Available from: https://doi.org/10.29166/odontologia.vol27.n2.esp.2025-e8428
19. Waal I van der. Oral Leukoplakia: Diagnosis And Management Revisited. Journal of Dentistry Indonesia [Internet]. 2023 Aug 31 [cited 2025 Oct];30(2). Available from: https://doi.org/10.14693/jdi.v30i2.1507
20. Kumari P, Debta P, Dixit A. Oral Potentially Malignant Disorders: Etiology, Pathogenesis, and Transformation Into Oral Cancer. Frontiers in Pharmacology [Internet]. Frontiers Media; 2022 Apr 20 [cited 2025 Oct];13. Available from: https://doi.org/10.3389/fphar.2022.825266
21. Trends in Infectious Diseases [Internet]. InTech eBooks. 2014 [cited 2025 Sep]. Available from: https://doi.org/10.5772/57062
22. Pimenta-Barros LA, Ramos-García P, González-Moles MÁ, Aguirre-Urizar JM, Warnakulasuriya S. Malignant transformation of oral leukoplakia: Systematic review and comprehensive meta- analysis. 2024.
23. Mustafa E, Parmar S, Praveen P. Premalignant Lesions and Conditions of the Oral Cavity. In 2021 [cited 2025 Oct]. p. 1845. Available from: https://doi.org/10.1007/978-981-15-1346-6_80
24. Evren I, Brouns ER, Wils LJ, Poell JB, Peeters CFW, Brakenhoff RH, et al. Annual malignant transformation rate of oral leukoplakia remains consistent: A long-term follow-up study. Oral Oncology [Internet]. 2020 Oct 8 [cited 2025 Jul];110:105014. Available from: https://doi.org/10.1016/j.oraloncology.2020.105014
25. Abdulhussain MM, Muhsin AS. Clinical Review and Management of Oral Potentially Malignant Disorders with Epithelial Dysplasia. Journal of Health and Medical Sciences [Internet]. 2021 Oct 10 [cited 2025 Apr];4(4). Available from: https://doi.org/10.31014/aior.1994.04.04.186
26. Zhang R, Gao T, Wang D. Photodynamic therapy (PDT) for oral leukoplakia: a systematic review and meta- analysis of single-arm studies examining efficacy and subgroup analyses. 2023.
27. Zhang C, Li B, Zeng X, Hu XS, Hua H. The global prevalence of oral leukoplakia: a systematic review and meta-analysis from 1996 to 2022. BMC Oral Health [Internet]. BioMed Central; 2023 Sep 6 [cited 2025 Aug];23(1). Available from: https://doi.org/10.1186/s12903-023-03342-y
28. Waal I van der. Oral potentially malignant disorders: Is malignant transformation predictable and preventable? Medicina oral, patología oral y cirugía bucal [Internet]. Medicina Oral S.L.; 2014 Jan 1 [cited 2025 Oct]; Available from: https://doi.org/10.4317/medoral.20205
29. Larsen MK, Sørensen JA, Godballe C, Thygesen T. Oral leukoplakia : Diagnosis and treatment. Research Portal Denmark [Internet]. 2016 Jan 1 [cited 2025 Jul];5(2):57. Available from: https://local.forskningsportal.dk/local/dki-cgi/ws/cris-link?src=sdu&id=sdu-f21416f3-3169-4eb4-b3a3-bc3a8b6985d9&ti=Oral%20leukoplakia%20%3A%20Diagnosis%20and%20treatment
30. Das NK, Kadir AKMS, Shemanto MU, Akhter E, Sharfaraz A, Tripura S, et al. Genetic Revelation of the Potentially Malignant Disorders in the Oral and Maxillofacial Region. In: In-

techOpen eBooks [Internet]. IntechOpen; 2024 [cited 2025 Oct]. Available from: https://doi.org/10.5772/intechopen.112697

