

Investigation of the Internal Structure and Radiological Characteristics of Distant Metastases to the Jaws: A Retrospective Study

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Abstract

Aim Distant metastases to the jaws are uncommon but carry a grave prognosis, with an average survival of only a few months. This study aimed to investigate the internal structure and radiological features of metastatic lesions in the jaws, as well as their clinical presentations, to better understand their diagnostic characteristics and guide appropriate management.

Material and method Among 4,908 patients who underwent cone beam computed tomography (CBCT), 14 cases with histopathologically confirmed metastatic tumors to the jaws were identified. Clinical data, imaging modalities (orthopantomography, CBCT, magnetic resonance imaging, ultrasound), and histopathological findings were reviewed. The primary tumor sites, radiographic appearances (osteolytic vs. osteoblastic lesions), and histopathological patterns were examined.

Results Thirteen lesions were located in the mandible and one in the maxilla. The most common primary tumors originated from the breast, prostate, lung, kidney, and colon. While breast and prostate metastases appeared mostly as sclerotic (radiopaque) lesions, lung, kidney, and colon metastases typically presented as osteolytic (radiolucent) defects. In some cases, pathologic fractures and cortical destruction were evident. Histopathological evaluation confirmed metastatic carcinoma in all cases, demonstrating characteristic osteoblastic activity in breast and prostate cancers.

Conclusion Recognizing the radiological and histopathological features of distant metastases to the jaws is crucial for prompt diagnosis, accurate identification of the primary tumor, and appropriate treatment planning. Awareness of these lesions aids clinicians in differentiating metastases from other jaw pathologies and underscores the importance of multidisciplinary collaboration.

Keywords Cone-Beam computed tomography, Diagnostic imaging, Jaw neoplasms, Neoplasm metastasis, Oral cancer

Introduction

Metastatic tumors involving the jaws are quite rare, accounting for less than 1% of all malignancies affecting the oral cavity. Despite their low incidence, such lesions pose a significant clinical challenge due to their frequently aggressive behavior and poor prognosis—reports indicate an average survival of roughly seven months following diagnosis (1-7). The mandible is more commonly affected than the maxilla, which has been attributed to its richer vascular supply and higher concentration of hematopoietic marrow (1, 3, 5-7).

Metastases can originate from various primary tumors, most notably the breast, prostate, lung, kidney, and colon (2-9). These lesions often present with nonspecific symptoms such as pain, paresthesia, swelling, and sometimes pathologic fractures, thus mimicking common odontogenic conditions like periapical

abscesses or benign tumors (1, 2, 4, 6, 7, 9).

Radiologically, metastatic lesions can manifest as osteolytic or osteoblastic defects. Breast and prostate cancers frequently induce osteoblastic changes, while lung, kidney, and colon cancers tend to result in osteolytic lesions (2-6). Proper recognition of these patterns, combined with histopathological confirmation, is essential for timely diagnosis. This study provides an overview of the radiological features of distant metastases to the jaws, with the aim of increasing clinician awareness and improving early detection.

Material and Methods

Study design and study population

A retrospective review was conducted using the patient database of the Department of Oral and Maxillofacial Radiology, covering the period from January 2016 to December 2020. During this time, 4,908 patients underwent Cone-Beam Computed Tomography (CBCT) for various clinical indications. Among these, 14 patients were identified with histopathologically confirmed metastatic lesions in the jaws.

Patients were included if they had radiological evidence of metastatic lesions in the jaws (confirmed through CBCT, orthopantomography [OPG], magnetic resonance imaging [MRI], or ultrasound [US]), sufficient clinical data indicating a definitive primary tumor diagnosis, and histopathological confirmation of metastatic carcinoma. Patients with benign primary tumors, pri-

