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DENTAL ARTICLE

# Diagnostic Accuracy of CBCT for Aggressive Periodontitis

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## ABSTRACT

Cone beam computed tomography (CBCT) is an indispensable diagnostic imaging tool for dento-alveolar examination. CBCT scanning has become a valuable imaging modality in the field of Periodontology for the detection of very small osseous defects. A patient reported to the department of Periodontology with a complaint of loose teeth. Clinical and direct digital radiographic (DDR) examination revealed advanced periodontal destruction, but failed to diagnose the morphology of generalized osseous defects, around all the surfaces of each tooth. CBCT images were obtained for detailed examination of each and every osseous defect around all the teeth. Patient was then diagnosed with generalized aggressive periodontitis. Flap surgery was performed in order to eliminate the periodontal pockets, exposing and degranulating the osseous defects. Actual measurements of surgically exposed osseous defects were compared with that seen in CBCT images and found to be exactly identical. CBCT has proved to be as accurate in measuring osseous defects as direct measurements with a periodontal probe. Buccal and lingual periodontal defects that could not be diagnosed by conventional radiography can be identified with CBCT.

**Key words:** Aggressive periodontitis, cone beam computed tomography, direct digital radiography, periodontal osseous defects

## INTRODUCTION

Radiographs are an important component of dental and periodontal examination and are essential in establishing periodontal diagnosis. Despite their value in diagnosing periodontal diseases, they have several limitations as a diagnostic tool, one being underestimation of the amount of periodontal destruction in a tooth.

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Aggressive periodontitis (AgP) is defined as a destructive periodontal disease primarily affecting the younger age group. It is a rapidly progressing form of periodontitis that frequently starts at an early age.[1] According to the 1999 international classification of periodontal diseases,[2] AgP is rare and displays a severe phenotype of periodontitis characterized by rapid bone destruction and loss of attachment in the absence of any systemic disease, often with familial aggregation. Progression of AgP is so rapid that, if not treated, supporting tissue around



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the teeth may be lost early in life, along with severe bone loss.[3]

Detection of periodontal bone loss in a patient with AgP is mandatory for proper treatment planning. The current diagnostic methods, including clinical probing and intraoral radiography have shown several limitations in their reliability. Clinical probing is dependent on the probing force, shape and the size of probe tip, direction of penetration and resistence of the tissue, while periapical or bitewings may over- or underestimate the amount of bone loss due to projection errors.[4]

One of the main drawbacks of intraoral radiography is the overlap of anatomical structures and lack of three-dimensional (3D) information. This often hinders an exact distinction between the buccal and lingual cortical plate and complicates the evaluation of periodontal bone defects, especially the infrabony lesions, such as craters, furcation involvements, and walled defects. Several efforts for optimizing these diagnostic tools such as use of electronic probes and digital subtraction radiography have been made over the past few years.

Unfortunately, electronic probes have not demonstrated significant advantages over manual probing[5] and direct digital radiography (DDR) lacks information of the 3D nature, thus emphasizing the need for further improvement in the early diagnosis of AgP.

Cone beam computed tomography (CBCT), also called dental CT, is a recently developed imaging modality which when compared with 2D radiography reduces considerably patient's exposure to radiation[6] and is also a more accurate diagnostic tool. Although there have been a few publications reporting use of CBCT for periodontal assessment, comparing this new imaging modality with the existing direct digital radiography may offer new perspectives in its use in diagnosis and treatment planning of AgP. Therefore, considering some of the limitations of conventional radiography for detection of periodontal bone lesions, advanced imaging methods such as CBCT may offer a more effective investigation tool for diagnosis, treatment planning, and thus better prognosis.

## CASE REPORT

A 27-year-old male patient reported to the department of periodontology with a 2-year history of his teeth slowly becoming loose. Clinical and radiological examinations were carried out. On clinical examination, generalized periodontal pockets with severe loss of attachment was observed. Grade III mobility of mandibular anterior teeth and left maxillary second premolar, Grade II mobility of right mandibular first molar, Grade II furcation involvement of maxillary and mandibular molars were recorded. Treatment planned included scaling and root planning (phase I) followed by flap surgery (phase II) for the elimination of the periodontal pockets. The treatment plan was explained to the patient and the consent of the patient as well as the institutional ethical clearance in accordance with the Helsinki declaration was obtained.