31. Porto UN, Laureano NK, Santos NP, Rodrigues AZ, Ferri CA, Lima TB, et al. Leukoplakia and erythroplakia in youngers versus older individuals: a clinicopathological retrospective study. Medicina oral, patología oral y cirugía bucal [Internet]. 2024 Jan 1 [cited 2025 Sep]; Available from: https://doi.org/10.4317/medoral.26659
32. Vlad R, Panainte I, Stoica A, Monea M. The Prevalence of Oral Leukoplakia: Results From a Romanian Medical Center. European Scientific Journal ESJ [Internet]. 2016 Sep 30 [cited 2025 Sep];12(27):12. Available from: https://doi.org/10.19044/esj.2016.v12n27p12
33. Rubert A, Bagán L, Sebastián JVB. Oral leukoplakia, a clinical-histopathological study in 412 patients. Journal of Clinical and Experimental Dentistry [Internet]. 2020 Jan 1 [cited 2025 Oct]; Available from: https://doi.org/10.4317/jced.57091
34. Eccles K, Carey B, Cook R, Escudier M, Freitas MD, Posse JL, et al. Oral potentially malignant disorders: advice on management in primary care. Journal of Oral Medicine and Oral Surgery [Internet]. 2022 Jan 1 [cited 2025 Oct];28(3):36. Available from: https://doi.org/10.1051/mbcb/2022017
35. Monteiro L, Barbieri C, Warnakulasuriya S, Martins M, Salazar F, Pacheco J, et al. Type of surgical treatment and recurrence of oral leukoplakia: A retrospective clinical study. Medicina oral, patología oral y cirugía bucal [Internet]. 2017 Jan 1 [cited 2025 Oct];0. Available from: https://doi.org/10.4317/medoral.21645
36. Warnakulasuriya S. Oral potentially malignant disorders: A comprehensive review on clinical aspects and management. Oral Oncology [Internet]. Elsevier BV; 2020 Jan 22 [cited 2025 Nov];102:104550. Available from: https://doi.org/10.1016/j.oraloncology.2019.104550
37. Saade-Rodríguez MP, Guio-Gomez YD. Desordenes orales potencialmente malignos: factores de riesgo y expresión de p16 INK4a. IATREIA [Internet]. 2023 Dec 4 [cited 2025 Aug]; Available from: https://doi.org/10.17533/udea.iatreia.243
38. Kshersagar J, Bedge P, Jagdale R, Toro Y, Sharma S, Joshi MG. A REVIEW ON CURRENT SCENARIO OF ORAL CANCER IN INDIA WITH SPECIAL EMPHASIS ON MODERN DETECTION SYSTEMS AND BIOMARKERS. International Journal of Applied Pharmaceutics [Internet]. Innovare Academic Sciences; 2020 Oct 28 [cited 2025 Aug];1. Available from: https://doi.org/10.22159/ijap.2020.v12s4.40098
39. Shaji J, Balakrishnan G, Halim N, Jayaraj L, Rumaisha R. Potentially -malignant disorders. Journal of Otolaryngology-ENT Research [Internet]. 2022 Aug 3 [cited 2025 Oct];14(2):44. Available from: https://doi.org/10.15406/joentr.2022.14.00504
40. Yang S, Lee Y, Chang L, Yang C, Luo C, Wu P. Oral tongue leukoplakia: analysis of clinicopathological characteristics, treatment outcomes, and factors related to recurrence and malignant transformation. Clinical Oral Investigations [Internet]. 2021 Jan 7 [cited 2025 Oct];25(6):4045. Available from: https://doi.org/10.1007/s00784-020-03735-1
41. Aggarwal N. "Leukoplakia- Potentially Malignant Disorder of Oral Cavity -a Review." Biomedical Journal of Scientific & Technical Research [Internet]. 2018 May 29 [cited 2025 Sep];4(5). Available from: https://doi.org/10.26717/bjstr.2018.04.0001126
42. Ai R, Yan T, Hao Y, Jiang L, Dan H, Ji N, et al. Microenvironmental regulation of the progression of oral potentially malignant disorders towards malignancy. Oncotarget [Internet]. Impact Journals LLC; 2017 Aug 17 [cited 2025 Oct];8(46):81617. Available from: https://doi.org/10.18632/oncotarget.20312
43. Sang Z, Zhang Y, Kao E, Zhu T, Yang JZ, Xu ZZ, et al. Decoding oral leukoplakia: microbiome dysbiosis and inflammatory dynamics unveiled in a rat model. Frontiers in Microbiology [Internet]. 2025 Oct 22 [cited 2025 Oct];16. Available from: https://doi.org/10.3389/fmicb.2025.1613165
44. Inchanalkar M, Srivatsa S, Ambatipudi S, Bhosale PG, Patil A, Schäffer AA, et al. Genome-wide DNA methylation profiling of HPV-negative leukoplakia and gingivobuccal complex cancers.

Clinical Epigenetics [Internet]. 2023 May 27 [cited 2025 Oct];15(1). Available from: https://doi.org/10.1186/s13148-023-01510-z

45. Palma V de M, Laureano NK, Frank LA, Rados PV, Visioli F. Chemoprevention in oral leukoplakia: challenges and current landscape. Frontiers in Oral Health [Internet]. Frontiers Media; 2023 May 24 [cited 2025 Jul];4. Available from: https://doi.org/10.3389/froh.2023.1191347
46. Tan Y, Wang Z, Xu M, Li B, Huang Z, Qin S, et al. Oral squamous cell carcinomas: state of the field and emerging directions. International Journal of Oral Science [Internet]. Springer Nature; 2023 Sep 22 [cited 2025 Oct];15(1). Available from: https://doi.org/10.1038/s41368-023-00249-w
47. Lorini L, Bescós C, Thavaraj S, Müller-Richter U, Ferranti MA, Romero JP, et al. Overview of Oral Potentially Malignant Disorders: From Risk Factors to Specific Therapies. Cancers [Internet]. Multidisciplinary Digital Publishing Institute; 2021 Jul 23 [cited 2025 Aug];13(15):3696. Available from: https://doi.org/10.3390/cancers13153696
48. Sundaresan S. Prevention, Detection and Management of Oral Cancer [Internet]. IntechOpen eBooks. IntechOpen; 2019 [cited 2025 Aug]. Available from: https://doi.org/10.5772/intechopen.79314
49. Rajabzadeh M, Yagubova N, Öçbe M. CURRENT DIAGNOSTIC METHODS OF ORAL SQUAMOUS CELL CARCINOMA: A BRIEF LITERATURE REVIEW. DergiPark (Istanbul University) [Internet]. 2024 Mar 26 [cited 2025 Sep]; Available from: https://dergipark.org.tr/tr/pub/jokohtu/issue/86896/1459281
50. Waal I van der. Oral Leukoplakia: Present Views on Diagnosis, Management, Communication with Patients, and Research. Current Oral Health Reports [Internet]. 2019 Jan 14 [cited 2025 Oct];6(1):9. Available from: https://doi.org/10.1007/s40496-019-0204-8
51. Akbulut N, Altan A. Early Detection and Multidisciplinary Approach to Oral Cancer Patients. In: IntechOpen eBooks [Internet]. IntechOpen; 2019 [cited 2025 Aug]. Available from: https://doi.org/10.5772/intechopen.81126
52. Alotaibi KZ, Kolarkodi SH. Effectiveness of adjunctive screening tools for potentially malignant oral disorders and oral cancer: A systematic review. The Saudi Dental Journal [Internet]. Elsevier BV; 2023 Oct 18 [cited 2025 Nov];36(1):28. Available from: https://doi.org/10.1016/j.sdentj.2023.10.011

