REVIEW ARTICLE

Modalities of Possible Treatment in Furcation Involvement: A Review

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Abstract

Furcation areas are most difficult areas to maintain the oral hygiene because of limited accessibility and anatomical variations. Thus, these areas are prone to accumulation of plaque and onset of periodontal disease. There are various modalities for treatment of furcation defect based on its morphology. Various surgical as well as non-surgical therapies are briefly described in this review article for treatment of furcation involvement.

Keywords: Furcation, Periodontitis, Regeneration.

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Introduction

Periodontitis is a multifactorial, chronic inflammatory disease affecting the supporting structures of periodontium. It is the main cause of tooth loss and is considered one of the biggest threats to the oral health.[1] Posterior dentition is usually difficult to clean mainly due to factors such as limited accessibility and anatomical variations (Fig. 1). This further influences the onset and progress of periodontal disease affecting furcation, usually seen in the first upper and lower molars,[2] thereby increasing the risk of losing the affected tooth. Several studies have been reported that a higher rate of periodontal breakdown and bone loss is seen in furcation involved molars when compared with single rooted teeth.[3]

The treatment of multirooted teeth offers a challenge to all practitioners because the posterior position of these teeth in the dental arch limits access for diagnostics, therapy, and maintenance of oral hygiene by the patient. Once furcation invasion occurs, these areas become difficult to clean and frequently demonstrate continued deterioration. The methods by which furcation involved teeth can be treated can be either nonsurgical, i.e., scaling and root planing, furcationplasty, or surgical procedure which involves various regenerative procedures, root resection, or hemisection.

Conventional periodontal treatments are highly effective at repairing disease-related defects and halting the progression of disease. But it is always preferable to regenerate the lost periodontium. However, the predictability for regeneration in the case of a through-and-through furcation is low. It is time-consuming and expensive. The defects with the most promising prospects for regeneration have a vertical wall of bone buccal to the furcation and divergent roots to allow proper root debridement.

Prevalence

In the Indian subpopulation, several studies have been conducted to know the prevalence of periodontitis. Grewal and Agarwal et al.[4,5] concluded that periodontal pockets were more prevalent in males than in female, and this may be due to their higher indulgence in adverse oral habits when compared to women.

A contrary report published by Singh et al.[6] stated that more amount of periodontal breakdown occurs in females in rural area than in males. The disease rate among females could be attributed to poor nutrition, hormonal imbalance, and frequent childbirths.

There is variability among the prevalence of this disease among the population. This can be due to several factors such as study designs, sample size, eligibility criteria, recording of data, criteria for assessment of disease, microbial pathogens, disease activity, and multifactorial nature of periodontal diseases including age, gender, socioeconomic status, educational status, stress, and genetic factors, and it is difficult to compare these observational studies.[7]

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Classification

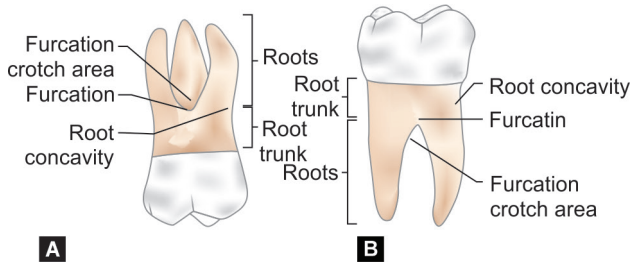
Periodontal involvement of the furcation regions has been classified based on degree and severity of involvement.

Glickman Classification (1953)

Grade I: pocket formation into the furcation but intact interradicular bone (Fig. 2).
Grade II: loss of interradicular bone and pocket formation but not extending through to the opposite side.
Grade III: through-and-through lesion but occluded by buccal and lingual gingival tissue.
Grade IV: through-and-through lesion with gingival recession, leading to a clearly visible furcation area.

Easley and Drennan (1969)

Class I: incipient involvement, fluting coronal to furcation entrance is involved, but there is no horizontal component to the furca.
Class II: divided further into types I and II.
Type I: a definite horizontal loss of attachment into the furcation, but the pattern of bone loss remains horizontal.



