Assessment of Osseo integrated Dental Implants With CBCT: A Prospective Study.

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ABSTRACT

Background: Accurate evaluation of osseointegration in dental implants need detailed radiographic analysis of anatomic structures as well as pathological conditions. CBCT is most reliable three dimensional radiographic techniques in implant imaging.

Aim: This study was carried out with an objective to carry out role of CBCT in assessment of osseointegration in dental implants.

Materials and methods: The patients having requirement of replacement of missing teeth as well as extraction of completely non restorable teeth reporting to the outpatient department were included in the study. Written informed consent was obtained from the study subjects and clearance was obtained from the ethical committee before commencement of the study. Sixty patients were included in the study. Some measurements were carried out using digitalized orthopantomograph within seven days of implant placement. These measurements were as follows: Distance (in mm) from the apical region of implant upto the bony layer around the implant. Height (in mm) of bone at the alveolar crest. Crestal bone height was evaluated at distal as well mesial aspect of the implants along the implant edges. Same measurements were carried out with CBCT using advanced software called "Blue Sky Plan" within seven days of insertion of implant. These measurements were again carried out three months later of implant placement.

Results: When analysis was carried at apical portion in CBCT then the length of bone formed at one week was 0.378± 0.0.076 mm and after three months 0.341± 0.054mm. The difference was statistically significant.(p≤0.03). On evaluating crestal bone height at mesial side in CBCT the crestal bone height at

one week was 3.936 ±0.723 mm while the value was 3.865±0.746 mm at three months after placement of implants. On evaluating crestal bone height at mesial side in CBCT the crestal bone height at one week was 3.725 ±0.695 mm while the value was 3.865±0.686 mm at three months after placement of implants. Conclusion: **The conclusion drawn from the current study was that CBCT can be useful radiographic technique for the assessment of osseointegrated implants but the duration of evaluation should be upto six months. More studies should be carried out in future with larger sample size and longer follow up.**
Keywords: Cone beam computed tomography, Implants, Osseointegration.

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INTRODUCTION

The concept of replacement of missing tooth with artificial prosthesis is several centuries old because there are historical evidences when human being of ancient civilization carried out replacement of lost teeth through attachment of artificial replacements of lost teeth with the teeth remaining in the oral cavity with the help of metallic bands.[1] When implants are placed in bone then the anchorage should be provided by the sheath of connective tissue present around the implant. However the structural and organizational properties of this sheath are not comparable to the periodontal ligament. Therefore it cannot act as a substitute of the natural periodontal ligament. There have been many cases when there is incidence of implant failure mainly because of loosening of implants.[2,3] This loosening of implants is due to increase in space between the implant surface and fibrous tissue around it after loading of implants with the prosthesis. This is because of the fact that sheath of fibrous tissue is incompletely differentiated tissue in the form of scar unlike the periodontal ligament which well differentiated tissue.[4,5]

For success of implants there is serious requirement of osseointegration. According to Dorland the osseointegration is development of bone surrounding the implant at the implant bone interface instead of the development of fibrous tissue at the interface of implant and bone. Moreover it is also considered as functional and structural interaction between the well differentiated living bone and surface of implant carrying the load.[6] The main function of the boundary between the implant and bone is to ensure a proper and effective transfer of the load exerted by occlusal forces to bone tissue through dental implant. There are some literatures present which indicate that the boundary between the implant and the bone tissue is more affected by factors which are biochemical in nature as compared with biomaterial factors. The biochemical factors having effect on regeneration of bone are more pronounced than the biomaterials.[7]

The assessment of oeeointegration is quite important. Radiographic techniques are one of the most common methods for analysis of osseointegration. However most of the clinicians use radiographic techniques to analyse the loss of osseointegration in implants. It should be considered that radiography is not only for analysis of loss of osseointegration but it can also be incorporated in the assessment of alveolar bone status. Radiographic techniques are also useful in the evaluation of the change in the level of bone support during the gap between two radiographic examinations. There are several contemporary two dimensional radiographic techniques which are not reliable for the radiographic assessment of the implants.[8]

Cone Beam Computed Tomography popularly called as CBCT is the recent three dimensional imaging techniques being used in implant dentistry for several purposes like measurement of height, width and density of the remaining alveolar bone.[9] Moreover it is also used in determination of the angulation of the implants. It also helpful in the assessment of complex areas like maxillary sinus and bony canal having mandibular nerve. There is one important aspect of implant dentistry which is not evaluated by CBCT till now. This aspect is osseointegration in implants.[10,11] Therefore this study was conducted to evaluate of role of CBCT in the assessment of osseointegration in implants.