Chapter 7

ORAL CANDIDIASIS

Aysun ATASOY SINDIRAÇ[1]

INTRODUCTION

The oral cavity and its associated mucosal tissues constitute critical anatomical sites that reflect an individual's overall health status and frequently represent the earliest locations in which clinical manifestations of acquired systemic diseases become apparent. A wide range of systemic disorders may initially present with signs within the oral mucosa; conversely, pathological changes affecting the oral mucosa may act as clinical indicators of underlying systemic conditions (1). Within this framework, oral candidiasis represents the most prevalent fungal infection of the oral cavity in humans and holds particular clinical relevance owing to its strong association with local and systemic predisposing factors, as well as its opportunistic nature (2). Oral candidiasis (OC) is defined by the excessive proliferation of *Candida* species and their invasion of the superficial epithelial layers, involving multiple sites of the oral mucosa, most commonly the tongue (3).

CANDIDA COLONIZATION OF THE ORAL MICROBIOTA AND THE DEVELOPMENT OF OPPORTUNISTIC INFECTION

Oral candidiasis is extensively characterized in the literature as an opportunistic infection that is closely linked to compromised host defense mechanisms, alterations in the oral microbiota leading to dysbiosis, and disruption of local anatomical or physicochemical barriers. Disruption of the dynamic equilibrium between the virulence properties of *Candida* species and the host's clinical and immunological status plays a critical role in facilitating the onset and progression of candidiasis (3,4).

Among *Candida* species recovered from both healthy oral mucosa and lesions of oral candidiasis, *Candida albicans* remains the predominant isolate, attributable

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The clinical spectrum of the disease ranges from acute and chronic forms to rare chronic mucocutaneous candidiasis syndromes, and the risk of malignant transformation in some lesions necessitates early diagnosis and close follow-up. The fundamental approach to treatment involves the individualized use of appropriate antifungal agents, along with the elimination of predisposing factors and the maintenance of oral hygiene. Considering that oral candidiasis may be a reflection of systemic diseases, a multidisciplinary and comprehensive evaluation is of great importance for infection control and the prevention of recurrence.

REFERENCES

1. Hu L, He C, Zhao C, Chen X, Hua H, Yan Z. Characterization of oral candidiasis and the Candida species profile in patients with oral mucosal diseases. Microbial pathogenesis. 2019;134:103575.doi:10.1016/j.micpath.2019.103575
2. Millsop, Jillian W, Nasim Fazel. Oral candidiasis. Clinics in dermatology 2016;34(4):487-494. doi:10.1016/j.clindermatol.2016.02.022
3. Vila T, Sultan A S, Montelongo-Jauregui D, Jabra-Rizk M A. Oral candidiasis: A disease of opportunity. Journal of fungi 2020;6(1):15. doi:10.3390/jof6010015
4. Quindós G, Gil-Alonso S, Marcos-Arias C, Sevillano E, Mateo E, Jauregizar N, Eraso E. Therapeutic tools for oral candidiasis: Current and new antifungal drugs. Medicina oral, patologia oral y cirugia bucal 2019;24(2):e172.doi:10.4317/medoral.22978
5. Gendreau L, Loewy ZG. Epidemiology and etiology of denture stomatitis. Journal ofProsthodontics: Implant, Esthetic and Reconstructive Dentistry 2011;20(4):251-260. doi:10.1111/j.1532-849X.2011.00698.x
6. Newton AV. Denture sore mouth. A possible etiology. Br. Dent. J. 1962;112:357–360.
7. Al-Nuaimy MMT, Al-Tarjuman JK, Masyab HM, Saadi AM. Relationship between steroid and antibiotic therapy and the frequency of oral candidiasis. International Journal of Design & Nature and Ecodynamics 2025;20(2):447–452. doi:10.18280/ijdne.200222
8. Giannini PJ, Shetty KV. Diagnosis and management of oral candidiasis. Otolaryngologic Clinics of North America 2011;44(1):231–240.doi:10.1016/j.otc.2010.09.010
9. Scully C, El-Kabir M, Samaranayake LP. Candida and oral candidosis: a review. Critical Reviews in Oral Biology & Medicine1994;5(2):125–157.doi:10.1177/10454411940050020101
10. Lewis MAO, Williams DW. Diagnosis and management of oral candidosis. British Dental Journal2017;223(9):675–681. doi:10.1038/sj.bdj.2017.886
11. Cho E, Park Y, Kim KY, Han D, Kim HS, Kwon JS, Ahn HJ. Clinical characteristics and relevance of oral Candida biofilm in tongue smears. Journal of Fungi 2021;7(2):77.doi:10.3390/jof7020077
12. Sharma A. Oral candidiasis: an opportunistic infection: a review. International Journal of Applied Dental Sciences 2019;5(1):23–27.
13. Gracia MTP, Fernández CMH, Cebrian BM, García BS. Chronic hyperplastic candidiasis of the oral mucosa: a case report. J Clin Stud Med Case Rep 2014;1:001.
14. Lee SY, Choi JY, Kim JW, Yu DS, Lee YB. A case of cheilocandidiasis. Annals of Dermatology2019;31(Suppl):S22–S23.doi:10.5021/ad.2019.31.S.S22
15. Goregen M, Miloglu O, Buyukkurt MC, Caglayan F, Aktas AE. Median rhomboid glossitis: a clinical and microbiological study. European Journal of Dentistry2011;5(4):367–372. doi:10.1055/s-0039-1698907