Figs 1A and B: (A) Anatomy of furcation area of maxillary tooth; (B) Anatomy of furcation area of mandibular tooth

Type II: there is a buccal or lingual bony ledge and a definite vertical component to the furcation.
Class III: through-and-through loss of attachment into the furcation, and the pattern is horizontal in type I and vertical in type II.

Hamp et al. (1975)

Degree I: horizontal loss of periodontal tissue support not exceeding one-third of the width of the tooth.
Degree II: horizontal loss of periodontal support exceeding one-third of the width of the tooth but not encompassing the total width of the furcation area.
Degree III: horizontal through-and-through destruction of the periodontal tissue in the furcation.

Tarnow and Fletcher (1984)

Subclass A: vertical destruction to one-third of the total interradicular height (1–3 mm).
Subclass B: vertical destruction reaching two-thirds of the interradicular height (4–6 mm).
Subclass C: interradicular osseous destruction into or beyond the apical third (>7 mm).
Subclass D: vertical destruction beyond apical third of interradicular height.

Fedi (1985)

Combined Glickman and Hamp classifications: grades are same as Glickman's grades I through IV, but grade II is subdivided into degrees I and II.
Degree I: the furcation bone loss possesses a vertical component of >1 but <3 mm.
Degree II: the furcation bone loss possesses a vertical component of >3 mm but still does not communicate through-and-through.

Walter et al. (2009)

Walter et al. gave a newer classification system which was the modification of the Hamp et al. classification, wherein degree II is divided into degrees II and II–III.
Degree II: horizontal bone loss of support >3 mm but no more than 6 mm.
Degree II–III: horizontal bone loss of support >6 mm but no detectable "through-and-through" destruction.

Treatment of Furcation Defects

The major principle of treatment of furcation invasion is to eliminate the etiologic factor whenever possible and to create a predictably maintainable environment.

Different therapeutic alternatives are available relative to different degrees of involvement.

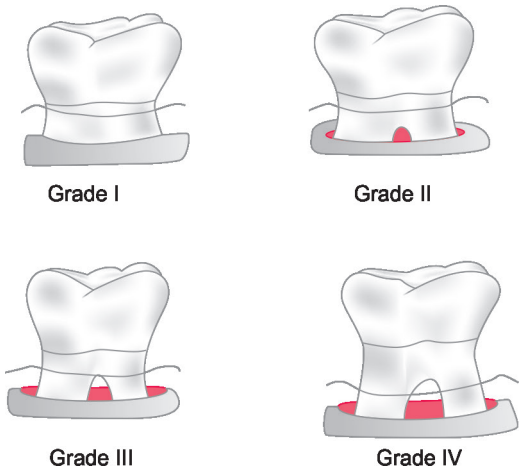


Fig. 2: Glickman's classification of furcation involvement

They can be broadly classified as follows:

- Conservative—comprises nonsurgical and surgical therapy employed to debride the furcation area, excluding regeneration and root separation procedures.
- Resective—includes root resection, hemisection, and tooth extraction.
- Regenerative—includes guided tissue regeneration (GTR) and bone grafting.

Recommended therapy according to the intensity of furcation involvement:

Furcation involvement degree I: scaling and root planing, furcation plasty.

Furcation involvement degree II: furcationplasty, tunnel preparation, root resection, tooth extraction, and GTR at mandibular molars.

Furcation involvement degree III: tunnel preparation and root resection.

Furcation grade IV: tooth extraction.

Scaling and Root Planing

Plaque accumulation causes gingivitis, which is believed to precede periodontitis. Calculus, which harbors plaque, has been shown to be more irritating to the soft tissues than plaque alone. Therefore, therapy for molar furcation involvement should always include the removal of plaque and calculus by scaling and root planing and the prevention of their recurrence by good patient oral hygiene regardless of the severity of the lesions or additional therapeutic techniques used.

Scaling and root planing produces good clinical results during initial stages (grade I) of furcation involvement. However, various long-term clinical studies performed by Hirschifeld and Wasserman, Goldman, Wang et al.[8–10] have shown unfavorable results of conservative nonsurgical and surgical therapy in deep furcation involvement.

