

# Comparative Study of DENTA Scan and Radiography for Pre-Operative Assessment of Dental Implants.

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## ABSTRACT

**Background:** Dental implant placement has become a very common procedure in the modern era. Pre operative assessment is of immense value to ensure the long term stability of dental implants. Aim: The aim of our study was to compare the efficacy of Dental CT with radiography in planning implant surgery and pre-operative evaluation prior to implant placement. **Methods:** We conducted a hospital based prospective study in which patients for dental implant placement were evaluated with Dental CT and Radiography. **Results:** The radiographs overestimated the height of the alveolar ridge in majority of the pre implant cases as compared to Dental CT. For bucco-lingual analysis Dental CT provided an overwhelming advantage over Dental Radiography and clinical examination. The angle of alveolar ridge could not be assessed on radiographs whereas could be accurately estimated on Dental CT. Bone density of the implant site could be quantitatively determined on Dental CT whereas could not be determined on Radiographs. **Conclusions:** We concluded that Dental CT yields significantly better information than radiographs regarding pre-operative assessment of dental implants.

**Keywords:** Dental, CT, implant, radiography, operative.

## INTRODUCTION

The jaw comprises of two complex bony structures: the mandible and maxilla. Their curved or arch like configuration makes radiographic imaging difficult.<sup>[1]</sup> Since conventional (plain film) radiographs (panoramic, periapical and occlusal) are a two dimensional image of a three dimensional object, their role in diagnosis is limited. When plain film radiographs are used for a three dimensional analysis, at least one additional radiograph perpendicular to the plane of the first radiograph, or two different angulated views are necessary. The use of such radiographs cannot always precisely determine the true morphology and relationship of an object in all dimensions, or overcome the misleading effect of superimposition.<sup>[2]</sup> Correct implant placement is crucial to prevent early implant loss or clinical complications, which is

especially important if implant perforation into the maxillary sinus or nasal cavity occurs. Another major complication is perforation of the implant into the mandibular canal.<sup>[1]</sup>

The aim of our study was to compare the efficacy of Dental CT with radiography in planning implant surgery and pre operative evaluation prior to implant placement.

## MATERIALS & METHODS

We conducted a hospital based prospective study in the Department of Radiodiagnosis and Imaging. Patients for preoperative assessment of implant surgery with radiographic evaluation for comparison were included in the study.

Dental radiography was performed in the Oral Medicine and Radiology Department comprising of Orthopantomogram (OPG) or Intraoral Periapical (IOPA) views. CT scan was done using Phillips - Brilliance multislice CT scanner. Informed consent was obtained from every patient undergoing the CT scan. The patient was placed supine in head first position with cervical spine slightly hyperextended. The head was positioned symmetrically and strapped to the head rest. The patient was instructed not to

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move or swallow during scan. The jaw was immobilized by having the patient bite on a cotton roll. In the scanned axial projection, it was ensured that both rami and angles of mandible were perfectly aligned. The orbits were not included in the field of view. The scanning was done from inferior margin of the mandible to the roof of the maxillary sinus

The radiation dose was minimised by using lead aprons for the patients, by using bony algorithm for the scans and keeping a small field of view. Multiplanar reconstructions using Dentascanner software were done on the Extended Brilliance Workstation. A planning line was drawn manually along the centre-line of the jaw arch which formed the base for subsequent orthoradial and panoramic reconstructions. The orthoradial reconstructions were calculated perpendicular to the planning line and the panoramic reconstructions were calculated parallel to the planning line.

#### **Statistical analysis**

All the relevant data was analysed using IBM SPSS Statistical software version 16. Weighted Kappa-values (which are a measure of intra-observer agreement) were calculated using the Stata 10 and SPSS 16 softwares. The statistical significance of the results was determined at p-value < 0.05.

## **RESULTS**

66 patients were evaluated prior to implant placement. 40 out of 66 cases were assessed for pre-implant placement in maxilla and 26 for mandible. 15 cases involved missing incisors, 22 involved missing molars, 11 involved missing premolars and 18 involved missing multiple teeth. The mean height of alveolar ridge obtained by radiographs was 17.5 mm whereas that obtained by CT was 16.5 mm. The bucco-lingual width could not be estimated on the radiographs whereas could be accurately estimated on CT. The bucco-lingual width estimated by the dentist using vernier callipers overestimated the width as compared to that estimated by CT. The angle of alveolar ridge could not be assessed on radiographs whereas could be accurately estimated on CT. Angle of alveolar ridge was found to be more than 45 degrees in 35 out of 66 cases. The distances from maxillary sinus and nasal floor in respective cases could not be visualized on radiograph but was accurately determined on CT. Bone density could be quantitatively determined on CT. 40 cases were found to have poor quality bone that is <600 HU.

## **DISCUSSION**

It is imperative to preoperatively evaluated candidates for dental implants to know if there is enough bone in the alveolar ridge to allow a titanium implant to be placed.<sup>[3,4]</sup>

#### **Height of alveolar ridge**

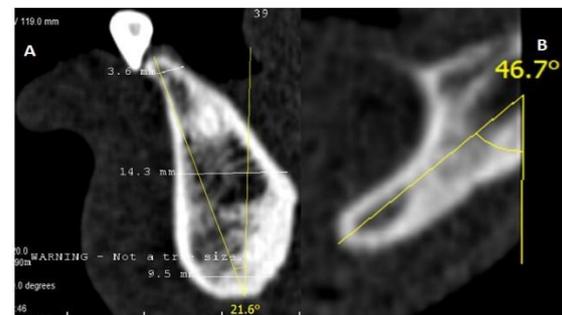
The radiographs overestimated the height of the alveolar ridge in 42 out of 66 cases as compared to CT. Our findings were similar to those of

Stephen L. G. Rothman et al,<sup>[5]</sup> who also concluded that dental CT allows direct measurement of the alveolar ridge from CT as compared to radiographs which are affected by film size or magnification.

