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IMAGING MODALITIES FOR THE EVALUATION OF MAXILLOFACIAL METASTATIC BONE LESIONS: A SYSTEMATIC REVIEW AND AN EVIDENCE MAP[1]

Luciana Moraes HORNOS
School of Dentistry - University of São Paulo (FOUSP)
E-mail: lucianahornos@usp.br
ORCID: http://orcid.org/0009-0007-1590-997X

Gabriela Franco da Rosa CAETANO
School of Dentistry - University of São Paulo (FOUSP)
E-mail: gabrielafrc@hotmail.com
ORCID: http://orcid.org/0000-0002-4392-8402

Thaís GIMENEZ
School of Dentistry - University of São Paulo (FOUSP)
E-mail: thais.gimenez@usp.br
ORCID: http://orcid.org/0000-0002-1528-0370

Marcelo Gusmão Paraiso CAVALCANTI
School of Dentistry - University of São Paulo (FOUSP)
E-mail: mgpcaval@usp.br
ORCID: http://orcid.org/0000-0001-8011-9623

ABSTRACT

Objectives: To conduct a systematic review and develop an evidence map of the main radiographic features and the usefulness of imaging modalities for the evaluation of maxillofacial metastatic bone lesions. Methods: The PECO strategy was used to define eligibility and to answer the question: Do cancer patients (P) undergoing imaging exams (E) present radiographic/imaging signs of metastases in the head region (O)? Searches were performed in PubMed, Embase, Scopus, and Google Scholar in accordance with the PRISMA statement. Only case reports/case series with histopathological confirmation were included. Risk of bias was assessed with Joanna Briggs Institute tools. Results: From 8,475 initial records and 20 manually retrieved studies, 29 articles met the inclusion criteria. The studies included 63 patients with metastases in maxilla (4.8%) or mandible (95.3%). Panoramic radiography is the primary imaging modality for the evaluation of metastatic lesions of the jaws (64.8%), followed by scintigraphy (25.39%), HCT (20.6%), lateral oblique radiograph (18.3%), periapical radiograph (14.1%), MRI (6.9%), SPECT (6.3%), PET/CT (3.17%), occlusal

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radiograph (2.8%), posteroanterior mandibular radiograph (2.8%), ultrasonography (1.58%), and mentonasal radiograph (1.4%). The predominant radiographic appearance of panoramic radiograph was an ill-defined osteolytic lesion (76.2%), although mixed or sclerotic patterns were noted in cases of breast and prostate cancer. Conclusions: Panoramic radiography supported initial screening. HCT and MRI defined lesion extent and soft tissue involvement. Scintigraphy showed increased tracer uptake near the affected jaw, while PET/CT demonstrated homogeneous uptake. Dental surgeons should remain vigilant during clinical and imaging evaluations, particularly in patients with a history of cancer.

Keywords: Jaw Neoplasms. Metastasis. Panoramic Radiograph. Computed Tomography. Magnetic Resonance Imaging. Dentistry.

INTRODUCTION

Metastases from primary tumors to the orofacial region are rare, accounting for approximately 1% to 3% of all malignancies affecting the oral cavity (Kumar et al, 2013). The most common primary sites are the lungs in men and the breasts in women, with the posterior mandible being the most frequently affected area (Kirschnick et al, 2022). Imaging modalities play a significant role in the screening, diagnosis, and staging of diseases (Glasspool a el, 2000; Kumar et al, 2021). According to a systematic review by Marcello Scotti et al. (2022), magnetic resonance imaging (MRI), helical computed tomography (HCT), and ultrasonography (US) assist in determining the depth of invasion and/or tumor thickness during the preoperative phase of oral cavity cancers. HCT is important for defining the size of malignant lesions, assessing the involvement of adjacent structures, and detecting lymph node metastasis (Figueiredo et al, 2010). US is useful in the preoperative evaluation of patients with small lesions that are not detectable by HCT or MRI (Marcello Scotti et al, 2022). MRI provides accurate measurements of tumor invasion depth and demonstrates high sensitivity and specificity for detecting bone invasion (Lo Casto et al, 2022). Positron emission tomography combined with computed tomography (PET-CT) offers both metabolic and functional anatomical information about underlying tissues (Glasspool et.al, 2000).

In dental practice, panoramic radiography is commonly used as the initial imaging modality for investigating signs and symptoms due to its greater accessibility, lower cost, and ability to visualize maxillomandibular bony structures (Shah et al, 2014). Panoramic radiography aids in the diagnosis of malignant lesions, as most pathologies present with relatively characteristic radiographic features (George et al, 2019). Periapical radiographs may assist in the initial investigation, particularly when findings such as periapical radiolucency, widening of the periodontal ligament space, and subtle changes that may mimic endodontic infection are present (Evangelista et al, 2022). Cone-beam computed tomography (CBCT) demonstrates high diagnostic accuracy and a high negative predictive value in detecting bone invasion in patients with oral cancer (Bombeccari et al, 2019).

Certain clinical and radiographic features can help dental surgeons raise diagnostic suspicion of possible metastatic lesions to the oral cavity (de Carvalho Kimura et al, 2022). Early diagnosis of oral metastases is challenging due to the lack of specific signs or symptoms, which often resemble inflammatory, benign, or reactive lesions (Pakfetrat et al, 2024). However, early detection can positively influence survival rates, demonstrating the role of the dental surgeon in this context (de Carvalho Kimura et al., 2022; Pakfetrat et al, 2024).

Previous systematic reviews have evaluated the main primary tumor sites that metastasize to the oral cavity, clinical manifestations and the most commonly regions in the maxilla and mandible (Atarbashi-Moghadam et al, 2024; Kirschnick et al., 2022; Labrador et al, 2022; Lopes et al, 2023; Pakfetrat et al, 2024). However, the present literature review did not identify studies that specifically assess the role of imaging in the diagnosis of maxillofacial bone metastases. Therefore, this study aimed to conduct a systematic review and develop an evidence map of the usefulness of imaging modalities for the evaluation of maxillofacial metastatic bone lesions.

MATERIALS AND METHODS

This systematic review of case reports and case series was conducted in accordance with the guidelines and standards of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al, 2021). A protocol was developed and registered in the International Prospective Register of Systematic Reviews (PROSPERO – CRD42024552504).

Search Strategy

Individual searches in English were conducted on January 20, 2025, across the PubMed, Embase, and Scopus databases. A partial search of the gray literature was performed using Google Scholar. No time restrictions were applied. All studies addressing the topics below were included according to the PECO strategy to answer the following question, based on MeSH and Emtree terms: Do cancer patients (P) undergoing imaging exams (E) present radiographic/imaging signs of metastasis in the head region (O) Comparison (C) was not applicable to this study. Manual searches were also performed through reference lists of the included articles.

Eligibility Criteria

Included studies reported patient age, sex, primary malignant tumor location, primary tumor type, oral cavity site, clinical manifestations, imaging modalities, radiographic features, and histological confirmation of metastasis to bony regions of the maxilla and/or mandible. Eligible study designs included randomized clinical trials, cohort studies, case-control studies, cross-sectional studies, prospective and retrospective studies, case series, and case reports, published only in English.

Studies focusing on primary tumors located in the head and neck region, that didn't specify or with unknown primary tumor location, as well as metastases to sites other than the oral cavity, were excluded. Additionally, literature reviews, systematic reviews, animal studies, pilot studies, integrative reviews, scoping reviews, overviews, and letters to the editor were excluded. Studies without access to the full text were also excluded.