Full mouth DDRs were obtained using Dental X-ray machine (Planmeca, Finland, 70 Kv, 8 mA) by long cone/paralleling technique and a charge coupling device (Kodak, RVG 5100, size 35 × 5 mm) [Figure 1].

CBCT scan were performed with Kodak CS 9300 scanner at voxel resolution of 0.18 × 0.18 × 0.18 mm. The beam height of surface image receptor was adjustable and set to visualize both jaws at low dose protocol of 90 Kv and 8 mA. Panoramic volumetric reconstructive CBCT image of maxillary and mandibular jaws [Figure 2a and b] and volumetric rendering (VR) images of maxillary and mandibular teeth [Figures 3 and 4] were procured. Based on the clinical findings, radiographic analysis, and CBCT image, the patient was diagnosed with generalized AgP.

Phase I therapy performed consisted of scaling and root planning and the patient was evaluated after strict maintenance of oral hygiene for a month. Patient did not present any significant medical history that contraindicated surgery.

Full mouth quadrant wise flap surgery (phase II) was planned. Mucoperiosteal flap on each quadrant was raised. Debridement of the periodontal osseous defects was performed in order to visualize the entire osseous defect at each tooth surface, which is considered as a Gold standard in study of these defects. Measurements of the osseous defects were carried out with UNC15 probe taking CEJ (cemento-enamel junction) as a reference point and measuring till the base of the defect [Figure 5]. Flap was then sutured and periodontal dressing (Coe-Pak, USA) was applied


**Figure 1:** Photo of the (a) Dental X-ray machine (Planemeca, Finland, 70 Kv, 8 mA), and (b) a charged coupling device (Kodak, RVG5100, size 35 × 15 mm).

to cover the surgical wound. The measurements obtained during surgical exposure of the defects were then compared with that obtained from digital and CBCT reconstructive images. CBCT images of periodontal osseous defects were identical to the measurements of osseous defects that were obtained during surgery. While digital radiography failed to reveal the extent of the osseous defects.

Panoramic reconstruction view of the CBCT images allowed measurements of periodontal linear and nonlinear bone levels that were comparable with those seen in intraoral digital radiography. Measurements on 3D reconstructive images demonstrated a more accurate assessment, due to the absence of overlapping structures. Measurements

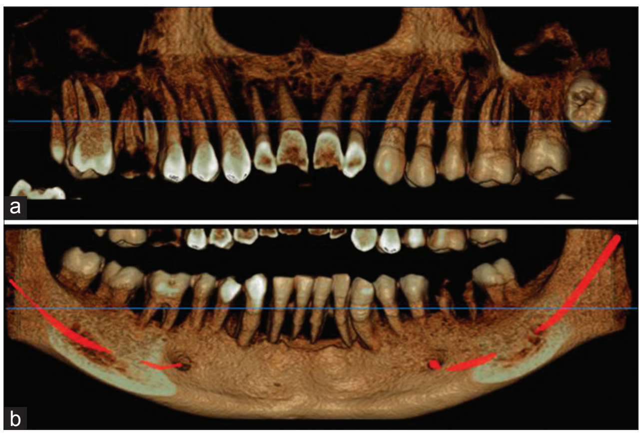


**Figure 2:** 27-yearold male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis (GAP).(a) 3D Panoramic volumetric reconstructive CBCT image of maxillary arch and (b)3D Panoramic volumetric reconstructive CBCT image of mandibular arch reveal the severity of alveolar bone destruction and loss of alveolar bone from cemento-enamel junction till its base mainly in the molar and premolar region of both the arches. The red line depicts the passage of inferior alveolar nerve in the mandibular arch.

of periodontal defects after surgical exposure when compared with measurements taken on the CBCT images showed 100% accuracy in the morphological description of periodontal bone crater, furcation involvements, and 3-walled osseous defects [Figures 6 and 7].

Postoperative instruction were given to the patient for the care of the surgical site, not disturbing the periodontal dressing for a week till the removal of the sutures. Patient was prescribed antibiotic, Amoxicillin (500 mg) every 8 h for 1 week and scheduled for a postoperative visit after 1 week and periodic checking after every 3 months for evaluation. Only clinical examination was done during the six month postoperative check up and healing was found to be satisfactory with elimination of periodontal pockets, and increase in clinical attachment levels (CALs). Imaging was not performed at this point of time since 6 months postoperative healing of alveolar bone would not show significant gain in alveolar bone height.

