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Furcation Involvement: A Review

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Abstract

Periodontal disease is an extension of Inflammation of the supporting tissues of the teeth. Usually, a progressively destructive change leads to loss of bone and periodontal ligament. Furcation lesion describes various classification systems that have been proposed Glickman's classification (1953) which is most widely utilized for many years to Kolte and Philloni classification (2018) are used for a proper guide to clinicians in proper diagnosis and treatment planning. The presence of furcation involvement is one clinical finding that can lead to a diagnosis of advanced periodontitis and potentially to a less favorable prognosis for the affected tooth or teeth. This review evaluates the different aspects of furcation in terms of etiology, classification, diagnosis, and various treatment possibilities.

Keyboard: Furcation, Bone Loss, Classification, Management

Introduction

The furcation involvement (FI) is the inflammatory periodontal disease, resulting in loss of connective tissue attachment sufficient to affect the base of root trunk of a tooth where the bifurcation or trifurcation of multi-rooted teeth & is one of the most serious sequels of periodontitis. [1]. Periodontal disease is characterized by the loss of connective tissue attachment in the apical direction affecting all periodontal tissue: cementum, periodontal ligament & alveolar bone. The degree to which a lesion progresses is affected by an inflammatory response, type of bacteria present, organic conditions, &local factors. In the posterior segments of dentition, numerous factors play a role in influencing the onset & progression of periodontal disease. [2] The furcation area is a complex anatomic morphology that may be difficult or impossible to debride by routine periodontal instrumentation, and difficult to maintain routine home care methods also may not keep the furcation area free of plaque and clinical

findings of furcation indicate advanced periodontitis and less favorable prognosis.[3]Furcation involvement is usually seen in the maxillary and mandibular first molars which are primarily exposed to plaque retention for a longer duration.[4]

Definition

Glickman (1950) Commonly occurring condition in which the bifurcation and trifurcation of multi-rooted teeth are denuded by periodontal disease. [7]

Prichard (1965) Bifurcation and trifurcation involvements are common periodontal lesions that occur as a result of gingival inflammation and bone resorption adjacent to and within the furcation of multi-rooted teeth.

Goldman & Cohen (1968) Extension of pocket into the inter radicular area of bone in multirooted teeth. [8]

Glossary of periodontal terms (AAP 1992) defines Furcation as "the area of a multi-rooted tooth where the roots diverge".

According to the glossary of terms (AAP 2001), a furcation involvement exists when periodontal disease has caused the resorption of bone into the bi- or trifurcation area of a multi-rooted tooth. [9]

Etiology

The etiology of furcation involvement may be classified into three major groups.[5]

A. **Primary factor:** Common cause for furcation involvement is “Plaque” and the inflammation due to its long-term presence.
B. **Predisposing factors:** include location relative to the cementoenamel junction (CEJ), root trunk length, root length, root form, inter radicular dimension, furcation shape, location of the entrance, furcation entrance diameter, facial and lingual radicular bone, enamel projections, enamel pearls, bifurcation ridges, root concavities, and carious lesions.
C. **Contributing factors:** include plaque-associated inflammation, trauma from occlusion, pulpal pathology, vertical root fractures, and iatrogenic factors.[2,4]
D. **Other causes:** Increase in age, Bacterial invasion, Trauma from occlusion, Dental caries.

Classification

Authors	Year	Classification
Glickman, I. [7]	1953	Grade I: Early lesion. The pocket is suprabony, involving the soft tissue. There is slight bone loss in the furcation area and no radiographic evidence of bone loss. Grade II: The bone is destroyed in one or more aspects of the furcation, but a portion of the alveolar bone and periodontal ligament remains intact, permitting only partial penetration of the probe. The radiograph may or may not reveal the grade II furcation involvement. Grade III: Destruction of the connective tissue and bone wall all the way through the furcation. The radiographs clearly show it as a radiolucent area between the roots. Grade IV: Interdental bone is destroyed and the soft tissues recede apically. The furcation opening is visible.
Goldman et al. [8]	1958	Grade I: Incipient lesion. Grade II: Cul-de-sac lesion.

