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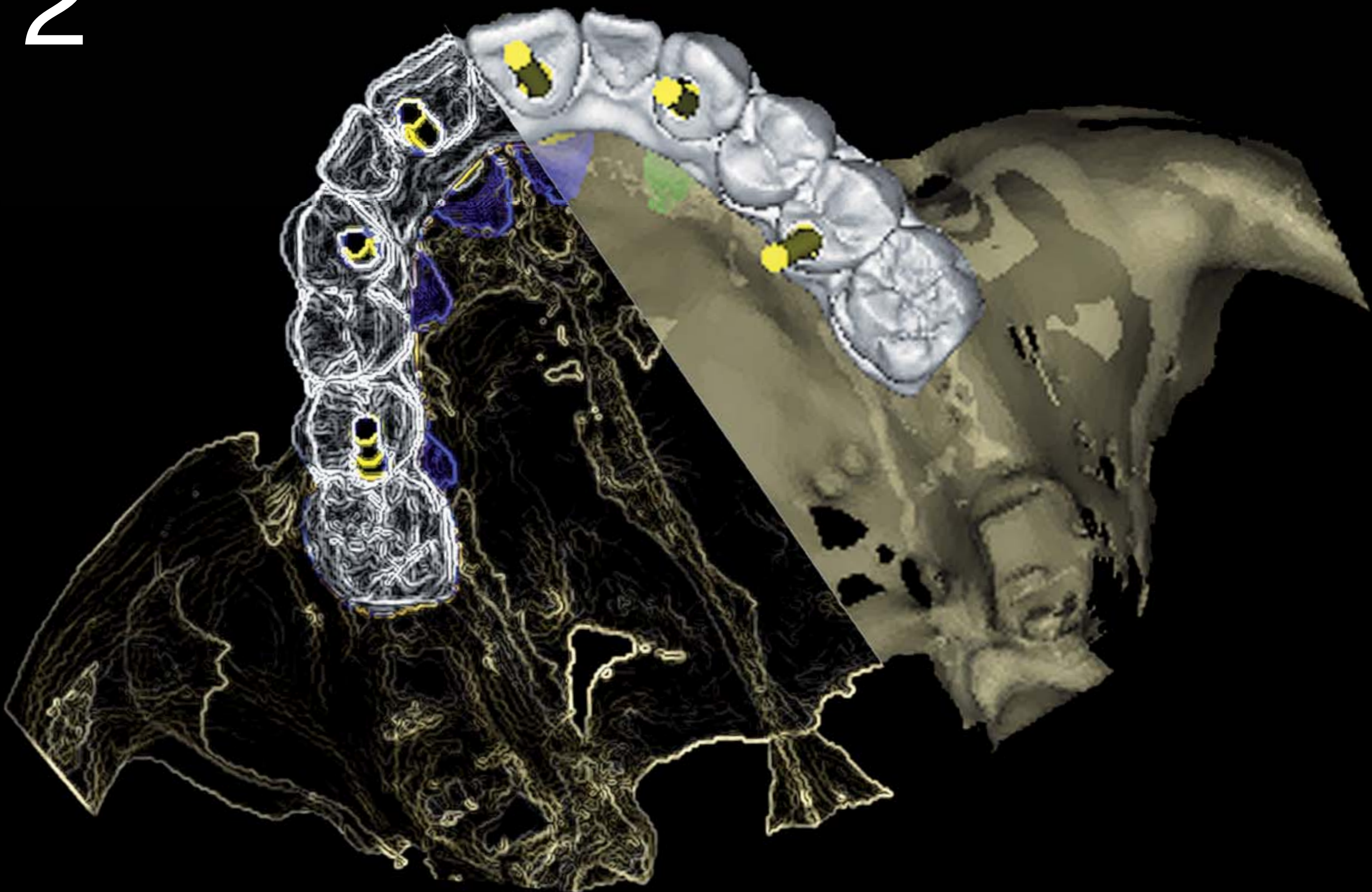

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Volumetric CBCT in neuromuscular dentistry

dti] Dental Tribune International

To scan or not to scan, is that the question?

