Original Article

Comparative Evaluation Of Clinical Probing Versus Cbct For Furcation Involvement In Patients With Periodontitis - A Step Ahead In Comprehensive Implant Planning

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Abstract:

Aim: The study aims to compare the use of clinical probing and Cone Beam Computed Tomography (CBCT) in the diagnosis of furcation involvement (FI) in patients with periodontitis. Methods and materials: Twenty-two patients, aged 30 to 65 years with periodontitis were included in the study. The patients who visited from April 2021 to May 2022 were assessed based on selection criteria. A total of 135 teeth were checked for furcation involvement. Buccal, mesiopalatal, and distopalatal sites of maxillary molars and buccal and lingual sites of mandibular molars were examined clinically using a Nabers probe and radiographically by CBCT.

Results: There was a significant difference between clinical and radiographic evaluations with the percentage of grade (III) cases detected with radiographic evaluation being significantly higher than that of clinical evaluation. The maxillary 1st molar 21 (60%) and maxillary 2nd molar had no furcation involvement on clinical evaluation. In Radiographic evaluation Grade I FI was more in maxillary first molars least in mandibular 2nd molar. Furcation involvement was detected clinically more on the buccal side, maxillary 1st molar and least detected at maxillary 2nd molar at MP and DP sides (0.00%) Radiographically the FI was detected more on the buccal side, maxillary 1st molar 14 (40.00%) and least detected at maxillary 1st molar at DP and MP side of maxillary 2nd molar (4.00%).

Conclusion: CBCT was more reliable in the detection of grade III FI compared to clinical probing. It can be a useful tool in detecting maxillary furcations. This makes CBCT reliable in the diagnosis of furcation involvement compared to conventional methods. Dental implant planning made easy with CBCT scans as it is evaluated for its efficiency.

Keywords: Clinical diagnosis, Furcation involvement, CBCT, Periodontitis, Dental Implants.

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Introduction:

Periodontal diseases are defined as inflammation of the periodontium which includes gingiva, cementum, periodontal ligaments, and alveolar bone.[1] Periodontal diseases are the most prevalent among oral diseases and it affects about 20% to

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50% of the population.[2] Many risk factors have a negative impact on periodontal health and may aggravate periodontal disease progressions such as smoking, stress, genetics, medication and endocrinal disorders. [2]

A growing body of research suggests that diabetes and periodontitis are linked in a reciprocal manner, with diabetes raising the chance of developing periodontitis and periodontal inflammation affecting glycemic control.[2]

If gingivitis remains untreated, it progresses to periodontitis which is an irreversible condition. The composition of dental plaque shifts from gram +ve rods and cocci to gram -ve motile organisms and spirochetes.[3]

Cardinal signs include a change in colour, contour, and texture of the gingiva, bleeding on probing, pocket formation, attachment loss, alveolar bone loss, furcation involvement, tooth mobility, and tooth drifting and which might end up with tooth loss.[4]

Furcation involvement can be defined as the bone loss in the furcation area of multirooted teeth due to periodontal diseases. [5,6] Furcation is the anatomical area where the roots are separated and it is found only in multirooted teeth such as molars and premolars.[7] Accessory canals are quite common in molar teeth that open into the furcation areas. It is one of the co-factors contributing to development of furcation lesion. With advanced periodontitis and makes prognosis less favour- able.[8]

There are different systems for the classification of furcation involvement such as Glickman, Gold- man, Hamp, Ramjford, Tarnow, and other systems. The most widely used system is the Glick- man's Classification which classifies furcation involvement into four grades.[9]

Grade I furcation involvement is the incipient or early lesion, there is supra body pocket, soft tissue involvement, and little bone loss in the furcation area and it can't be seen by radiograph because there is minimal bone loss.[9]

Grade II furcation involvement Cul-de-sac, affects one or more sides of furcation in the same tooth. This furcation involvement may or may not show in the radiograph.[8,9]

Grade III furcation involvement is a through and through lesion where the inter radicular bone is completely lost. Radiolucency is visible in radiographs between the roots of mandibular molars while the overlapping roots in maxillary molars make it difficult to diagnose.[9]

Grade IV furcation involvement: in this grade, the inter radicular bone is completely lost with gingival recession resulting in clinically visible furcation opening. On a radiograph, it appears similar to Grade III furcation involvement. [8,9]

The degree of separation is the angle of separation between two root cones. Divergence is the distance between two root cones and it increases apically. The coefficient of separation is the length of root cones in relation to the length of the root complex. [10]

Cervical enamel projection (CEP) is flat, ectopic deposits of enamel located apically to the cementoenamel junction (CEJ) level in the regions of the molar furcation. There are three classifications of CEP:

Grade I: From the CEJ of the tooth towards the furcation entrance, the enamel projection expands.