Furcationplasty

In this technique, odontoplasty is mainly done to widen a narrow entrance of the furca and to reduce the horizontal depth of the involvement. It also eliminates the dentinal hood of tooth structure over the furcation and provides a smooth surface from the seam of the root surface and bone-to-occlusal surface of the tooth. The purpose of the procedure is to establish a condition in the

dentogingival region which facilitates a self-performed plaque control. It results in the establishment of a soft tissue papilla which covers the entrance to the interradicular periodontal tissues.

Tunnel Procedure

It is the intentional creation of a class III furcation to class IV with its entrance accessible for oral hygiene procedure. The objective of this treatment is to obtain the possibility of cleaning the furcal area by the patient using an interdental tooth brush.

During surgery, bone is reshaped to obtain a scalloped morphology and the soft tissues are apically positioned; care is taken that the space obtained under the roof of the furcation will allow proper plaque removal. Surgical packs may be applied to prevent excessive granulation tissue forming in the tunnel space during healing, which may interfere with the accessibility to oral hygiene devices. The main advantage of this technique is the avoidance of prosthetic reconstruction and endodontic therapy. It can be utilized only when the furcation entrance dimension is wide enough and coronally located to allow for an easy utilization of cleaning devices. A degree of divergence longer than 30″ is required.

Vandersall and Detamore[11] presented a case report of a 23-year observation period of the tunneling treatment approach and stated that with frequent (three to six months) supportive periodontal treatments, along with meticulous oral hygiene by patient, root caries in tunneled mandibular molars may be less a problem than earlier perceived.

Bicuspidization

It is a procedure in which separation of a two-rooted tooth (mandibular molar) and restoration of the crown portion of each section is done. It has been described to enhance plaque control and to convert the part of the tooth most susceptible to caries attack (dentin and cementum in the furcation) into metal. This is indicated in grade III furcation with divergent and well-supported roots.

Resective Periodontal Surgeries

Resective techniques are designed to eliminate the morphological characteristics and create an area conducive to good oral hygiene. Several definitions for root resection and root amputation have been proposed. According to the glossary of periodontics 1986 terms, root resection (root amputation, radectomy, and radiectomy) is the process by which one or more roots are removed at the level of the furcation while leaving the crown and remaining roots in function.

Hemisection

The surgical separation of the multirooted tooth through the furcation area in such a way that a root or roots may be removed with the associated portion of the crown.

The guidelines for periodontal therapy produced by the American Academy of Periodontology (AAP) in 1992 list only root resection and tooth hemisection as a resective treatment of the multirooted teeth.

Guided Tissue Regeneration

Nyman and coworkers[12] introduced GTR in the clinical practice with an experiment that was originated from Melcher's hypothesis that only cells originating from the periodontal ligament and repopulating the root surface during healing could regenerate the tooth supporting structures.[13] They concluded that new cementum with inserting periodontal fibers are formed on previously diseased tooth. Lekovic et al.[14] treated furcation involved teeth using nonresorbable Gore-Tex periodontal material held in place by sling sutures of expanded polytetrafluorethylene. The results showed statistically significant reduction in pocket depth and gain in attachment levels. Later, the same author used collagen membranes as GTR membrane and found statistic results. Moreover, these resorbable membranes were better as resurgical innervation was avoided, although histological evaluation remains the only reliable method of determining the nature of attachment apparatus resulting from regenerative periodontal therapy.[15]

GTR in Combination with Other Regenerative Materials

Mellonig et al.[16] treated four patients with chronic advanced periodontitis each having at least one mandibular first molar with hopeless periodontal and prosthetic prognosis. The furcal area was root planed and was grafted with the combination of recombinant human platelet-derived growth factor (PDGF) and beta-tricalcium phosphate. At 6 months, all teeth demonstrated a reduction in probing depth and a gain in clinical attachment.

Sharma et al.[17] conducted a study in which 18 patients with 36 mandibular molars and class II furcation defects were randomly allotted and treated either with autologous platelet-rich fibrin and open flap debridement (OFD) or OFD alone. They concluded that a statistically significant improvement was seen on the sites treated with PRF and OFD compared to those with OFD alone.