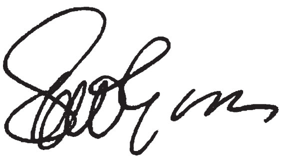
Dr Scott D. Ganz

_In 1996, I was honoured to have been invited to present at the first joint meeting of the European Association for Osseointegration and the Academy of Osseointegration held in Amsterdam in the Netherlands. At this meeting, I presented on the use of CT for the diagnosis and treatment planning of dental implants. A novel concept at the time was to create a radiopaque scanning or scannographic template to identify the tooth position in relation to the underlying bone. This template was fabricated prior to the scan and was worn by the patient during the scan acquisition. In the mid-1990s, we did not have virtual teeth and could not create a virtual occlusion, or import an optical scan of a stone cast, and therefore the information received was invaluable and provided the necessary information to plan for restoratively driven implant reconstruction. The industry was just then integrating the necessary software tools to choose implant sizes (diameters and widths) as positioned within the available bone of the receptor site, and then to simulate the abutment projections that would link the proposed implant to the radiopaque tooth incorporated in the scannographic template. Therefore, 18 years ago, it was suggested that to achieve the most from the scan, advanced planning and extra steps were needed to fabricate a scan template prior to the actual scan. At that time, we had to send our patients to a radiology centre or a hospital for the CT scan, at a high cost per scan. This created several barriers to the use of the technology.

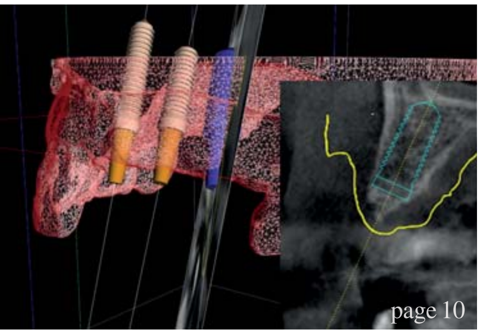
With the introduction of CBCT devices during the past decade, most barriers to acquiring the scan have been diminished. In the normal course of diagnosis and treatment planning, we now have a much lower radiation dose to work with. With many devices, we have the ability to collimate the image (field of view) to further reduce exposure to the patient, and we can even obtain a full diagnostic image with a scan time of less than five seconds with the newest devices!

However, with these advances, several questions come to mind. Are we getting the most from the scans that are acquired each day? Are clinicians spending the extra time with pre-surgical planning steps to fabricate scanning templates and diagnostic wax-ups, or using fiducial markers when appropriate? Have these protocols been incorporated into everyday practice now that CBCT devices are so predominant, and who is providing these extra services? Are we using the software tools to their full potential to diagnose and treatment plan with the highest degree of accuracy? Our new digital workflow may need to start sooner than we think, indicating a paradigm shift that may include intra-oral optical scanning, desktop scanners, associated software applications, and collaboration with dental laboratory technicians who are quickly adapting to this technology.

It is my personal hope that clinicians will read about the latest state-of-the-art uses of the technology for a variety of different treatment modalities within the pages of our new cone beam **International Magazine**. It is through further education that the questions above will be answered, as we all learn from our combined experiences to obtain the most diagnostic information from each CBCT scan. Our patients are counting on it!



