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Comprehensive assessment of 'CBCT' in evaluating bone loss around dental implants in patients with mandibular implant supported over dentures: An original research study

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Abstract
Aim: The sole aim of this study was to evaluate bone loss around implants after insertion of implant supported over dentures using CBCT. Here authors had attempted to assess the existing bone level around mandibular dental implants using cone beam computed tomography (CBCT).
Materials & Methods: The present study was entirely based on a cross sectional perspective. Firstly, a total of 10 completely edentulous patients those rehabilitated by implant over dentures were selected by randomized sampling procedure. The implants were divided in two groups. Group I consist of the implants of the right side of the jaw and Group II consisted of implant placed on the left side of the jaw. Finally, the twenty inserted implants were studied in detail for bone losses in post operative phases. The mesial, distal, buccal and lingual bone level around the dental implants was evaluated; using the CBCT.
Statistical Analysis and Results: Statistical analysis was completed by statistical software Statistical Package for the Social Sciences (SPSS). The recorded data was subjected to appropriate statistical tests to obtain p values, mean, standard deviation, standard error an 95% CI. $P \leq 0.05$ was considered as statistically significant. All participating patients were divided into 3 groups depending upon their age ranges. 4 patients were belonging to the age range of 35-44 years consequently we can presume that most of the patients were belonging to younger age groups. P value was significant in the age range 55-64 years. The measured value was 0.00. Significant inferences were drawn for all bone losses at all measured surfaced in all studied implants.
Conclusion: Within the limitations of the study authors concluded that the CBCT analysis of bone level revealed noticeable bone loss around all aspects of the inserted twenty dental implants. These findings would have been unrecognizable if authors would have used two dimensional radiographic measures.

Keywords: cone beam computed tomography, bone loss, implant, over denture

1. Introduction

Panoramic radiographs and computed tomography (CT) play a paramount role in the accurate diagnosis, treatment planning, and prognostic evaluation of various complex dental pathologies. The advent of cone-beam computed tomography (CBCT) has revolutionized the practice of dentistry, and this technique is now considered the gold standard for imaging the oral and maxillofacial area due to its numerous advantages, including reductions in exposure time, radiation dose, and cost in comparison to other imaging modalities. Since the discovery of the X-ray, dental radiology has played a vital role as an important diagnostic adjunct to the clinical assessment of dental patients, treatment planning, and prognostic evaluation of dental diseases [1-4]. Intraoral and conventional radiographic procedures suffer from the limitations of. 2-dimensional (2D) projections, which include magnification, distortion, superimposition, and misrepresentation of structures [5-6]. Cone-beam computed tomography (CBCT) presents as a separate C-arm to conventional computed tomography (CT) and it has gained broad acceptance in dentistry in the last 5 years as it generates 3-dimensional (3D) data at lower radiation dose and cost and a higher spatial resolution than conventional CT [7]. CBCT has revolutionized the imaging of the maxillofacial region due to its wide range of applications across the fields of dentistry, ranging from diagnosis to treatment planning. However, a lack of proper education and awareness among dentists is leading to unnecessary referrals for CBCT imaging. CBCT provides cross-sectional images in several planes that help with the accurate assessment of the height, width, and angulation of bone, as well as with visualization of the position of the inferior alveolar canal and mental foramen in the mandible and the sinus in the maxilla. In edentulous patients, CBCT provides better visualization of buccolingual alveolar ridge patterns, such as irregular, narrow crestal, or knife-edge ridge, undulating concavities, and alveolar bone quality and quantity [8-10]. In many situations, CBCT implantology has minimized or eliminated the need for procedures like bone and tissue grafts, as it enables precise measurement of the distance, area, and volume of the bone in which the implant is to be placed. The use of software planning prior to implant placement helps surgeons position the implants more accurately and safely [11-12]. Using this technology, minimally invasive surgery can be performed without raising a flap, thereby minimizing surgery time, postoperative pain and swelling, and recovery time. The stored information from the scan can be used pre-surgically to fabricate a master cast, and provisional restoration could be placed immediately after surgery [13-16]. However, the American Academy of Radiologists (AAOR) has recommended panoramic radiography as the primary imaging modality for the initial assessment of the implant site. Cross-sectional CBCT images should be considered only when clinical conditions require sinus augmentation procedures or bone grafting [17-18]. The sole aim of this study was to evaluate bone loss around implants after insertion of implant supported over dentures using CBCT. Here authors had attempted to assess the existing bone level around mandibular dental implants using cone beam computed tomography (CBCT).

