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A study on Bioengineering treatment modalities in furcation defects

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Abstract

Microbial colonization on tooth surfaces is either because of the systemic, social and environmental factors can leads to plaque build-up and with gradual increase in time which further worsens the oral health status and leads to various gum problems which includes gingivitis, periodontitis, furcation involvement.

Most commonly Upper second molars are involved. There are different treatment modalities for the treatment of the furcation like tunnel preparation, hemisection, bicuspidization, root resection, root amputation etc. We discussed about different treatment modalities, to provide an overview of the past and currently used treatment modalities of furcation so we can be arresting the disease process, restoring the lost tissues and ultimately maintaining the teeth in health and function with appropriate esthetics.

Keywords: Hemisection, Bicuspidization, Root Resection, Root Amputation.

Introduction

Microbial colonization on tooth surfaces is either because of the systemic, social and environmental factors can leads to plaque build-up and with gradual increase in time which further worsens the oral health status and leads to various gum problems which includes gingivitis, periodontitis, furcation involvement.

Furcation term involvement refers to commonly occurring conditions in which bifurcations and trifurcations of multi rooted teeth are invaded by the disease process. Periodontal pockets and certain concavities exists in furcation areas which causes the accumulation of bacterial plaque in these retentive areas, making its removal almost impossible, most commonly.

Upper second molars are involved. Sometimes, certain pathologies also develop in the furcation region due to many factors eg. - traumatic lesions, artificial crowns and pulpal lesion with involvement of periodontal membrane through the accessary canals, or even a combination of these factors.

Different Treatment Modalities for Furcation Lesions

1. Conventional procedures such as scaling and root planning and if indicated, furcationplasty, employ curettes, periodontal files and rotating fine diamonds.
2. Conventional flap surgery with odontoplasty, osteoplasty and osteotectomy.
3. Tunnel Preparation
4. Regenerative Procedures
5. Resective measures, such as hemisection or root resection
6. Tooth Extraction

Various above treatment modalities used alone or in various combinations with the objectives to facilitate maintenance, prevent further attachment loss and/or to obliterate the furcation defect.

Treatment Modalities for Grade I Furcation Defect

A. Non-Surgical Conventional therapy include scaling and root planning followed by monitoring the oral hygiene status which prevents the progression of periodontal disease to advanced stage.

B. Conventional Therapy with or without Flap with or without out furcationplasty, both the interventional strategies can be adopted to arrest and prevents the progression of periodontal disease by reducing the probing depth (PD) in the deepest area of the lesion but gain in clinical attachment level improve slightly but not significantly in conventional therapy without flap.

C. Odontoplasty with or without furcationplasty mainly indicated for incipient lesions with very well defined cemento-enamel junction. Technique improves accessibility and facilitates hygiene as well as removes bacterial reservoirs in the grooves of furcation pillars but possible drawbacks include sensitivity, secondary caries, progression of disease may not be avoided if the patient is not highly motivated.

Treatment Modalities for Grade II Furcations

Treatment options available vary from case to case that are

1. Conventional flap with osteoplasty and/or osteotectomy
2. Mucogingival techniques (coronally positioned flap)
3. Regenerative techniques (bone grafts, GTR membranes, combination of GTR with bone grafts, biologic factors etc)
4. Tunnel preparation
5. Root amputation, Hemisection
6. Other treatment modalities
7. Extraction

Conventional Flap Therapy

Shallow class II horizontal involvement without significant vertical bone loss, isolated deep class II furcation, usually respond favorably to localized conventional flap procedures with odontoplasty and/or osteoplasty because it reduces the dome of furcation and alter the gingival contour to facilitates patient's plaque removal.

Regenerative Techniques

Indications

1. Mesiopalatal class II furcation involvement of maxillary molars.
2. The following were considered to have no indication for, or even a contraindication to, regenerative measures
3. Degree 1 furcation involvement+
4. Degree III involvement.
5. Distopalatal degree II involvement of maxillary molars.

6. Buccal and/or mesiopalatal degree II furcation involvement in the presence of degree II involvement of the distopalatal furcation or through and through involvement between two furcation entrances.
7. Furcation involvement of third molars.
8. Furcation involvement of maxillary premolars.

Bone Replacement Grafts (BRG) are widely used for the correction of periodontal osseous defects. Autogenous bone graft material out of allograft, alloplast, xenograft and synthetic grafts is considered to be the gold standard because of its osteogenic, osteoinductive, osteoconductive properties. The bone grafts can be used alone or in various combination in grade II furcation involvement to improve the overall periodontal condition.