Chapter 8

ULTRASONOGRAPHY IN PEDIATRIC DENTISTRY: A RADIATION-FREE DIAGNOSTIC PARADIGM

Katibe Tugce TEMUR[1]
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1. INTRODUCTION

The ongoing growth and development of the pediatric population, in conjunction with an increased biological sensitivity to ionising radiation, necessitates a careful assessment of the risk-benefit balance in dental imaging practices. This state of affairs necessitates the prioritisation of the principle of justification in the clinical decision-making process and the adoption of more cautious imaging strategies for the purpose of safeguarding patient safety (1–6).

RADIATION SENSITIVITY IN PEDIATRIC PATIENTS

Pediatric patients present a unique challenge in maxillofacial radiology due to the increased sensitivity of developing tissues to ionising radiation. The thyroid gland, salivary glands and active bone marrow in the jaws are particularly vulnerable to the cytostatic effects of X-rays (1).

In this context, both biological and technical factors contribute to the higher risk of ionising radiation in pediatric patients compared to adults. Firstly, the high rate of cell division in children's developing tissues makes them more sensitive to radiation. In addition, their long life expectancy means there is a longer time frame in which radiation-related diseases can develop. Furthermore, due to their body structure, children absorb more radiation into their organs, and if imaging settings are not optimised for age, they can receive a higher dose than adults (1, 2).

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dentistry, owing to its non-radiation properties, capacity to facilitate real-time imaging, and ease of implementation in clinical settings. However, given the technical limitations and operator-dependent nature of the method, its use should be restricted to appropriate indications and with sufficient experience. In the future, the integration of artificial intelligence-supported systems will increase the diagnostic accuracy of ultrasonography, contributing to the development of safer, standardised, and individualised imaging approaches in pediatric patients.

REFERENCES

1. White SC, Pharoah MJ. Oral radiology: principles and interpretation. 8th ed. St. Louis: Elsevier; 2019.
2. Scarfe WC. Radiation risk in low-dose maxillofacial radiography. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2012;114(3):277–280.
3. Granata C, Sofia C, Francavilla M, et al. Let's talk about radiation dose and radiation protection in children. *Pediatr Radiol.* 2025;55(3):386–396.
4. Hall EJ. Radiation biology for pediatric radiologists. *Pediatr Radiol.* 2009;39(Suppl 1):57–64.
5. Kühnisch J, Anttonen V, Duggal MS, et al. Best clinical practice guidance for prescribing dental radiographs in children and adolescents: an EAPD policy document. *Eur Arch Paediatr Dent.* 2020;21(4):375-386.
6. American Academy of Pediatric Dentistry. Prescribing dental radiographs for infants, children, adolescents, and individuals with special health care needs. In: *The Reference Manual of Pediatric Dentistry.* Chicago: AAPD; 2025. p.332–336.
7. Theodorakou C, Walker A, Horner K et al. Estimation of pediatric organ and effective doses from dental cone beam CT using anthropomorphic phantoms. *Br J Radiol.* 2012;85(1010):153–160.
8. Ertuğrul ÇÇ, Apaydın BK. Assessment of cone-beam computed tomography indications in pediatric patients: a retrospective radiographic analysis. *BMC Oral Health.* 2026;26:108.
9. Evirgen Ş, Kamburoğlu K. Review on the applications of ultrasonography in dentomaxillofacial region. *World J Radiol.* 2016;8(1):50–58.
10. Elbarbary M, Sgro A, Khazaei S, Goldberg M, Tenenbaum HC, Azarpazhooh A. Applications of ultrasound in dentistry: a scoping review. *Clin Oral Investig.* 2022;26(3):2299–2316.
11. Ozturk EMA, Yalcin ED. Evaluation of submandibular and parotid salivary glands by ultrasonography in patients with diabetes. *J Oral Rehabil.* 2024;51(7):1144–1157.
12. Baum G, Greenwood I, Slawski S, Smirnow R. Observation of internal structures of teeth by ultrasonography. *Science.* 1963;139(3554):495–496.
13. Caglayan F, Ilbas FY, Aksakal B. The use of ultrasonography in oral radiology: an ultrasound archive study. *J Oral Maxillofac Radiol.* 2021;9(1):20-20.
14. Altan Şallı G, Öksüz MF, Köse TE, et al. USG and CBCT indications in pediatric to adult dental patients. *BMC Oral Health.* 2025;25(1):1010.
15. Patil S, Alkahtani A, Bhandi S, et al. Ultrasound imaging versus radiographs in differentiating periapical lesions. *Diagnostics.* 2021;11(7):1208.
16. Orhan K, Różyło-Kalinowska I. Basics of ultrasonography physics and technique. In: *Imaging of the Temporomandibular Joint.* Springer; 2018. p.133.
17. Harorlı A, Akgül M, Yılmaz B, et al. Ağız, Diş ve Çene Radyolojisi. [Oral and Maxillofacial Radiology]. Istanbul: Nobel Tip Kitabevleri; 2014. p. 484-500. Turkish.
18. Kumar SB, Mahabob MN. Ultrasound in dentistry: a review. *J Indian Acad Dent Spec.* 2010;1(4):44–45.

