International Journal of Research in Medical Sciences
Parvez MF et al. Int J Res Med Sci. 2018 May;6(5):1765-1769
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20181776

Original Research Article

Comparative assesment of accuracy of IOPA and CBCT for maxillary molar furcation involvement: a clinical and radiological study

Mohammed Fahad Parvez[1]*, Nandini Manjunath[1], Raghavendra Kini[2]

[1]Department of Periodontics, [2]Department of Oral Medicine Radiology, AJ Institute of Dental Science, Manglore, Karnataka, India

Received: 12 March 2018
Accepted: 03 April 2018

***Correspondence:**
Dr. Mohd Fahad Parvez,
E-mail: dr.fahadparvez@gmail.com

ABSTRACT

Background: Radiographs in periodontics will provide a two-dimensional image of a three-dimensional object and this leads to problems in terms of validity, accuracy and precision. Hence, the study was conducted with an aim to assess the accuracy of IOPA And CBCT for Maxillary Molar Furcation involvement by clinical and radiological methods.
Methods: The study sample consisted of 17 subjects from the Out patient Department of A.J. Institute of Dental Science, Manglore belonging to both sexes and with age ranging from 35-55 years. The selected patients were those having presence of periodontal pockets of >5-6mm and advanced periodontal disease requiring surgical intervention. For the purpose of standardization, 3 sites of the maxillary first molars were assessed-Mid-buccal, Mesio-buccal, Disto-buccal. Iopa and CBCT measurements were taken which was followed by surgical intervention during which probing measurements were recorded. Statistical analysis was done using 'unpaired t test'.
Results: There was no statistically significant difference between CBCT measurements and surgical measurements ($p \leq 0.05$).
Conclusions: CBCT accurately reproduced the clinical measurement of periodontal bone defects.

Keywords: Alveolar bone loss, Chronic periodontitis, Cemento-enamel junction, Cone beam computed tomography

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] Periodontal disease alters the morphological features of the bone in addition to reducing bone height. Vertical bone loss is the most common pattern of bone loss in periodontal disease it occurs when the pathway of inflammation travels directly into the Periodontal ligament space.[1] Early detection of periodontal disease is important in the prevention of tooth loss and for the patient's general health.[3]

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] Radiographs reveal the extent of interdental and inter-radicular bone loss, root length, periodontal ligament space, and any apical changes in the tooth.[5]

Intra oral periapical radiographs (IOPA) and panoramic radiographs (OPG) are the most established imaging

techniques[6], however Benn et al, suggested that the current measurement techniques are insufficiently sensitive to measure 1mm of bone loss until 1.9mm of bone resorption has occurred.[7] 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.[8]

It is with these limitations in recent technological advances that volumetric Cone Beam Computed Tomography (CBCT) has become increasingly popular.[4] CBCT provides 3D images that facilitate the transition of dental imaging from initial diagnosis to image guidance throughout the treatment phase.[9]

The first reported applications of CBCT in periodontology were for diagnostic and treatment outcome evaluations of periodontitis.[10,11] 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.[12,13]

Hence the purpose of this study was to compare CBCT, IOPA to probing by surgical intervention and to investigate the accuracy of CBCT in assessing bone defects.

METHODS

This comparative Study was conducted on 17 subjects with age ranging from 30-55 years visiting the Out patient Department of A.J. Institute of Dental Science, Manglore. Ethical clearance was obtained from the institutional ethical committee. Subjects with moderate to severe periodontitis with at least one maxillary molar with grade II furcation aged between 30 to 55 years and patients having periodontal pockets with probing pocket depth of >5-6mm and grade II furcation who were willing to participate in the study were included.

Whereas, Patients with furcation caries, Metal crown and silver amalgam filling near alveolar crest; Pregnant or lactating female patients; Patients with a habit of smoking and/or tobacco chewing; Patients with systemic disorders predisposing to periodontitis; Patients using any form of partial dentures or undergoing orthodontic Treatment were excluded from the study. Before the start of the study, the health of the subjects were as curtained by obtaining detailed medical history, dental history, and clinical examination following the inclusion and exclusion criteria mentioned above.