Study Selection

References were imported into EndNote (Thompson Reuters, New York, NY, USA) for management and duplicate removal, and then exported to Rayyan (http://rayyan.qcri.org). Two reviewers (LMH and GFRC) independently screened the titles and abstracts of all identified records. The reviewers were calibrated based on their assessment of the titles/abstracts of the first 50 references retrieved during the searches. Full texts of studies deemed eligible for inclusion were obtained and reviewed. Disagreements during both the title/abstract and full-text screening phases were resolved through discussion between the two reviewers. When consensus could not be reached, a third experienced author (MGPC) was consulted.

Data Extraction

The following data were extracted from each article: author name, year and country of publication, patient sex and age, primary malignant tumor location, primary tumor type, location of bony metastasis in the oral cavity, clinical manifestations, imaging modalities used for diagnosis, radiographic features, complementary exams, and follow-up time, when available. Based on the extracted data, an evidence map was created to assist dental surgeons in diagnosing possible patients with metastases. An evidence map is a methodology that systematically and visually organizes and presents the distribution and quantity of scientific evidence available on a given topic (Hetrick et al, 2010; Khalil and Tricco, 2022; Miake-Lye et al, 2016).

Methodological Assessment

The methodological quality of the articles was evaluated using the Joanna Briggs Institute tool from the University of Adelaide for case reports and case series (Gagnier et al, 2013; Moola et al, 2017). Only studies that clearly and comprehensively reported the essential aspects recommended for clinical case studies were included. These criteria include: a description of patient characteristics, a chronological presentation of clinical history, the diagnostic methods used and their results, and the intervention procedures performed.

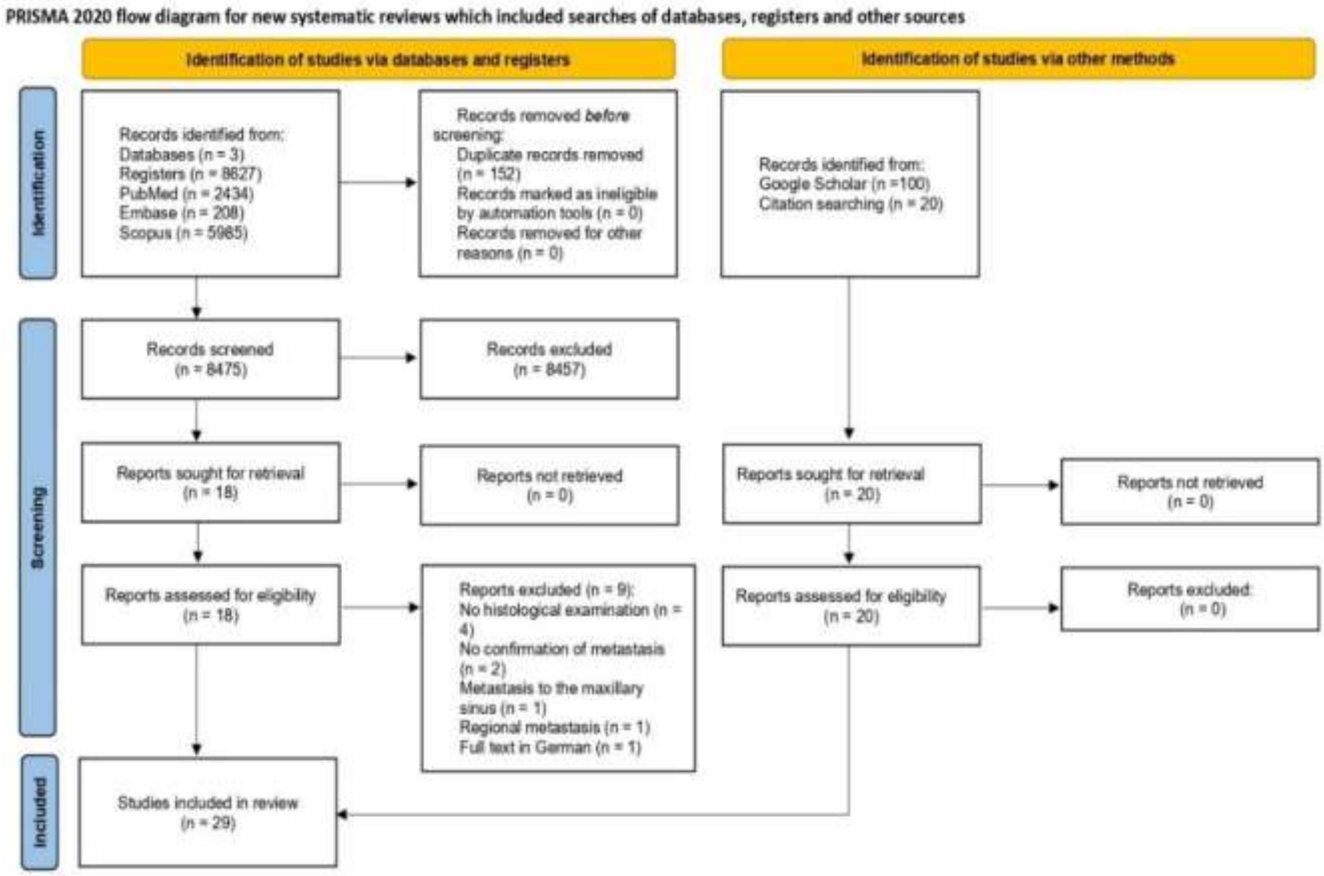
RESULTS

Search Results

Searches conducted in the PubMed, Embase, and Scopus databases identified 2434, 208, and 5985 records, respectively; additionally, 100 records were retrieved from the gray literature via Google Scholar. Duplicates were manually removed, resulting in 8,475 unique studies. Twenty additional studies were included through manual searches and reference list screening. Publication dates of the studies ranged from 1954 to 2024.

Fimollagure 1 presents the PRISMA flowchart outlining the selection process. After screening the titles of all 8,475 records, 18 articles were deemed eligible for inclusion in the review based on title and abstract screening and full-text reading. Nine studies (Divya et al, 2010; Friedrich and Abadi, 2010; Gobel et al, 2014; Issing et al, 1999; Kader et al, 2016; Magat et al, 2019; Som et al, 1987; Williams et al, 2015; Yfanti et al, 2023) did not meet the strict inclusion criteria and were excluded. Ultimately, nine studies were considered eligible for inclusion in the narrative synthesis of this review through the search strategy, comprising twenty nine studies.

Figure 1: PRISMA flow diagram illustrating the identification, screening, eligibility, and inclusion of studies in the systematic review.



Source: Author

Study Characteristics

The results are shown in the Table 1.

Table 1: Study characteristics (authors, year of publication, country of origin, age, gender, primary site, histological type, metastasis site, clinical aspects, and imaging examinations).

AUTHOR, YEAR	AGE	GENDER	PRIMARY SITE	HISTOLOGICAL TYPE	METASTASIS SITE	CLINICAL ASPECTS	IMAGING EXAMS[2]	FOLLOW-UP (MONTHS)
Castigliano and Rominger, 1954 (USA)	53	M	testis	seminoma	mandible	pain, ulceration	LO	< 6
	47	M	lung	carcinoma	mandible	swelling	LO	> 12
	36	F	rectum	adenocarcinoma	mandible	pain, swelling, teeth mobility, bleeding	PA	< 6
	46	F	breast	carcinoma	mandible	palpable mass	LA, AP	> 12
	37	F	breast	carcinoma	mandible	pain, expansion	LO	< 6

[2] Abbreviations: LO: lateral oblique radiograph; PA: posteroanterior radiograph; LA: lateral oblique radiograph; AP: anteroposterior radiograph; O: occlusal radiograph; PAN: panoramic radiograph; PERI: periapical radiograph; CNP: mentonasal (chin–nose) radiograph; CT: computed tomography; SCI: scintigraphy; HCT: helical computed tomography; SPECT: single-photon emission computed tomography; MRI: magnetic resonance imaging; PET-CT: positron emission tomography–computed tomography.

