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Invited Commentary

Role of cone-beam computed tomography in evaluating osseous invasion from oral squamous cell carcinoma

The role of cone beam computed tomography (CBCT) using a dedicated maxillofacial imaging unit has recently evoked interest as a potential diagnostic tool for determining early osseous invasion in oral squamous cell carcinoma (OSCC) along with conventional panoramic imaging and other advanced modalities such as multidetector computed tomography (MDCT), magnetic resonance imaging (MRI), and nuclear medicine studies. CBCT offers a low-dose, high-accuracy, noninvasive diagnostic tool that could be employed to accurately detect radiographic bone invasion.[1] However, the unique advantages of CBCT—including its significantly high spatial resolution, isotropic voxel dimensions, low radiation dose burden, shorter acquisition times, smaller fields of view, relative ease of access, low cost, and fewer artifacts generated by high-attenuation objects in the oral cavity and surrounding areas—must be realized through judicious use of the modality through selection of appropriate exposure parameters, postprocessing filters, and viewing software that is capable of reconstructing and displaying the dataset with diagnostically acceptable signal-to-noise ratios based on the task at hand. All of these are critical to the accuracy of interpretation. This study clearly demonstrates the utility of CBCT for detection of mandibular invasion by OSCC.[1]

It must be noted, however, that few studies reported to date have made an objective comparison of CBCT with MDCT for detection of osseous involvement by carefully controlling for factors that could have a pronounced effect on the outcome. Despite these limitations, CBCT promises to deliver a fairly accurate dataset of images that delineate subtle cortical involvement, although frank erosion and infiltration have been difficult to differentiate once cancellous bone involvement occurs. Determination of proximity of the tumor to the inferior alveolar canal has been evaluated in an in vitro study using CBCT and noted to be suboptimal.[2] However, for early detection of bone involvement in OSCC, CBCT is clearly a useful tool to be added to the imaging armamentarium, given the advantages listed above.

Although most studies published in the literature have used a small sample size, one study with a larger sample size utilizing CBCT datasets with ultra-thin slices approximating the voxel dimensions of the system and minimal slice separation has further validated the superior overall diagnostic accuracy over MDCT for detection of early cortical erosion.[3] MDCT in comparative studies reported to date has utilized 0.8 to 3.0 mm slice thickness and/or separation, leading to accuracy metrics varying widely for MDCT systems, as sensitivity and specificity values change for specific diagnostic tasks.[1] Ideally, a prospective study will throw definitive light on the utility of CBCT versus MDCT in detecting and characterizing osseous invasion, and the limitations of both.

It should also be borne in mind that scatter is usually more with CBCT, but choosing a limited field of view helps limit noise. Other drawbacks of some reported studies include lack of specific experience of radiologists with different types of maxillofacial CBCT units offering widely different capabilities and associated advantages or limitations, and a steep learning curve[4] associated with nonmaxillofacial radiologists reading these studies using suboptimal postprocessing parameters that are routinely used in relatively low-resolution routine imaging tasks using MDCT within PACS. This makes a meaningful comparison of CBCT with MDCT data for a specific diagnostic task challenging. It is therefore important to conduct comparative assessments of CBCT with MDCT studies using receiver operating characteristic analysis to detect signals of interest resulting from OSCC bone invasion using datasets acquired with optimal exposure and postprocessing parameters to try to address some of the relative drawbacks reported with CBCT.

Interreader agreement is critical to its success as a useful imaging modality for localization purposes. Calibration of participating radiologists reading CBCTs in such studies, development of optimal acquisition protocols for its routine use in suspected OSCC-related invasion of bone,[1] use of a sufficiently large sample size to test for significance, and a thorough understanding of unique cone beam artifacts are central to the diagnostic interpretation process of CBCT datasets. Optimal combination of CBCT with other imaging modalities such as MDCT for soft tissue delineation along with contrasted studies, MRI, and bone scans will offer a more robust diagnostic armamentarium for prompt and timely diagnosis, especially for tumor staging using radiographic findings. As such, CBCT findings will be relevant for more efficient staging and surveillance applications using American Joint Committee on Cancer/World Health Organization criteria, possibly leading to upstaging of tumors based on bone invasion.

As Michael Saylor said: "It's easy to fall into the trap of assuming that a new technology is very similar to its predecessors. A new technology is often perceived as the linear extension of the previous one, and this leads us to believe the new technology will fill the same roles—just a little faster or a little smaller or a little lighter." CBCT, within limits of the technology, shows promise of delivering a readily available, low-dose, low-cost, and higher-accuracy imaging modality that could be included in the initial diagnostic workup of a patient with OSCC, but full utilization of its diagnostic value is dependent on recognition of factors that directly influence the outcome.

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1. Neal TW, Wahidi J, Williams FC, Schlieve T, Donepudi J, Kim RY. The utility of cone-beam computed tomography for the evaluation of invasion by mandibular squamous cell carcinoma. *Proc (Bayl Univ Med Cent).* 2024;37(3):396–400. doi:10.1080/08998280.2024.2308477.
2. Wang Z, Zhang S, Pu Y, Wang Y, Lin Z, Wang Z. Accuracy of cone-beam computed tomography for the evaluation of mandible invasion by oral squamous cell carcinoma. *BMC Oral Health*. 2021;21(1):226. doi:10.1186/s12903-021-01567-3.
3. Linz C, Müller-Richter UD, Buck AK, et al. Performance of cone beam computed tomography in comparison to conventional imaging techniques for the detection of bone invasion in oral cancer. *Int J Oral Maxillofac Surg*. 2015;44(1):8–15. doi:10.1016/j.ijom.2014.07.023.
4. Czerwonka L, Bissada E, Goldstein DP, et al. High-resolution cone-beam computed tomography for assessment of bone invasion in oral cancer: Comparison with conventional computed tomography. *Head Neck*. 2017;39(10):2016–2020. doi:10.1002/hed.24858.