MATERIALS AND METHODS

The patients having requirement of replacement of missing teeth as well as extraction of completely non restorable teeth reporting to the outpatient department were included in the study. Written informed consent was obtained from

the study subjects and clearance was obtained from the ethical committee before commencement of the study. Sixty patients were included in the study.

Inclusion Criteria

- Study subjects having the need of replacement of the missing teeth as well need for extraction of unrestorable teeth.
- Study subjects in the age group of sixteen to sixty years.
- Study subjects who were sincere regarding their oral health and who agreed to provide written informed consent were included in the study.

Exclusion Criteria

- Study subjects suffering from systemic disease like hyperparathyroidism, osteoporosis, chronic kidney disease etc that could affect the successful placement of implants.
- Study subjects having habit of maintaining low hygiene of the oral cavity.
- Study subjects having habits which can damage the biological tissues of the oral cavity.

Method of Data Collection

The teeth which were completely non restorable and were decided to be replaced with dental implant were extracted. Once the extraction was complete then there was preparation of the extraction socket for the placement of the dental implant. Then the dental implant was inserted and affixed in fixed position in the extraction socket prepared. Study subjects with missing teeth who agreed for dental implant placement underwent surgical procedure for placement of dental implant in the edentulous area. Within one week of the implant placement a digital orthopantomography was carried out using Vatech 8000C digital panoramic machine. A CBCT scan was also conducted on the same patient with the help of Vatech 3D CBCT machine. The exposure parameters of CBCT were adjusted as 75 Kvp, 12 seconds exposure time, 8x8 cm field of view. Both CBCT scan and digital orthopantomography was conducted again three months later having the same exposure parameters.

Evaluation Parameters

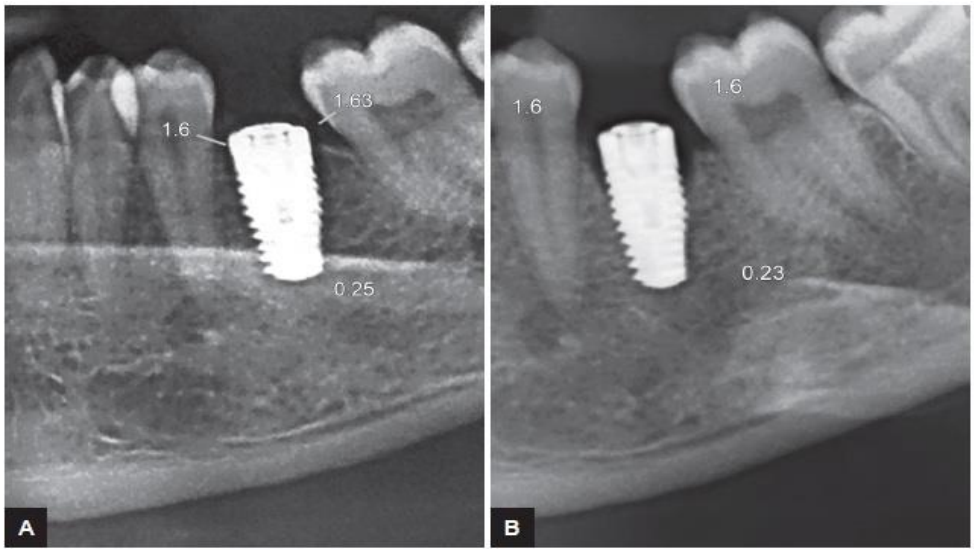
Some measurements were carried out using digitalized orthopantomograph within seven days of implant placement. These measurements were as follows:

i) Distance (in mm) from the apical region of implant upto the bony layer around the implant
ii) Height (in mm) of bone at the alveolar crest.

Crestal bone height was evaluated at distal as well mesial aspect of the implants along the implant edges. Same measurements were carried out with CBCT using an advanced software called “Blue Sky Plan” within seven days of insertion of implant. These measurements were again carried out three months later of implant placement. Some other assessments were carried out in CBCT using an advanced software. These assessments were[12]:

Area One: It is present just adjacent to surface of implant. This area correlate with the zone of osseointegration i.e boundary between bone and implant surface.