AUTHOR, YEAR	AGE	GENDER	PRIMARY SITE	HISTOLOGICAL TYPE	METASTASIS SITE	CLINICAL ASPECTS	IMAGING EXAMS[2]	FOLLOW-UP (MONTHS)
Cohen 1958 (ENG)	71	F	breast	carcinoma	mandible	pain	O	-
Stockdale 1959 (ENG)	61	F	breast	carcinoma	mandible	pain, swelling	LA, AP	-
Cash et al. 1961 (USA)	48	F	kidney	adenocarcinoma	mandible	expansion	PAN	< 6
Clausen and Poulsen, 1963	60	M	colon	adenocarcinoma	mandible	swelling	PERI	< 6
	77	M	prostate	adenocarcinoma	mandible	pain, swelling,	LO	> 12
	63	F	breast	carcinoma	mandible	pain	CNP	-
	45	F	breast	carcionoma	mandible	pain	LO	< 6
	54	M	lung	carcionoma	mandible	pain, swelling, numbness	LO	< 6
Meyer and Shklar, 1965 (USA)	36	F	breast	adenocarcinoma	mandible	palpable mass	PAN	-
	72	F	breast	adenocarcinoma	mandible	palpable mass	LO	-
	70	F	breast	adenocarcinoma	mandible	palpable mass	PA, CT, PAN	-
	58	F	breast	adenocarcinoma	mandible	teeth mobility	PAN	-
	48	F	breast	adenocarcinoma	mandible	palpable mass	PAN	-
	57	M	kidney	hypernephroma	mandible	palpable mass	LO	-
	48	M	kidney	hypernephroma	mandible	palpable mass	PERI	-
	73	F	kidney	hypernephroma	maxilla	palpable mass	PERI	-
	43	M	kidney	sarcoma	mandible	teeth mobility	PERI	-
	70	F	rectum	adenocarcinoma	mandible	palpable mass	PAN	-
	64	F	rectum	adenocarcinoma	mandible	palpable mass	PAN	-
	78	F	rectum	adenocarcinoma	maxilla	palpable mass	PERI	-
	60	M	stomach	adenocarcinoma	maxilla	teeth mobility	PERI	-
	62	M	prostate	adenocarcinoma	mandible	teeth mobility	PERI	-
	10	M	femur	osteosarcoma	mandible	teeth mobility	PAN	-
	9	M	scapula	sarcoma	mandible	palpable mass	PAN	-
Albers, 1970 (USA)	68	M	prostate	adenocarcinoma	mandible	pain	PA, LO	< 6
Martis et al. 1977 (GRE)	40	F	breast	adenocarcinoma	mandible	pain, numbness	PAN	-
Bucin et al. 1982 (SWE)	61	F	breast	carcinoma	mandible	numbness	PAN	> 12
	67	M	kidney	carcinoma	mandible	swelling, palpable mass	PAN, SCI	< 6
	61	F	eye	melanoma	mandible	swelling, numbness	PAN	< 6
Vigneul et al. 1982 (FRA)	52	M	liver	carcinoma	mandible	teeth mobility, bleeding	PAN, SCI	< 6
Curtin and Radden, 1985 (AUS)	44	F	Fallopian tube	adenocarcinoma	mandible	numbness, ulcerated, palpable mass	PAN	< 12
Mast and Nissenblatt, 1987 (USA)	85	F	cecum	adenocarcinoma	mandible	pain, swelling	PAN, HCT	-
Nevins et al. 1988 (USA)	39	F	breast	carcinoma	mandible	swelling	PAN, PERI	
Maxymiw and Wood 1991 (CAN)	63	F	endometrial	adenocarcinoma	mandible	swelling, palpable mass	PERI	< 6
Carroll et al. 1993 (USA)	24	F	kidney	adenocarcinoma	mandible	numbness, palpable mass	LO, HCT, SCI	-

AUTHOR, YEAR	AGE	GENDER	PRIMARY SITE	HISTOLOGICAL TYPE	METASTASIS SITE	CLINICAL ASPECTS	IMAGING EXAMS[2]	FOLLOW-UP (MONTHS)
	18	F	kidney	carcinoma	mandible	swelling, numbness	PAN, PERI, HCT, SCI	< 12
Laga at al. 1993 (USA)	46	F	breast	carcinoma	mandible	numbness	PAN, SCI	-
	44	F	breast	carcinoma	mandible	numbness	PAN, SCI	-
	47	F	breast	carcinoma	mandible	numbness	PAN, SCI	-
Carmichael et al. 1996 (UK)	71	M	prostate	adenocarcinoma	mandible	swelling, numbness	PAN, SCI	> 12
	73	M	prostate	adenocarcinoma	mandible	pain, numbness	PAN, SCI	> 12
Pruckmayer et al. 1996 (AUT)	62	M	prostate	-	mandible	pain, swelling	PAN, HCT, SCI	
Glaser et al. 1997 (AUT)	66	F	Breast3	-	mandible	pain , swelling, numbness	PAN, SPECT	> 12
		F	breast	-	mandible	pain , swelling, numbness	PAN, SPECT	
		F	breast	-	mandible	pain , swelling, numbness	PAN, SPECT	
		M	prostate	-	mandible	pain , swelling, numbness	PAN, SPECT	
Yoshimura, Matsuda and Naitoh, 1997 (JPN)	61	M	liver	carcinoma	mandible	pain, swelling	PAN, HCT, SCI, MRI	< 6
Galen, 1998 (USA)	55	F	endometrial	adenocarcinoma	mandible	swelling	PAN, PERI, HCT, MRI	
Laurencet et. al 2000 (SWZ)	56	F	lung	carcinoma	mandible	numbness	PAN, HCT, SCI	< 6
	47	M	prostate	adenocarcinoma	mandible	numbness	SCI	< 6
Ogütcen-Toller et al. 2002 (TUR)	50	F	breast	-	mandible	pain, swelling, numbness	PAN	< 6
Yoshioka et al. 2009 (JPN)	69	M	prostate	-	mandible	pain, numbness	PAN, HCT, SCI	> 12
	79	F	bone marrow	myeloma	mandible	numbness	PAN, HCT	
Shah et al. 2010 (UK)	81	M	testis	leiomyosarcoma	mandible	swelling, numbness	PAN, HCT	
Matsuda et al 2018 (JPN)	83	F	lung	adenocarcinoma	mandible	pain, swelling, functional limitation	PAN, LO, HCT, MRI, PET-CT	> 12
Savithri et al. 2018 (IND)	64	F	lung	adenocarcinoma	mandible	pain, swelling, numbness	PAN, O, PET-CT	< 12
Friedrich e Madani, 2021 (GER)	44	F	breast	carcinoma	mandible	no sensory disturbance	PAM, HCT,MRI	
Vettori et al. 2024 (ITA)	68	M	lung	adenocarcinoma	mandible	pain, swelling, functional limitation, white lesions	PAN, HCT, SCI, US	< 6

Source: Author.

A total of 63 patients were included across the thirty studies, comprising 24 males and 39 females. The mandible was the most affected oral site (95.3%), with few cases involving the maxilla (4.8%). Panoramic radiography was the primary imaging modality for the evaluation of metastatic lesions of the jaws (64.8%), followed by scintigraphy (25.39%), HCT (20.6%), lateral oblique radiograph (18.3%), periapical radiograph (14.1%), MRI (6.3%), SPECT (6.3%), PET/CT (3.17%), occlusal radiograph (2.8%), posteroanterior mandibular radiograph (2.8%), US (1.58%), and mentonasal radiograph (1.4%). The most prevalent radiographic feature of panoramic radiograph was poorly defined osteolytic lesions (76.2%), followed by mixed lesions (6.4%), horizontal bone loss (1.6%), sclerotic/radiopaque lesions (1.6%), and well-defined radiolucent areas (1.6%).