Materials & Methods

The present study was entirely based on a cross sectional perspective. Firstly, a total of 10 completely edentulous patients those already rehabilitated by implant overdentures were selected by randomized sampling procedure in the nearby vicinity. We studied total 5 male and 5 female patients. The inclusion criteria were; patients with edentulous jaws and Angle class I with moderate inter-arch distance and residual ridges. The exclusion criteria were inadequate inter-occlusal space, uncontrolled systemic diseases, heavy smokers and history of chemotherapy or radiotherapy. Standard clinical and laboratory techniques were followed for implant insertion and denture construction for all patients. While selecting the patient, we had ensured that patients must be having retained mandibular overdentures by two implants in the canine region and retained locator attachments. We have also verified that standard clinical and laboratory techniques were followed for implant osteotomy and denture fabrication. The implants were divided in two groups. Group I consist of the implants of the right side of the jaw and Group II consisted of implant placed on the left side of the jaw. Finally, the twenty inserted implants were studied in detail for bone losses in post operative phases. The mesial, distal, buccal and lingual bone level around the dental implants was evaluated; using the CBCT at 6 months follow up period. We have also screened the edentulous ridges for any pathological lesions, impactions or remaining roots (Figure 1 and. 2). Informed consent was taken from the patients those were willingly ready for involvement. Right before the execution of the study, author had explained the relative significance of this study to all participating patients. The privacy and other interrelated rights of the patients along with their freedom of expression were kept absolutely confidential. Results thus received was compiled in table and subjected to basic statistical analysis. P value less than 0.05 was considered significant (p< 0.05).

Statistical analysis and results

All inferences those gathered from questionnaire exercise were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version. 21 (IBM Inc., Armonk, New York, USA). The finalized data was subjected to appropriate statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Table 1 and Graph 1 showed that out of 10 patients, males were 5 and females were 5. All participating patients were divided into 3 groups depending upon their age ranges. 4 patients were belonging to the age range of 35-44 years consequently we can presume that most of the patients were belonging to younger age groups. P value was significant in group III of age range 55-64 years. The measured value was 0.00. Table. 2, 3 and Graph. 2 shows basic statistical description with level of significance evaluation using Pearson chi-square test [for Group I and II]. Group I showed higher bone losses than Group II. Significant inferences were drawn for all bone losses at all measured surfaced in all studied implants. (p<0.05 significant)

Table 1: Age & gender wise distribution of patients

Age Group (Yrs)	Male	Female	Total	P value
35-44	2	2	4	0.06
45-54	1	2	3	0.70
55-64	2	1	3	0.00*
Total	5	5	10	*Significant

*p<0.05 significant

Table. 2: Basic statistical description with level of significance evaluation using pearson chi-square test [for group i]

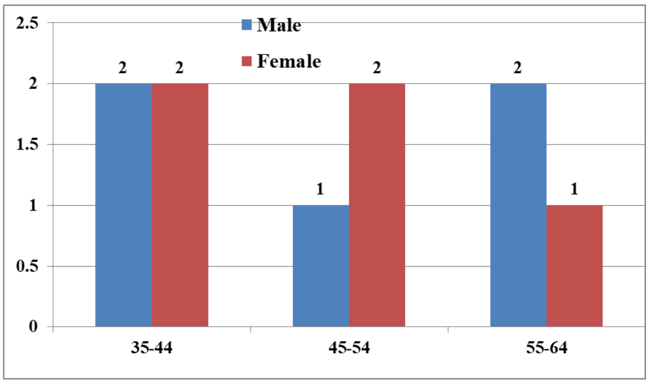
Variables	Mean Bone Loss	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
Mesial [n=10]	0.54	0.765	0.544	1.96	2.564	1.0	0.02*
Distal [n=10]	0.78	0.255	0.532	1.45	2.335	2.0	0.01*
Buccal [n=10]	0.23	1.274	0.657	1.96	2.767	1.0	0.00*
Lingual [n=10]	0.89	0.864	0.644	1.54	1.234	1.0	0.01*

*p<0.05 significant

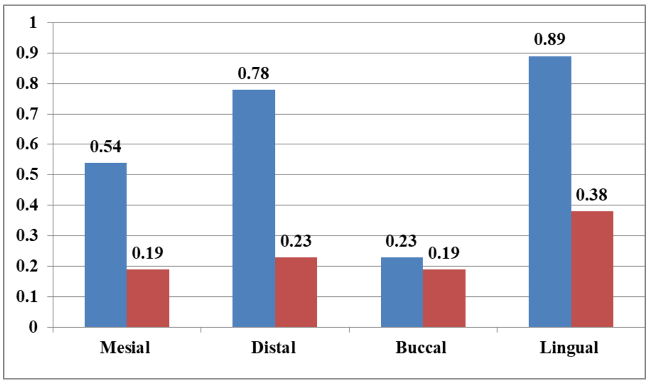
Table 3: Basic statistical description with level of significance evaluation using pearson chi-square test [for group ii]

Variables	Mean Bone Loss	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
Mesial [n=10]	0.19	0.864	0.644	1.54	1.234	1.0	0.04*
Distal [n=10]	0.23	0.489	0.765	1.34	2.546	2.0	0.01*
Buccal [n=10]	0.19	0.454	0.563	1.56	2.654	1.0	0.01*
Lingual [n=10]	0.38	0.677	0.657	1.76	1.342	1.0	0.01*