		Grade III: Through-and-through lesion.
Staffing, H.J. [11]	1969	Class I: Furcation with a soft tissue lesion extending to furcal level but with a minor degree of osseous destruction. Class II: Furcation with a soft tissue lesion and variable degree of osseous destruction but not a through-and-through communication through the furcation. Class II F: Furcation with osseous destruction from facial aspect only. Class II L: Furcation with osseous destruction from lingual aspect only. Class II M: Furcation with osseous destruction from mesial aspect only. Class II D: Furcation with osseous destruction from distal aspect only. Class III: Furcation with osseous destruction with through-and-through communication.
Easley &Drennan [12]	1969	Class I. Incipient involvement, the entrance of the furcation detectable with no horizontal bone loss. Class II. Type 1. Horizontal bone loss, but no vertical component. Class II. Type 2. Horizontal and vertical bone loss. Class III. Type 1. Through-and-through loss of attachment into the furcation with no vertical component Class III. Type 2. Through-and-through loss of attachment into the furcation with a vertical component.
Hamp et al. [5]	1975	Degree I: Horizontal attachment loss < 3 mm; Degree II: Horizontal attachment loss > 3 mm not encompassing the width of the furcation area; Degree III: Horizontal through-and-through destruction of the periodontal tissue in the furcation area.
Rosenberg, M.M. [13]	1978	Horizontal Degree I. When the result of probing is not greater than 4 mm. Degree II. When probing shows a value greater than 4 mm (i.e., the bifurcation lesion has already passed the center of the trifurcation). Degree III. Two or three furcations classified as degree II are found. Vertical Shallow: Slight lateral extension of an inter radicular defect, horizontally from the center of the furcation toward one or both adjacent furcations. Deep: Internal furcation involvement denotes the greater lateral extension of the interradiculardefect into but not penetrating the adjacent furcation.
Ramfjord & Ash.	1979	Class I. Beginning involvement. Tissue destruction <2 mm (1/3 of tooth width) into the

[14]		furcation. Class II. Cul-de-sac, tissue destruction >2 mm (>1/3 of tooth width), but not through-and-through. Class III. Through-and-through involvement.
Goldman & Cohen. [15]	1980	Degree I. Involves furcation entrance. Degree II. Involvement extends under the roof of furcation but not through and through. Degree III. Through-and-through involvement.
Ricchetti, P.A. [16]	1982	Class I. 1 mm of horizontal measurement, the root furrow. Class Ia. 1–2 mm of horizontal invasion, earliest damage. Class II. 2–4 mm of horizontal invasion. Class IIa. 4–6 mm of horizontal invasion. Class III. >6 mm of horizontal invasion.
Tal& Lemmer. [17]	1982	The degree of severity of the furcation defects affecting each molar is assigned to one of four groups designated 1, 2, 3, and 4, referred to as furcation involvement index (FII) scores. Furcal rating 1. The depth of the furcation is 0 mm. Furcal rating 2. The depth of the furcation is 1 to 2 mm. Furcal ratings dept of the furcation is 3 mm. Furcal rating 4. The depth of the furcation is 4 mm or more.
Tarnow &Fletcher. [6]	1984	For each class of horizontal classification (I–III), a subclass based on the vertical bone resorption was added: Subclass A: 0–3 mm. Subclass B: 4–6 mm. Subclass C: >7 mm.
Eskow & Kapin. [18]	1984	Furcation involvement is classified as grade I subclasses A, B, and C (vertical involvement): Subclass A: Vertical destruction > 1/3. Subclass B: Vertical destruction of 2/3. Subclass C: Vertical destruction beyond the apical third of inter radicular height.
Fedi, P.F. [19]	1985	Combined Glickman and Hamp classifications: Grade II is subdivided into degrees I and II. Degree I. Vertical bone loss 1–3 mm. Degree II. Vertical bone loss > 3 mm, not communicate through-and-through.
Grant, D.A. et al.	1988	Class I: Involvement of the flute only;

[20]		Class II: Involvement partially under the roof; Class III: Through-and-through loss.
Basaraba, N. [21]	1990	Class I. Initial/incipient furcation involvement. Class II. Partial furcation involvement. Class III. Communicating furcation involvement.
Carnevale, G. et al. [22]	1997	Modified Hamp et al. (1975) classification: Degree I: Horizontal attachment loss < 1/3 Degree II: Horizontal attachment loss > 1/3. Degree III: Horizontal through-and-through destruction.
Nevins & Capetta. [23]	1998	Class I: Incipient or an early loss of attachment. Class II: A deeper invasion and loss of attachment that does not extend to a complete invasion. Class III: Complete loss of periodontium extending from buccal to lingual surface. Diagnosed radiographically and clinically.
Hou et al. [24]	1998	Classification based on root trunk length and horizontal and vertical bone loss. Types of root trunk: Type A: Furcation involving the cervical third of root length. Type B: Furcation involving cervical third and cervical two-thirds of root length. Type C: Furcation involving cervical two-thirds of root length. Classes of furcation: Class I: Horizontal loss of 3 mm. Class II: Horizontal loss > 3 mm. Class III: Horizontal ―through-and-through‖ loss. Subclasses by radiographic assessment of the periapical view: Sub-class a‘. Suprabony defect. Sub-class be. Infrabony defect. Classification of furcation: AI, AII, AIII. Type A root trunks with class I, class II and class III furcations. BI, BII, BIII Type B root trunks with class I, II, and III furcations. CI, CII, CIII.Type C root trunks with class I, class II and class III furcations.
Fedi et al. [25]	2000	Modified Glickman's classification: Grade II degree I - exists when furcal bone loss possesses a vertical component of >1 but <3mm. Grade II degree II - exists when furcal bone loss possesses a vertical component of >3mm, but still does not communicate through and through.