Results of Methodological Assessment

The risk of bias and methodological quality assessment was conducted using the Joanna Briggs Institute tool for case reports and case series. The methodological quality assessment of the case series demonstrated that most studies fulfilled the majority of the evaluated criteria, with high agreement for items related to case definition, outcome reporting, and methodological description. Some uncertainty was observed in items related to follow-up and statistical analysis, which is expected given the nature of case series. The methodological quality assessment of the included case reports demonstrated high compliance with most appraisal criteria, particularly those related to patient description, diagnostic assessment, adverse events, and clinical lessons. However, some uncertainty and noncompliance were observed in items related to the description of interventions and post-intervention clinical conditions.

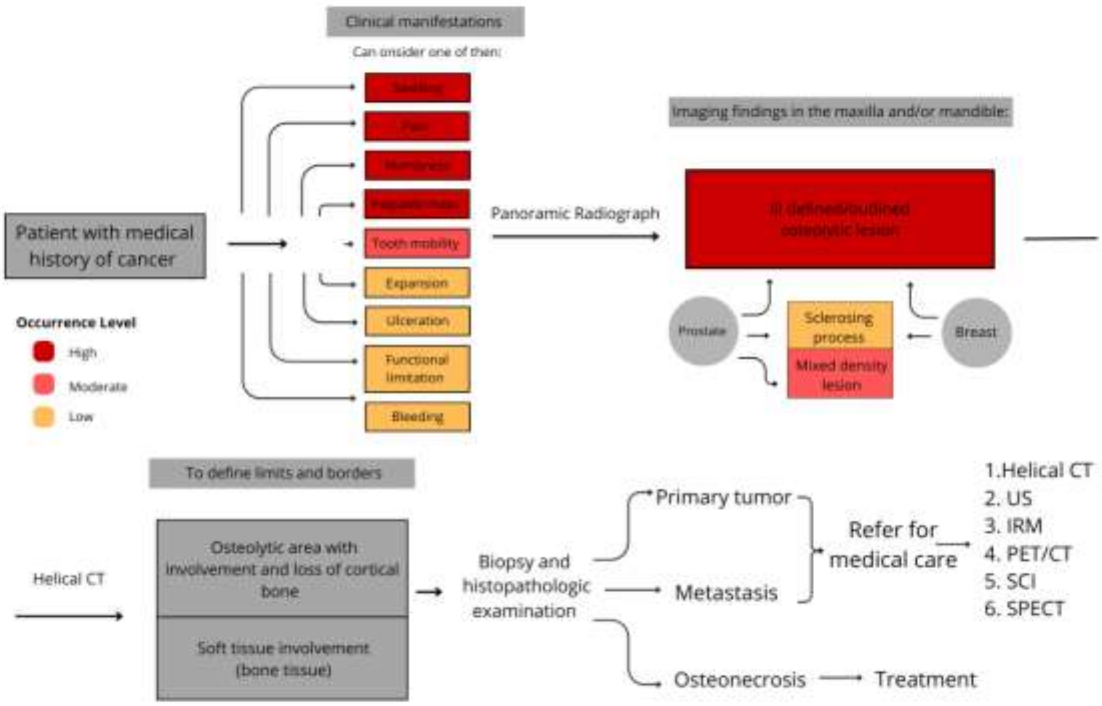
Evidence Map

Based on the results obtained, an evidence map was developed (Figure 2). During anamnesis, when a patient has a prior history of cancer and presents at least one clinical sign or symptom such as pain, swelling, numbness, bone expansion, ulceration, functional limitation, palpable mass, tooth mobility, or bleeding it is recommended that the dental surgeon request an initial panoramic radiograph. This exam should be compared with previous radiographic exams, when available, to allow a thorough evaluation of the maxillomandibular complex.

In the presence of a radiographic image suggestive of a poorly defined osteolytic lesion, the professional may refer the patient for HCT to enable a more detailed analysis of the lesions extent (margins and borders) and assess involvement of adjacent soft tissues. It is important to highlight that, in patients with specific primary neoplasms such as prostate and breast cancer, radiographic manifestations of metastases may vary, presenting not only as osteolytic lesions but also as mixed or sclerotic lesions in prostate cancer, and predominantly sclerotic lesions in breast cancer patients.

Following radiographic identification of the lesion, biopsy is essential for definitive diagnosis, considering the possibilities of bone metastasis, a new primary tumor, or osteonecrosis. In confirmed cases of osteonecrosis, treatment should follow current dental protocols. In cases of metastasis or new primary tumor, the patient must be referred for specialized medical evaluation and treatment. The oncologist may decide to request additional imaging modalities, such as HCT, US, MRI, PET/CT, scintigraphy and/or SPECT.

Figure 2: Diagnostic flowchart for patients with a medical history of cancer with clinical manifestations in the maxilla and/or mandible.



Source: Author.

DISCUSSION

Imaging techniques are considered an essential complementary role in the clinical examination, allowing the identification of suspicious radiographic signs and the assessment of their extent to guide therapeutic decisions (El Yacoubi et al., 2025; Glasspool et al, 2000; Kumar et al, 2021). Panoramic radiographs are the most common for the initial evaluation of the jaws due to their low cost, low radiation dose, and high patient acceptability (Sathyamoorthy et al, 2024). However, when malignancy is suspected on panoramic radiograph, a second-level radiological exam is necessary to accurately assess the lesion's location and morphology (Vettori et al, 2024), which corroborates the findings of the present study that demonstrated that panoramic radiograph was the most requested exam by dental practitioners. The panoramic radiograph was the primary imaging modality for the evaluation of metastatic lesions of the jaws (64.8%) in the presence of clinical manifestations in patients with a history of primary cancer, considerably aiding the identification of bone metastases. The imaging features consistent with metastases are predominantly radiolucent and ill defined (76.2%).

Periapical radiographs assist in diagnosing early features of pathological processes but often do not reveal clear radiographic signs of malignancy, which can delay definitive diagnosis (Evangelista et al, 2022). For example, in the study by Nevins et al. (1988), included in the present systematic review, a metastatic lesion in the mandible was mistaken for a periapical lesion of endodontic origin at the left second premolar. The lesion followed the mandibular canal path, was diffuse, and showed cortical bone disruption. The tooth had an extensive amalgam restoration and tested negative for pulp vitality (Nevins et al, 1988). An ill-defined/outlined osteolytic lesion in the posterior mandible should be considered a potential metastatic lesion in patients with a history of primary cancer (Carvalho Kimura et al, 2022; Khalili et al, 2010; Nevins et al, 1988).

Some studies included in the present systematic review employed HCT (20,6%) to define the margins and borders of metastatic lesion and determine the extent of soft tissue involvement (Kumar et al, 2021). In the study conducted by Yoshioka et al. (2009), no apparent lesions were identified on the patients' panoramic radiographs, whereas mandibular metastases from primary malignant tumors of the prostate and multiple myeloma were detected by HCT. According to Cavalcanti et al. (1998), HCT increases diagnostic accuracy by providing detailed visualization of the extent and margins of bone lesions. Volumetric reconstruction may contribute to the differentiation between metastatic lesions and other bone alterations, as well as to the identification of involvement of adjacent anatomical structures, complementing conventional imaging examinations and supporting clinical decision-making (Cavalcanti et al, 1998). The use of HCT is recommended in patients with a history of primary cancer who present with numbness in the lip and chin region for the diagnosis of Numb Chin Syndrome and metastases (Yoshioka et al, 2009).