For standardization purpose, 3 sites of maxillary first molars were assessed: Mid buccal, mesiobuccal, and distobuccal was done by preparing an occlusal stent upto the Cemento-Enamel Junction (CEJ). All the patients were advised to take IOPA and CBCT. After the Radiological Investigation and recording the clinical parameters, the selected patients underwent access flap surgery.

For CBCT scanning, a Promax 3D CBCT device (Planmecaoy, Helsinki, Finland) was used. The occlusal plane of the jaws was positioned horizontally to the scan plane and mid sagittal plane will be centred. The beam height at the surface of image receptor (CMOS flat plane) will be adjusted and set to visualize the entire jaws comprising a field of view (FOV) of 80 mm width and 80mm height. Slice thickness of 0.2mm and slice interval of.2mm will be obtained. For image acquisition, the dose protocols will 80kv and 12ma using pulsed scanning time of 12s. During surgical intervention, the distance between the cement-enamel junction and alveolar crest was measured by a single experienced professional using Williams graduated periodontal probe placed in a line parallel to the long axis of the tooth. The horizontal component of furcation was measured using colour coded Nabers Probe. The clinical and CBCT measurements were compared to each other to evaluate the accuracy of the CBCT imaging.

Clinical parameters

All patients were assessed for pocket depth using Williams graduated periodontal probe, clinical attachment level prior to flap surgery and horizontal component of the furcation defect was measured clinically at the time of Flap surgery. Furcation involvement was measured at three sites (buccal, mesio palatal and disto palatal) of the suspected maxillary molar using a curved Nabers probe marked at 3 mm intervals without elevation of the soft tissue flap. The defect were characterized according to Hamp et al, using a modification of the furcation classification degree II, which was divided into degrees II, and II-III.

- Degree 0: Furcation not accessible with a periodontal probe.
- Degree I: Horizontal loss of periodontal tissue support up to 3mm.
- Degree II: Horizontal loss of support exceeding 3 mm but not more than 6mm.
- Degree II-III: Horizontal loss of support exceeding 6mm but no detectable ‘through and through destruction.
- Degree III: Horizontal ‘through and through’ destruction of periodontal tissue in furcation.

Statistical analysis

The data collected was entered into the excel spreadsheet and analysed using Statistical package for social sciences version 17.0. Descriptive statistics with mean and standard deviation were taken. Statistical significance was considered at $p<0.05$ (confidence interval- 95%). Statistical tests such as paired t test was used.

RESULTS

Three sites were examined (mesibuccal, mid-buccal, disto-buccal) among 17 samples and the comparison was made among IOPA, surgical and CBCT methods. Table 1 shows significant results between IOPA and surgical methods with respect to mesio-buccal, midbuccal and disto-buccal sites. Similar results were found for comparison between CBCT and surgical (Table 2) and between IOPA and surgical methods (Table 3).

Table 1: Comparison of the IOPA and surgical methods using paired t test.

Sites	Methods	Mean ±S.D	t value	p value
Mesio	IOPA	5.29±0.47	23.75	0.00*
	Surgical	8±0.5		
Mid	IOPA	5.03±0.57	14.36	0.00*
	Surgical	8.29±0.59		
Disto	IOPA	5.47±0.62	13.14	0.00*
	Surgical	8.18±0.53		

*significant

Table 2: Comparison of the CBCT and surgical methods using paired t test.

Sites	Methods	Mean ±S.D	t value	p value
Mesio	CBCT	7.61±2.09	0.86	0.00*
	Surgical	8±0.5		
Mid	CBCT	6.24±1.26	5.39	0.00*
	Surgical	8.29±0.59		
Disto	CBCT	7.42±2.08	1.61	0.00*
	Surgical	8.18±0.53		

*significant

Table 3: Comparison of the IOPA and CBCT methods using paired t test.