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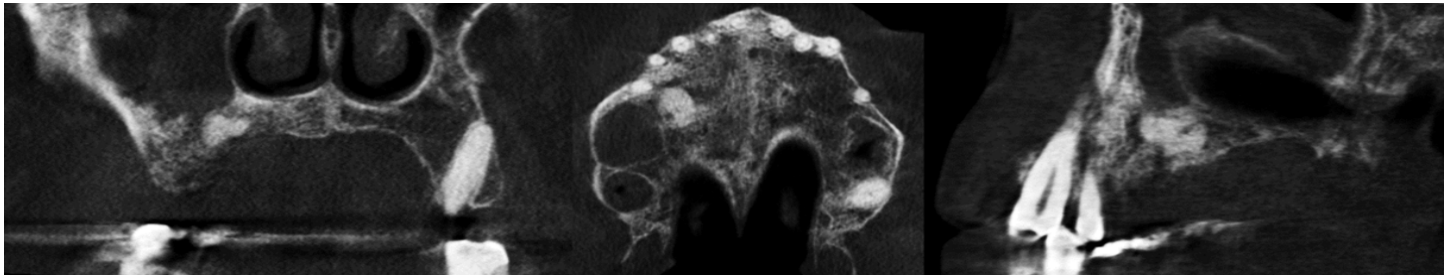


Figure 1: CBCT images showing a prostate cancer metastasis in the maxilla. The lesion demonstrates a hyperdense internal structure with ill-defined borders. Destruction of the floor of the maxillary sinus is evident and closely associated with the lesion.

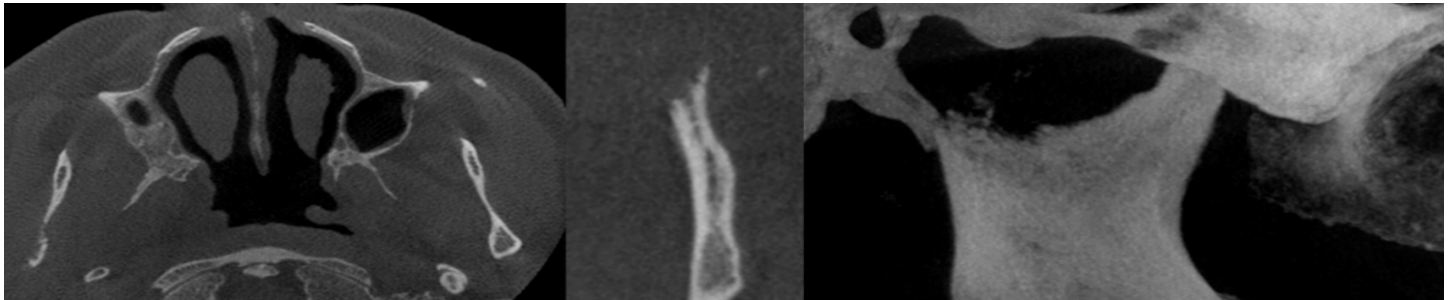


Figure 2: CBCT images demonstrating a lung cancer metastasis involving the right condyle. The lesion is hypodense with significant bone destruction, and an associated pathologic fracture.

many malignant tumors originating within the jaws, or incomplete imaging or clinical data were excluded from the analysis.

Data Collection

The following parameters were collected and analyzed for each patient: age, sex, primary tumor location, metastatic lesion location in the jaws, and the radiological characteristics of the metastatic lesions (including their internal structure—osteoblastic or osteolytic—and peripheral structure—well-defined or ill-defined borders). Histopathological diagnoses of the lesions were retrieved from the database to confirm metastatic carcinoma and provide details of tumor morphology. Additionally, clinical findings such as paresthesia, pain, swelling, pathologic fractures, and soft tissue involvement were documented to provide a comprehensive overview of each case.

Results

Demographics

A total of 14 patients (10 males, 4 females) aged between 51 and 75 years were identified with metastatic tumors in the jaws. Thirteen of these lesions involved the mandible, whereas one was located in the maxilla.

Primary Tumor Sites

The most common primary tumors identified in this study were prostate cancer and lung cancer, each accounting for four cases. Breast cancer was the next most frequent, with three cases observed. Colon cancer contributed two cases, while renal cell carcinoma was identified in a single patient. These findings highlight the diverse origins of metastatic lesions to the jaws, with a predominance of cancers commonly associated with skeletal metastases.

Clinical Presentations

In our series, the most frequently observed clinical presentations included paresthesia and anesthesia in the lower lip and chin region, particularly in cases where the mandible was involved. Pathologic fractures occurred mainly in advanced lesions arising from lung and colon cancers. Nearly all patients presented with swelling, pain, and varying degrees of local bone expansion; in four cases, the destructive process progressed to the extent that soft tissue masses extended into the oral cavity.