Dr Scott D. Ganz
Editor-in-Chief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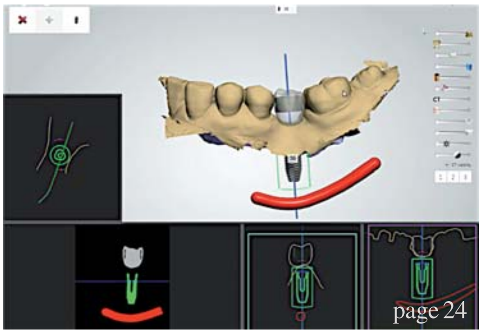
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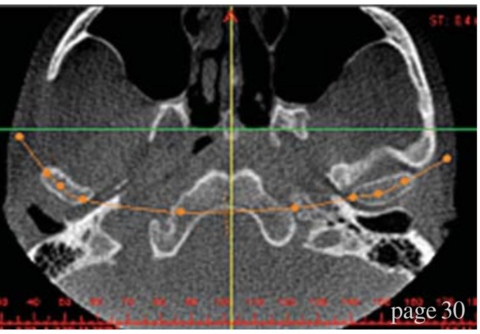
Cover image courtesy of Dr Scott D. Ganz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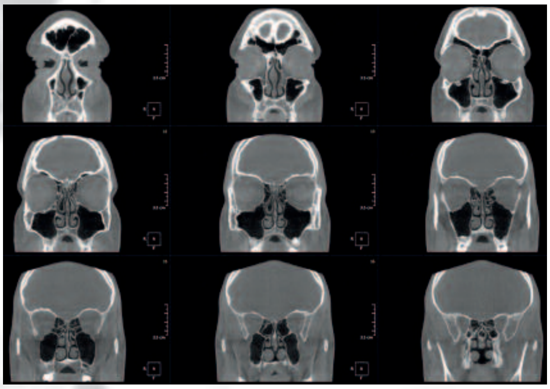

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Current perspectives on oral surgery

How to improve consistency and implementation of contemporary treatment recommendations and options in general dental practice

Author_Dr Ziad Noujeim, Lebanon

Dr Ziad Noujeim, Lebanon

_The term "surgery" is derived from the Greek words "chir" (hand) and "ergos" (work). According to this etymology, surgery should include any clinical work implemented with our hands. In daily clinical practice, however, the use of this word is often limited to practical therapeutic acts, such as those involving cutting soft tissue (incisions), flap raising, osteotomies and reconstruction, as well as repairing and dressing living tissue.

The term "oral" pertains to the mouth (or oral cavity), and oral surgery would consequently encompass maxillary sinus membrane lifts, onlay and inlay bone grafts, the placement of dental osseointegrated implants, exodontia (including surgical extraction of impacted teeth and tooth-like structures), as well as the incision and drainage of cellulitis, just to name a few. Despite these different fields of use, the limits of oral surgery are not yet well defined and may reach maxillofacial surgery, a term that implies a greater scope of surgical interest, such as temporomandibular joint surgery, orthognathic surgery, the treatment of head and neck trauma, as well as cancer surgery.

General dental practitioners are only required to undertake surgical treatment of teeth, tooth-like structures, and soft tissue surrounding teeth. In this regard, the UK General Dental Council defines "surgical dentistry" as "those surgical procedures within the mouth which would normally be accomplished for a cooperative patient under local anaesthesia, with or without sedation, in a tolerably short operating time."

In the past 30 years, oral surgery has progressed significantly in the diagnosis and treatment of dental and jaw pathology. Dentistry, particularly surgical dentistry, is rapidly changing and evolving, and dentists worldwide are attempting to adapt to the revolutionary changes and new opportunities resulting from globalisation of dental and medical surgical specialties. New insights and discoveries related to oral surgery are indeed astonishing and many of them have already been applied in every-day practice, and addressed in textbooks and at international conventions.

The near future will probably witness Er:YAG laser bone ablation replacing surgical drill osteotomy in oral surgical practice. Indeed, scanning electron microscope observations have determined that Er:YAG laser treatment produces well-defined edges. Melting and carbonisation associated with carbon dioxide lasers could not be observed on sites irradiated with Er:YAG lasers. In addition, FTIR spectroscopy revealed that the chemical composition of bony surfaces after ablation with an Er:YAG laser was almost the same as that after conventional drilling with a bur, proving that the use of Er:YAG laser ablation can be an alternative to traditional bur ablation in oral and periodontal osseous surgeries, particularly in mandibular ramus onlay block harvesting, apicectomy, cysts and benign jaw tumour surgery, or the irradiation of bisphosphonate-associated jaw osteonecrosis.