*p<0.05 significant



Graph 1: Age & gender wise distribution of patients



Graph 2: Mean bone loss around implants in group i and ii

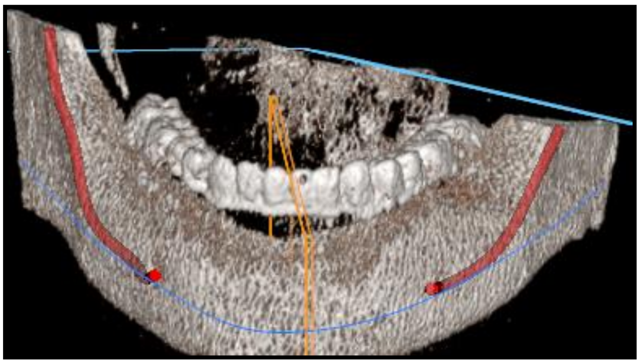


Fig 1: CBCT yields images with isotropic sub millimeter spatial resolution; as a result, its use is perfectly suited for mandibular implant over denture cases

Fig 2: CBCT provides a highly sophisticated format for precisely defining the jaw structure and locating critical anatomic structures. CBCT in conjunction with software that renders the most real and accurate information, provide the most precise radiographic modality currently available for the evaluation of patients for mandibular implant over denture

Discussion

As we all know that the overall success of an implant can be evaluated by the appearance of normal bone surrounding it and its deposition to the surface of the implant body. The development of a thin radiolucent area that closely follows the outline of the implant usually correlates to clinically detectable implant mobility; it is an important indicator of failed osseointegration [19-20]. In implant dentistry, three-dimensional (3D) imaging can be realized by dental cone beam computed tomography (CBCT), offering volumetric data on jaw bones and teeth with relatively low radiation doses and costs. Radiography is considered the most frequent diagnostic tool in daily dental practice, with more than one quarter of all medical radiographs in Europe being made by dentists [21-24]. Since the discovery of x-rays 120 years ago, dental radiographs have been the predominant source of diagnostic information in the oral and maxillofacial complex. Yet, two-dimensional (2D) imaging techniques are unable to depict complicated three-dimensional (3D) anatomical structures and related pathologies. In the nineties, there was a growing tendency in using 3D information as an aid for dento-maxillofacial diagnosis and treatment, while in the current time; cone beam computed tomography (CBCT) imaging started to offer a solution for this growth by being made available in specialty clinics [25-28]. These developments went hand in hand with the increasing use of 3D imaging applications for presurgical planning and transfer of oral implant treatment (Figure 1 &. 2). While the required 3D acquisition for dental applications was initially realized by medical computed tomography (CT), dental CBCT rapidly took over [29-30]. The main reasons for the triumph of CBCT are its capabilities of volumetric jaw bone imaging at reasonable costs and doses, with a relative advantage of having a compact, affordable, and nearby or in-house equipment. The goal of modern dentistry is to restore the patient to normal contour, function, comfort, esthetics, speech, and health [31-32]. What makes implant dentistry unique is the improved ability to achieve this goal. However, careful diagnosis and treatment planning are must for favorable outcome. Treatment planning for implants includes a through radiographic and clinical examination. Evaluation of the dimensions of the available alveolar bone is an important prerequisite for dental implant placement. Bone evaluation limited to the use of panoramic and/or periapical radiographs may be insufficient because it only provides two-dimensional (2D) information about implant sites. Advanced digital radiographic techniques such as "computed tomography (CT)" have now become the mainstay for pre-implantation assessment. The introduction of cone beam (CB) CT, in 1998, provided a new form of three dimensional (3D) evaluations [33]. Several studies have shown that cone-beam computed tomography (CBCT) provides high quality, accurate cross-sectional images with relatively low dose exposure. Diagnostic radiography is essential for implants in pre-operative, intra-operative, and postoperative assessment by use of a variety of imaging techniques. In the past, periapical radiographs, occlusal radiograph along with panoramic images were used as the sole determinants of implant diagnosis and treatment planning [34-36]. Hence, these radiographic modalities provide a. 2D representation of 3D structures, the advanced use of CT, CBCT with 3D information is cardinal for the implantologist before placing dental implants.

Conclusion

Since the discovery of x-rays 120 years ago, dental radiographs have been the predominant source of diagnostic information in the oral and maxillofacial complex. CBCT and two dimensional measurements when compared individually, CBCT proved to be a highly specific and sensitive method in measuring bone losses around dental implants. Within the limitations of the study authors concluded that the CBCT analysis of bone level revealed that there was noticeable bone loss around all aspects of the inserted twenty dental implants. These findings would have been unrecognizable if authors would have used two dimensional radiographic measures. Because, the CBCT is a promising innovation in the field of oral implantology, repeated awareness campaigns and educational demonstrations must be performed thoughtfully. However, we expect some other large scale studies to be conducted that could further establish certain standard guidelines in these perspectives.

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