

Review Article

FURCATION INVOLVEMENT & ITS TREATMENT: A REVIEW

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Abstract: The presence of furcation involvement is one clinical finding that can lead to a diagnosis of advanced periodontitis and potentially to a less favourable prognosis for the affected tooth or teeth. Furcation involvement therefore presents both diagnostic and therapeutic dilemmas. This review explains the vast aspects of furcation involvement in form of etiology, classification, diagnosis and different treatment modalities in detail.

Key Words: Furcation, periodontitis, plaque.

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INTRODUCTION:

Periodontal disease is characterised by the loss of connective tissue attachment induced by the presence of periodontal pathogens within the gingival sulcus.¹ The destruction of periodontal tissues progresses in the apical direction affecting all periodontal tissues: cementum, periodontal ligament & alveolar bone. The degree to which a lesion progresses is affected by several factors: 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. The progress of inflammatory periodontal disease, if unabated, ultimately results in attachment loss sufficient enough to affect the bifurcation or trifurcation of multi-rooted teeth & this is one of the most serious sequels of periodontitis. The furcation is an area of complex anatomic morphology that may be difficult or impossible to debride by routine periodontal instrumentation. Routine home care methods may not keep the furcation area free of plaque.² The etiology of periodontal disease is complex and so is its management. One of the most compelling

challenges faced in management of a periodontal disease in multi-rooted teeth is furcation involvement. Involvement of the furcae in multi-rooted teeth by chronic periodontitis is a common event resulting from loss of bone adjacent to and within the furcae. Extension of the periodontal disease process between the roots of multi-rooted teeth is believed strongly to influence the prognosis of the involved teeth. Nevertheless Conservation of natural dentition has been the aim of periodontics since time immemorial.

Some authors recommended extraction of the teeth with furcation invasions rather than trying to retain them.³ Long-term studies on treated periodontal patients have reported that molar teeth with prior furcation involvement were the most frequently lost teeth, probably because of their complex anatomy. Nevertheless these same studies showed that in the majority of patients who responded well to treatment, many molar teeth with furcation involvement were retained for periods as long as 40-50 years.³ Way back in 1884, Farrar reported the so-called radical and heroic treatment of alveolar abscess by amputation of roots of teeth 'In order to enable the nature to have a

better chance for cure.' He absolutely correctly stated that 'If an entire tooth should be extracted from a diseased socket, the treatment might be termed highly radical' and further that such treatment might not only be unwise and unnecessary but absolutely wrong and unscientific.⁴ Though a century has passed since the description of this heroic attempt of root amputation to save the tooth and in spite of all the development in modern periodontics and endodontics, furcation involvement still remains a challenge and a problem that has not actually been solved.

The presence of furcation involvement is one clinical finding that can lead to a diagnosis of advanced periodontitis and potentially to a less favourable prognosis for the affected tooth or teeth. Furcation involvement therefore presents both diagnostic and therapeutic dilemmas.

ETIOLOGY:

1. Plaque associated inflammation:

Extension of inflammatory periodontal disease processes into the furcation area leads to interradicular bone resorption and formation of furcation defect. Glickman (1950) concluded from microscopic features that furcation involvement is a phase in root ward extension of periodontal pocket.

2. Pulpo-periodontal disease

The high percentage of molar teeth with patent accessory canals opening into the furcation suggests that pulpal disease could be an initiating cofactor in the development of furcation involvement. If there is no established periodontal furcaion involvement, these pulpal lesions are initially pure endodontic sinus tracts draining through the periodontal ligament and gingival sulcus. If detected and treated early by endodontic therapy, these furcation defects resolve with regeneration of new interfurcal bone and attachment. If not detected and treated before plaque and calculus are allowed to form on the root surface adjacent to the endodontic therapy, these furcation defects resolves with

regeneration of new interfurcal bone and attachment. If not detected and treated before plaque and calculus are allowed to form on the root surface adjacent to the endodontic sinus tract, the furcation involvement becomes a combined endo-perio defect and prognosis becomes poor.

CLASSIFICATION OF FURCATION INVOLVEMENT:

A) Horizontal Component of Furcation Involvement:

1) GLICKMAN (1953)⁵

Grade I Involvement: Grade I is the incipient or early lesion. The pocket is supra bony, involving the soft tissue; there is slight bone loss in the furcation area. Radiographic change is not usual, as bone is minimal.