Area Two: This area is present immediately adjacent to the area one and it correspond with the bone around implant.



Figs 1A and B: Measurement on digital OPG: (A) 1 week of implant placement; and (B) after 3 months of implant placement

Figs 2A and B: Measurement on CBCT: (A) 1 week of implant placement; and (B) after 3 months of implant placement

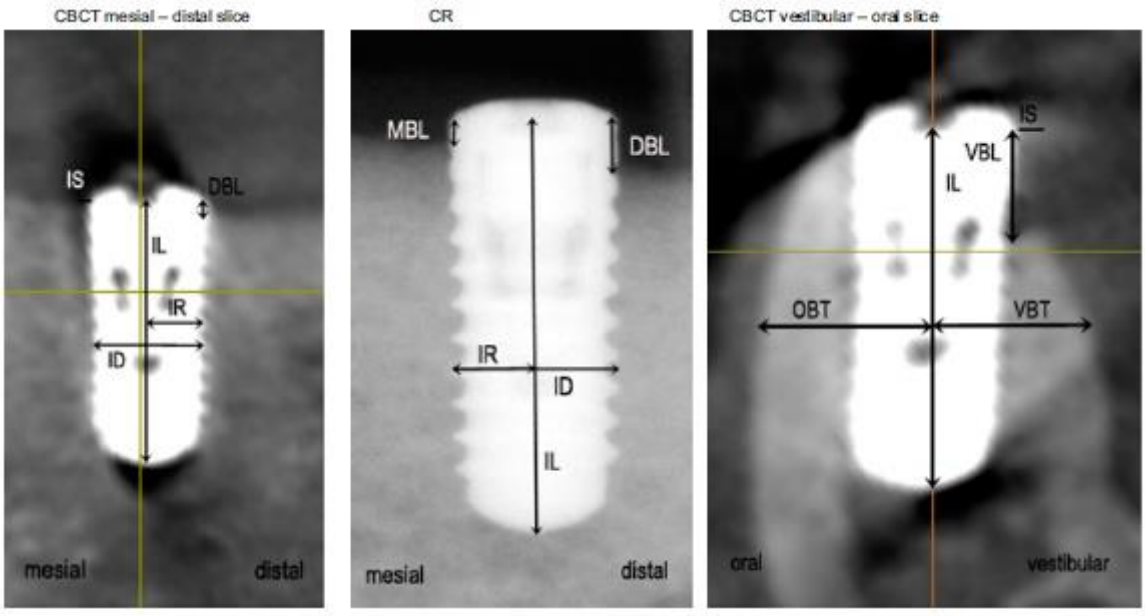


Figure 3: Data preparation of cone beam CT (CBCT) slices. DBL, distal bone level MBL, mesial bone level.

RESULTS

In this study sixty implant sites were analysed. However in three implants the measurement of the crestal bone height was not possible because they were submerged in the bone. When analysis was carried at apical portion in digital OPG then the length of bone formed at one week was 0.719± 0.285 mm and after three months 0.718± 0.278mm. The difference was statistically significant.(p≤0.02).

Table 1: Comparison of mean apical portion after 1 week and 3 months by using digital OPG

Apical portion (AD)	***Number of cases (n)***	***Apical portion***		***P value***
		Mean	*SD*	
One week	60	0.719	0.285	<0.002
Three months	60	0.718	0.278	

Out of sixty implants there was evaluation of fifty seven implants for crestal bone height because three implants were more submerged in the bone due to which there was assessment of crestal bone height in three implants sites. On evaluating crestal bone height on mesial side in digital OPG the crestal bene height at one week was 3.578±0.755mm while the value was 3.518±0.756mm at three months after placement of implants. The difference was statistically significant p=0.005.

Table 2: Comparison of mean CHM after 1 week and 3 months by using digital OPG

Crestal bone height (mesial) (CHM)	*Number of cases (n)*	*CHM*		*P value*
		Mean	*SD*	
One week (CHM1)	57	3.578	0.755	0.005
Three months (CHM2)	57	3.518	0.756	

On evaluating crestal bone height at distal side in digital OPG the crestal bene height at one week was 3.584±0.773 mm while the value was 3.528±0.743 mm at three months after placement of implants.