Grade II: The enamel protrusion is getting close to the furcation's entrance. Since it does not cross the furcation, there is no horizontal component.

Grade III: The enamel projection penetrates the furcation horizontally.[11]

Enamel pearl is ectopic enamel mass that is visible in the furcation or another region of the root surface. One radicular enamel pearl is more frequent, but teeth can have up to four of enamel pearls. [12]

Diagnosis of the furcation involvement can be done using clinical and radiographic methods.[10] Clinically, probes designed for the furcation area like the Nabers probe can be used to detect and measure the horizontal defect, whereas the UNC-15 probe is used for measuring the vertical defect. Another method used for the diagnosis of furcation involvement is furcation bone sounding. It is performed under local anaesthesia. Intraoral periapical (IOPA) radiographs, bitewing (BW), and orthopantomograms (OPG) are Conventional radiographs that are used widely due to easy access and less cost.

Cone-beam computed tomography (CBCT) is a new tool introduced to the field of dentistry and is being used in oral and maxillofacial surgery, orthodontics, oral medicine, endodontics, and periodontics.[11] In periodontics CBCT can be to detect localized intrabony defects, furcation involvement, and buccal cortical plate defects.[13]

Dental cone beam computed tomography (CBCT), which provides volumetric data on jaw bones and teeth, can be used in implant dentistry to achieve three-dimensional (3D) imaging. Additionally, the three-dimensional scans showed a number of discoveries, including the bony support that surrounds each maxillary molar root, the proximity or fusion of roots, periapical lesions, root perforations, and/or missing bony walls. [14]

Various treatment options according to Lindhe[14]: Grade 1 to Grade 4 the treatment modalities are as SRP, furcation plasty, Hemisection and trisection, Tunnel preparation, open flap debridement and emdogain respectively.

The use of CBCT in the identification of advanced periodontal disease seems to be more prudent and educational. With CBCT, a thorough evaluation of furcation involvement is possible, helping to improve therapy choices. Even if it would appear that the results point to a better understanding of the specifics in Grade II furcation flaws, the same is true of periodontal defects, which may be assessed and confirmed in further investigations in the future. [15]

Acc to lindhe [14] treatment options according to graduation of invasiveness categorised from GoI 0 to GoI 5 as SPT, Open flap debridement, root separation, tunnel preparation, trisection and extraction of entire tooth respectively. Accurate detection of osseous defects, particularly involvement of the furcation, has a significant impact on decision-making in periodontal treatments. Diagnostic techniques that are often utilized, including clinical probing and traditional radiography, have their drawbacks. Therefore, this study was designed to compare the clinical probing and CBCT in the detection of furcation involvement.

Aim and Objectives

This study aims to compare the use of clinical probing and Cone Beam Computed Tomography (CBCT) in the diagnosis of furcation involvement (FI) in patients with periodontitis and the outcome will help to improve periodontal diagnosis.

Methods and materials

Twenty-two patients (aged 30 to 65 years) with periodontitis were included in the study. Informed consent was signed by the patient who was willing to participate in this study. The study has been approved by the Institutional Review Board of Gulf Medical University before its start (IRB/COD/STD/26/Apr-2021). The patients who visited from april 2021 to may 2022 were assessed based on selection criteria. The inclusion criteria were patients with periodontitis, aged between 30 and 65 years old, and of both sexes. Third molars, patients under the age of 30 and over 65, and pregnant and lactating women were excluded. Patients with Glickman grade IV furcation were also excluded from the study. A total of 135 teeth were checked for furcation involvement. Buccal, mesiopalatal, and distopalatal sites of maxillary molars and buccal and lingual sites of mandibular molars were examined clinically using a curved Nabers probe and radiographically by CBCT. The clinical and radiographic examination of FI was done by one examiner.

For the clinical examination a nabers probe was used to detect the furcation involvement according to Glickman's classification. [8,9] CBCT scanning was done at Thumbay Dental Hospital, Ajman using the ProMax3DMid device (Planmeca). Scanning was done for both arches with a field of view of 100x 85mm. The image was acquired at 90 kVp, 8mA, 12s, voxel size 200mm, and slice thickness of 0.600mm.

Results

Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows. The significance level was set at $p \leq 0.05$ for all tests. The maxillary 1st molar 21 (60%) and maxillary 2nd molar had no furcation involvement on clinical evaluation. (Table 1). In Radiographic evaluation

Grade I FI was more in maxillary first molars 10 (28.6%) and least in mandibular 2nd molar 2 (5.30%). (Table 2). Furcation involvement was detected clinically more on the buccal side, maxillary 1st molar 13 (37.1%) and least detected at maxillary 2nd molar at MP and DP sides (0.00%) (Table 3). Radiographically the FI was detected more on the buccal side, maxillary 1st molar 14 (40.00%) and least detected at maxillary 1st molar at DP and MP side of maxillary 2nd molar (4.00%) (Table 4).