Grade II Involvement: In grade II cases, bone is destroyed on one or more aspects of furcation, but a portion of the alveolar bone and PDL remains intact, permitting only partial penetration of the probe into the furcation. The lesion is essentially a cul-de-sac. The depth of the horizontal component of the pocket will determine whether the furcation involvement is early or advanced. The radiograph may or may not reveal the grade II furcation involvement.

Grade III Involvement:

The interradicular bone is completely absent, but the facial and/or lingual orifices of the furcation and occluded by gingival tissue. Therefore the furcation opening cannot be seen clinically, but is essentially a through-and-through tunnel. There may be a crater-like lesion in the interradicular area, creating an apical or vertical component along with the horizontal loss of bone. If the radiograph of the mandibular molars is taken as a proper angle and the roots are divergent, these lesions will appear on the radiograph as a radiolucent area between the roots. The maxillary molars present a diagnostic difficulty owing to roots overlapping each other.

Grade IV Involvement:

The interradicular bone is completely destroyed. The gingival tissue is also

recessed apically so that the furcation opening is clinically visible. Therefore these involvements also exhibit tunnels without the orifices being occluded by the gingiva. The radiographic picture is essentially the same as that of grade III lesions.

II) GOLDMAN (1958)⁶

Grade I: Incipient

Grade II: Cul-de-sac

Grade III: Through and through

III) RAMJFORD AND ASH (1979)

Class I: Beginning Involvement:

The tissue destruction should not extend more than 2mm [or not more than 1/3 of the tooth width into the furcation.

Class II: Cul-de-sac Involvement:

The tissue destruction extends deeper than 2mm [or more than 1/3rd of the tooth width] into the furcation opening.

Class III: Through and through involvement:

Tissue destruction extends throughout the entire length of furcation. So, that an instrument can be passed between the roots and emerges on the other side of the tooth.

DIAGNOSIS:

Proper diagnosis is essential to intelligent treatment. Diagnostic procedures must be systematic and organized for specific purposes; merely assembling facts is insufficient. The findings must be correlated so that they provide a meaningful explanation of the patient's periodontal problem.

DIAGNOSIS OF FURCATION INVASION

1) Clinical Assessment

i) Probing:

- Naber's Probe: The Naber's probe is used to detect and measure the involvement of furcal areas by the periodontal disease process in multirooted teeth.
- In maxillary molars, the mesial furcation entrance is located much closer to the palatal than to the buccal half of the tooth surface (because of the larger buccolingual width of the mesiobuccal root, the mesial furcation opens 2/3rd of the way toward the

palate rather than midway buccolingually). Thus the mesial furcation should be probed from the palatal aspect of the tooth.

II) Bone Sounding or Transgingival probing:

Transgingival probing is extremely useful just prior to flap reflection. It is necessary to anesthetize the tissue locally prior to inserting the probe. The probe should be "walked" along the tissue-tooth interface so that the operator can feel the topography. The probe may also be passed horizontally through the tissue to provide more three-dimensional information regarding bony contours (i.e.; the thickness, height, and shape of the underlying base).

- Bone sounding or transgingival probing with local anesthesia may aid in the diagnosis of furcation defects more accurately determining the underlying bony contours. Greenburg et al. (1988) reported that bone sounding yielded accurate measurements when compared to surgical entry measurements. Diagnosing furcation invasion is therefore best accomplished using a combination of radiographs, periodontal probing with a curved explorer or Nabers probe and bone sounding.

2) Radiographic Assessment:

- Radiographs are helpful but show artefacts that make it possible for furcation involvement to be present without detectable radiographic changes. As a general rule, bone loss is always greater than it appears in the radiograph.
- Radiographs must always be obtained to confirm findings made during probing of a furcation-involved tooth. The radiographic examination includes intraoral periapical radiographs and vertical "bitewing" radiographs for detection of furcation invasion. In the radiographs, the location of the interdental bone as well as the bone level within the root complex should be examined. Situations may occur when findings from clinical probing and from

the radiograph are inconsistent. Then, the localized but extensive attachment loss which may be detected within the root complex of a maxillary molar with the use of a probe will not always appear in the radiograph. This may be due to the superimposition in the radiograph of the palatal root of remaining bone structure. In such a case, additional radiographs with different angles of orientation of the central beam should be used to identify bone loss within the root complex.

