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Review Article

Diagnosis, a Predominant Aspect in Furcation Management: A Review

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Abstract

The diagnosis of a disease is of utmost importance and the entire outcome of the treatment depends upon it. For a proper diagnosis, different traditional as well as new modalities are there and many more are still under progression. The traditional and the gold standard diagnosis for furcation depends on the clinical examination using a Naber's probe along with the periapical radiography. Various new modalities such as Computed tomography, Cone beam computed tomography, substraction radiography, digital radiography have been introduced with various latest fronteirs like fiberscopes, ultrasonography etc. This article reviews the traditional as well as new frontiers that have made the diagnosis more precise and feasible.

Keywords: Diagnosis; New Frontiers; Furcation Involvement; Furcation Defects; Furcation Probes

Abbreviations

ROF-BOD: Roof of Furcation to the Base of the Defect; RDCB: Root Divergence at Crest of the Bone; HBOD-F: Horizontal Extent (base) of Defect at Level of Crest of Bone; ROF-COB: Roof of Furcation to Crest of Bone at Furcation Entrance; CBCT: Cone Beam Computed Tomography; DVT: Digital Volume Tomography; OCT: Optical Coherence Tomography

Introduction

One of the most crucial prognostic factor for the molar loss is furcation involvement and its treatment and management is quite challenging as access to this area is limited and also the furcation area has complicated anatomy. Hence, its diagnosis and management at an early stage is quite important. In order to provide the most suitable treatment, it is important to rule out the proper diagnosis leading to a prognosis for the involved tooth. The traditional and the gold standard diagnosis for furcation depends on the clinical examination using a Naber's probe along with the periapical radiography [1]. It has been documented as per various studies that molars are generally at high risk for extraction as compared to the anterior teeth even in cases where supportive periodontal therapy is provided. Response of these teeth towards the treatment is not as good as compared to the single rooted teeth [2]. Various treatment modalities has been introduced now than ever but choosing the right one changes the entire scenario. Various factors are taken into account while making this decision considering both local and general aspects. Foremost, patient's age, his or her general condition, type of the periodontal disease, type of the tooth, degree of the involvement are mainly considered by the therapist. Other important factors like anatomy, root morphology, bony lesion morphology, attachment apparatus, degree of the mobility should also be taken into consideration. Also, the clinician's skills and experience plays an important role as management of furcation involvement is quite complicated. Management of the interradicular periodontal disease is the most difficult. It not only demands the technical skills of the clinician but also it demands the compliance, confidence and understanding of the patient. Today's expensive treatment modalities can only be justified if the clinician is able to fulfil the patient's expectations for that a careful diagnosis is the foremost important thing. Also, a thorough diagnosis, including all the aspects is required for the clinical experimentation [3]. In order to rule out the indications and contraindications of a treatment modality, patient and tooth- related factors must be considered leading to a proper diagnosis followed by a step wise approach to treat the furcation involvement [4]. Hence, this article reviews different modalities for the diagnosis of these defects including the most recent ones.

Types

- Occlusal origin
- Plaque-associated origin
- Endodontic origin

- Combined origin.
- **Lesions with Occlusal origin:** Within interradicular area, it is histologically characterized by the vascular alterations heading forward to remodelling of periodontal ligament space and also demineralization of bone. Along with the enhanced tooth mobility without a probeable furcation, interradicular space radiolucency are common signs when extreme occlusal forces are applied to a molar [5]. Waerhaug stated that rise in mobility is relatively a late symptom in the molars and it has no part in the initiation of the furcation defect [6].
- **Lesions with Plaque associated origin:** Marginal periodontitis includes the periodontal attachment apparatus. Attachment loss of the periodontal structures is mainly due to the subgingival plaque [7]. Bleeding from the gingiva, pocket formation, connective tissue attachment loss and alveolar bone loss is a sign of lesions associated with the dental plaque. These lesions can be diagnosed by various methods like gingival fluid composition, assessment of the rate of flow of gingival crevicular fluid, by various immunological, genetic and microbiological methods [6].
- **Lesions with Endodontic origin:** Pathogenesis of the pulp can lead to the furcal invasion [8]. Extention of the accessory canal into the furcation area leads to the accessibility of this area to products of pulpal necrosis leading to inflammatory lesions in interradicular bone with possible periapical involvement. Laterally, a sinus tract can form with no affect on the periodontal or gingival complex and the infection may expand next to periodontal ligaments and may lead to probeable furcation area [5]. Radiographically, the pulpal interradicular lesion seems identical to the lesion caused by marginal periodontitis and it is quite difficult to make a differential diagnosis [9]. Endodontic origin of interradicular lesion can be diagnosed by the non-vitality of the tooth that can be assessed by pulpal tests in combination with increased mobility of the tooth and positive percussion test. Even after an endodontic therapy, if a lesion is still there, periodontal treatment is provided accordingly [5].
- **Combined lesions:** Periodontal and pulpal lesions can exist separately or at the same time in the same tooth. The endodontic lesion may lead to a communication with oral cavity by moving coronally next to the periodontal ligament and can get out by periodontal pocket or gingival sulcus in an interradicular area. These lesion can be non-distinguishable after the periodontal lesion and endodontic lesions connect. Prognosis of the tooth with furcation having combined periodontal and pulpal lesions depend on the scale of periodontal component. After providing endodontic therapy, sufficient time must be given for healing of the pulpal lesion of this combined defect. After that, the periodontal defect is again evaluated to know the extent of the periodontal component and its severity. After the outcome of the endodontic treatment, periodontal treatment is decided [5].

