

3D imaging in clinical dentistry : Short review with case reports

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Abstract

Dentistry has come a long way in terms of obtaining predictable and long term clinical results for the practicing dental clinician. Techniques, materials, philosophies have all evolved in the field for better final outcomes for the patient and the clinician. Dental technology has been at the forefront and has helped the dental team take informed evidence based approaches to counter the clinical challenges with which the patient presents in routine practice. Dental imaging has seen a paradigm shift from 2D to 3D imaging for the practicing clinicians and it has benefitted the patients in a variety of ways. This article intends to throw some light on this advancement in dentistry showcasing some routine clinical cases encountered in a day to day dental practice.

Keywords: 3D Imaging; Clinical Dentistry

Introduction

Dentists have traditionally used 2-dimensional (2-D) radiographic images (i.e. bitewing, periapical, occlusal, panoramic, and cephalometric radiographs) to diagnose and treat patients. While doing so, they have needed to understand and work within the limitations of these technologies [1]. The evolution in sophisticated diagnostic imaging modalities and associated software applications continues to impact the specialty of dentistry [2]. The information gained from a 3D imaging modality allows the clinician to appreciate the “reality of anatomy” for any given patient, yielding views of structures aided by advances in data processing power of the computer-driven technology. 3D imaging technology and interactive treatment planning software applications helps bridge the communication gap between all members of the dental team, while removing the guesswork from the process.

Applications of 3D imaging for the dental clinician

Evaluation of third molars, periodontal evaluation, edentulous space treatment planning for dental implants, endodontic prognostic decision making, pathology detection around the maxillofacial region, sinus evaluation for posterior maxilla edentulous area planning, are some of the routine indications for an accurate 3D planning for a dental clinician. Fabrication of dental implant surgical guides and stereolithographic models for evaluation of large maxillofacial pathology which are made from the 3D Computed Tomographic dicom data are other applications from 3D imaging data in dentistry.

Advantages of 3D imaging

1. Pre-operative assessment of teeth, edentulous site or a pathology becomes easier and accurate especially in relation to a vital anatomical structure involved.
2. Pre-operative assessment of a dental pathology like endodontic periodontic lesion, sometimes detection of a crack in a tooth root in the buccolingual dimension, bone evaluation for treatment planning involving orthodontics or for a dental implant assessment becomes predictable.
3. Pre-operative assessment of a large maxillofacial pathology involving multiple anatomic landmarks for treatment planning becomes accurate.
4. Surprises during the surgical procedures are avoided and the team is better prepared with 3D reconstruction of the area involved during planning phase itself. Maxillary sinus evaluation for a pathology or assessment for dental implant planning as well as Temporomandibular joint pathosis in 3D imaging shows a clear picture for an accurate planning and predictable treatment outcomes.
5. Fabrication of dental implant surgical guides ensures minimally invasive flapless implant surgery options and stereolithography model fabrication from 3D CT data ensures accurate marking of the extent of maxillofacial pathology during the planning phase itself increasing the functional and esthetic outcome of the maxillofacial surgical procedure involved [3-6].

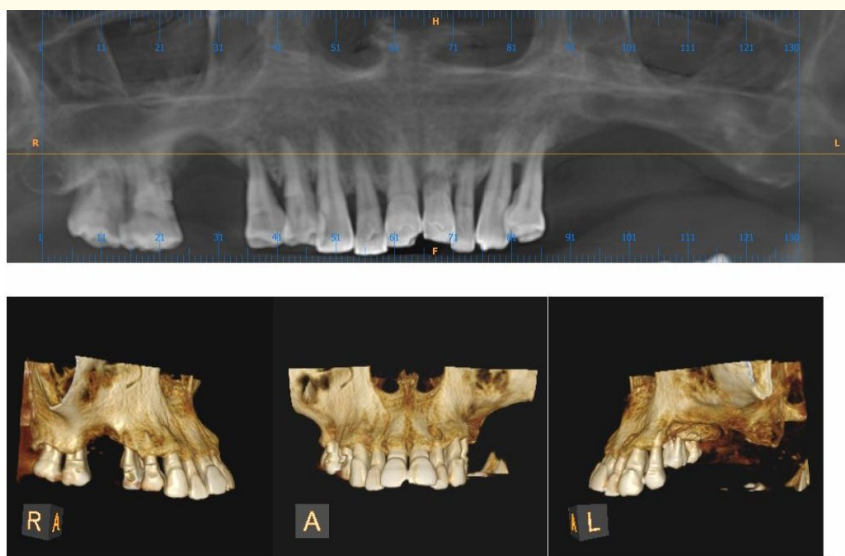


Figure 1: Posterior maxilla bone defect in 2D vs 3D volume reconstruction tomography