Dental pulp stem cells (DPSCs) can nowadays be cryopreserved and stored for years, while still retaining their multipotency and bone-producing capacity. These highly specialised cells show very low morbidity and are easy to collect from extracted wisdom teeth or buds, for example. They also interact with bone biomaterials and substitutes, which makes them an ideal cell population for jaw reconstruction. In addition, stromal bone-producing DPSCs, a multipotent stem cell subpopulation of DPSCs, are capable of differentiating into osteoblasts, and they are claimed to possess immune privilege and exert anti-inflammatory abilities like many other mesenchymal stem cells.

Introduced in the late 1990s, CBCT is becoming the main imaging armamentarium of oral surgeries, as it provides more and comprehensive anatomical information and data that help to improve pre-operative and peroperative clinical implementation of the extraction of impacted teeth, cystectomies, removal of benign jaw tumours, and placement of dental implants.

While oral surgery continues to develop further with new technologies and visions, the assessment and diagnosis of patients will still form the cornerstone of any surgical specialty. Decision-making, a complex cognitive process that involves consideration of surgical patients' complaints and preferences, the availability of evidence-based data, as well as practitioners' case-specific clinical judgement, consequently remains an ongoing challenge for oral surgeons and dental general practitioners alike.

Inter-clinician variability and disparity in decision-making are very well known in dentistry and medicine.[1–5] In oral surgery, treatment recommendations, options and decisions can vary widely among practising dentists. In many cases, they are based more on personal values and expertise than on objective, rigorous or evidence-based analysis of treatment alternatives, risks, prognosis and benefits. There are treatment guidelines for the management of impacted teeth but none for aggressive and relapsing jaw cysts and odontogenic tumours, for which documented long-term treatment success has not yet been achieved. Owing to this lack, the treatment planning process in oral surgery remains a dilemma and warrants further interest and research.

As a matter of fact, regional differences in training, education, and dental school treatment philosophy, the "schools effect", may significantly influence decision-making processes.[6,7] It seems likely that specialists are much more confident in their ability to manage surgical cases successfully. A better understanding of interclinician variability in collaborative decision-making will definitely help the oral health community in improving consistency and implementation of oral surgical treatment recommendations and options.

One of the most promising approaches is probably the non-surgical medical treatment of tumours and lesions of the jaws, as reported by Marx and Stern in 2003.[8] They found a 65 per cent rate of complete resolution of central giant cell granulomas (CGCGs) in the jaws through intra-lesional corticosteroid injections. Dexamethasone and triamcinolone are currently the most popular intralesional steroids, and weekly injections with these are common practice not only for CGCGs, but also for solitary jawbone lesions of Langerhans cell histiocytosis, a proliferative disease of the macrophage/dendritic cell lineage.

CGCGs, considered troublesome pathologies, are also currently medically managed by calcitonin, a polypeptide hormone produced in humans primarily by parafollicular cells of the thyroid gland, C cells. Calcitonin is known to counteract parathyroid hormone, inhibit osteoclast activity and increase calcium influx in bones. In this regard, salmon calcitonin, which is used in postmenopausal osteoporosis, hypercalcaemia, Paget's disease and bone metastases, is considered to be more active than human calcitonin and to be an important tool in the medical treatment of jaw tumours and lesions. The main question is whether intranasal salmon calcitonin is as effective as subcutaneous human calcitonin in the medical treatment of CGCGs of the jaws.

Finally yet importantly, many clinicians and clinical investigators believe in the radical treatment of ameloblastomas, odontogenic tumours well known for their aggressiveness and high recurrence after conservative treatment. For these reasons, en bloc resection is often implemented, which includes a resection of at least 1–2 cm of normal sound jawbone beyond the tumour's margins. Such a radical surgical procedure is unacceptable in children with growing jaws though because segmental resection often leads to jaw deformity and dysfunction, which in turn may hamper physical growth and the mental wellbeing of the child/adolescent.