## DISCUSSION

AgP constitutes a group of rare and rapidly progressing form of periodontitis, leading to tooth loss and edentualism. Many clinicians report difficulty in establishing a differential diagnosis for AgP and chronic periodontitis due to an overlapping "gray area" that often makes difficult a clear-cut diagnosis. Such issues raise the question of whether these are actually two distinct clinical entities.[4]

The diagnosis of AgP relies almost exclusively on clinical parameters and traditional 2D dental radiography. Clinical probing is dependent on probing force. Clinical

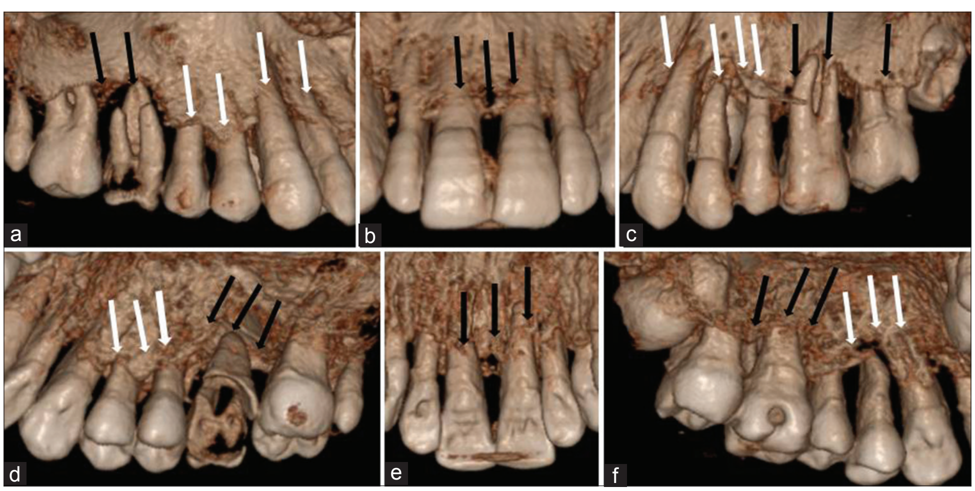


**Figure 3:** 27-year old male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis (GAP). 3D Volumetric reconstructive CBCT images of the different sections of maxillary arch, a, b and c (top) are labial and buccal view and d, e, and f (bottom) are palatal views. (a) Right posterior region of the jaw reveals advance periodontal bone destruction tillapical root regions in relation to maxillary first molar (tooth 16) (Black arrow) and middle third of the root of the premolars (teeth 14, 15) and canine (tooth 13) (White arrows). (b) Anterior region shows bone destruction around incisors (arrow). (c) Left posterior jaw region shows alveolar bone destruction till the apical third of the first molar (tooth 26) (black arrow), premolars (teeth 24, 25) and canine (tooth 23) (white arrow) with the involvement of the buccal cortical plate. (d, e and f) Palatal view show same areas of osseous defects in Generalized Aggressive Periodontitis with severe bone destruction seen in the maxillary arch (arrows).