Diagnosis

These defects can be measured and diagnosed by radiographic as well as clinical methods.

Various types of furcation probes

Furcation defects can be measured with special probes like Nabers probe, ZA2, ZA3, NS2, NP2C, HO2, NP2C and ACE probe. Other than these probes straight periodontal probe, automated probe like Florida probe having disc attachment can also be used [10].

Figure 1

1. Nabers 2N, having smooth non-calibrated surface, accesses all buccal and lingual furcations and consists of a shallow curve at the working end.
2. Nabers 1N, with smooth non-calibrated surface, and sharper, more defined curves/angles used for measuring mesial and distal furcations on maxillary molars.
3. ZA2 probe having graduations at 2, 4, 6 and 8 mm and with a diameter of 0.5 mm.
4. Nabers Q2N, having color coding at 3, 6, 9 and 12 mm and is a color-coded variant of the 2N.
5. HO2 probe have a diameter of 0.4 mm, is non-graduated.
6. ZA3 probe, have graduations at 3, 6, 9 and 12 mm and have a diameter of 0.5 mm.
7. NP2C probe has graduations at 3-5 mm and a diameter of 0.5mm
8. NS2 probe has a diameter of 0.5 mm and is nongraduated [10].

Clinical methods

- **Bone sounding:** This method is done under local anesthesia in which transgingival probing is carried out in order to assess the morphological outline of the furcation defect [11]. The vertical probing depth is taken with straight probe like UNC 15 probe and the horizontal probing depth can be taken by Naber's probe. As per various studies, the surgical measurement of furcation and bone sounding have an average minute difference of 0.4 to 0.5mm [12].
- **Other clinical techniques:** by intersection of two periodontal probes; by the use of a rubber stop on a probe, serving as a reference point for penetration depth; A stent can be used in conjunction of an orthodontic bracket that will serve as a reference point for calculation of depth of furcation involvement as well as for probe penetration; Orthodontic molar tube along with a stent can also be used for the same [10].

Surgical measurements

Numerous methods of direct measurements after surgical exposure of the furcation defects include

- **Open measurement of the bone using a probe:** After we reflect the lingual and the facial flap, the debridement of the defected area is done, the vertical attachment level is measured using a UNC-15 probe from furcation fluting till the base of the defect. Likewise, the measurement of the Horizontal attachment level is done from the fluting of the furcation till the horizontal extent of the defect. Due to its direct nature, it is generally seen as the gold standard method [10].
- **Impression method:** the furcation can be measured by taking an impression of the furcation area. As per this method, buccal and lingual full thickness flaps are reflected and a rubber based impression is injected into the defect using a syringe. From the impression, the dimensions in terms of the volume of the defect is figured out using Leitz stereomicroscope. It provides a three dimensional picture of the sample. Zappa et al in the year 1993 stated that the mean absolute error for the impression method is 0.02 mm where as for the surgical measurement it is 0.07mm. However, this method is technique sensitive. It is quite challenging as it require careful injection of the impression material into the narrow furcations, distortion of the impression can also be a challenge, also the use of the stereomicroscope need prior training and knowledge [13].
- **Mathematical algorithm**

$$\frac{(\text{ROF-BOD})2\ (\text{RDCB})\ (\text{HBOD-F})}{2(\text{ROF-COB})}$$

  - Roof of furcation to the base of the defect- (ROF-BOD)
  - Root divergence at crest of the bone- RDCB
  - Horizontal extent (base) of defect at level of crest of bone- HBOD-F
  - Roof of furcation to crest of bone at furcation entrance- ROF-COB
  - This method was given by Bowers., *et al*. in the year 2003 but there are no further studies to support this method [14].