PROGNOSIS:

Clinical research has indicated that furcation problems are not as severe a complication as originally suspected, if one can prevent the development of caries in the furcation.⁹ Relatively simple periodontal therapy is sufficient to maintain these teeth in function for long periods.⁹

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.
- Operator's skill and experience must also be taken into account.

TREATMENT:

The treatment is intended to meet two objectives:

- 1) The elimination of microbial plaque from the exposed surfaces of the root complex.
- 2) The establishment of an 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 of the furcation. Some provide only increased accessibility for plaque removal; some reduce the susceptibility of the tooth to caries.

Treatment protocol considering various classifications:

A) Glickman (1953)

- Grade I. Pocket formation into the flute, but intact interradicular bone (incipient).
- Grade II. Loss of interradicular bone and pocket formation, but not extending through to the opposite side.
- Grade III. Through-and-through-lesion.
- Grade IV. Through-and-through lesion with gingival recession, leading to a clearly visible furcation area.

B) Ramjford & Ash (1979)

- Class I :
 - Scaling and root planing
 - Odontoplasty
- Class II:
 - Scaling and root planing
 - Odontoplasty
 - Open debridement/furcation operation
 - Bone grafting procedure
 - GTR (mandibular molars)
 - Root resection
 - Tunnel preparation
 - Extraction/implant placement
- Class III:
 - Open debridement/furcation operation
 - GTR
 - Root resection
 - Tunnel preparation
 - Extraction/implant placement

Scaling, Root Planing & Curettage:

The preliminary phase of oral rehabilitation is good patient plaque control before proceeding with surgical correction of periodontal abnormalities.³⁶ Plaque accumulation causes gingivitis, which is believed to proceed to periodontitis. Calculus, which harbours plaque, has been

shown to be more irritating to the soft tissues than plaque alone. Therefore therapy for furcation invasion should always include the removal of plaque and calculus by scaling and root planing. These procedures result in elimination of pocket, resolution of inflammation and repair of the periodontal ligament and adjacent bone margin in Glickman's grade I furcation.

Open flap debridement and root conditioning:

Even though by itself a non surgical approach to therapy is very efficient in decreasing the risk of onset and progression of various diseases of the gingival tissues, it is also known to have therapeutic limitations. Factors that contribute to the decreased effectiveness of non surgical therapy include; time constraints, difficulty in accessing the area to be treated, operator experience, individual responses to the therapy by the patient, and anatomical and microbiological influences. For these above mentioned reasons it may be advantageous and indicated to have surgical access to the area in need of decontamination.

The possibility to elevate a flap and visualize the roots surfaces allows for an accurate and complete elimination of local etiologic factors. Many different surgical techniques have been described based on the type of case being treated as well as on the objectives of therapy. Among the most relevant clinical problems that can occur after surgery are the unaesthetic outcomes in aesthetic areas (lengthening of the clinical crowns). Some of the incision techniques, that allow us to gain adequate access to the area under treatment, have been designed in such a way as to decrease these undesired outcomes.

Bone Graft Materials & Procedures:

Regeneration of new bone, cementum, and periodontal ligament is considered one of the primary objectives of periodontal therapy and has been demonstrated by numerous therapeutic grafting modalities for restoring periodontal osseous defects have been investigated.

1. Autografts: Material to be grafted can be obtained from the same individual.
2. Allografts: From a different individual of the same species
3. Xenografts: From different species.

Bone graft materials are generally evaluated based on their osteogenic, osteoinductive osteoconductive.

1. **Osteogenesis:** Refers to formation or development of new bone by cells contained in the graft.
2. **Osteoinduction:** is a chemical process by which molecules contained in the graft (bone morphogenic proteins) convert the neighbouring cells into osteoblasts, which in turn form bone.
3. **Osteoconduction:** is a physical effect by which the matrix of the grafts forms a scaffold that favours outside cells to penetrate the grafts and form a new bone.

Autografts in the form of osseous coagulum, bone blend, and marrow have the most promise for bone induction and regeneration of lost tissues. Osseous coagulum and bone utilizing intraoral cancellous bone and marrow grafts exhibit some lack of predictability in restoring furcation lesions. Iliac autografts have yielded the best potential for osseous regeneration. Despite a promise of high predictability for success, the use of iliac autografts has been reserved, possibly because of the need for additional surgical intervention, expense of procurement, and a significant incidence of root resorption.