Although no studies were found using CBCT for the assessment of metastases, its use has been increasing. The applications of CBCT in oral cancer treatment include image-guided radiotherapy, which allows rapid imaging and ensures precise radiation delivery, detection of bone invasion, and increased surgical accuracy by defining surgical margins and assessing treatment-related complications (Mohd

Nizar et al, 2025). CBCT demonstrated high sensitivity but low specificity in detecting bone invasion by tumors (Mohd Nizar et al, 2025). Additionally, it has limitations in evaluating soft tissues, which requires its association with MRI or HCT for a more comprehensive assessment (Mohd Nizar et al, 2025; Shah et al, 2010).

MRI offers advantages such as better characterization of the local tumor extent, evaluation of bone marrow involvement, and detection of perineural spread when compared to helical computed tomography (HCT) (Marcello Scotti et al, 2022). It is effective in diagnosing metastases, as they replace fatty marrow with hypointense tumor tissue, which was identified in bones with a high fat content (Vanel, 2004). Despite its applications, few studies included in this systematic review (6.3% of the sample) utilized MRI to assist in the diagnosis of metastases.

Nuclear Medicine imaging is a useful exam in the diagnosis and treatment of bone metastases, enabling detection of disease at early stages regarding metabolic patterns of the lesion. The predominant nuclear imaging technique used for managing bone metastases in this study was bone scintigraphy (25,39%). However, it has limitations, including lack of specificity and low sensitivity for osteolytic bone lesions (Ouvrard et al, 2024). The majority of studies that employed bone of increased tracer uptake in several locations of skeletal system, consistent with widespread, and near the jaw. The higher utilization rate is likely due to the inclusion of older studies. Positron emission tomography combined with computed tomography (PET/CT) evaluates both bone alterations and metabolic and anatomical data, commonly used for detecting metastases (Omami et al, 2014). In the present systematic review, the PET/CT (3,17%) showed a homogeneous tracer uptake in the whole lesion, with intense FDG concentration, demonstrating higher specificity than bone scintigraphy.

Metastases on panoramic radiographs generally appear as a radiolucent lesion with ill-defined borders associated with a soft tissue component, resembling a "moth-eaten" pattern. Periosteal reaction may also be observed (Vyas et al, 2017), where radiopaque lines radiate over the affected bone, resembling “sun rays”. Osteolytic metastasis is characterized by a “vicious cycle” in which osteoclasts, directly or indirectly activated by tumor cells, increase their function and cause abnormal bone resorption, leading to the release of bone matrix growth factors such as transforming growth factor beta (TGF-β) (Maroni et al, 2020). Due to their aggressive behavior, malignant intraosseous lesions promote bone resorption, with consequent compromise of adjacent dental support (Carvalho Kimura et al, 2022). In the present study, metastatic lesions predominantly presented with this pattern (76.2%) in panoramic radiograph. An exception was observed in patients with primary breast and prostate cancer, who, in addition to radiolucent images, also exhibited mixed and radiopaque lesions, similar to the study conducted by de Carvalho Kimura et al. (2022). This occurs because metastatic neoplasms from the breast and prostate stimulate bone formation (Magat et al, 2019). Osteocytes secrete pro-metastatic factors that promote tumor proliferation, migration, and invasion in breast and prostate cancer, especially in response to biomechanical changes in the bone (Maroni et al, 2020).

Based on the results mentioned, an evidence map was developed to guide dental surgeons in clinical decision-making and management of patients with possible metastases. Evidence mapping is a methodology designed to collect and disseminate up-to-date information to professionals (Hetrick et al, 2010), with the aim of identifying knowledge gaps and/or future research needs. The findings are presented in an accessible format, often as a figure or visual chart (Miake-Lye et al, 2016).

This study presented certain limitations, including the overall quality of the included studies despite the use of the Joanna Briggs Institute appraisal tool the lack of complete information in case reports and case series, and the retrospective nature of many studies. Case reports and case series inherently carry a risk of publication bias. Variability in clinical and imaging descriptions, as well as the frequent absence of comprehensive data, may affect the reliability of the findings (Carvalho Kimura et al, 2022).

CONCLUSIONS

The results of this systematic review demonstrated that panoramic radiograph can be considered a primary imaging technique in the initial identification of bone metastases in the oral and maxillofacial region. Panoramic radiograph and HCT imaging most commonly presented as osteolytic lesions, with exceptions in cases of primary breast, which may also appear as sclerotic, and prostate tumors, which may also appear as sclerotic or mixed lesions.

Also, HCT imaging and MRI are essential for determining the involvement and extension of soft tissue. Bone scintigraphy showed increased tracer uptake near the affected jaw, and despite being more used in the studies, it demonstrated lower specificity compared to PET/CT. The PET/CT showed a homogeneous tracer uptake in the whole lesion. Different imaging modalities support early diagnosis, treatment planning, postoperative evaluation, and the detection of possible recurrences of metastatic lesions.

Therefore, it is essential that dental surgeons remain vigilant during clinical and imaging evaluations, particularly in patients with a history of cancer, as early detection of metastatic lesions may positively influence prognosis and treatment planning.

REFERENCES

ALBERS, D. D. Adenocarcinoma of the prostate, metastatic to the mandible: report of case. **Journal of the American Dental Association**, Chicago, v. 81, n. 4, p. 883-886, 1970. Disponível em: https:// doi: 10.14219/jada.archive.1970.0326. Acesso em: 14 maio. 2025.

ATARBASHI-MOGHADAM, S.; ATARABASHI-MOGHADAM, F.; NIAZMAND, M.; SHAHRABI-FARAHANI, S. Metastatic sarcomas of the oral cavity: a systematic review. **Journal of Stomatology, Oral and Maxillofacial Surgery**, Paris, v. 125, n. 2, p. 101656, 2024. Disponível em: https:// doi: 10.1016/j.jormas.2023.101656. Acesso em: 16 maio. 2025.

BOMBECCARI, G. P. et al. Accuracy of the cone beam computed tomography in the detection of bone invasion in patients with oral cancer: a systematic review. **Eurasian Journal of Medicine**, Erzurum, v. 51, n. 3, p. 298-306, 2019. Disponível em: https:// doi: 10.5152/eurasianjmed.2019.18101. Acesso em: 14 maio. 2025.

BUCIN, E.; ANDRÉASSON, L.; BJORLIN, G. Metastases in the oral cavity: case reports. **Journal of Oral and Maxillofacial Surgery**, Copenhagen, v. 11, n. 5, p. 321-325, 1982. Disponível em: https:// doi: 10.1016/S0300-9785(82)80033-1. Acesso em: 20 maio. 2025.

CARMICHAEL, F. A.; MITCHELL, D. A.; DYSON, D. P. Two contrasting radiological presentations of prostatic adenocarcinoma in the jaws. **Dentomaxillofacial Radiology**, London, v. 25, n. 5, p. 283-286, 1996. Disponível em: https:// doi: 10.1259/dmfr.25.5.9161183. Acesso em: 20 maio. 2025.

CARROLL, M. K.; KROLLS, S. O.; MOSCA, N. G. Metastatic carcinoma to the mandible: report of two cases. **Oral Surgery, Oral Medicine, Oral Pathology**, St. Louis, v. 76, n. 3, p. 368-374, sep., 1993. Disponível em: https:// doi: 10.1016/0030-4220(93)90270-e. Acesso em: 20 maio. 2025.

CARVALHO KIMURA, T. et al. Oral metastasis as the first indication of undiscovered malignancy at a distant site: a systematic review of 413 cases. **Head & Neck, Hoboken,** v. 44, n. 7, p. 1715-1724, 2022. Disponível em: https:// doi: 10.1002/hed.27041. Acesso em: 20 maio. 2025.

CASH, C. D.; ROYER, R. Q.; DAHLIN, D. C. Metastatic tumors of the jaws. Oral Surgery, **Oral Medicine, Oral Pathology**, St. Louis, v. 14, p. 897-905, 1961. Disponível em: https:// doi: 10.1016/0030-4220(61)90001-9. Acesso em: 20 maio. 2025.

