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CASE REPORT

"Incidental" Finding with Major Clinical Significance in a Routine CBCT Volume Acquired for Dental Implants

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Figure 1. Panoramic image.

Introduction

Since the introduction of Cone Beam Computed Tomography (CBCT) scanners for the oral and maxillofacial region in the early 2000s, their applications and utilization in dentistry has grown exponentially. The ability to view anatomical structures in head and neck area in three dimensions without the drawback of image distortion that may be associated with some two dimensional imaging modalities has made CBCT the modality of preference for diagnosis and treatment planning of many dental tasks. Clinical applications of CBCT in diagnosis and treatment planning for dental implants, TMJ analysis, jaw lesions and endodontic treatment cases are well documented. Among CBCT's multiple clinical applications, its use in treatment planning for dental implants is among the most prominent. CBCT enables visualization and assessment of residual alveolar ridge and its abnormalities in three dimensions and enables accurate measurement of the distance between the alveolar crest and mandibular canal to avoid impingement of inferior alveolar nerve. It also helps in evaluation of mandibular posterior lingual undercut to avoid perforation on lingual cortical plate and potentially damaging the lingual nerve. It also aids in visualization of maxillary sinuses for anatomy, pathology and possibility of sinus lift and evaluation of the density and quality of bone. Considering the great advantage of visualizing structures in three dimensions, the American Academy of Oral and Maxillofacial Radiology has published a joint statement with the American Academy of Implantology which states that cross-sectional imaging are the modality of choice in dental implant treatment planning, and that CBCT is the modality of choice for its low-radiation dose and high image quality.

On the other hand, while using CBCT data can give us a lot of information about the task at hand, there is also more information about surrounding structures that are included in the volume that are not the primary intent of

the CBCT exam called incidental findings. Incidental findings can range from benign calcifications of palatine tonsils or idiopathic sclerosis to more noteworthy jaw abnormalities such as localized or generalized benign or malignant neoplasms, cysts, inflammatory, and fibro-osseous lesions that are visualized within the three dimensional CBCT scan volume. While well-demarcated lesions in the jaws have a higher probability of getting picked up by dentists, diagnosis of poorly defined and infiltrative lesions is an important task and can be a serious challenge that requires advanced radiographic interpretation skills and radiographic pattern recognition training.

Case History

A 42 year-old female with history of metastatic breast carcinoma was presented to our clinic to be evaluated for possibility of getting dental implants for the area of missing #29 and #30. Teeth #27 & #28 were slightly mobile. Other medical history was non-significant.

Radiographic findings:

At the initial evaluation stage, panoramic and periapical radiographs were acquired. In the panoramic image (Fig. 1) radiolucent periodontal ligament (PDL) space widening associated with teeth #22, #27 and #29 are noted.

Due to presence of radiopaque shadow of the spine in the midline area, radiolucency associated with the rest of mandibular anterior teeth could not be verified. In the periapical image (Fig. 2a) loss of lamina dura and PDL widening at the periapical aspect of #26, and more extensive irregular PDL widening associated with mesial, distal and apical aspects of #26 and #27 are noted. Interdental radiolucency indicative of alveolar bone resorption at the area between #26 and #27 (distal to #26 and mesial to #27) are noted.
Figure 2b is a schematic view of irregular PDL widening that could be seen in association with generalized malignancies such as leukemia, multiple myeloma, non-Hodgkin's lymphoma infiltrates, or metastatic disease where malignant cells travel through the blood stream and randomly infiltrate the bone in a generalized manner. Those infiltrates can be transported to different parts of the PDL space and cause irregular PDL widening, resorption of lamina dura (part of cortical bone) and bone loss.

