MULTIPLANAR REFORMATION (DENTASCAN)
REVIEW OF A NEWER MAXILLOFACIAL
IMAGING TECHNIQUE

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ABSTRACT

Multiplanar reformation or DentaScan is a unique new computer software program which provides computed tomographic (CT) imaging of the mandible and maxilla in three planes of reference: axial, panoramic, and oblique sagittal (or cross-sectional). The clarity and identical scale between the various views permits uniformity of measurements and cross-referencing of anatomic structures through all three planes. Unlike previous imaging techniques, the oblique sagittal view permits the evaluation of distinct buccal and lingual cortical bone margins, as well as clear visualization of internal structures, such as the incisive and inferior alveolar canals.

Studies have proved that DentaScan is an accurate method of postoperative evaluation for mandibular invasion in patients with squamous cell carcinoma (SCC) of the oral cavity. The present review is on DentaScan with special stress on its diagnostic accuracy in cases of mandibular invasion of squamous cell carcinoma.

Key words: DentaScan, Multiplanar reformation, Squamous cell carcinoma, Invasion

INTRODUCTION

DentaScan, a dental computed tomographic software program, is an extension of CT technology. It can be done on the conventional CT scan machines or newer OPG like machines are available with dentaScan facility. (Fig. 1) Developed in the 1980s to assist maxillofacial surgeons in planning for endosseous implantation, DentaScan reformats standard axial CT scans into 2 unique views: panelliptical and parasagittal (Fig. 2). Reformattting images allows for close inspection of buccal and lingual cortices, and in theory should improve specificity and sensitivity over standard CT imaging.

Basically, dental CT programs, which are now commercially available through most scanner companies, use 1-mm transverse images of the jaw to reformat multiple cross-sectional and panoramic views. The transverse images are scanned parallel to the alveolar ridge or plane of the teeth by using a bone algorithm, 15-cm field of view, and 512 x 512 matrix. The mandible and maxilla are each imaged with separate studies. (Fig. 2)

After the transverse images are acquired, the technologist chooses an image that shows the curve of the jaw and deposits the cursor in the center of the jaw at approximately six locations along the curve of the jaw. The program then connects these points to form a smooth curved line that is superimposed on the center of the jaw. This line defines where the center panoramic view will be reformatted. Several other panoramic images will be reformatted buccal and lingual to the center image.

Next, the program automatically draws a series of multiple numbered lines perpendicular to the curved line. These numbered lines define where the numbered cross-sectional images will be reformatted. The distance between the perpendicular lines, and thus between the cross-sectional images, can be varied; however, it is typically 2 mm. The numbers along the bottom of the panoramic images correspond to the numbered perpendicular lines, and thus to the numbered cross-sectional images. The scale along the side of the panoramic images corresponds to the numbered transverse images that were used to reformat the panoramic view.

REVIEW

According To American Cancer Society statistics, there were 29000 estimated new cases of oral cavity...
cancer diagnosed in 2008. Approximately 90% of these were squamous cell carcinoma (SCC). A total of 13400 deaths occurred as a result of oral cavity cancer in 2008. Therefore, this disease represents a significant problem for both patients and surgeons who care for them.1

Given the anatomic constraints of the oral cavity, many of these tumors lie in close proximity to the mandible. The variants of mandibular invasion of squamous cell carcinoma are classified as T1, T2, T3 & T4 (Fig. 3).1, 3 Lesions encroaching upon the adherent gingiva of the mandible are often fixed to it, and therefore a dilemma exists: how much, if any, of the mandible will need to be resected to obtain oncologically clear margins.1, 5

Mandibular resection for oral cancers has significant aesthetic and functional sequelae. A reliable preoperative predictor of mandibular invasion is required to guide the need for and extent of mandibular resection. An orthopantomogram of the mandible is an accurate, reliable, cost-effective predictor of bony involvement except for central arch lesions.1, 2, 1 Determining mandibular invasion preoperatively, however, has proven difficult and controversy surrounding this subject has existed for decades. Several modalities including clinical examination, plain radiographs, nuclear medicine studies, magnetic resonance imaging (MRI), and computed tomography (CT) have all been studied. Each method has its advantages and disadvantages, but CT imaging has, in recent years, demonstrated some of the best results.1, 6

The ideal test to determine mandibular invasion in patients with SCC of the oral cavity should be highly sensitive and specific, noninvasive, inexpensive, and widely available. While several different diagnostic tests have been advocated, each has its own particular set of advantages and disadvantages. The modalities that have been studied to date include clinical examination, Panorex radiographs, MRI, radionuclide scanning, CT, and now DentaScan.1, 7

Clinical examination has been shown by several authors to be an accurate method of preoperative mandibular assessment. Leipzig compared clinical examination with plain film and bone scan and found clinical examination to be more accurate than the other 2 modalities. Shaheen determined that clinical examination was more accurate than Panorex radiographs and CT scan. Clinical examination is best performed when the patient is under general anesthesia. Patients with oral cancer often have significant pain and trismus, making examination in the office difficult.1

Panorex is the best plain film for determining mandibular involvement because of its view of the body, ramus, and condyle. Spine artifact, however, limits its usefulness for the parasympyseal and symphseal regions.1