CASTIGLIANO, S. G.; ROMINGER, C. J. Metastatic malignancy of the jaws. **American Journal of Surgery**, New York, v. 87, n. 4, p. 496-507, 1954. Disponível em: https:// doi: 10.1016/0002-9610(54)90410-9. Acesso em: 20 maio. 2025.

CAVALCANTI, M. G.; VANNIER, M. W. The role of three-dimensional spiral computed tomography in oral metastases. **Dentomaxillofacial Radiology**, London, v. 27, n. 4, p. 203-208, 1998. Disponível em: https:// doi: 10.1038/sj/dmfr/4600348. Acesso em: 10 jan. 2026.

CLAUSEN, F.; POULSEN, H. Metastatic carcinoma of the jaws. **Acta Pathologica et Microbiologica Scandinavica**, Copenhagen, v. 57, p. 361-374, 1963. Disponível em: https:// doi: 10.1111/j.1699-0463.1963.tb05105.x. Acesso em: 25 jun. 2025.

COHEN, B. Secondary tumours of the mandible. **Annals of the Royal College of Surgeons of England**, London, v. 23, n. 2, p. 118-130, 1958. Acesso em: 25 maio. 2025.

CURTIN, J.; RADDEN, B. G. Mandibular metastasis from a primary adenocarcinoma of the fallopian tube. **Journal of Oral and Maxillofacial Surgery**, Philadelphia, v. 43, n. 8, p. 636-638, 1985. Disponível em: https:// doi: 10.1016/0278-2391(85)90138-7. Acesso em: 25 jun. 2025.

DIVYA, K. S.; MORAN, N. A.; ATKIN, P. A. Numb chin syndrome: a case series and discussion. **British Dental Journal,** London, v. 208, n. 4, p. 157-160, 2010. Disponível em: https:// doi: 10.1038/sj.bdj.2010.157. Acesso em: 25 jun. 2025.

EL YACOUBI, O.; TALEB, B.; DGHOUGHI, S. Early detection of jaw malignancies: insights from three clinical case reports for dental professionals. **Cureus**, Palo Alto, v. 17, n. 5, e84174, 2025. Disponível em: https:// doi: 10.7759/cureus.84174. Acesso em: 20 jun. 2025.

EVANGELISTA, K. et al. Malignant tumours mimicking periapical lesions: a report of three cases and literature review. **Australian Endodontic Journal**, Hoboken, v. 48, n. 3, p. 515-521, 2022. Disponível em: https:// doi: 10.1111/aej.12597. Acesso em: 20 jun. 2025.

FIGUEIREDO, P. T. et al. Comparison between computed tomography and clinical evaluation in tumour/node stage and follow-up of oral cavity and oropharyngeal cancer. **Dentomaxillofacial Radiology**, London, v. 39, n. 3, p. 140-148, 2010. Disponível em: https:// doi: 10.1259/dmfr/69910245. Acesso em: 20 jun. 2025.

FRIEDRICH, R. E.; ABADI, M. Distant metastases and malignant cellular neoplasms encountered in the oral and maxillofacial region: analysis of 92 patients treated at a single institution. **Anticancer Research**, Athens, v. 30, n. 5, p. 1843-1848, 2010. Acesso em: 20 maio. 2025.

FRIEDRICH, R. E.; MADANI, E. Consolidation of tumorous mandibular ramus defect during denosumab treatment for rapidly progressive metastatic breast cancer. **Anticancer Research**, Athens, v. 41, n. 10, p. 5081-5087, 2021. Disponível em: https:// doi: 10.21873/anticanres.15324. Acesso em: 20 maio. 2025.

GAGNIER, J. J. et al. The CARE guidelines: consensus-based clinical case reporting guideline development. **Headache**, Hoboken, v. 53, n. 10, p. 1541-1547, 2013. Disponível em: https:// doi: 10.1111/head.12246. Acesso em: 20 jun. 2025.

GALEN, D. M. Mandibular metastasis of endometrial carcinoma diagnosed via a dental radiograph. **Journal of the American Dental Association**, Chicago, v. 129, n.

11, p. 1595-1598, 1998. Disponível em: https:// doi: 10.14219/jada.archive.1998.0106. Acesso em: 20 maio. 2025.

GEORGE, R. et al. Metastatic tumour to the mandible – a diagnostic and management dilemma. **Cureus**, Palo Alto, v. 11, n. 7, e5093, 2019. Disponível em: https:// doi: 10.7759/cureus.5093. Acesso em: 20 maio. 2025.

GLASER, C. et al. Clinical manifestations and diagnostic approach to metastatic cancer of the mandible. **International Journal of Oral and Maxillofacial Surgery**, Copenhagen, v. 26, n. 5, p. 365-368, 1997. Disponível em: https:// doi: 10.1016/s0901-5027(97)80798-9. Acesso em: 20 maio. 2025.

GLASSPOOL, R. M.; EVANS, T. R. Clinical imaging of cancer metastasis. European **Journal of Cancer**, Oxford, v. 36, n. 13, p. 1661-1670, 2000. Disponível em: https:// doi: 10.1016/s0959-8049(00)00154-4. Acesso em: 20 maio. 2025.

GOBEL, Y.; VALETTE, G.; ABGRAL, R.; CLODIC, C.; MORNET, E.; POTARD, G. et al. Interpretation of suspect head and neck fixations seen on PET/CT in lung cancer. **European Annals of Otorhinolaryngology, Head and Neck Diseases**, Paris, v. 131, n. 4, p. 217-221, 2014. Disponível em: https:// doi: 10.1016/j.anorl.2013.06.004. Acesso em: 20 maio. 2025.

HETRICK, S. E. et al. Evidence mapping: illustrating an emerging methodology to improve evidence-based practice. **Journal of Evaluation in Clinical Practice**, Hoboken, v. 16, n. 6, p. 1025-1030, 2010. Disponível em: https:// doi: 10.1111/j.1365-2753.2008.01112.x. Acesso em: 20 maio. 2025.

ISSING, P. R.; KETTLING, T.; KEMPF, H. G.; HEERMANN, R.; LENARZ, T. Sonographische Dignitätsbeurteilung von Halslymphknoten unter besonderer Berücksichtigung der Farbdopplersonographie. **Laryngorhinootologie**, Stuttgart, v. 78, n. 10, p. 566-572, 1999. Disponível em: https:// doi: 10.1055/s-1999-9181. Acesso em: 20 maio. 2025.

KADER, I.; LEAVERS, B.; SHASHINDER, S.; WYLIE, B.; CHI, K. K.; SUNDARESAN, P. Synchronous or metachronous lymphoma and metastatic cutaneous squamous cell carcinoma in the head and neck region: a diagnostic and management dilemma. **Journal of Laryngology and Otology**, London, v. 130, Suppl. 4, p. S45-S49, 2016. Disponível em: https:// doi: 10.1017/S002221511600832X. Acesso em: 20 jun. 2025.

KHALIL, H.; TRICCO, A. C. Differentiating between mapping reviews and scoping reviews in the evidence synthesis ecosystem. **Journal of Clinical Epidemiology**, Oxford, v. 149, p. 175-182, 2022. Disponível em: https:// doi: 10.1016/j.jclinepi.2022.05.012. Acesso em: 20 jun. 2025.

KHALILI, M.; MAHBOOBI, N.; SHAMS, J. Metastatic breast carcinoma initially diagnosed as pulpal/periapical disease: a case report. **Journal of Endodontics**, Chicago, v. 36, n. 5, p. 922-925, 2010. Disponível em: https:// doi: 10.1016/j.joen.2010.01.010. Acesso em: 20 jun. 2025.