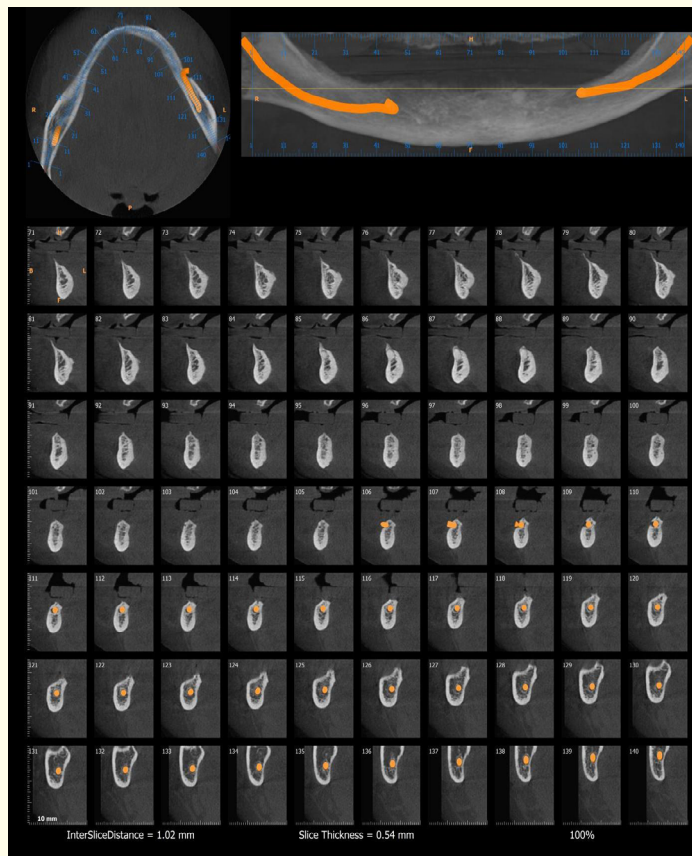


Figure 2: 3D Cone beam computed tomography mandible : Axial , panoramic and cross section views with inferior alveolar nerve tracing

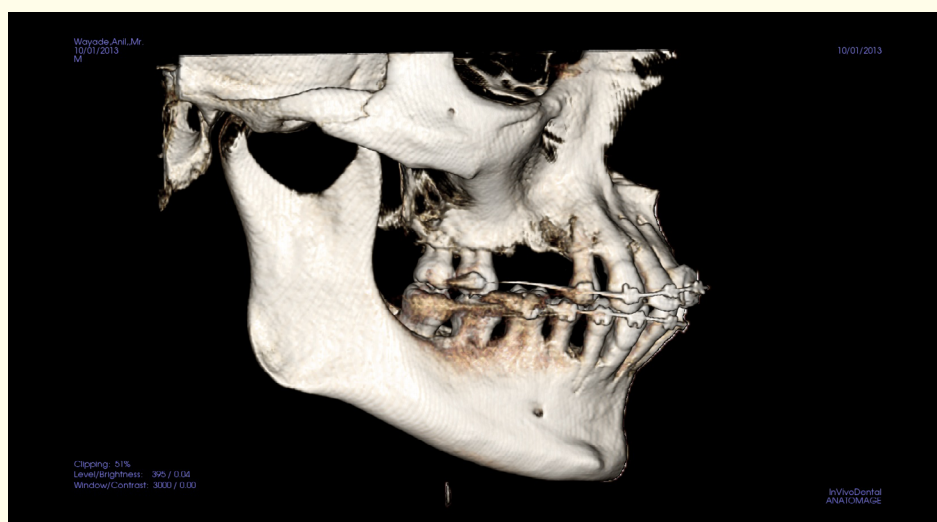


Figure 3: 3D volume reconstruction right maxilla and mandible to evaluate periodontal condition during orthodontic treatment