Radiological Features

Radiologically, sclerotic or osteoblastic lesions were most often associated with prostate and breast metastases. On OPG and CBCT, these lesions appeared as poorly defined radiopaque or mixed radiolucent-radiopaque defects, sometimes accompanied by spiculated periosteal reactions or a Codman's triangle, both indicative of an aggressive periosteal response (Figure 1). In contrast, osteolytic or radiolucent lesions predominated in metastatic tumors originating from the lung, kidney, or colon. These lesions were characterized by significant bone destruction with irregular, ill-defined borders and visible cortical perforation. MRI often demonstrated infiltration into surrounding soft tissues, highlighting the destructive potential of these metastases (Figure 2).

Discussion

The rarity of jaw metastases demands heightened clinical suspicion, especially when patients present with unexplained jaw pain, paresthesia, or non-healing extraction sites. In the present cohort, the mandible was the predominant site of metastasis, consistent with previous findings attributing this pattern to its robust vascular supply (1, 2, 4, 6, 7, 9).

Metastatic involvement from breast and prostate pri-

maries often produces sclerotic (radiopaque) or mixed radiolucent-radiopaque lesions in the jaw, paralleling the osteoblastic activity typically observed in their axial skeletal metastases. This characteristic can provide a vital diagnostic clue, especially in patients with a known history of breast or prostate cancer (1, 4, 6, 8, 9).

Lung, kidney, and colon metastases typically exhibit osteolytic lesions, leading to radiolucent appearances on OPG and CBCT. These often display aggressive features such as ill-defined borders and cortical destruction, extending into the surrounding soft tissues. Paresthesia is especially common in mandibular lesions, possibly due to involvement of the inferior alveolar nerve (1, 4, 6, 8, 9).

These findings underscore the importance of a thorough clinical evaluation and the inclusion of advanced imaging techniques, such as PET/CT, to screen for metastatic disease. PET/CT offers functional data on metabolic activity, enabling the detection of smaller or occult metastases in both the jaws and distant sites. MRI likewise remains invaluable for assessing soft tissue extension, marrow involvement, and neurovascular compromise. The combined use of multiple imaging modalities improves diagnostic accuracy, allowing clinicians to distinguish metastatic lesions from benign pathologies and thus facilitating prompt intervention (1, 10, 11).

Another crucial consideration in managing jaw metastases is the coordination of care among multiple specialties, including medical oncologists, radiation oncologists, and oral and maxillofacial surgeons. Treatment often entails systemic therapy aimed at the primary cancer site, alongside local interventions such as radiation therapy or surgical resection for symptom palliation and to prevent further skeletal complications. Given the high morbidity and poor prognosis associated with jaw metastases, early detection, a multidisciplinary treatment approach, and attentive follow-up are essential to optimize patient outcomes (11-13).

Finally, these observations emphasize the critical need for clinicians to maintain an index of suspicion for metastatic disease in older adults presenting with atypical jaw lesions, even those initially suggestive of benign odontogenic pathologies. Early detection, guided by radiographic findings and confirmed by histopathology, can prompt timely intervention and may provide an opportunity to identify or monitor an underlying primary malignancy.

Conclusion

Distant metastases to the jaws remain a diagnostic challenge due to their relatively low incidence and nonspecific clinical presentations. Nevertheless, early recognition of radiographic patterns—particularly distinguishing osteoblastic from osteolytic lesions—combined with thorough histopathological evaluation is vital for prompt diagnosis and effective management. Collaboration among oral and maxillofacial radiologists, oncologists, pathologists, and maxillofacial surgeons is paramount in developing a comprehensive treatment strategy, potentially improving outcomes for patients affected by these aggressive tumors.

Declarations

Author Contributions: Conception/Design of Study- G.U.; Data Acquisition- A.F.E.; Data Analysis/Interpretation- G.U., A.F.E.; Drafting Manuscript- G.U., A.F.E.; Critical Revision of Manuscript- K.O.; Final Approval and Accountability- G.U.; Material and Technical Support- A.F.E.; Supervision- K.O.

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