KIRSCHNICK, L. B. et al. Metastasis to the oral and maxillofacial region: a systematic review. **Oral Diseases**, Hoboken, v. 28, n. 1, p. 23-32, 2022. Disponível em: https:// doi: 10.1111/odi.13611. Acesso em: 20 maio. 2025.

KUMAR, G.; MANJUNATHA, B. Metastatic tumors to the jaws and oral cavity. **Journal of Oral and Maxillofacial Pathology**, Mumbai, v. 17, n. 1, p. 71-75, 2013. Disponível em: https:// doi: 10.4103/0973-029X.110737. Acesso em: 20 jun. 2025.

KUMAR, J.; VANAGUNDI, R.; MANCHANDA, A.; MOHANTY, S.; MEHER, R. Radiolucent jaw lesions: imaging approach. **Indian Journal of Radiology and Imaging**, Mumbai, v. 31, n. 1, p. 224-236, jan./mar., 2021. Disponível em: https:// doi: 10.1055/s-0041-1729769. Acesso em: 20 jun. 2025.

LABRADOR, A. J. P.; MARIN, N. R. G.; VALDEZ, L. H. M.; SANCHEZ, K. B. T.; ZABARBURU, W.; IBAZETTA, K. A. R. et al. Metastasis to the oral and maxillofacial region: a systematic review. **Journal of Stomatology, Oral and Maxillofacial Surgery**, Paris, v. 123, n. 5, p. e474-e483, 2022. Disponível em: https:// doi: 10.1016/j.jormas.2021.12.009. Acesso em: 20 jun. 2025.

LAGA, E. A. Jr.; TOTH, B. B.; PODOLOFF, D. A.; KEENE, H. J. Clinical correlation of oral-dental findings with radiographs and with total body bone scans. Oral Surgery, Oral Medicine, **Oral Pathology**, St. Louis, v. 75, n. 2, p. 253-263, 1993. Disponível em: https:// doi: 10.1016/0030-4220(93)90102-a. Acesso em: 20 maio. 2025.

LAURENCET, F. M.; ANCHISI, S.; TULLEN, E.; DIETRICH, P. Y. Mental neuropathy: report of five cases and review of the literature. **Critical Reviews in Oncology/Hematology**, Amsterdam, v. 34, n. 1, p. 71-79, 2000. Disponível em: https:// doi: 10.1016/s1040-8428(00)00050-0. Acesso em: 20 maio. 2025.

LO CASTO, A. et al. Diagnostic and prognostic value of magnetic resonance imaging in the detection of tumor depth of invasion and bone invasion in patients with oral cavity cancer. **La Radiologia Medica**, Milan, v. 127, n. 12, p. 1364-1372, 2022. Disponível em: https:// doi: 10.1007/s11547-022-01565-7. Acesso em: 20 maio. 2025.

LOPES, A. M.; FREITAS, F.; VILARES, M.; CARAMÊS, J. Metastasis of malignant tumors to the oral cavity: systematic review of case reports and case series. **Journal of Stomatology**, Oral and Maxillofacial Surgery, Paris, v. 124, n. 1, p. 101330, feb., 2023. Disponível em: https:// doi: 10.1016/j.jormas.2022.11.006. Acesso em: 20 maio. 2025.

MAGAT, G.; SENER, S. O.; CETMILI, H. Metastatic breast cancer to bilateral mandibular ramus regions**. Journal of Cancer Research and Thera**peutics, Mumbai, v. 15, n. 5, p. 1177-1180, 2019. Disponível em: https:// doi: 10.4103/jcrt.JCRT_447_17. Acesso em: 20 maio. 2025.

MARCELLO SCOTTI, F.; STUEPP, R. T.; LEONARDI DUTRA-HORSTMANN, K.; MODOLO, F.; GUSMÃO PARAISO CAVALCANTI, M. Accuracy of MRI, CT, and ultrasound imaging on thickness and depth of oral primary carcinomas invasion: a systematic review. **Dentomaxillofacial Radiology**, London, v. 51, n. 5, p. 20210291, jul., 2022. Disponível em: https:// doi: 10.1259/dmfr.20210291. Acesso em: 10 jan. 202.

MARONI, P.; BENDINELLI, P. Bone, a secondary growth site of breast and prostate carcinomas: role of osteocytes. **Cancers**, Basel, v. 12, n. 7, 1812, 2020. Disponível em: https:// doi: 10.3390/cancers12071812. Acesso em: 20 jun. 2025.

MARTIS, C.; KARAKASIS, D.; LAZARIDIS, N. Metastatic adenocarcinoma to the mandible: report of case. **Journal of the American Dental Association**, Chicago, v.

94, n. 6, p. 1163-1165, jun., 1977. Disponível em: https:// doi: 10.14219/jada.archive.1977.0388. Acesso em: 20 maio. 2025.

MAST, H. L.; NISSENBLATT, M. J. Metastatic colon carcinoma to the jaw: a case report and review of the literature. **Journal of Surgical Oncology**, New York, v. 34, n. 3, p. 202-207, mar., 1987. Disponível em: https:// doi: 10.1002/jso.2930340316. Acesso em: 20 maio. 2025.

MATSUDA, S. et al. Mandibular metastasis as the first clinical indication of occult lung adenocarcinoma with multiple metastases: a case report. **Medicine**, Baltimore, v. 97, n. 15, e0296, 2018. Disponível em: https:// doi: 10.1097/MD.0000000000010296. Acesso em: 20 jun. 2025.

MAXYMIW, W. G.; WOOD, R. E. Metastatic endometrial carcinoma to the mandible: a case report. **Journal of Oral and Maxillofacial Surgery**, Philadelphia, v. 49, n. 1, p. 78-80, jan., 1991. Disponível em: https:// doi: 10.1016/0278-2391(91)90271-m. Acesso em: 20 maio. 2025.

MEYER, I.; SHKLAR, G. Malignant tumors metastatic to mouth and jaws. **Oral Surgery, Oral Medicine, Oral Pathology**, St. Louis, v. 20, p. 350-362, sep., 1965. Disponível em: https:// doi: 10.1016/0030-4220(65)90167-2. Acesso em: 20 maio. 2025.

MIAKE-LYE, I. M.; HEMPEL, S.; SHANMAN, R.; SHEKELLE, P. G. What is an evidence map? A systematic review of published evidence maps and their definitions, methods, and products. **Systematic Reviews**, London, v. 5, p. 28, feb., 2016. Disponível em: https:// doi: 10.1186/s13643-016-0204-x. Acesso em: 20 jul. 2025.

MOHD NIZAR, M. A.; NABIL, S. Cone beam computed tomography in oral cancer: a scoping review. **Diagnostics**, Basel, v. 15, n. 11, p. 1378, may, 2025. Disponível em: https:// doi: 10.3390/diagnostics15111378. Acesso em: 20 jul. 2025.

MOOLA, S.; MUNN, Z.; TUFANARU, C.; AROMATARIS, E.; SEARS, K.; SFETCU, R. et al. Systematic reviews of etiology and risk. In: AROMATARIS, E.; MUNN, Z. (org.). **Joanna Briggs Institute Reviewer's Manual. Adelaide:** The Joanna Briggs Institute, 2017. cap. 7. Disponível em: https:// https://doi.org/10.46658/jbirm-17-06. Acesso em: 20 jul. 2025.

NEVINS, A. et al. Metastatic carcinoma of the mandible mimicking periapical lesion of endodontic origin. **Endodontics & Dental Traumatology, Copenhagen**, v. 4, n. 5, p. 238-239, 1988. Disponível em: https:// doi: 10.1111/j.1600-9657.1988.tb00329.x. Acesso em: 20 jan. 2025.