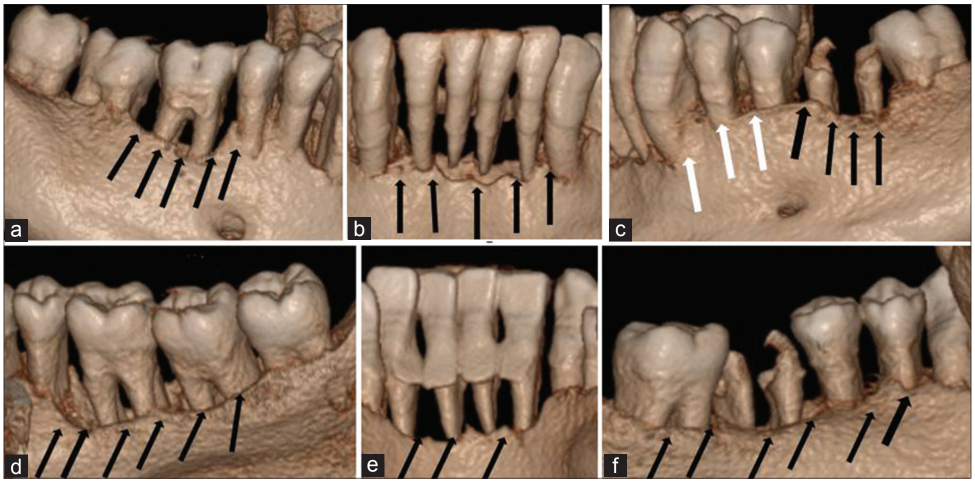


**Figure 4:** 27-year old male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis (GAP). 3D Volumetric reconstructive CBCT images of different sections of mandibular arch of the a, b and c (top) are buccal and labial view and d, e, and f (bottom) are lingual views. (a) Right posterior jaw shows arc shaped bone loss (arrow) in relation to first molar extending from second premolar to second molar. (b) Anterior region shows severe bone destruction till the apical third of all the central and lateral incisors (arrow) including canines. (c) Left posterior jaw region shows bone destruction in relation to first molar (only the root stumps are seen as shown with arrows) and around premolars. (white arrow) (d, e, and f) Lingual view images show same areas of severity of osseous defects in Generalized Aggressive Periodontitis.

**Figure 5:** 27-year old male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis. Photo of the teeth during flap surgery reveals osseous defect around mandibular first molar. Measurement of defect in furcation area done with UNC 15 periodontal probe from cemento-enamel junction till the base of the defect (arrows).

assessments such as probing depth (PD) and CAL are somewhat subjective and time consuming and therefore underutilized in general dental practice.

Radiographs are an essential component of periodontal examination and indispensable in establishing a periodontal diagnosis. Important information regarding the position and architecture of the alveolar crest of bone is obtained from radiographs. Despite their value in periodontal diagnosis bitewing and periapical radiographs may overestimate or underestimate the amount of bone loss due to projection errors and they also lack 3D information and have difficulty in distinguishing the buccal and the lingual cortical plate.[7,8]

A successfully treated case of AgP is likely to have similar pre- and posttreatment levels of radiographic bone loss. Thus, there is a need for 3D images that can provide useful information about the regeneration of the bone after the surgery that may assist in monitoring the case following surgical intervention.

The present case report demonstrated that the CBCT images provided a high accuracy for the detection and diagnosis of periodontal osseous defects in AgP, when compared with digital radiography. CBCT allowed accurate assessment of bone levels and a better description of infrabony defects, such as interdental craters, 3-walled osseous defects, furcation involvement, than intraoral digital images. This finding indicated that the current CBCT system can become an indispensible tool in the diagnosis of periodontal defects.

When compared with CBCT, direct digital radiograph remains a 2D imaging technique, which cannot visualize 3D periodontal defects. Maxillary trifurcations could hardly be detected or interpreted by direct digital radiographs. The radiation dose of CBCT has been reported to be 15 times lower than conventional radiography, only 4-15 times the dose of a standard panoramic image.[9]

## CONCLUSION

CBCT technology is highly relevant for oral health professionals, especially in the field of Periodontology as it potentially provides greater information in the assessment of osseous defects around the teeth than direct digital intraoral radiographs. Diagnosis of a periodontal lesion