At the very least, conservative treatment of an ameloblastoma, if indicated, will gain time until growth of the jaw is finally complete.[9] Considering that the majority of ameloblastomas in children are unicystic and have a very low rate of recurrence,[10] they can be managed by enucleation, a conservative form of surgical treatment.[11–14]_

Editorial Note: A complete list of references is available from the publisher.

_about the author — cone beam

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CBCT-predicted marginal mandibular resection in patient with oral squamous cell carcinoma

Authors_ Dr Drago B. Jelovac & Prof. Vitomir S. Konstantinović, Serbia

_**One of the most important** aspects of pre-operative staging in head and neck surgery is the preoperative determination of local bone invasion by the malignancy because prediction of the extent of the surgical procedure is very important for the surgical outcome. It is especially important if a tumour extends into bone structures, that is, the mandible, because it often requires a mandibulectomy. In addition, for such cases, the supero-inferior extent of bone invasion is important for the surgeon to plan for either marginal or segmental mandibulectomy.

According to current literature, the standard protocol for staging oral cavity malignancies includes multi-slice computed tomography (MSCT) and MRI of the head and neck, CT, conventional 2-plane X-ray of the chest and abdominal ultrasound. The results gathered from MSCT, MRI and CT are usually reviewed to determine whether local bone invasion has occurred. In 1998, cone beam computed tomography (CBCT) technology was clinically introduced, allowing 3-D diagnosis of the hard tissue of the face and jaws, third molars and salivary calculi, as well as other indications.

There is also evidence that CBCT is a potential tool in the assessment of facial skull bone invasion caused by oral cavity malignancies. Based on the newest data in the literature concerning the comparison of sensitivity and specificity, it can be concluded that

Fig. 1

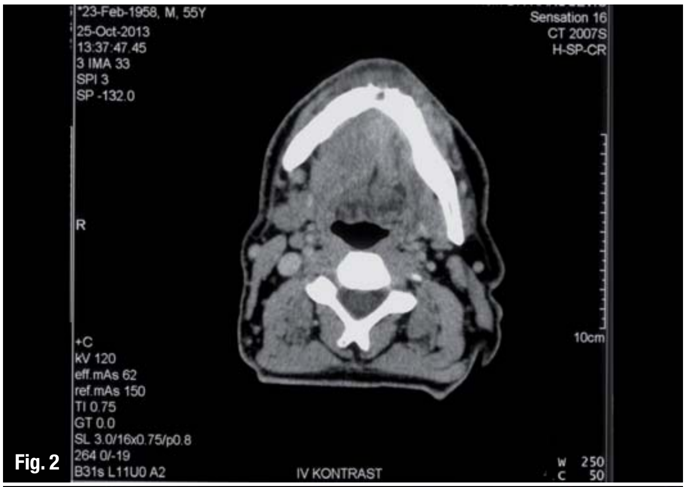

Fig. 2

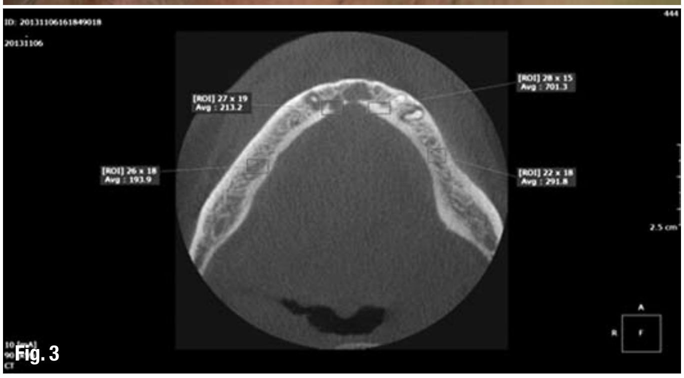

Fig. 3

Fig. 4

Fig. 1_Oral squamous cell carcinoma of the anterior part of the alveolar mandibular ridge.
Fig. 2_A CT scan in the axial view, in which there is no clear sign of bone invasion.
Fig. 3_A CBCT scan showing the osteolytic zone of the lingual mandibular cortex.
Fig. 4_Panoramic detail, linear quantification.