OGÜTCEN-TOLLER, M.; METIN, M.; YILDIZ, L. Metastatic breast carcinoma mimicking periodontal disease on radiographs. **Journal of Clinical Periodontology**, Copenhagen, v. 29, n. 3, p. 269-271, mar., 2002. Disponível em: https:// doi: 10.1034/j.1600-051x.2002.290314.x. Acesso em: 20 jan. 2025.

OMAMI, G.; TAMIMI, D.; BRANSTETTER, B. F. Basic principles and applications of (18)F-FDG-PET/CT in oral and maxillofacial imaging: a pictorial essay. **Imaging Science in Dentistry**, Seoul, v. 44, n. 4, p. 325-332, dec., 2014. Disponível em: https:// doi: 10.5624/isd.2014.44.4.325. Acesso em: 20 jan. 2025.

OUVRARD, E. et al. Nuclear medicine imaging for bone metastases assessment: what else besides bone scintigraphy in the era of personalized medicine? **Frontiers in Medicine**, Lausanne, v. 10, 1320574, 2024. Disponível em: https:// doi: 10.3389/fmed.2023.1320574. Acesso em: 20 jul. 2025.

PAGE, M. J.; MCKENZIE, J. E.; BOSSUYT, P. M.; BOUTRON, I.; HOFFMANN, T. C.; MULROW, C. D. et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. **BMJ**, London, v. 372, p. n71, mar., 2021. Disponível em: https:// doi: 10.1136/bmj.n71. Acesso em: 21 jun. 2025.

PAKFETRAT, A. et al. Tumor metastasis to the oral soft tissues and jaw bones: a retrospective study and review of the literature. **Clinical and Experimental Dental Research**, Hoboken, v. 10, n. 6, e70011, 2024. Disponível em: https:// doi: 10.1002/cre2.70011. Acesso em: 20 maio. 2025.

PRUCKMAYER, M.; GLASER, C.; NASEL, C.; LANG, S.; RASSE, M.; LEITHA, T. Bone metastasis with superimposed osteomyelitis in prostate cancer. **Journal of Nuclear Medicine**, New York, v. 37, n. 6, p. 999-1001, jun., 1996. Acesso em: 20 maio. 2025.

SATHYAMOORTHY, H.; KUCHIBHOTLA, N.; KUMAR, M.; SMRITI, K.; PENTAPATI, K. C.; GEORGE, V. T. et al. Utility of panoramic radiographs in the screening of individuals with edentulous arches: a need-analysis study. **Pesquisa Brasileira em Odontopediatria e Clínica Integrada**, João Pessoa, v. 24, p. e210105, 2024. Disponível em: https:// doi.org/10.1590/pboci.2024.007. Acesso em: 20 jul. 2025.

SAVITHRI, V.; SURESH, R.; JANARDHANAN, M.; ARAVIND, T. Metastatic adenocarcinoma of mandible: in search of the primary. **BMJ Case Reports**, London, v. 11, n. 1, p. e227862, dec., 2018. Disponível em: https:// doi: 10.1136/bcr-2018-227862. Acesso em: 20 maio. 2025.

SHAH, N.; BANSAL, N.; LOGANI, A. Recent advances in imaging technologies in dentistry. **World Journal of Radiology**, Hong Kong, v. 6, n. 10, p. 794-807, oct., 2014. Disponível em: https:// doi: 10.4329/wjr.v6.i10.794. Acesso em: 20 maio. 2025.

SHAH, D.; SHETTY, S.; MACBEAN, A. D.; OLLEY, S. F. Numb chin syndrome: a metastatic deposit in the mandible. **Dental Update**, London, v. 37, n. 4, p. 244-246, may, 2010. Disponível em: https:// doi: 10.12968/denu.2010.37.4.244. Acesso em: 20 maio. 2025.

SOM, P. M.; NORTON, K. I.; SHUGAR, J. M.; REEDE, D. L.; NORTON, L.; BILLER, H. F. et al. Metastatic hypernephroma to the head and neck. **American Journal of Neuroradiolog**y, Oak Brook, v. 8, n. 6, p. 1103-1106, nov./dec., 1987. Acesso em: 20 maio. 2025.

STOCKDALE, C. R. Metastatic carcinoma of the jaws secondary to primary carcinoma of the breast. Oral Surgery, Oral Medicine, **Oral Pathology**, St. Louis, v. 12, p. 1095-1101, sep., 1959. Disponível em: https:// doi: 10.1016/0030-4220(59)90319-6. Acesso em: 20 maio. 2025.

VANEL, D. MRI of bone metastases: the choice of the sequence. **Cancer Imaging**, London, v. 4, n. 1, p. 30-35, mar., 2004. Disponível em: https:// doi: 10.1102/1470-7330.2003.0029. Acesso em: 20 maio. 2025.

VETTORI, E.; BORELLA, A.; COSTANTINIDES, F.; RIZZO, R.; MAGLIONE, M. Mandibular metastasis of pulmonary adenocarcinoma: how unexpected could it be? **Gerodontology**, Hoboken, v. 41, n. 2, p. 283-288, jun., 2024. Disponível em: https:// doi: 10.1111/ger.12707. Acesso em: 20 maio. 2025.

VIGNEUL, J. C.; NOUEL, O.; KLAP, P.; AL HELALI, M. Metastatic hepatocellular carcinoma of the mandible. **Journal of Oral and Maxillofacial Surgery**, Philadelphia, v. 40, n. 11, p. 745-749, nov., 1982. Disponível em: https:// doi: 10.1016/0278-2391(82)90152-5. Acesso em: 20 maio. 2025.

VYAS, R. R.; SONI, H. C.; BHALODIA, A. C.; SISODIYA, D. J. Malignant lesions of mandible on orthopantomogram: our experience. **Journal of Evidence Based Medicine and Healthcare**, Ahmedabad, v. 4, n. 24, p. 1407-1413, mar., 2017. Disponível em: https:// doi: 10.18410/jebmh/2017/274. Acesso em: 20 jun. 2025.

WILLIAMS, S. P.; KINSHUCK, A. J.; WILLIAMS, C.; DWIVEDI, R.; WIESHMANN, H.; JONES, T. M. Incidental head and neck findings on 18F-fluoro-deoxy-glucose positron emission tomography computed tomography. **Journal of Laryngology and Otolog**y, London, v. 129, n. 9, p. 898-902, sep., 2015. Disponível em: https:// doi: 10.1017/S0022215115001826. Acesso em: 20 jun. 2025.

YFANTI, Z.; TETRADIS, S.; NIKITAKIS, N. G.; ALEXIOU, K. E.; MAKRIS, N.; ANGELOPOULOS, C. et al. Radiologic findings of osteonecrosis, osteoradionecrosis, osteomyelitis and jaw metastatic disease with cone beam CT. **European Journal of Radiology**, Amsterdam, v. 165, p. 110916, aug., 2023. Disponível em: https:// doi: 10.1016/j.ejrad.2023.110916. Acesso em: 20 jun. 2025.

YOSHIMURA, Y.; MATSUDA, S.; NAITOH, S. Hepatocellular carcinoma metastatic to the mandibular ramus and condyle: report of a case and review of the literature. **Journal of Oral and Maxillofacial Surgery**, Philadelphia, v. 55, n. 3, p. 297-306, mar., 1997. Disponível em: https:// doi: 10.1016/s0278-2391(97)90547-4. Acesso em: 20 maio. 2025.

YOSHIOKA, I.; SHIIBA, S.; TANAKA, T.; NISHIKAWA, T.; SAKAMOTO, E.; KITO, S. et al. The importance of clinical features and computed tomographic findings in numb chin syndrome: a report of two cases. **Journal of the American Dental Association**, Chicago, v. 140, n. 5, p. 550-554, may, 2009. Disponível em: https:// doi: 10.14219/jada.archive.2009.0224. Acesso em: 20 maio. 2025.