Sites	Methods	Mean ±S.D	t value	p value
Mesio	IOPA	5.29±0.47	5.76	0.00*
	CBCT	7.61±2.09		
Mid	IOPA	5.03±0.57	4.73	0.00*
	CBCT	6.24±1.26		
Disto	IOPA	5.47±0.62	3.54	0.003*
	CBCT	7.42±2.08		

*significant

DISCUSSION

Periodontal disease consists of a variety of conditions affecting the periodontal tissues such as gingiva, periodontal ligament, root cementum and alveolar bone which can result in attachment loss and destruction of the alveolar bone.[14] 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.[15] However, evaluation of the type and depth of the defect during surgery gives little time to the surgeon to plan out the type of procedure for periodontal regeneration.[16]

Radiographs are valuable diagnostic tools which act as an adjunct to clinical examination. On subsequent radiographic examinations bone loss or gain may be assessed by comparing subsequent radiographs to the initial radiographs.[17,18] However, these methods are limited by overlapping anatomical structures, difficulty in standardization and under-estimation of size and occurrence of bone defects. The advent of digital imaging modality, digital subtraction radiography, and tuned aperture computed tomography have added considerable improvements to traditional IOPA radiographs, but have their own sets of limitations, including that they too represent 2D images of 3D structures.[19] The introduction of CT has overcome the drawbacks associated with 2D images. It has the potential to allow precise assessment of bone defects caused by periodontal disease, however the application of CT imaging for periodontal diagnosis have unfavourable cost-benefit ratio, furthermore CT imaging exposes patient to high radiation dose.[5,19]

CBCT provides 3D imaging which obtains cross sectional and volumetric images with elimination of image deformity but of higher radiation dose.[20] 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 re-construct the projection data to provide inter-relational images in three orthogonal planes and thicken multi-planar images by increasing the number of adjacent voxels included in the display which is referred to as ray sum.[9]

Periodontal changes mainly in the bone defects of lingual/palatal regions, are difficult for the examiner to examine. The present study aimed to assess the accuracy of CBCT in the diagnosis of periodontal bone defects mainly in buccal region where the two dimensional (2D) radiographs may be inappropriate.

The results from our study indicated that CBCT is highly accurate for diagnosing bone defects which was in line to a study done by Feijo et al, wherein the accuracy of CBCT for the detection of horizontal periodontal bone defects was evaluated.[21] 72 defects in the maxillary molar region in patients with periodontitis were measured using CBCT and clinical measurements were recorded during surgical intervention. There was no statistically significant difference between clinical and CBCT measurements when mesial and distal aspects were compared. Banodkar et al, conducted a similar study to evaluate the accuracy of CBCT in the detection of alveolar bone defects by comparing it with surgical methods.[16] 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. The results of the present study are also in accordance with a study done by Pour et al, wherein CBCT enabled accurate measurements of bone level comparable to surgical exploration.[22]

Several in vivo and invitro studies have been done to assess the role of CBCT in periodontics. Mengel et al, demonstrated that CBCT images were better in detection of periodontal bone defects compared with periapical radiographs.[5] Likewise Vandenberge et al, concluded that CBCT demonstrated more potential in the morphological description of periodontal bone craters and furcation involvements than 2D intraoral images.[23] Grimard et al, found that CBCT was significantly more precise and accurate than periapical radiographs and concluded that CBCT may obviate surgical re-entry as a technique for assessing regenerative therapy.[24] Patel et al, and Mish et al, conducted various studies and concluded that CBCT offers significant advantages as all defects can be detected and quantified.[25,26]