Discussion

Furcation defect detection and classification are crucial aspects of a periodontal evaluation for treatment planning and tooth prognosis. There are major challenges in evaluating the degree of furcation involvement due to the constraints of 2-dimensional imaging obtainable with conventional radiography. Our findings showed that there was a significant difference between clinical and CBCT evaluations, with clinical evaluation having a significantly higher percentage of not detected cases (37.10%), and CBCT evaluation having a significantly higher percentage of detected cases (84.2%). A similar study conducted by Milena M et al 2015, reported that the number of FI found by CBCT was higher than the number found by periodontal probing.[5] The study performed by Zhang W et al 2018, showed that FI was more detected in mandibular first molars than maxillary first molars due to variation in anatomical structure and the presence of palatal roots making it difficult to detect FI.[16]

In this study, there was some significant difference between clinical and radiographic evaluations for the grading FI, especially grade (III) FI which was higher detected with CBCT at 9.6% than that of clinical evaluation at 1.5%. Similarly, the study performed by Marinescu AG et al 2014, to see how accurate CBCT was at diagnosing FI. The authors reported that the use of CBCT can provide information about the size and nature of the inter radicular defect quickly and painlessly.

[17] A study conducted by Padmanabhan S et al 2017, they concluded that the accuracy of CBCT assessments of mandibular molar FI was equivalent to direct surgical measurements.[18] In another study performed by Parvez MF et al 2018, reported that[18] CBCT is an alternative method for detection of FI instead of OFS which is considered an invasive technique.

The current study also found FI is more detected on the buccal side than in other aspects both clinically and CBCT. The CBCT enables to detect more of the FI in maxillary 1st molar at buccal side (37.10%). Similarly, Zhang W et al 2018 found that more FI was detected on the buccal side of maxillary first molars.[16] In an animal study Salineiro FC et al 2017[20] used a pig mandible to assess the accuracy, sensitivity, and specificity of periapical radiography (PR) and two CBCT imaging methods in diagnosing incipient furcation involvement, as well as to examine metal artifact interference. The CBCT imaging techniques' accuracy ranged from 67.5% to 82.5% in images taken with a metallic post and from 72.5% to 80% in images taken without a metallic post. In images with a metallic post, PR accuracy ranged from 37.5 % to 55 %, while in those without a metallic post, it ranged from 42.5% to 62.5%. They concluded that detection of incipient furcation involvement by both CBCT imaging procedures outperformed PR in terms of accuracy, sensitivity, and specificity.

Today's rapid advancements in digital technology and CAD/CAM technologies do undoubtedly present difficult challenges for diagnosis, surgical implant planning, and the delivery of implant-supported prostheses. Even if there is still a strong demand for the maximum integration of 3D datasets obtained from diverse imaging sources, there is still a need for more straightforward solutions. However, when aiming for the best possible patient-specific implant rehabilitation, the main objective still remains to fully integrate the available 3D imaging data, creating a virtual patient that will help with presurgical simulation and preoperative transfer to the operating room with further prosthetic rehabilitation.

Limitations

Glickman's classification for FI was used in the study which only measure the horizontal bone loss. Radiation exposure dose of CBCT is higher than for conventional radiograph.

Conclusion

According to the result, CBCT was more reliable in the detection of grade III FI compared to clinical

probing. It can be a useful tool in detecting maxillary furcations. The maxillary grade III FI in the MP and DP aspect which is almost impossible with clinical evaluation.

The Data Availability

The numerical and categorical data used to support the findings of this study were restricted by the Institutional Review Board of Gulf Medical University (IRB/COD/STD/26/Apr-2021) in order to protect the patient privacy. Data are available from the name Dr. Fatima Nasser Alshamsi, 2019mdsperio01@mygmu.ac.ae for researchers who meet the criteria for access to the main manuscript. The prior studies are cited at relevant places within the text as references (Ref 5,16,17,18).

Recommendation

Update of implant chart is recommended so as to consider furcation involvement of neighboring and opposing teeth to dental implant as a potential risk factor for long term success of dental im- plant. It acts as a scaffold for subsequent fair prognosis of the periodontally involved teeth.

Ethical Approval

Ethical approval was obtained from the IRB of Gulf medical university, Ajman, UAE.

Conflicts of Interest

The authors affirm that the publishing of this paper does not involve any conflicts of interest.

All authors agreed to be responsible for all parts of the work and authorised the final manuscript version for publishing. This ensured that any concerns about the accuracy or integrity of the work were duly investigated and addressed.

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