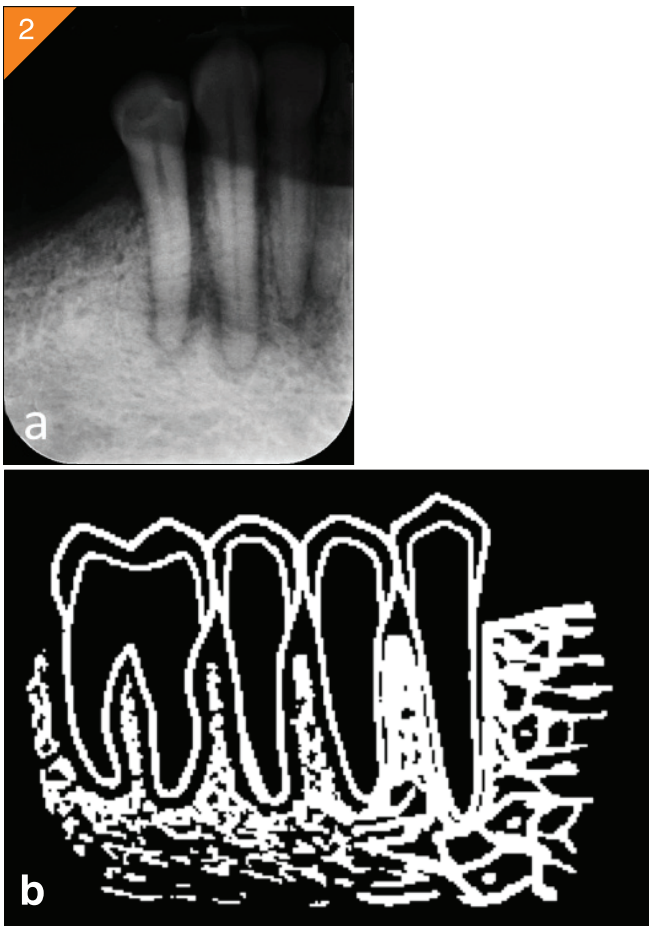

Figure 2a,b. a) Periapical radiograph. Notice irregular PDL widening associated with the mandibular lateral incisor, the canine, and the premolar.
b) Illustration of Irregular PDL widening which could be seen in association with generalized malignancies or metastatic disease.

Considering the findings above that correlate with possibility of a malignant (metastatic) neoplasm, CBCT volume was acquired to evaluate the condition of buccal and lingual plates for presence or absence of expansion, thinning or possible interruption. (Figure 3)

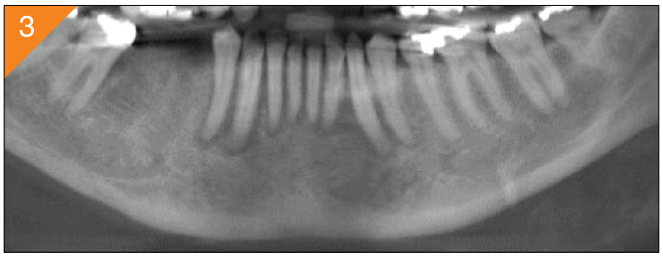

Figure 3. Cropped panoramic reconstruction from CBCT data.

Cropped panoramic reconstruction from CBCT data confirms multiple low density (radiolucent) areas of irregular PDL widening in anterior mandible associated with teeth #21 through #27.
On axial view (Fig. 4a) multiple small low density areas associated with permeative changes in labial and lingual cortical plates are visualized. (Figure 4b)

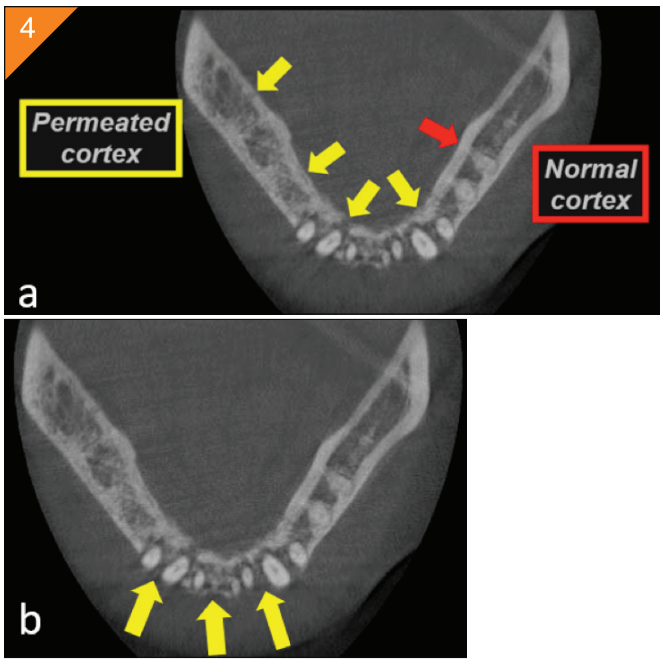

Figure 4a,b. a) Axial view of CBCT mandibular lingual cortex exhibits multiple low density areas (permeative changes) in cortical bone associated with metastatic breast carcinoma.
b) Axial view of CBCT mandibular labial/buccal cortex exhibits multiple low density areas of permeative changes associated with metastatic breast carcinoma.

Multiple localized areas of interruption of labial and lingual cortical plates without expansion are noted. No sign of periosteal reactions of labial or lingual cortical plates or resorption of mandibular anterior teeth are noted. (Figure 5a,b)