Magnetic resonance imaging has also been investigated as a tool to assess mandibular invasion. Ator et al suggested that MRI may be superior to CT and other modalities for this purpose. They stress the superior resolution of tumor and soft tissue interface and ability to better evaluate the mandibular medullary space using MRI. The most frequent problems stated are the lack of signal generated by bone on MRI, and high cost. In their multivariate analysis, Tsue et al7 found CT and physical examination to be the best predictors of mandibular invasion. They state that MRI was not as accurate as other modalities.1, 4, 5

Bone scanning for detection of mandibular invasion has been plagued with low specificity. Introduced in the 1970s, this technique has been advocated as a useful adjunct study by several authors. Weissman and Kimmelman did a retrospective study of 40 patients who underwent bone scanning prior to mandibulectomy and found a false-positive rate of 53%. Single positron emission computed tomography has been recently used with slightly better results. Imola et al recently showed this diagnostic test to be 95% sensitive and 72% specific for mandibular invasion in patients with oral cancer.1, 5, 8

Computed tomography has been used with varying results. In a series of 43 patients, Close et al determined its sensitivity to be 100% with a false-positive rate of 8.3%. These impressive results, however, have not been duplicated in more recent studies. Lane et al determined that CT was a useful but potentially inaccurate predictor of bone invasion in tumors of the retromolar trigone. In their study, bone invasion was missed in 27% of patients, but their positive predictive value of 91% suggested good specificity. Recent studies have shown better results. Mukherji et al, in a series of 49 patients, calculated the diagnostic accuracy of CT as follows: sensitivity, 96%; specificity, 87%; positive predictive value, 89%; and negative predictive value, 95%.3, 7, 10

DentaScan has been proposed as a means to improve the diagnostic accuracy of standard CT. Talmi et al & King et al described using DentaScan in 17 patients...
Figure 1: CT scan machines and newer OPG like machine with Dentascan facility.

Figure 2: Dentascan images - panelliptical and parasagittal

Figure 3: Classification of mandibular invasion of squamous cell carcinoma

Figure 4a: Clinical photograph of patient with carcinoma of buccal mucosa along with OPG.

Figure 4b: CT scan images of same patient showing involvement of mandible but doesn't show exact extension of tumor

Figure 4c: Dentascan images of the same patient showing the exact location and extent of the lesion with 3D

Figure 5: Approach towards suspected mandibular invasion of squamous cell carcinoma
with varying intraoral pathological conditions. Although the authors found it to be useful, they did not determine its diagnostic accuracy.\(^1\)

John M. Brockenbrough et al in 2003 conducted a study to quantify the diagnostic accuracy of DentaScan in preoperative determination of mandibular invasion in patients with SCC of the oral cavity. The diagnostic accuracy for DentaScan in this study was as follows: sensitivity, 95%; specificity, 79%; positive predictive value, 87%; and negative predictive value, 92%\(^1\). A case of mandibular invasion of squamous cell carcinoma is presented showing clinical photograph, OPG, CT images and DentaScan images for comparison. (Fig 4a, 4b, 4c) DentaScan shows exact location and extent of the tumour within the mandible as compared to other modalities.\(^1\)

The importance of preoperative identification of mandibular invasion cannot be overemphasized. Optimal management of these unfortunate patients requires much planning, and often reconstruction must be coordinated with a microsurgical vascular team for segmental bony defects.\(^4\) The primary surgical goals in managing these patients are complete resection, preservation of physiologic function, and maximisation of cosmetics. Achieving complete resection often comes at the expense of the latter two. If marginal mandibulectomy can be performed without sacrificing oncologically sound margins, the patient will most likely have a superior physiologic and functional outcome and require a less complicated reconstruction. A simple algorithm for management of these patients is shown in (Figure 5)\(^1\)

Advantages of DentaScan includes height and width of the jaw, location of vital structures, detailed internal anatomy, relationship between lesions and the cortical margins and roots of the teeth, eliminate the streak artifact from dental restorations that degrades direct coronal CT scans.\(^1\)

One of the drawbacks of DentaScan is the difficulty in resolving the difference between coroidal irregularities and true tumor invasion. In addition, highly curved areas such as the parasympathetic is slightly more difficult to evaluate using this technique. Despite its imperfections, however, DentaScan provides a detailed anatomic map of the mandible and is therefore useful in planning the extent of surgery, even when cortical erosion is equivocal. Also in terms of radiation exposure, dentascans has more exposure as compared to panoramic radiography and MRI, but is still relatively less compared to CT scan and bone scan.\(^1\,6\,7\)

**SUMMARY & CONCLUSION**

DentaScan is an accurate method of preoperative evaluation for mandibular invasion in patients with SCC of the oral cavity. Thus providing patient with better function and cosmetic postoperatively, ultimately benefitting the livelihood of the patient.

In addition, dentascans is also useful for preoperative evaluation of dental implants, cysts, inflammatory diseases, oroantral fistulas, silicone implants, fractures & other surgical procedures. Though further research work are required to exactly evaluate the reliability of the technique.

REFERENCES