Glossary of periodontal terms	2001	Class I: Minimal but notable bone loss in furcation. Class II: Variable degree of bone destruction but not extending completely through furcation. Class III: Bone resorption extending completely through furcation. [26]
Walter, C. et al. [27]	2009	Modification of the Hamp et al. classification. Degree I: Horizontal attachment loss < 1/3 of the width of the tooth. Degree II: Horizontal loss of support > 3 mm, < 6 mm. Degree II–III: Horizontal loss of support > 6 mm, but not extending completely through furcation. Degree III: Horizontal through-and-through destruction.
Carnevale, G. et al. [22]	2012	Degree I: Horizontal attachment loss < 1/3; Degree II: Horizontal attachment loss > 1/3; Degree III: Horizontal through-and-through destruction.
Pilloni A., Rojas, M.A. [28]	2018	NE – non exposed; E – exposed. NEI: The furcation lesion is not clinically exposed. The horizontal attachment loss is 2 mm or less. NEII: The furcation lesion is not clinically exposed. The horizontal attachment loss is 3 mm or more. NEIII: The furcation lesion is not clinically exposed. The horizontal attachment loss is total, with through and through the opening of the furcation. EI: The furcation lesion is clinically exposed. The horizontal attachment loss is 2 mm or less. EII: The furcation lesion is clinically exposed. The horizontal attachment loss is 3 mm or more. EIII: The furcation lesion is clinically exposed. The horizontal attachment loss is total, with through and through the opening of the furcation.
Kolte, A.P. et al. [29]	2018	Grade I - This type of furcation involvement is an inchoate lesion that develops by mild to moderate and uniform periodontal destruction extending into the flute of the furcation, and manifesting itself with increased probing depth. Grade Ia: It comprises all the features of Grade I FI, with the normal position of gingival margin which is slightly coronal to the CEJ. Grade Ib: It comprises all features of Grade I FI, with the position of the gingival margin, 0-3 mm apical to CEJ. Grade Ic: It comprises all features of Grade I FI, with the position of gingival margin which is more than 3 mm apical to CEJ and may lead to a mucogingival problem.

		Grade II: This type of FI is a confined lesion that develops by moderate periodontal destruction of varying amounts extending into the inter-radicular area, with an arched roof created by the furca and bordered by roots and bone. Grade II type1a– It comprises all the features of Grade II Type 1 FI with the normal position of gingival margin which is slightly coronal to the CEJ. Grade II type1b – It comprises all the features of Grade II Type 1 FI with the position of gingival margin which is 0-3 mm apical to the CEJ. Grade II type1c– It comprises all the features of Grade II Type 1 FI with the position of gingival margin which is more than 3 mm apical to the CEJ and may lead to a mucogingival problem. Grade II type2a– It comprises all the features of Grade II Type 2 FI with the normal position of gingival margin which is slightly coronal to the CEJ. Grade II type2b– It comprises all the features of Grade II Type 2 FI with the position of gingival margin which is 0-3 mm apical to the CEJ. Grade II type2c– It comprises all the features of Grade II Type 2 FI with the position of gingival margin which is more than 3 mm apical to the CEJ and may lead to a mucogingival problem. Grade III – This type of FI is a complete lesion that develops by moderate to severe periodontal destruction in the furcation area permitting the passage of a probe buccolingual on the mandibular molars and Bucco-mesially and bucco-distally on the maxillary molars. Grade III type1a– It comprises all the features of Grade III Type 1 FI with the normal position of gingival margin which is slightly coronal to the CEJ. Grade III type1b– It comprises all the features of Grade III Type 1 FI with the position of gingival margin which is 0-3 mm apical to the CEJ. Grade III type1c– It comprises all the features of Grade III Type 1 FI with the position of gingival margin which is more than 3 mm apical to the CEJ and may lead to a mucogingival problem. Grade III type2a– It comprises all the features of Grade III Type 2 FI with the normal position of gingival margin which is slightly coronal to the CEJ. Grade III type2b– It comprises all the features of Grade III Type 2 FI with the position of gingival margin which is 0-3 mm apical to the CEJ. Grade III type 2c comprises all the features of Grade III type 2 FI with the position of gingival margin which is more than 3 mm apical to the CEJ and may lead to a mucogingival problem.

Diagnosis

A. Clinical Assessment

Nabers Probe: Naber's probe is used to detect and measure the involvement of furcal areas. Buccal and lingual furcation can be easily probed. Proximal furcations are difficult for probing particularly when broad contacts are present in adjacent teeth.[22]

Naber's probe is used to detect and measure the involvement of furcation. It has markings of 3mm,6mm,9mm,12mm with a black band at 6mm &12mm.