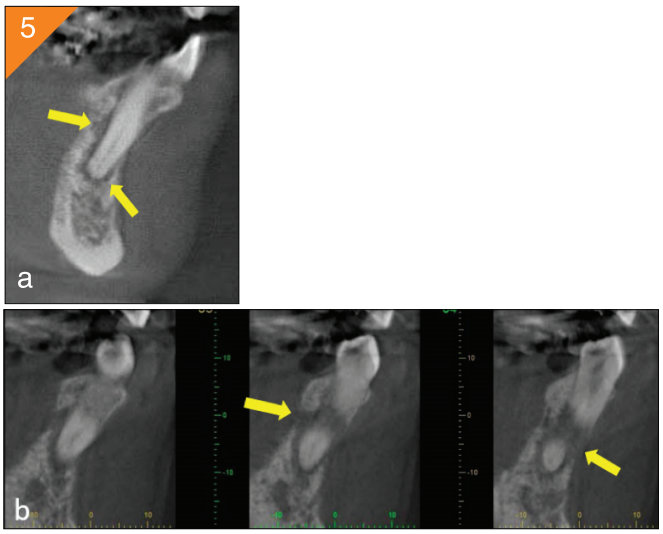

Figure 5a,b. a) Cross sectional view of CBCT data at the #28 area. Note irregular PDL widening, destruction of lamina dura.
b) Cross sectional view from CBCT data. Note localized interruption of buccal and lingual cortical plates with no expansion.

Cross sections from CBCT data confirm irregular PDL widening, increased sclerosis and localized interruption of labial and lingual cortical plates with no expansion.

Figure 6. 3D Volume rendering from CBCT data.

3D volume rendering from CBCT data gives a visual presentation of multiple generalized areas of bone destruction in anterior mandible. (Figure 6)

Histology findings:

Considering patient's radiographic findings and past medical history decision to perform a biopsy of the site to rule out metastatic disease was made. (Figures 7-9) Histopathological slides of anterior mandible show cords and islands of metastatic breast carcinoma invading vital lamellar bone with multiple areas of bone resorption, confirming the diagnosis of metastatic breast carcinoma to the anterior mandible area.

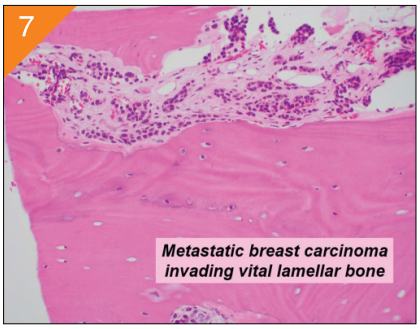

Figure 7. Histopathological slide of anterior mandible showing metastatic breast carcinoma invading vital lamellar bone.

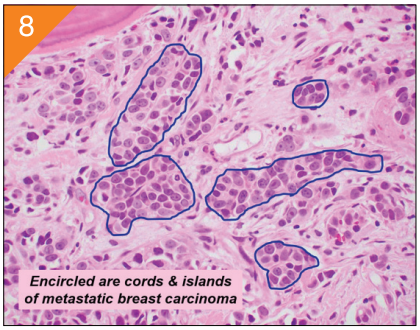

Figure 8. Histopathological slide of anterior mandible showing cords and islands of metastatic breast carcinoma.

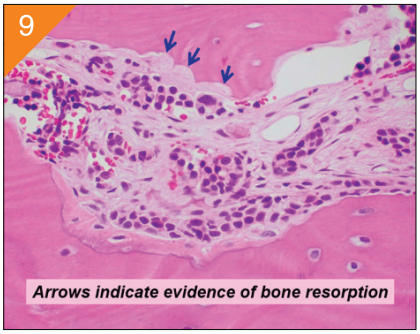

Figure 9. Histopathological slide of anterior mandible showing metastatic breast carcinoma and the surrounding bone resorption areas.

Discussion

3D CBCT provides a more comprehensive view of head and neck structures compared to 2D periapical and panoramic images and has a potential to reveal more pathologies and incidental findings compared to 2D modalities. Due to complexity of anatomical structures viewed in a 3D format and the need for 3D radiographic interpretation skills, use of CBCT could pose a liability issue for prescribing dentists who are not familiar with essential concepts of 3D radiographic interpretation and CBCT volume manipulation. For that reason and also to protect patients from misdiagnosis of their 3D scans, the American Academy of Oral and Maxillofacial Radiology has published a number of position papers and recommendations regarding the importance of evaluation of CBCT volumes by qualified Oral and Maxillofacial Radiologists who have completed specialty training in Oral and maxillofacial radiology. In the past few years, some dental colleagues have argued the fact that when they acquire a CBCT for a specific purpose such as dental implants or endodontics. They look at the areas that are related to the intent of the dental treatment, for example, dental implants or the specific tooth for endodontic treatment. However, the reality is that just like in 2D modalities, the prescribing dentist who prescribes the 3D image modality is responsible for complete interpretation of the volume and will be held to same standard of a board certified oral radiologist should, as a litigation may arise due to misdiagnosis or an undiagnosed pathology. In line with that, it is of outmost importance for dentists who acquire CBCT scans for different purposes to constantly seek continuing education courses in concepts of 3D radiographic interpretation and best practices in systematically reviewing and reporting head and neck abnormalities that are found in the CBCT volumes, and also to consider seeking an oral and maxillofacial radiologist's consult to help with the radiographic interpretation of the scan.

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Conflict of interest:
The author declares that he has no conflict of interests relating to this article.