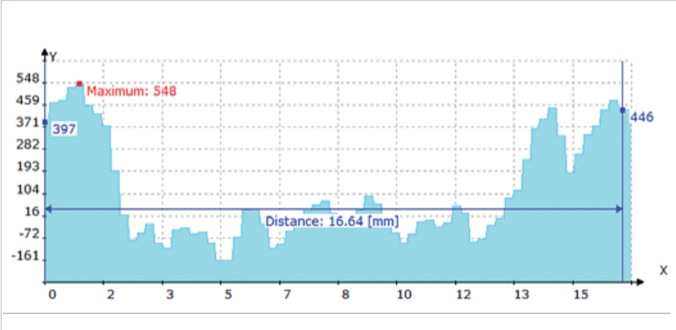

Fig. 5

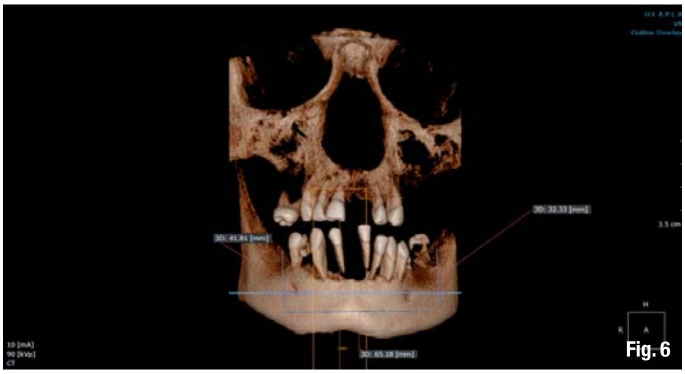

Fig. 6

Fig. 7

Fig. 8

CBCT is superior to CT and MRI in the assessment of bone invasion by tumours in the maxillofacial region. Further advantages of CBCT imaging include lower radiation doses than MSCT and its ability concerning the anatomic assessment of the stomatognathic system.

_Case report

This case report concerns a 55-year-old male patient suffering from oral squamous cell carcinoma (Fig. 1). The CT scan did not show any clear bone invasion in this case (Fig. 2). In order to obtain information that was more precise and to determine appropriate surgical planning related to the extent of bone invasion, a CBCT scan of the mandible was performed (SCANORA 3Dx, SOREDEX, Tuusula, Finland). In the axial view (Fig. 3), it may be seen that the tumour had invaded the lingual mandibular cortex in the symphyseal region, extending up to the buccal cortex.

OnDemand3D image editing software (Cybermed) offers a tool for the quantification of measurements by using the ROI and Profile function. ROI analysis of the bilateral segments of the mandible showed a lower average grey scale value in the suspected osteolytic zone (Figs. 4 & 5).

After a detailed examination of the suspected mandibular bone invasion, a precise surgical plan could be compiled. Resection lines were determined according to the profile and ROI tool results (Fig. 6). In this case, a marginal mandibular resection was the treatment of choice, performed "en bloc" with a specimen taken by radical neck dissection (Figs. 7 & 8).

_Conclusion

According to the adequate CBCT-based pre-operative surgical planning, the tumour could be resected in toto, showing free margins in the non-resected area of the mandible.

Owing to its variability in imaging and resolution, CBCT could be of great importance in oncological surgery and diagnosis._

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Fig. 5_Lower grey scale values, a distance of approximately 16.64 mm.
Fig. 6_Pre-op planning for the mandibular resection.
Fig. 7_Marginal resection.
Fig. 8_Surgical specimen en bloc after radical neck dissection.