Another method to treat furcation is by osseous grafting. The biological rational behind the use of bone grafts is the assumption that the material may either (1) contain bone forming cells (osteogenesis), (2) serves as a scaffold for bone formation (osteoconduction), or (3) the matrix of the grafting material contains bone inductive substance (osteoinduction) which would stimulate both the regrowth of alveolar bone formation of new attachment. Such complete regeneration of the periodontal attachment apparatus following the grafting procedure would imply that cells derived from the bone would possess the ability to form new cementum with inserting collagen fibers on a previously periodontitis affected root surface. This assumption, however, is in conflict with the present knowledge about the biology of periodontal wound healing that repopulation of the detached root surface with cells from the PDL is the prerequisite for the new attachment formation.[17]

McClain[19] stated that complete furcation fill has been reported at 74% with composite osseous grafting and GTR at 3–12 months postoperative evaluation and long-term stability (61 months of 100% of short-term findings). Whereas Anderegg et al.[20] depicted short-term incidence of complete furcation fill ranging from 15% to 71%.

Periodontal regeneration is a complex multifactorial process involving biological events such as cell adhesion, migration, proliferation, and differentiation in orchestrated sequences. Various biomaterials have been used for the periodontal tissue regeneration in addition to autogenous and allogeneic graft material but not a single graft material is considered as a gold standard for this type of tissue destruction.[20]

Development of the bioactive surgical additives is one of the greatest challenges of clinical research which has been used to regulate inflammation and increase the speed of healing process. A wide range of extracellular events and various signaling proteins mediate and regulate the healing process of both hard and soft tissues, respectively. But understanding this entire process is still incomplete; however, it is known that platelets play a crucial role not only in hemostasis but also in the wound healing process.[21] Platelets are rich in growth factors that may contribute to accelerated tissue regeneration.[22]

Platelets form an intracellular storage pool of proteins vital to wound healing, including PDGF, transforming growth factor (TGF-β), and insulin-like growth factor (IGF-I). These active proteins allow binding of transmembrane receptors of the target cells which induce activation of intracellular signal proteins and later result in the expression of a gene sequence that directs cellular proliferation, collagen synthesis, osteoid production, and so on.[23]

The use of autologous products with high platelet concentrations such as platelet-rich plasma (PRP), platelet concentrates (PC), and platelet gels developed to combine the fibrin sealants properties with growth factor effects of platelets providing an ideal growth factor delivery system at the site of injury. Platelets also secrete fibrin, fibronectin, and vitronectin, which act as a matrix for the connective tissue and as adhesion molecules for a more efficient cell migration. This has led to the idea of using platelets as therapeutic tools to improve tissue repair particularly in the periodontal wound healing.[24]

The Choukroun's PRF has opened the floodgates in the field of dentistry, majorly focusing on the improved healing and regeneration. Thus, PRF has also been tagged as a healing biomaterial. Platelet-rich fibrin is a second-generation PC widely used to accelerate soft and hard tissue healing and is a strictly autologous fibrin matrix containing a large quantity of platelet and leukocyte cytokines. With the introduction of A-prf[25] and T-prf,[26] new avenues of regeneration in furcation defects are possible.

Bone morphogenetic proteins (BMPs) are multifunctional growth factors belonging to the TGF-β superfamily. Modern molecular biology theories state that BMPs are morphogenetic proteins, namely, molecules which induce the genome to initiate the formation of a morphogenetic area. Bone morphogenetic proteins diffuse through a concentration gradient, thereby altering the developmental process. In response to this stimulus, the cells proliferate and differentiate following a predefined pattern and spatial arrangement, establishing cell and tissue organization. The general role of BMPs in the process of bone formation has been well established. Their use in periodontal regeneration is not frequent because of their high cost.[27]

Conclusion

Successful treatment, management, and long-term retention of multirooted teeth with periodontal destruction of varying degrees into their furcations have long been a challenge to the dentist. The decision for a specific treatment mode for furcation involved tooth depends on several factors, with both a general and local perspective. 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 such as 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.

The management of furcation involvement should include the selection of an appropriate treatment modality from the array of treatment options available. Preserving natural and functional dentition should be the ultimate goal of the treatment.

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