19. Reda R, Zanza A, Cicconetti A, et al. Ultrasound imaging in dentistry: literature overview. *J Imaging.* 2021;7(11):238.
20. Aldrich JE. Basic physics of ultrasound imaging. *Crit Care Med.* 2007;35(5 Suppl):S131–S137.
21. Kawashima K, Ogawa M, Tachikake M, et al. Dentoalveolar abscess caused by pericoronitis. *Diagnostics.* 2025;15(12):1531.
22. Pšeničny, E., Glušič, M etal. Ultrasonography of lymphadenopathies in children. *Cent Eur J Paediatr.* 2023;19(1).
23. Marrani E, Fulvio, G., Virgili, C et al. Ultra-high-frequency ultrasonography of labial glands in pediatric Sjögren's disease. *Diagnostics.* 2023;13(16):2695.
24. Yatabe M, Kripfgans O, Chan HL, et al. Ultrasonography to localize impacted canines. *Oral Radiol.* 2025;41:131–143.
25. Issa, J., Malček, M et al. Mandibular distraction osteogenesis monitored with ultrasonography. *Pediatr Rep.* 2026;18(1):6.
26. Yatabe M, Soki F, Chan HL, Kalani K, Kripfgans OD. Applicability of intra-oral ultrasonography in patients with cleft lip and palate: A preliminary study. Semin Orthod. 2025;31:710-715 .
27. Tatlı EC, Arslan ZB. Bruxism effects on masseter thickness in children. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 2023;135(3):456–461.
28. Lambrou P, Kalfas S, Arhakis A. Gingival thickness in children. *Eur Arch Paediatr Dent.* 2024;25(2):217–225.
29. Aldhuwayhi S, Bhardwaj A, Deeban YAM, Bhardwaj SS, Alammari RB, Alzunaydi A. A narrative review on current diagnostic imaging tools for dentomaxillofacial abnormalities in children. *Children (Basel)*. 2022;9(5):621.
30. Dumitriu D, Menten R, Clapuyt P. Ultrasonography of bone surface in children. *Pediatr Radiol.* 2022;52(7):1392–1403.
31. Zhao Y, Dong R, Chen X, et al. Ultrasound features of periosteal abnormalities. *J Med Ultrason.* 2025;52:365–376.
32. Tonni I, Fossati G, Garo ML, Piancino MG, Cattalini M, Visconti L, et al. Temporomandibular joint involvement in patients with Juvenile Idiopathic Arthritis: comparison of ultrasonography and magnetic resonance imaging in assessing the periarticular space width. Oral Radiol. 2023;39(4):750-758 .
33. Farronato M, Cressoni P, Farronato D, Cattaneo G, Borzani I, Biagi R, Maspero C. Noninvasive Ultrasound Imaging in Juvenile Idiopathic Arthritis: Diagnostic and Findings on the Temporomandibular Joint-A Prospective Study. *Int J Dent*. 2025;9491663.
34. Chana J, Baghaei K, Fagundes NCF, Hareendranatan A, Jaremko JL, Twilt M, Almeida FT. Ultrasound assessment of TMJ in JIA: systematic review. *Int J Dent.* 2026;2026:2825133.
35. Charalampidou M, Antonarakis GS, Kiliaridis S. Changes in masseter thickness during orthodontic treatment. *Eur J Orthod.* 2025;47(5):cjaf063.
36. Kaya S, Avci B. Effect of occlusion on masseter thickness. *Oral Radiol.* 2025;41(4):577-586.
37. Nguyen KT, Le LH, Kaipatur NR, Almeida FT, Lai H, Lou EHM, Major PW. Measuring the alveolar bone level in adolescents: A comparison between ultrasound and cone beam computed tomography. Int J Paediatr Dent. 2023 Sep;33(5):487-497.
38. An NH, Ngoc VTN, Bau TH, Anh NH, Hung DT. Lower lip abscess by foreign body embedded after facial trauma and application of ultrasound in diagnosis: A case report. Pediatr Dent J. 2024;34:196-200.
39. Frid H, Bilder A, Hija A, Emodi O. Diagnostic Accuracy and Clinical Impact of Handheld Point-of-Care Ultrasound in Pediatric Odontogenic Infections: A Prospective Cohort Study. *Children (Basel)*. 2025;12(10):1392.
40. Asantogrol F, Ciftci BT. Segmentation of masticatory muscles using AI in pediatric population. Ann Med Res. 2023;30(10):1330-1336.

Chapter 9

ODONTOGENIC PATHOLOGIES AND RADIOLOGICAL FINDINGS OF THE MAXILLARY SINUS

Mehmet Feryüz ÖKSÜZ[1]

INTRODUCTION

The maxillary sinus (antrum of Highmore), the largest and first to develop among the paranasal sinuses, holds a distinct place in dental practice due to its close anatomical and physiological relationship with the posterior teeth of the upper jaw. This pyramidal air-filled cavity not only plays a role in respiratory physiology but also constitutes a critical anatomical region for the spread of odontogenic infections and for dental implant surgery [1]. The close proximity of the root apices of maxillary premolar and molar teeth to the sinus floor, and in some cases, their protrusion into the sinus, renders the risk of odontogenic pathologies evolving into sinusitis (odontogenic maxillary sinusitis) inevitable [2].