Table 3: Comparison of mean CHD after 1 week and 3 months by using digital OPG

Crestal bone height (distal) (CHD)	*Number of cases (n)*	*CHM*		*P value*
		Mean	*SD*	
One week	57	3.584	0.773	0.009
Three months	57	3.528	0.743	

When analysis was carried at apical portion in CBCT then the length of bone formed at one week was 0.378± 0.0.076 mm and after three months 0.341± 0.054mm. The difference was statistically significant.(p≤0.03).

Table 4: Comparison of mean apical portion after 1 week and 3 months by using CBCT

Apical portion (AD)	***Number of cases (n)***	***Apical portion***		***P value***
		Mean	*SD*	
One week	60	0.378	0.076	<0.003
Three months	60	0.341	0.054	

On evaluating crestal bone height at mesial side in CBCT the crestal bone height at one week was 3.936 ±0.723 mm while the value was 3.865±0.746 mm at three months after placement of implants.

Table 5: Comparison of mean CHM after 1 week and 3 months by using CBCT

Crestal bone height (mesial) (CHM)	*Number of cases (n)*	*CHM*		*P value*
		Mean	*SD*	
1 week (CHM1)	57	3.936	0.723	0.360
3 months (CHM2)	57	3.865	0.746	

On evaluating crestal bone height at mesial side in CBCT the crestal bone height at one week was 3.725 ±0.695 mm while the value was 3.865±0.686 mm at three months after placement of implants.

Table 6: Comparison of mean CHD after 1 week and 3 months by using CBCT

Crestal bone height (distal) (CHD)	*Number of cases (n)*	*CHM*		*P value*
		Mean	*SD*	
One week	57	3.725	0.695	0.385
Three months	57	3.865	0.686	

DISCUSSION

The dental implants have got more commonly used in rehabilitation of oral cavity since the introduction of the concept of osseointegration. The main motive behind conducting this study was to analyse the degree of osseointegration in dental implants within three months of insertion of implants by using CBCT and comparing it with the findings of the digital OPG. The results of this study showed that there is osseointegration in implants within three months of implant insertion as according to the findings of both CBCT and digital OPG. The findings of present study were in accordance with the other previous studies.[12,13]

In our study it was found that magnification was observed in the digital OPG as compared to that of CBCT imaging. This magnification was in the range of 1.3% to 1.6% in both vertical and horizontal planes. On the other hand the magnification was marginal in CBCT.

In present study there was assessment of the measurements of same study subject in both CBCT and digital OPG. It was observed that readings were greater in digital OPG as compared with CBCT. For example crestal bone height on both distal and mesial aspect of implant was 3mm as measured in digital OPG while it was 2mm when measured in

CBCT. Therefore changes after 3 months of implant insertion were more significantly different in digital OPG.
In our study 04 cases out of 60 cases were assessed after six months of the implant insertion. It was observed that there was change in measurement from 0.36 mm to 0.30 mm in apical portion and change was from 3.13 to 3.0 mm in the crestal bone in CBCT. This is because according to findings of Cochran et al there is remodeling of the bone around implant and it is more pronounced after six months of insertion of implants. In our study there was analysis after three months therefore significant changes regarding periimplant bone remodeling was not observed. [14]
The results of the present study were similar to the results of the study conducted by Dreiseidler et al who showed that CBCT give better radiographic information about the important structures in osseointegrated implants in comparison to the digital OPG.[15]
In our study there was measurement distance (in mm) from the apical region of implant upto the bony layer around the implant and height (in mm) of bone at the alveolar crest. Crestal bone height was evaluated at distal as well mesial aspect of the implants along the implant edges. These measurements were conducted only in few studies earlier like Bedi et al.[16,17]
The limitation of this study was that assessment was done at one week and 3 months only. The assessment should have been done at six months duration also. Besides the sample size was small because the high charges of CBCT examination. Morever there was risk of increased radiation exposure to the study subjects. The results of CBCT should have been confirmed with surgical exploration.

CONCLUSION

The conclusion drawn from the current study was that CBCT can be useful radiographic technique for the assessment of osseointegrated implants but the duration of evaluation should be upto six months. More studies should be carried out in future with larger sample size and longer follow up.

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