Accuracy of Cone Beam Computed Tomography (CBCT) in the detection of horizontal bone loss: A case report

Catherine[1,*], Chaithanya[2], Melba[3], Marina[4], Jenny Susan[5], Faima Bhanu[6]

[1, 5,6 PG] Student, [2]Reader, [3]Assistant Professor, A.J. Institute of Dental Sciences, Mangaluru, Karnataka, India

***Corresponding Author:**
Email: drcatherinejacob@gmail.com

Abstract

The most accurate method of assessing bone level is surgical exposure which is considered to be the gold standard as it aids in accurate detection of the extent and type of bone loss as well as to evaluate bone gain after treatment. Radiographs are valuable diagnostic tools which act as an adjunct to clinical examination. The present case report aimed to evaluate the accuracy of cone beam computed tomography (CBCT) in the diagnosis of horizontal periodontal defects mainly in buccal and lingual/palatal regions where the two dimensional (2D) may be inappropriate. There was high correlation between surgical and CBCT measurements which proved that CBCT was highly accurate in the measurement of periodontal defects. CBCT is a useful aid in periodontal examination and diagnosis and it offers improved visualization of the morphology of periodontal defects. Thus we conclude that CBCT can effectively reproduce the clinical measurements of horizontal periodontal bone defects.

Introduction

Periodontal disease is considered as an inflammatory disease condition which results from a complex interplay between the subgingival biofilm and host immune inflammatory events that develop in gingival and periodontal tissues.(1) Progression of periodontal disease causes attachment loss, bone crest resorption, alveolar bone loss and consequent tooth mobility.(2) Early detection of periodontal disease is important in the prevention of tooth loss and for the patient's general health.(3)

Horizontal bone loss is the most common pattern of bone loss in periodontal disease. The bone is reduced in height, but bone margins remains approximately perpendicular to the tooth surface. The interdental septa and facial and lingual plates are affected, but not necessarily to an equal degree around the same tooth. Radiographs are considered as an important source of information, which complement the clinical information obtained during initial examination of a periodontal patient. One of the main purposes of radiographs in a periodontal examination is to assess the level and pattern of alveolar bone destruction which can be measured as a linear distance from the CEJ to the alveolar crest.(4) The major limitation when using radiographs in periodontics is that they provide a two dimensional image of a three dimensional object and this leads to problems in terms of validity, accuracy and precision.(5) It is with these limitations in recent technological advances that volumetric Cone Beam Computed Tomography (CBCT) has become increasingly popular. The main advantage of CBCT imaging includes

- Providing clear images of highly contrasted structures.
- Providing high quality panoramic, cephalometric and 3D images of specific regions.
- Rapid scan time compared with panoramic radiography.
- Reduced patient radiation dose (29-477µSv) as compared with conventional CT. Patient radiation dose is five times lower than normal CT, as the exposure time is approximately 18 seconds, that is one seventh the amount compared with conventional medical CT.
- Reduced image artefacts.(6,7)

The first reported applications of CBCT in periodontology were for diagnostic and treatment outcome evaluations of periodontitis.(8,9) CBCT was found to be very helpful in visualizing interproximal defects, furcation defects, diagnosing dehiscence and fenestrations defects, diagnostic and treatment outcome evaluations of periodontitis, evaluate post-surgical results of regenerative periodontal therapy and in planning the outcome of implant dentistry.(10,11) It is found to be as accurate as direct measurements using a periodontal probe and as reliable as radiographs for interproximal areas.

Hence the purpose of this case report is to compare CBCT to probing by surgical intervention and to investigate the accuracy of CBCT in assessing horizontal bone defects.

Case Report

A 37 year old man visited the department of periodontology at AJ Institute of Dental Sciences, Mangalore, India complaining of food accumulation in lower right back tooth region. A detailed medical history and a complete clinical examination was done. The pre-surgical measurements recorded were probing depth, clinical attachment loss, mobility and radiographic measurements. On clinical examination periodontal pockets were >6mm measured using Williams periodontal probe, for the purpose of standardization, 6 sites of mandibular first molars were assessed-Mid buccal, Mid lingual(Mid-palatal), Mesiobuccal, Distobuccal Mesiolingual (Mesiopalatal) and

Distolingual (Distopalatal)**.** The initial therapy which included oral hygiene instruction, scaling, root planning was completed.

For CBCT scanning, a Newton 3D CBCT device was used. The beam height at the surface of the image receptor (CMOS flat plane) was adjusted and set to visualize the entire jaws comprising a field of view (FOV) of 50mm width and 50mm height. Slice thickness of .2mm and slice interval of .2mm was obtained. For image acquisition, the dose protocols were 80Kv and 12ma using pulsed scanning time of 12s. Prior to the surgery, CBCT measurement was recorded from the CEJ to the crest of the alveolar bone**.[Fig 1]**

Periodontal surgical procedures were performed .Following the presurgical phase, the patient was anesthetized using 2% lignocaine with 1:100,000 epinephrine. An intraoral asepsis was performed by preprocedural mouth rinse with 10 ml of 0.2% chlorhexidine gluconate (Hexidine 0.2%, ICPA, India) solution. The extraoral asepsis was carried by swabbing with 5% povidine-iodine solution (Betadine, Win Medicare, India). After the administration of local anesthesia, buccal and lingual/palatal sulcular incisions were made and mucoperiosteal flaps were reflected. Care was taken to preserve as much of the interproximal soft tissue as possible. After the flap was reflected, the osseous defect was exposed, and thorough surgical debridement of the soft and hard tissues was carried out using Gracey's area specific curettes. The surgical site was irrigated copiously using normal saline. During surgical intervention, the distance between the CEJ and alveolar crest was measured by a single experienced professional using William's graduated periodontal probe placed in a line parallel to the long axis of the tooth (Fig. 1-7). The mucoperiosteal flaps were repositioned and secured using 4-0 interrupted direct loop silk sutures, and the area was protected by non-eugenol dressing. The clinical and CBCT measurements were then compared to each other to evaluate the accuracy of the CBCT imaging**.**