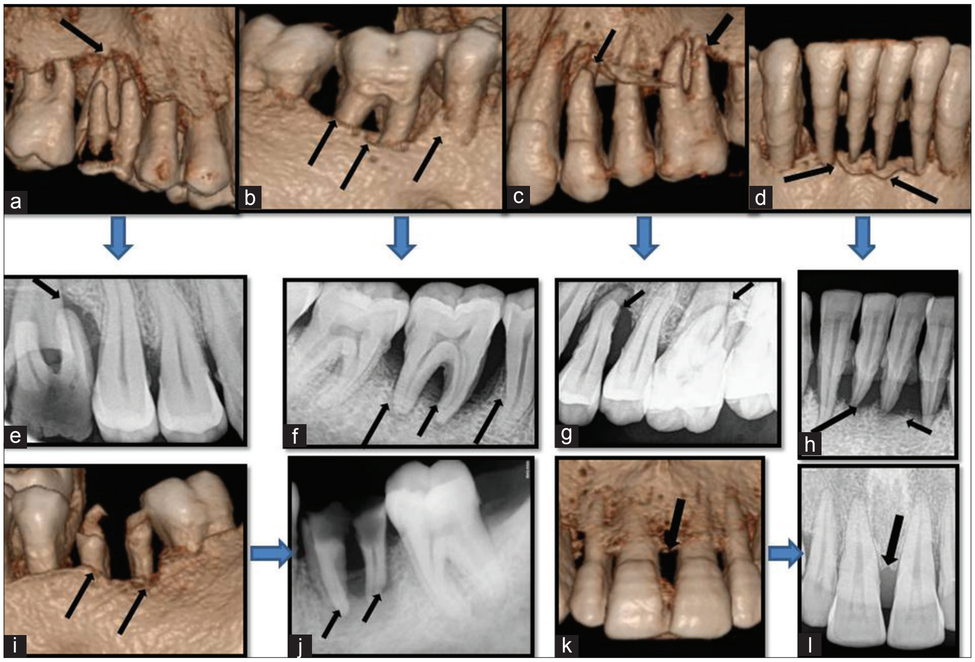


**Figure 6:** 27-year old male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis.3D volumetric rendered images (a, b, c, d), (i) and (k) in the areas of the both maxillary and mandibular arch as shown in Figures 3 and 4 compared with 2D digital Periapical Radiographs (e, f, g, h) and (j and l) show underestimation of the amount of bone loss in digital radiographs due to projection errors and also due to lack of 3D information that help in distinguishing the buccal and the lingual cortical plates (arrows).

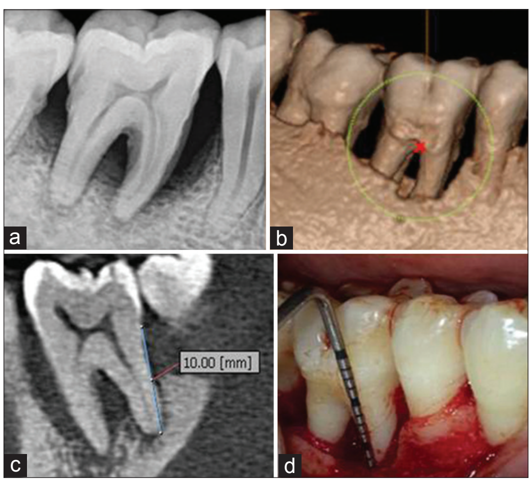


**Figure 7:** 27-year old male patient with 2-year history of loosening of teeth diagnosed with generalized aggressive periodontitis (GAP). (a) Direct digital radiograph of the mandibular first olar (tooth 46) shows the osseous defect, (b) 3D volumetric rendering of the same tooth shows the osseous defect, (c) CBCT sagittal view of right mandibular first molar shows measurement of bone loss done by the CBCT software, and (d) Photo of the same tooth (tooth 46) during intraoral procedure for measuring bone destruction in furcation area using UNC 15 probe reveals the measurement to be exactly same as the measurement obtained in CBCT image c.

has been made easy and accurate with the use of CBCT, without need for any surgical exposure of the affected area to study the defect. CBCT can help in planning treatment, in follow-up monitoring of patients postsurgery and exposes the patient to a lower dose of radiation.

## REFERENCES

1. Genco RJ, Christersson LA, Zambon JJ. Juvenile periodontitis. Int Dent J 1986;36:168-76.
2. Wiebe CB, Putnins EE. The periodontal disease and classification system of the American Academy of Periodontology:A an update. J Can Dent Assoc 2000;66:594-7.
3. Noack B, Hofmann T. Aggressive periodontitis. Periodontol 2000;1:335-44.
4. Eickholz P, Hausmann E. Accuracy of radiographic assessment of interproximal bone loss in intrabony defects using linear measurements. Eur J Oral Sci 2000;108:70-3.
5. Quirynen M, Callens A, van Steenberghe D, Nys M. Clinical evaluation of constant force electronic probe. J Periodontol 1993;64:35-9.
6. 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 Pathol Oral Radiol Endod 2007;104:395-401.
7. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol 2007;77:1261-6.
8. 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.
9. Ludlow JB, Davies-Ludlow LE, Brooks SL, Howerton WB. Dosimetry of 3 CBCT devices for oral and maxillofacial radiology: CB Mercuray, NewTom 3G and i-CAT. Dentomaxillofac Radiol 2006;35:219-26.

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