The limitation of CBCT is its cost, higher radiation dose and lack of availability. But considering the enormous benefits, this can be overlooked. It can be concluded that CBCT images provide better diagnostic and quantitative information of periodontal bone levels in three dimensions as compared to IOPA. CBCT is a useful aid in periodontal examination and diagnosis and it offers improved visualization of the morphology of periodontal defects. The images obtained with CBCT combined with various techniques such as assessment of clinical probing depth, attachment levels, and alveolar bone levels increase the ability to determine the treatment outcome following periodontal treatment without the use of surgical re-entry procedure.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Newman, Takei, Klokkevold, Carranza. Periodontal pathogenesis. Carranza's clinical periodontology. 2012;1(11):260-290.
2. Indurkar MS, Verma R. Evaluation of the prevalence and distribution of bone defects associated with chronic periodontitis using cone beam computed tomography. A radiographic study J interdisciplinary Dentistry. 2016;6(3):104.
3. Vandenberghe B, Jacobs R, Yang J. Detection of periodontal bone loss using digital intraoral and cone beam computed tomography images: an in vitro assessment of bony and/or infrabony defects. Dentomaxillofac Radiol. 2008;37:252-60.
4. AH du Bois, B Kardachi, PM Bartold. Is there a role for the use of volumetric cone beam computed tomography in periodontics? Aust Dental J. 2012;57(1):103-8.
5. Mengel R, Candir M, Shiratori K, Flores-de-Jacoby L. Digital volume tomography in the diagnosis of periodontal defects: an in vitro study on native pig and human mandibles. J Periodontol. 2005;76(5):665-73.
6. Lang NP, Hill RW. Radiographs in periodontics. J Clin Periodontol. 1977;4(1):16-28.
7. Benn DK. A review of the reliability of radiographic measurements in estimating alveolar bone changes. J Clin Periodontol. 1990;17:14-21.
8. Hausmann E. Radiographic and digital imaging in periodontal practice. J Periodontol. 2000;71:497-503.
9. Mohan R, Singh A, Gundappa M. Three-dimensional imaging in periodontal diagnosis-Utilization of cone beam computed tomography. J Indian Soc Periodontol. 2011;15:11-7.
10. Tyndall DA, Rathore S. Cone beam CT diagnostic applications: caries, periodontal bone assessment and endodontic applications. Dent Clin North Am. 2008;52:825-41.
11. Yoshinuma N, Goke E, Arai Y, Shinoda K. Clinical application of a new compact computed tomography system for evaluating the outcome of regenerative therapy: A case report. J Periodontol. 2001;72:696-702.
12. Mol A, Balasundaram A. In vitro cone beam CT imaging of periodontal bone. Dentomaxillofac Radiol. 2008;37:319-24.
13. Ganz SD. Conventional CT and cone beam CT for improved dental diagnostics and implant planning. Dent Implantol Update. 2005;16:89-95.
14. Lindhe J, Karring T, Araujo M. The anatomy of periodontal tissues. Clinical periodontology implant dentistry. 2015;2(6):3-49.
15. Shah MA, Shah SS, Dave DH. CBCT-a positive amelioration in periodontics. NJIRM 2013;4(3):144-8.
16. Banodkar AB, Gaikwad RP, Gunjikar TU, Lobo TA. Evaluation of accuracy of cone beam computed tomography for measurement of periodontal defects: A clinical study. J Indian Soc Periodontol. 2015;19(3):285.
17. Jeffcoat MK. Current concepts in periodontal disease testing. J Am Dent Assoc. 1994;125:1071-8.
18. Reddy MS. Radiographic methods in the evaluation of periodontal therapy. J Periodontol. 1992;63:1071-8.
19. Mol A. Imaging methods in periodontology. Periodontol. 2004;34:34-48.
20. Songa VM, Jampani ND, Babu V, Buggapati L, Mittapally S. Accuracy of cone beam computed tomography in diagnosis and treatment planning of periodontal bone defects: A case report. J Clin Diagn Res. 2014;8(12):23-5.

21. Vieira Feijó C, Granjeiro Feitosa de Lucena J, Mitsuo Kurita L, da Silva Pereira SL. Evaluation of cone beam computed tomography in the detection of horizontal periodontal bone defects: an in vivo study. Int J Perio Rest Dent. 2012;32:162-8.
22. Pour DG, Romoozi E, Shayesteh YS. Accuracy of Cone Beam Computed Tomography for Detection of Bone Loss. J dentistry (Tehran, Iran). 2015;12(7):513.
23. Vandenberghe B, Jacobs R, Yang J. Diagnostic validity (or acuity) of 2D CCD versus 3D CBCT-images for assessing periodontal breakdown. Oral Surg, Oral Med, Oral Radiol and Endod. 2007;104(3):395-401.
24. Grimard BA, Hoidal MJ, Mills MP, Mellonig JT, Nummikoski PV, Mealey BL. Comparison of clinical, periapical radiograph, and cone-beam volume tomography measurement techniques for assessing bone level changes following regenerative periodontal therapy. J Periodontol. 2009;80:48-55.
25. Patel S, Dawood A, Mannocci F, Wilson R, Pitt Ford T. Detection of periapical bone defects in human jaws using cone beam computed tomography and intraoral radiography. Int Endod J. 2009;42(6):507-15.
26. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77:1261-6.

Cite this article as: Parvez MF, Manjunath N, Kini R. Comparative assesment of accuracy of Iopa and Cbct for maxillary molar furcation involvement: a clinical and radiological study. Int J Res Med Sci 2018;6:1765-9.