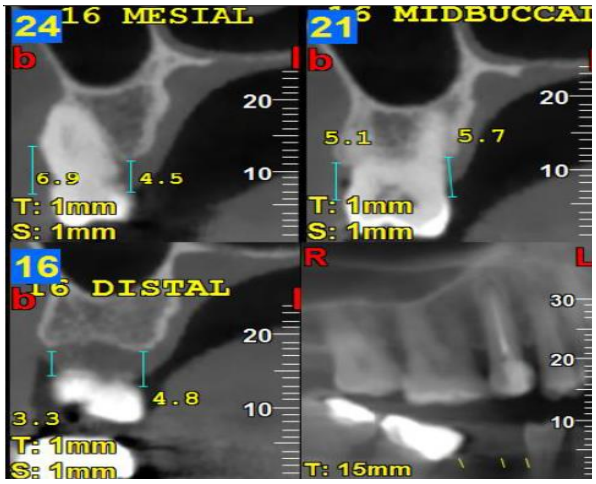

Fig 1: CBCT Measurements

Fig. 2: Mesiobuccal

Fig. 3: Distobuccal

Fig. 4: Mid Buccal

Fig. 5: MESIO Palatal

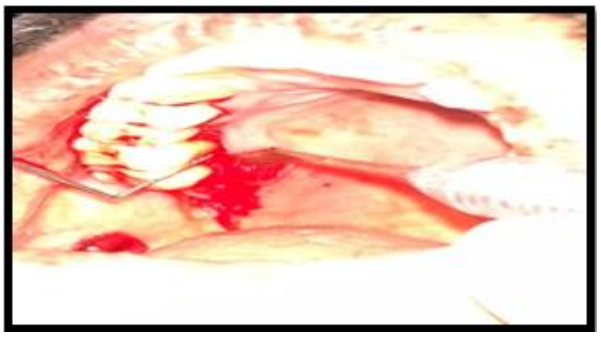

Fig. 6: Distopalatal

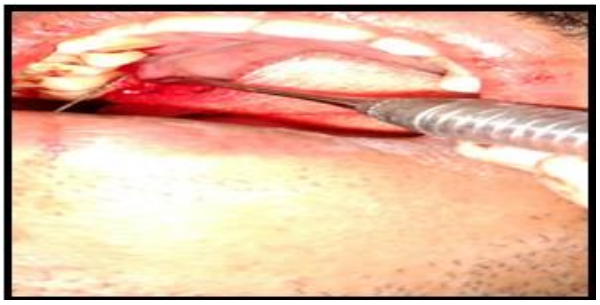

Fig. 7: Mid Palatal

Discussion

The most accurate method of assessing bone level is surgical exposure which is considered to be the gold standard as it aids in accurate detection of the extent and type of bone loss as well as to evaluate bone gain after treatment.[12] Radiographs are valuable diagnostic tools which act as an adjunct to clinical examination.[13] Radiographs give a two dimensional representation of three dimensional structures. Among the 2D radiographic diagnostic methods, bitewings and periapical radiographs are the most suitable because they are easily acquired, cheap and provide high resolution images.[14,15] However, these methods are limited by overlapping anatomical structures, difficulty in standardization and underestimation of size and occurrence of bone defects. CBCT technique came into the scenario to encounter these problems. It displays 2 dimensional and three dimensional images that are necessary for the diagnosis and treatment planning of intrabony defects, furcation involvements and buccal and lingual bone destructions.[12] Compared to periapical radiographs, CBCT provides 3D imaging which obtains cross sectional and volumetric images with elimination of image deformity but of higher radiation dose.[16] A single rotation is sufficient during irradiation of the patient for acquisition of base projection images and CBCT scanners use 2 dimensional flat panel detectors which provide a scan of the entire region. They reconstruct the projection data to provide inter relational images in three orthogonal planes and thicken multiplanar images by increasing the number of adjacent voxels included in the display which is referred to as ray sum.[17]

Periodontal changes mainly in the bone defects of lingual/palatal regions, are difficult for the examiner to examine. The present case report aimed to evaluate the accuracy of CBCT in the diagnosis of horizontal periodontal defects mainly in buccal and lingual/palatal regions where the two dimensional (2D) may be inappropriate. Banodkar et al conducted study to evaluate the accuracy of CBCT in the detection of alveolar bone defects by comparing it with surgical methods. Hundred periodontal bone defects in fifteen patients were included in the study. There was high correlation between surgical and CBCT measurements which proved that CBCT was highly accurate in the measurement of periodontal defects. Pour et al done a study wherein CBCT enabled accurate measurements of bone level comparable to surgical exploration. Patel et al, Vandenberghe et al and Mish et al conducted various studies and concluded that CBCT offers significant advantages as all defects can be detected and quantified.[18-20]

The limitation of CBCT is its cost, higher radiation dose and lack of availability. But considering the enormous benefits, this can be overlooked. CBCT is a useful aid in periodontal examination and diagnosis and it offers improved visualization of the morphology of periodontal defects. Thus we conclude that CBCT can effectively reproduce the clinical measurements of horizontal periodontal bone defects.

Conclusion

The perception of images of excellent quality using CBCT in the evaluation of alveolar bone loss, periodontal defects could lead to new approach in the evaluation of patients with periodontal disease. And thus conclude that CBCT can effectively reproduce the clinical measurements of horizontal periodontal bone defects.

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