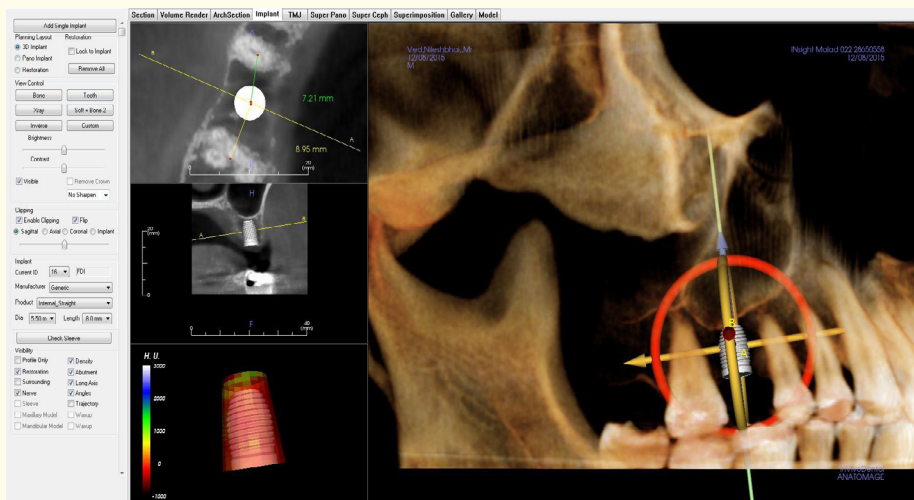


Figure 4: Virtual 3D dental implant pre operative planning with posterior maxilla

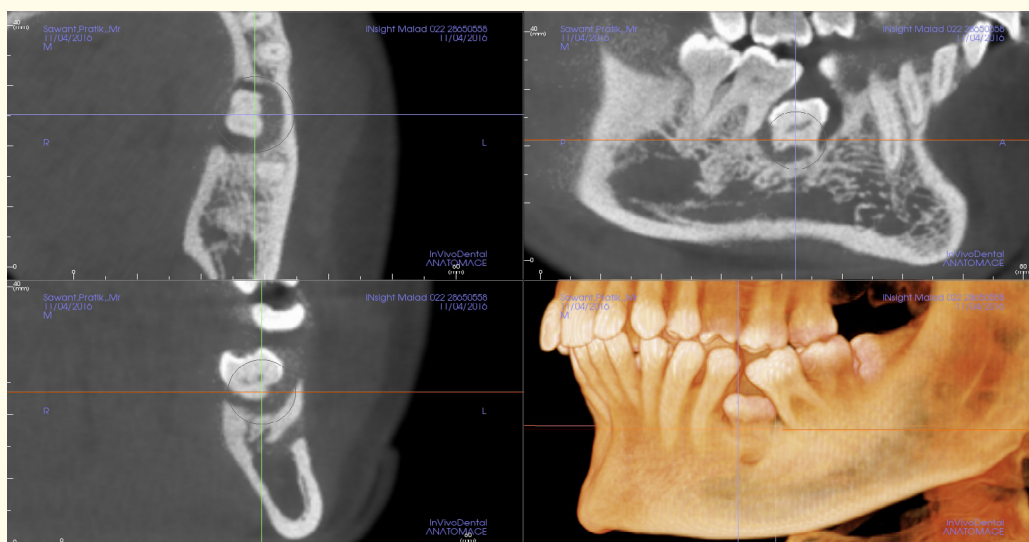


Figure 5: 3D Cone beam computed tomography view for a retained deciduous tooth and its relation with inferior alveolar canal

Conclusion

There is no doubt that 3D imaging in dentistry has helped the prognostic decision making for the dental team and for the patients who seek opinions for their challenges. This advancement as a pre-operative assessment tool serves as an important adjuvant for long term treatment planning and predictability. It has opened up new vistas in guided surgery planning and execution and fabrication of stereolithography models for accurate detection and treatment of pathology involving the maxillofacial region.

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