In dental practice, the radiological evaluation of the maxillary sinus has been limited to two-dimensional panoramic radiographs for many years. However, inherent limitations such as superimposition and distortion in panoramic images have made it difficult to detect pathologies in the early stages and to determine their boundaries precisely. The widespread adoption of cone-beam computed tomography (CBCT) technology, which has revolutionized dental radiology in recent years, has enabled the three-dimensional examination of anatomical variations and pathologies (cysts, tumors, mucosal thickening, etc.) in this region with micron-level precision [3].

Current literature indicates that approximately 10% to 40% of maxillary sinusitis cases are of odontogenic origin [4]. This necessitates the recognition and evaluation not only of dental structures but also of sinus pathologies observed in radiographs within dental practice. Radicular cysts, retention cysts (mucoceles), odontogenic tumors, or iatrogenic foreign bodies observed on the sinus floor

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increasing dental implant applications and surgical interventions today also bring along risks of iatrogenic complications such as oroantral communication or foreign body/implant migration into the sinus [56,57].

In conclusion; the evaluation of the maxillary sinus in dental practice should not be limited to the examination of teeth alone. Clinicians having a command of sinus anatomy and the radiological features of pathologies, and using advanced imaging methods like CBCT with the correct indication, play a key role in preventing misdiagnoses, managing complications, and increasing treatment success [58].

REFERENCES

1. Whyte, A., & Boeddinghaus, R. (2019). Imaging of odontogenic sinusitis. Clinical radiology, 74(7), 503-516.
2. Maillet, M., Bowles, W. R., McClanahan, S. L., John, M. T., & Ahmad, M. (2011). Cone-beam computed tomography evaluation of maxillary sinusitis. Journal of endodontics, 37(6), 753-757.
3. Venskutonis, T., Plotino, G., Juodzbalys, G., & Mickevičienė, L. (2014). The importance of cone-beam computed tomography in the management of endodontic problems: a review of the literature. Journal of endodontics, 40(12), 1895-1901.
4. Peñarrocha-Oltra, S., Soto-Peñaloza, D., Bagán-Debón, L., Bagán-Sebastián, J. V., & Peñarrocha-Oltra, D. (2019). Association between maxillary sinus pathology and odontogenic lesions in patients evaluated by cone beam computed tomography. A systematic review and meta-analysis. Medicina oral, patología oral y cirugía bucal, 25(1), e34.
5. Shahbazian, M., & Jacobs, R. (2012). Diagnostic value of 2D and 3D imaging in odontogenic maxillary sinusitis: a review of literature. Journal of oral rehabilitation, 39(4), 294-300.
6. Maillet, M., Bowles, W. R., McClanahan, S. L., John, M. T., & Ahmad, M. (2011). Cone-beam computed tomography evaluation of maxillary sinusitis. Journal of endodontics, 37(6), 753-757.
7. Lu, Y., Liu, Z., Zhang, L., Zhou, X., Zheng, Q., Duan, X., ... & Huang, D. (2012). Associations between maxillary sinus mucosal thickening and apical periodontitis using cone-beam computed tomography scanning: a retrospective study. Journal of endodontics, 38(8), 1069-1074.
8. Allevi, F., Fadda, G. L., Rosso, C., Martino, F., Pipolo, C., Cavallo, G., ... & Saibene, A. M. (2021). Diagnostic criteria for odontogenic sinusitis: a systematic review. American journal of rhinology & allergy, 35(5), 713-721.
9. Goller-Bulut, D., Sekerci, A. E., Köse, E., & Sisman, Y. (2015). Cone beam computed tomographic analysis of maxillary premolars and molars to detect the relationship between periapical and marginal bone loss and mucosal thickness of maxillary sinus. Medicina oral, patologia oral y cirugia bucal, 20(5), e572.
10. Sheikhi, M., Pozve, N. J., & Khorrami, L. (2014). Using cone beam computed tomography to detect the relationship between the periodontal bone loss and mucosal thickening of the maxillary sinus. Dental research journal, 11(4), 495–501.
11. Nurbakhsh, B., Friedman, S., Kulkarni, G. V., Basrani, B., & Lam, E. (2011). Resolution of maxillary sinus mucositis after endodontic treatment of maxillary teeth with apical periodontitis: a cone-beam computed tomography pilot study. Journal of endodontics, 37(11), 1504–1511. https://doi.org/10.1016/j.joen.2011.07.007
12. Vallo, J., Suominen-Taipale, L., Huumonen, S., Soikkonen, K., & Norblad, A. (2010). Prevalence of mucosal abnormalities of the maxillary sinus and their relationship to dental disease in pan-

oramic radiography: results from the Health 2000 Health Examination Survey. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 109(3), e80-e87.