Figure: 1[30]

Bone Sounding or Transgingival probing: It may aid in the diagnosis of furcation defects more accurately determining the underlying bone contours, [10] it is necessary to anesthetize the tissue locally before inserting the probe. Greenburg et al. (1988) reported that bone sounding yielded accurate measurements when compared to surgical enter measurements.

B. Radiographic Assessment

As a general rule, bone loss is always greater than it appears in the radiograph but it.

The radiographic examination includes intraoral periapical radiographs and vertical "bitewing" radiographs for detection of furcation invasion. Other than radiographs; computed tomography (CT) scan, cone-beam CT, ultrasound, dental endoscope, etc., are also nowadays being used for detection.

Differential diagnosis

1. Endo-perio lesions, [22]
2. Trauma from occlusion.

Prognosis

Prognosis of involved tooth depends on several factors like:

· Age of the patient.

· General condition of the patient.

· Form or expression of periodontal disease.

· Overall strategic importance of the respective tooth.

· Tooth-type and degree of furcation involvement.

· Tooth or root morphology, anatomical and topographical relation between different roots, the morphology of the bony lesion, the remainder of periodontal attachment apparatus around single roots, and their expected mobility need to be carefully considered.

· Operators' skills and experience must also be taken into account.

Treatment

The treatment is intended to meet two objectives: [22]

1) The elimination of microbial plaque from the exposed surfaces of the root complex.

2) The establishment of the anatomy of the affected surfaces so that it facilitates proper self-performed plaque control.

A variety of methods are available for treatment. Not all of them provide elimination of the furcation. Some provide only increased accessibility for plaque removal; some reduce the susceptibility of the tooth to caries.

Factors to be considered for successful treatment of furcation involvement: [22]

1. Degree of Involvement
2. Crown: Root ratio
3. Length of roots
4. Root anatomy/morphology
5. Degree of root separation

6. Strategic value of the tooth
7. Residual tooth mobility
8. Need for endodontic treatment
9. Prosthetic requirements
10. Periodontal condition of adjacent teeth
11. Ability to maintain oral hygiene
12. Quality of bone/ability to place implants
13. Financial considerations
14. Long-term prognosis.

Treatment protocol considering various classifications:

A. Glickman (1953)

· Grade I

1. Conservative periodontal therapy in the form of hygiene maintenance
2. Scaling and root planing
3. Odontoplasty
4. Recontouring /replacement of faulty restoration

Grade II:

1. Flap procedure
2. Odontoplasty
3. Osteoplasty
4. Guided tissue regeneration

Grade III:

1. Tunneling
2. Root resection
3. Extraction

Grade IV:

1. Tunneling
2. Root resection
3. Extraction

B) Ramjford & Ash (1979)

Class I

1. Scaling and root planing
2. Odontoplasty

Class II

1. Scaling and root planing
2. Odontoplasty
3. Open debridement/furcation operation
4. Bone grafting procedure
5. GTR (mandibular molars)
6. Root resection
7. Tunnel preparation
8. Extraction/implant placement

Class III

1. Open debridement/furcation operation
2. GTR
3. Root resection
4. Tunnel preparation
5. Extraction/implant placement

Nonsurgical Treatment

1. Oral hygiene procedures
2. Scaling and root planning

Oral Hygiene Procedures: Maintaining oral hygiene is an effective method to prevent periodontal problems. A regular visit to the dentist may help in the early diagnosis of the furcation. Nowadays periodontal brushes, Periodontal aids, and rubber tips, toothbrushes, both specific and general aids have been used over time for access to the patient.

Scaling And Root Planning: Nonsurgical therapy aims to eliminate both living bacteria in the microbial biofilm and calcified biofilm microorganisms from the tooth surface and adjacent soft tissue.

Scaling is a process by which plaque and calculus are removed from both supragingival and subgingival tooth surfaces. (Carranza). Root planning- This is the process by which residual embedded calculus and portion of cementum are removed from the roots to produce a smooth, hard, and clean surface. [31] (Carranza).

Surgical Therapy

1. Osseous Resection
2. Regeneration
3. Hemisection
4. Root Resection/ Hemi section procedure
5. Extraction
6. Dental implants

Conclusion

Furcation involvement is an extremely common clinical problem, resulted from progressive inflammatory periodontal pathology. Furcation involvement needs proper diagnosis, prognosis, and treatment plan. A proper diagnosis is most important to design the treatment plan because appropriate treatment depends on the rate of the disease. The degree of furcation and type of the tooth is noted, and tooth deformation and morphology are also considered. The new classifications (2018) are a more efficient guide to the clinician in proper diagnosis and treatment planning and provide a better understanding of furcation involvements.

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