Radiographic diagnosis

Clinical probing along with the radiographic assessment are the main methods for the diagnosis of the furcation defect. A properly developed radiograph act as an important additive tool in the periodontal diagnosis. Various radiographic techniques are available, including Orthopantomograms and Intra-oral peri-apical radiographs. These have certain shortcomings as these provide only two-dimensional overlapping images, also these are not much useful for detecting initial changes in the alveolar bone thus limiting the reliability. With the arrival of the digital technology, techniques like Digital radiography, substraction radiography, computed radiography, CBCT etc have also been introduced.

Digital radiography

It is also called as Radiovisiography. It has a digital detector that takes the radiographic image. Its advantages include abolishment of the chemical processing, decreased exposure of radiation and provides tools for precision.

Substraction radiography

Allows the detection of minute changes that are as small as 5%. Change in the image densities can be seen at separate time intervals. For now, this system is not as efficient to detect the furcation defect. It is time consuming that limits its usage as a diagnostic apparatus.

Computed tomography

Provides cross-sectional images with no superimpositions. Emits X-rays from a fan-shaped source. It produces sectional images that are recorded by gas or crystal detectors. Potency of the X-ray beam emerging from patient is then calculated and trans-

formed into digital data that in turn is transformed into grey scale showing densities of the tissue leading to the generation of a 3-D visual image.

Cone beam CT (CBCT)

Also known as digital volume tomography (DVT). Documents the volume of the patient in single rotation as it uses a cone-shaped x-ray beam, in alteration to the flat fan-shaped beam used in computed tomography. Advantages include reduced radiation dose, cost effective and the disadvantages include presence of metallic artefact. Authors like Mengel., *et al*. 2005; Vandenberghe., *et al*. 2007 stated that furcation defects can be easily differentiated into various classes using CBCT technique [10].

Latest Frontiers

- **Fiberscopes:** These are periodontal endoscopes which are minimally invasive, having a magnification of 24-48X. These works on fiberoptic endoscopy technology. Qzawa., *et al.* in the year 1999 conducted a study in which, fiberscopes are introduced through a fistula and it was able to differentiate the level of the bone loss, soft tissues and the root surfaces involved in periodontal disease [15].
- **Optical coherence tomography (OCT):** It emits a white light that is able to penetrate the tissues. It does not have any biological harmful effects. A signal is generated by utilizing the differences in the reflection of the lights that matches the composition and morphology of the underlying tissues. Sulcular depth, connective tissue attachment, periodontal tissue contour can be visually recorded by the use of Optical coherence tomography. However, till now there are no studies that has been reported, stating the efficacy of this technology for measuring the furcation defects [16].
- **Natural frequency analysis:** An electronic transducer is placed on the interested area and low-voltage current is passed via the transducer, followed by the digital recording of the resistance to the vibration of transducer in the adjacent bone. Wang., *et al.* (2009) reported that is better in identifying the furcation defects as compared to the traditional methods and proposed that it should be added along with the traditional methods for furcation defect measurements [10].
- **Ultrasonography:** An extremely high frequency of 7.5-20 MHz pulsed ultrasound beam is used in this technology that leads to the production of high-resolution images of the structures. It is a non-invasive technique. With the passage of the ultrasound waves, reflection of some of the waves by tissue interface occurs leading to the production of echoes that are then picked and transformed into electrical signals, that are then transformed into grey, black and white images. These images are displayed on a computer screen [10]. Chandrashekhar., *et al.* (2014) used the ultrasound for the diagnosis of the furcation and stated the accuracy of 76% where as clinical measurements showed the accuracy of 70% [10].

Discussion

According to a study conducted by Eickholz and Kim, 1998, there were no significant differences between pre- and intra-surgical Horizontal attachment loss using the Nabers probe [17]. Eickholz, 1995 stated that diagnosis of the furcation defects by clinical method provides a safe information for making a prognosis and hence in turn, in providing therpy to the patients with furcation involvement [18]. Graetz C., *et al*, 2014 stated that the reliability of furcation probing in comparison to radiographic assessment tools is dependent on the location as well as the anatomy of the tooth. Hence, both the diagnostic aids should be used in case of furcation involvement [19]. Otis L L., *et al.* 2014 compared images produced by two separate in vitro prototype Optical Coherence Tomography system. One of these systems had a wavelength of 700microW and the other had 1310 nm wavelength. As per this study the dental images produced by 1310 nm OCT system was much better, proving its reliability as dental imaging system [20]. kolsuz ME., *et al.* 2015 assessed three separate voxel sizes to evaluate the furcation defects. As per this study, the precision of the image assessed reduced in case of larger voxel size. However, the difference was not to a great extent [21]. Qiao., *et al*. evaluated the maxillary molars by using CBCT and correlated it to the intrasurgical results. As per this study, the results obtained by the CBCT have more accuracy for the incipient lesions [22].