13. Mehra, P., & Murad, H. (2004). Maxillary sinus disease of odontogenic origin. Otolaryngologic Clinics of North America, 37(2), 347-364.
14. Simuntis, R., Kubilius, R., & Vaitkus, S. (2014). Odontogenic maxillary sinusitis: a review. Stomatologija, 16(2), 39-43.
15. Little, R. E., Long, C. M., Loehrl, T. A., & Poetker, D. M. (2018). Odontogenic sinusitis: A review of the current literature. Laryngoscope investigative otolaryngology, 3(2), 110-114.
16. de Lima, C. O., Devito, K. L., Vasconcelos, L. R. B., do Prado, M., & Campos, C. N. (2017). Correlation between endodontic infection and periodontal disease and their association with chronic sinusitis: a clinical-tomographic study. Journal of endodontics, 43(12), 1978-1983.
17. Raghav, M., Karjodkar, F. R., Sontakke, S., & Sansare, K. (2014). Prevalence of incidental maxillary sinus pathologies in dental patients on cone-beam computed tomographic images. Contemporary clinical dentistry, 5(3), 361-365.
18. Peker, E., Öğütlü, F., Karaca, İ. R., Gültekin, E. S., & Çakır, M. (2016). A 5 year retrospective study of biopsied jaw lesions with the assessment of concordance between clinical and histopathological diagnoses. Journal of Oral and Maxillofacial Pathology, 20(1), 78-85.
19. Agung, A. A. G. D., & Anggreni, N. K. S. (2022). The effectivity of Cone Beam Computed Tomography (CBCT) in dentigerous cyst management: a literature review. Jurnal Radiologi Dentomaksilofasial Indonesia (JRDI), 6(2), 73-80.
20. Eninanç, İ., & Mavi, E. (2024). Three-dimensional evaluation of dentigerous cysts in the Turkish subpopulation. BMC Oral Health, 24(1), 677.
21. Khalil, M., Attia, D., & Sakr, H. H. (2024). The Impact of Posterior Maxillary Teeth on Maxillary Sinus: Insights From Cone-Beam Computed Tomography Analysis. Cureus, 16(12), e76578. https://doi.org/10.7759/cureus.76578
22. Yeung, A. W. K., Tanaka, R., Khong, P. L., von Arx, T., & Bornstein, M. M. (2018). Frequency, location, and association with dental pathology of mucous retention cysts in the maxillary sinus. A radiographic study using cone beam computed tomography (CBCT). Clinical oral investigations, 22(3), 1175-1183.
23. Zhang, L. L., Yang, R., Zhang, L., Li, W., MacDonald-Jankowski, D., & Poh, C. F. (2010). Dentigerous cyst: a retrospective clinicopathological analysis of 2082 dentigerous cysts in British Columbia, Canada. International journal of oral and maxillofacial surgery, 39(9), 878-882.
24. AlKhudair, B., AlKhatib, A., AlAzzeh, G., & AlMomen, A. (2019). Bilateral dentigerous cysts and ectopic teeth in the maxillary sinuses: A case report and literature review. International Journal of Surgery Case Reports, 55, 117-120.
25. Kara, M. I., Yanik, S., Altan, A., Oznalcin, O., & Ay, S. (2015). Large dentigerous cyst in the maxillary sinus leading to diplopia and nasal obstruction: case report. Journal of Istanbul University Faculty of Dentistry, 49(2), 46–50. https://doi.org/10.17096/jiufd.10506
26. Elmorsy, K., Elsayed, L. K., & El Khateeb, S. M. (2020). Case Report: Ectopic third molar in the maxillary sinus with infected dentigerous cyst assessed by cone beam CT. F1000Research, 9, 209.
27. Demiriz, L., Misir, A. F., & Gorur, D. I. (2015). Dentigerous cyst in a young child. European journal of dentistry, 9(04), 599-602.
28. Vallo, J., Suominen-Taipale, L., Huumonen, S., Soikkonen, K., & Norblad, A. (2010). Prevalence of mucosal abnormalities of the maxillary sinus and their relationship to dental disease in panoramic radiography: results from the Health 2000 Health Examination Survey. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 109(3), e80-e87.
29. Kim, E., & Duncavage, J. A. (2010). Prevention and management of complications in maxillary sinus surgery. Otolaryngologic Clinics of North America, 43(4), 865-873.
30. Donizeth-Rodrigues, C., Fonseca-Da Silveira, M., Gonçalves-De Alencar, A. H., Garcia-Santos-Silva, M. A., Francisco-De-Mendonça, E., & Estrela, C. (2013). Three-dimensional images

contribute to the diagnosis of mucous retention cyst in maxillary sinus. Medicina oral, patologia oral y cirugia bucal, 18(1), e151–e157. https://doi.org/10.4317/medoral.18141