Dental CT proves to be better than radiograph, as most panoramic machines have varied and unreliable magnifications (25% to 30%) especially in the vertical dimension thus leading to inaccurate determination of the height of alveolar ridge.

#### **Distance from maxillary sinus and nasal floor**

The distance from the maxillary sinus and nasal floor in respective cases could not be visualized on radiograph but was accurately determined on CT. This is again because of the non uniform magnification produced in the panoramic machines. Magnification is more pronounced in posterior than in anterior areas. This may give a false sense that more bone exists between the crest of the alveolar process and the inferior alveolar canal, nasal fossae or maxillary sinuses. Improper patient positioning may further contribute to image distortion. Even properly positioned and exposed panoramic radiographs cannot be used for direct bony measurements unless the magnification factor for the target area is predetermined. Hence, we concluded that radiographs are unreliable for determination of the accurate measurements. Similar findings have been proved in the previous study conducted for evaluation of tumours of the jaw.<sup>[6]</sup>



**Figure 1: Patient for assessment of pre implant placement- (A) Dental CT cross sectional view shows measurement of angle of alveolar ridge. Angle of alveolar ridge with the vertical is less than 45 degrees. (B) Dental CT cross sectional view shows measurement of angle of alveolar ridge. Angle of alveolar ridge with the vertical is more than 45 degrees.**

#### **Bucco-lingual width**

The bucco-lingual width could not be analysed on the radiographs whereas could be easily and accurately measured on CT. The bucco-lingual width estimated by vernier callipers overestimated the width as compared to CT because of the soft tissue interposition.

Dental CT provided an advantage over Dental Radiography and clinical examination for bucco-lingual analysis when employed for pre operative assessment in implant placement as found in our previous study.<sup>[7]</sup>

#### **Angle of alveolar ridge**

The angle of alveolar ridge which is an important factor to be assessed in patients undergoing tooth implant could not be assessed on radiographs whereas could be accurately estimated on CT [Figure 1].

Angle of alveolar ridge was found to be more than 45 degrees in 35 out of 66 cases which would have a prognostic implication as excessive angulation of the alveolar ridge precludes proper implant placement. If excess angulation should exist between the vertical axis through the fixture and that through the alveolar ridge, the resultant force vector may fall in an area unable to withstand occlusal forces and breakdown of the surrounding bone may occur.<sup>[8]</sup>

#### **Bone density of implant site**

Bone density could be quantitatively determined on CT.

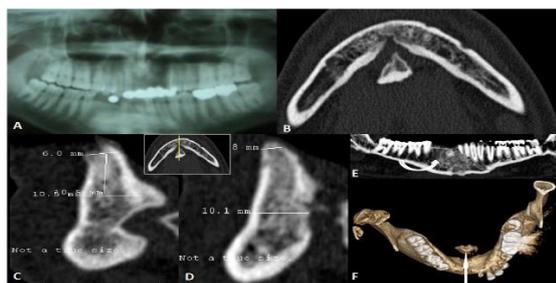
One case was found to have poor quality bone that is <600 HU. Values >600 HU is desirable by oral surgeons for implant placement.<sup>[9]</sup> This valuable information about the bone quality provides dental practitioners to make better treatment planning regarding the implant positions.

Our study was in agreement with the findings of the study conducted by I. Turkyilmaz et al,<sup>[10]</sup> they concluded that CT is a useful tool to determine the bone density of the concerned areas prior to implant placement, and the valuable information derived from CT may help clinicians to avoid placement of implants into the very poorest qualities of bone, where failure is more likely.

#### **Pre-implant augmentation procedure**

Pre-implant augmentation procedure was done for one patient – Radiograph showed good osseointegration of the bone graft whereas CT showed a radiolucent rim around the graft.

This aspect of implant evaluation needs further assessment with larger sample size



**Figure 2:** Case for implant placement – (A) Orthopantomogram -Height of alveolar ridge overestimated, No fracture visualized. (B) Axial CT section showing displaced fracture fragment of mandible. (C & D) Dental CT Cross sectional view showing accurate estimation of height of alveolar ridge & bucco-lingual width. (E) Dental CT Panoramic view shows the site for implant placement. (F) Volume rendered image showing fracture fragment.

#### **Associated abnormality**

Associated abnormality was found in one of the cases – that is displaced mandibular fracture fragment which was not seen on the radiograph

[Figure 2]. Radiographic signs could be absent as the orientation of X- ray beam may not be parallel to the plane of fracture.<sup>[11]</sup>

## CONCLUSION

Dental CT, being a multiplanar imaging modality, provides valuable information in preoperative assessment of the jaw for implants in evaluating the height and angulation of alveolar ridge, its bucco-lingual dimension, relation with adjacent structures and quantitative evaluation of bone density at implant site.

This study has shown the capabilities of Dental CT as an obligatory imaging tool for Dentistry in pre-implant assessment.

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