BONE MORPHOGENIC PROTEINS (bmps):

Bone morphogenic proteins are osteoinductive factors that may have the potential to stimulate mesenchymal cells to differentiate into bone-forming cells. Sigurdsson et al. (1995)⁷ evaluated bone and cementum formation following regenerative periodontal surgery using recombinant human BMP in surgically-created supra-alveolar defects in dogs. Following application of BMP the flaps were advanced to submerge the teeth and were sutured.

Histologic analysis showed significantly more cementum formation and regrowth of alveolar bone on BMP treated sites as compared to the control. Ripamonti et al. (1994)⁸ also reported about the efficacy of bovine BMPs to induce periodontal regeneration in degree II furcation in baboons. On one side BMP was implanted with a collagenous matrix, while at the control sites only the collagen matrix was used. Considerable regeneration of cementum, periodontal ligament and bone was observed in the BMP treated furcations as compared to the control furcations treated without BMP. Further experimentation is needed to evaluate a possible role of BMP in periodontal regeneration.

Root Resection and Hemisection:

Hemisection usually denotes removal of half the tooth performed in two procedures: tooth sectioning followed by removal of a root at the furcation or apical to it, without removal of the crown, usually on maxillary molars. Root sectioning generally is defined as removal of a root without reference to how the crown is treated. The treatment of advanced Grade II or Grade III furcation involvements will often require removal or resection of root. The primary benefit gained from these procedures is access to the remaining root surfaces for scaling and root planning and for the patient's plaque control regimen.

Tooth extraction:

This therapy is indicated when the destruction of the periodontium has progressed to such a level that no tooth can be preserved. Extraction may also be performed when the maintenance of the affected tooth will not improve the overall treatment or when treatment of the furcation involved tooth will not result in conditions which can be properly maintained by self-performed plaque control measure. The extraction of a periodontally involved multirooted tooth will of course predictably eliminate the disease in this particular area.

Restorative management:

Crowns used to restore root-resected teeth should follow the form created during the amputation procedure described previously. Proximal walls should taper evenly into the remaining root surface. No spurs of overhangs should remain to complicate maintenance. Interproximal areas should be open to facilitate cleaning. Root concavities in the furcation areas should be reproduced in the restoration. Contours should be flat for access for effective plaque removal. Hemisected teeth should not be cantilevered unless supported by splinting.

Endodontic therapy should be conservative with minimal enlargement of the root canal for root strength. Condensation should not be excessive. Gutta-percha permits the placement of posts without disturbing the apical seal. Badly broken-down teeth may be built up with a post and core before final restoration is attempted.

CONCLUSION:

Successful treatment, management and long-term retention of multi-rooted teeth with periodontal destruction of varying degrees into their furcations have long been a challenge to the discerning general dentist or dental specialist. Indeed, some earlier authors have reported that periodontal pockets that involve the domes of furcations of multi-rooted teeth present a hopeless or at best an unfavourable prognosis and should be extracted. However, long term studies of treated teeth with furcations have shown impressive on retention for period up to 50 years.

The decision for a specific treatment mode for furcation involved tooth depends on several factors, with a both general and local perspective. First of all, the age of the patient, his or her general condition and the form or expression of periodontal disease have to be taken into account. Next, the overall strategic importance of the respective tooth and its possible role in a comprehensive treatment plan must be considered. Tooth type and degree-of furcation involvement may be regarded as the most important factors. Also, further aspects like tooth or root morphology, the

anatomical and topographical relation between different roots, the morphology of the bony lesion, the remainder of the periodontal attachment around single roots and their expected mobility have to be considered. Finally, the operator's skill and experience must be taken into account.

A careful diagnosis is a pre-requisite for appropriate therapy. Novel treatment modalities compel the therapist to acquire the necessary data and to correctly interpret the respective observations. The current concept for treatment of interradicular periodontitis is complex. Not only technical skill of the therapist is required but also, understanding, confidence and compliance of the patient. The more expensive measures may be justified, if the operator is able to give at least the patient account of success or failure and last but not the least, a through detailed diagnosis of all aspects of furcation involvement is demanding in clinical experimentation. Complicated though it may sound, yet furcation involvement is a commonly encountered problem in day-to-day periodontal practice. The management of furcation involvement should include selection of appropriate treatment modality from the array of treatment options available. Preserving natural dentition, a functional natural dentition rather should be the goal of our practice.

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