31. Ahmed, J., Gupta, A., Shenoy, N., Sujir, N., & Muralidharan, A. (2023). Prevalence of Incidental Maxillary Sinus Anomalies on CBCT Scans: A Radiographic Study. Diagnostics (Basel, Switzerland), 13(18), 2918. https://doi.org/10.3390/diagnostics13182918
32. Sheikhi, M., Pozve, N. J., & Khorrami, L. (2014). Using cone beam computed tomography to detect the relationship between the periodontal bone loss and mucosal thickening of the maxillary sinus. Dental research journal, 11(4), 495.
33. Antonoglou, G. N., & Sándor, G. K. (2015). Recurrence rates of intraosseous ameloblastomas of the jaws: a systematic review of conservative versus aggressive treatment approaches and meta-analysis of non-randomized studies. Journal of Cranio-Maxillofacial Surgery, 43(1), 149-157.
34. Effiom, O. A., Ogundana, O. M., Akinshipo, A. O., & Akintoye, S. O. (2018). Ameloblastoma: current etiopathological concepts and management. Oral diseases, 24(3), 307–316. https://doi.org/10.1111/odi.12646
35. Wright, J. M., & Vered, M. (2017). Update from the 4th edition of the World Health Organization classification of head and neck tumours: odontogenic and maxillofacial bone tumors. Head and neck pathology, 11(1), 68-77.
36. Nastri, A. L., Wiesenfeld, D., Radden, B. G., Eveson, J., & Scully, C. (1995). Maxillary ameloblastoma: a retrospective study of 13 cases. The British journal of oral & maxillofacial surgery, 33(1), 28–32. https://doi.org/10.1016/0266-4356(95)90082-9
37. Isler, S. C., Demircan, S., Soluk, M., & Cebi, Z. (2009). Radiologic evaluation of an unusually sized complex odontoma involving the maxillary sinus by cone beam computed tomography. Quintessence international (Berlin, Germany : 1985), 40(7), 533–535.
38. Satish, V., Prabhadevi, M. C., & Sharma, R. (2011). Odontome: a brief overview. International journal of clinical pediatric dentistry, 4(3), 177.
39. Cabov, T., Krmpotić, M., Grgurević, J., Perić, B., Jokić, D., & Manojlović, S. (2005). Large complex odontoma of the left maxillary sinus. Wiener klinische Wochenschrift, 117(21-22), 780–783. https://doi.org/10.1007/s00508-005-0462-4
40. Chrcanovic, B. R., & Gomez, R. S. (2019). Odontogenic myxoma: an updated analysis of 1,692 cases reported in the literature. Oral Diseases, 25(3), 676-683.
41. Shivashankara C, Nidoni M, Patil S, Shashikala KT. Odontogenic myxoma: A review with report of an uncommon case with recurrence in the mandible of a teenage male. Saudi Dent J. 2017 Jul;29(3):93-101. doi: 10.1016/j.sdentj.2017.02.003. Epub 2017 Mar 16. PMID: 28725126; PMCID: PMC5503096.
42. Peltola, J., Magnusson, B., Happonen, R. P., & Borrman, H. (1994). Odontogenic myxoma--a radiographic study of 21 tumours. The British journal of oral & maxillofacial surgery, 32(5), 298–302. https://doi.org/10.1016/0266-4356(94)90050-7
43. Borgonovo, A. E., Berardinelli, F. V., Favale, M., & Maiorana, C. (2012). Surgical options in oroantral fistula treatment. The open dentistry journal, 6, 94.
44. Tumuluri, V., & Punnia-Moorthy, A. (2002). Displacement of a mandibular third molar root fragment into the pterygomandibular space. Australian dental journal, 47(1), 68-71.
45. Khandelwal, P., & Hajira, N. (2017). Management of oro-antral communication and fistula: various surgical options. World journal of plastic surgery, 6(1), 3.
46. Parvini, P., Obreja, K., Begic, A., Schwarz, F., Becker, J., Sader, R., & Salti, L. (2019). Decision-making in closure of oroantral communication and fistula. International journal of implant dentistry, 5(1), 13.
47. Ito, K., Hirahara, N., Muraoka, H., Okada, S., Kondo, T., Andreu-Arasa, V. C., ... & Kaneda, T. (2022). Normal variants of the oral and maxillofacial region: mimics and pitfalls. Radiographics, 42(2), 506-521.

48. Sgaramella, N., Tartaro, G., D'Amato, S., Santagata, M., & Colella, G. (2016). Displacement of Dental Implants Into the Maxillary Sinus: A Retrospective Study of Twenty-One Patients. Clinical implant dentistry and related research, 18(1), 62–72. https://doi.org/10.1111/cid.12244
49. Testori, T., Drago, L., Wallace, S. S., Capelli, M., Galli, F., Zuffetti, F., ... & Del Fabbro, M. (2012). Prevention and treatment of postoperative infections after sinus elevation surgery: clinical consensus and recommendations. International journal of dentistry, 2012(1), 365809.
50. Whyte, A., & Boeddinghaus, R. (2019). Imaging of odontogenic sinusitis. Clinical radiology, 74(7), 503-516.
51. Mehra, P., & Murad, H. (2004). Maxillary sinus disease of odontogenic origin. Otolaryngologic Clinics of North America, 37(2), 347-364.
52. Shahbazian, M., & Jacobs, R. (2012). Diagnostic value of 2D and 3D imaging in odontogenic maxillary sinusitis: a review of literature. Journal of oral rehabilitation, 39(4), 294-300.
53. Maillet, M., Bowles, W. R., McClanahan, S. L., John, M. T., & Ahmad, M. (2011). Cone-beam computed tomography evaluation of maxillary sinusitis. Journal of endodontics, 37(6), 753-757.
54. Yeung, A. W. K., Tanaka, R., Khong, P. L., von Arx, T., & Bornstein, M. M. (2018). Frequency, location, and association with dental pathology of mucous retention cysts in the maxillary sinus. A radiographic study using cone beam computed tomography (CBCT). Clinical oral investigations, 22(3), 1175-1183.
55. Effiom, O. A., Ogundana, O. M., Akinshipo, A. O., & Akintoye, S. O. (2018). Ameloblastoma: current etiopathological concepts and management. Oral diseases, 24(3), 307-316.
56. Sgaramella, N., Tartaro, G., D'Amato, S., Santagata, M., & Colella, G. (2016). Displacement of dental implants into the maxillary sinus: a retrospective study of twenty-one patients. Clinical Implant Dentistry and Related Research, 18(1), 62-72.
57. Parvini, P., Obreja, K., Begic, A., Schwarz, F., Becker, J., Sader, R., & Salti, L. (2019). Decision-making in closure of oroantral communication and fistula. International journal of implant dentistry, 5(1), 13.
58. Peñarrocha-Oltra, S., Soto-Peñaloza, D., Bagán-Debón, L., Bagán-Sebastián, J. V., & Peñarrocha-Oltra, D. (2019). Association between maxillary sinus pathology and odontogenic lesions in patients evaluated by cone beam computed tomography. A systematic review and meta-analysis. Medicina oral, patología oral y cirugía bucal, 25(1), e34.