Conclusion

Despite of the availability of different diagnostic aids, diagnosis of the furcation involvement is still considered as a challenge. Probing is practical, quite simple and comparatively cost effective as compared to other methods. Various new age radiographic techniques like CBCT, substraction radiography, computed radiography etc are quite reliable but still are not radially used due to the high cost and low availability. Hence, It can be concluded that as there is

no substantial documentation of the advantages of one technique over the other and no single method is completely reliable and has complete accuracy, so a combination of techniques can provide a better guidance.

Bibliography

1. Salineiro F., *et al.* "Detection of furcation involvement using periapical radiography and 2 cone-beam computed tomography imaging protocols with and without a metallic post: An animal study". *Imaging Science in Dentistry* 47 (2017): 17-24.

2. Eickholz P and Walter C. "Clinical and Radiographic Diagnosis and Epidemiology of Furcation Involvement". *Diagnosis and Treatment of Furcation-Involved Teeth* 1 (2018): 15-31.

3. Muller HP and Eger T. "Furcation diagnosis". *Journal of Clinical Periodontology* 26 (1999): 485-498.

4. Rotundo R and Fonzar A. "Furcation Therapy". Resective Approach and Restorative Options. Diagnosis and Treatment of Furcation-Involved Teeth 1 (2018): 161-175.

5. Carnevale G., *et al.* "Management of furcation involvement". *Periodontology* 9 (1995): 69-89.

6. Waerhaug J., *et al.* "The furcation problem: etiology, pathogenesis, diagnosis, therapy and prognosis". *Journal of Clinical Periodontology* 7 (1980): 73-95.

7. Kornman KS. "Nature of periodontal diseases: assessment and diagnosis". *Journal of Periodontal Research* 22 (1987): 192-204.

8. Lowman JV., *et al.* "Patent accessory canals: incidence in molar furcation region". *Oral Surgery, Oral Medicine, and Oral Pathology* 36 (1973): 580-584.

9. Harrington GW. "The perio-endo question: differential diagnosis". *Dental Clinics of North America* 23 (1979): 673-690.

10. Karthikeyan B., *et al.* "Furcation Measurements: Realities and Limitations". *Journal of the International Academy of Periodontology* 17.4 (2015): 103-115.

11. Laxman VK., *et al.* "Evaluation of a new furcation stent as a fixed reference point for class II furcation measurements". *Journal of Contemporary Dental Practice* 10 (2009): 18-25.

12. Mealey BL., *et al.* "Use of furcal bone sounding to improve accuracy of furcation diagnosis". *Journal of Periodontology* 65 (1994): 649-657.

13. Zappa U., *et al.* "Clinical furcation diagnoses and interradicular bone defects". *Journal of Periodontology* 64 (1993): 219-227.

14. Bowers GM., *et al.* "Factors influencing the outcome of regenerative therapy in mandibular Class II furcations". *Journal of Periodontology* 74 (2003): 1255-1268.

15. Ozawa T., *et al.* "Clinical application of a fiberscope for periodontal lesions: Case reports". *Quintessence International* 30 (1999): 615-622.

16. Otis LL., *et al.* "Optical coherence tomography: a new imaging technology for dentistry". *Journal of the American Dental Association* 131 (2000): 511-514.

17. Eickholz P and Kim TS. "Reproducibility and validity of the assessment of clinical furcation parameters as related to different probes". *Journal of Periodontology* 69 (1998): 328-336.

18. Eickholz P. "Reproducibility and validity of furcation measurements as related to class of furcation invasion". *Journal of Periodontology* 66 (1995): 984-989.

19. Graetz C., *et al.* "Periodontal probing versus radiographs for the diagnosis of furcation involvement". *Journal of Periodontology* 85 (2014): 1371-1379.

20. Otis LL., *et al.* "Dental optical coherence tomography: a comparison of two *in vitro* systems". *Dentomaxillofacial Radiology* 29.2 (2014): 85-89.

21. Kolsuz ME., *et al.* "Comparison of the influence of FOV sizes and different voxel resolutions for the assessment of periodontal defects". *Dentomaxillofacial Radiology* 44.7 (2015): 1-7.

22. Qiao J., *et al*. "The accuracy of cone-beam computed tomography in assessing maxillary molar furcation involvement". *Journal of Clinical Periodontology* 41 (2014): 269-274.