These materials demonstrated comparable clinical results to autogenous and allogeneic grafts. Alloplastic grafts are synthetic, inorganic, biocompatible, or bioactive bone graft substitutes. Alloplast materials are believed to promote bone healing through osteoconduction. Substitutes should have the following properties:

1. Biocompatibility
2. Minimal fibrotic reaction
3. The ability to undergo remodeling and support new bone formation
4. Similar strength comparable to cortical /cancellous bone
5. Similar modulus of elasticity comparable to bone to prevent fatigue fracture under loading.

Guided Tissue Regeneration (GTR)

The concept of GTR is based up on the exclusion of gingival connective tissue cells and prevention of epithelial down growth in to the wound, thereby allowing the cells with periodontal regenerative potential.

Different situations of class II furcations in which GTR is not indicated

1. Lack of access for adequate debridement of the furcation
2. Endodontic or prosthetic perforations in the furcation areas of the root
3. Crown lengthening procedures that invade the furcations
4. Root proximities untreatable by restorative alveolar interface (RAI)
5. Extensive gingival recessions
6. Deep caries involving the roots
7. Untreatable endo-perio lesions
8. Longitudinal root fractures. In these cases, hemisection is recommended

Treated mandibular first and second molar class II furcation by using e-PTFE membrane with bio-resorbable collagen. Both the treatment resulted in significant decrease in probing depth from surgery to 8 month follow up ($p<0.01$) and from surgery to 12-month re-entry ($p< 0.005$).

Also treated grade II furcation defect by using the combination of bone graft material (hydroxyapatite and beta-tricalcium phosphate) and bioresorbable GTR membrane. The mean gain in the in the relative clinical attachment levels in the test and control group, at the end of 6 months were 2.50 and 1.63 mm respectively, the mean change in the horizontal probing depth values were 2.88 and 1.63 mm respectively and mean reduction in the vertical probing depth values were 1.50 and 1.38mm respectively .They concluded that GTR membrane with bone material was more effective in the treatment of furcation defects than open debridement alone and also showed a mean difference of 2.0 mm after using an organic bovine xenograft with resorbable membranes.

Treated class II furcation defects on a mandibular molar with two types of combinations.

1. Bio-gen + biocollagen (control group)
2. Bio-gen + connective tissue (case group)

Platlet Rich Plasma

Mandibular molars with Class II furcation defects with bovine porous bone mineral (BPBM) with and without Plasma rich in growth factors (PRGF) and concluded that combination resulted in greater healing as compared to BPBM alone. No significant differences were observed in all clinical parameters 6 months postoperatively between two groups.

Other treatment techniques tunnel preparation, hemisection, bicuspidization, root resection, root amputation will be discussed commonly for grade II and grade III furcation lesions.

Grade III Furcation Defect Treatment Modalities

1. Guided Tissue Regeneration
2. Tunnel Preparation
3. Various resection procedures such as -:
i. Hemisection
ii. Bicuspidization
iii. Root resection
iv. Root Amputation

Root Resection/ Root Amputation and Hemisection

It refers to sectioning of a mandibular molar into two halves followed by removal of the diseased root and its coronal portion. Removal of one root involves removing significantly compromised root structure and the associated coronal structure through deliberate excision. This procedure represents a form of conservative dentistry, aiming to retain as much of the original tooth structure as possible.

Which root is to be resected/Amputed: consists of eliminating one of the roots, generally which provides the least support or that which, due to its proximity, may compromise the stability of a neighboring tooth. Palatine root of maxillary molar is rarely removed because it receives occlusal load poorly. Distovestibular root is the first choice because of poor bone support and its angulations.

Objective of Root resection

1. To facilitate maintenance
2. To prevent further attachment loss
3. To obliterate furcation defects as a periodontal maintenance problem

the following indications for tooth / root resection

A) Periodontal indications

1. Severe vertical bone loss involving only one root of multi-rooted teeth.
2. Through and through furcation destruction (Grade III furcation).
3. Unfavorable proximity of roots of adjacent teeth, preventing adequate hygiene maintenance in proximal areas.
4. Severe root exposure due to dehiscence.

B) Endodontic and restorative indications

1. Prosthetic failure of abutments within a splint:
2. Endodontic failure:
3. Vertical fracture of one root:
4. Severe destructive process:

Contraindications

1. Strong adjacent teeth available for bridge abutments as alternatives to hemisection.
2. Inoperable canals in root to be retained.
3. Root fusion-making separation impossible.

Root Resection/ Hemisectioning / Root Amputation for Grade II

Managed mandibular molar with grade II furcation involvement associated with 7mm of pocket around mesial root by performing hemisection with the removal

of mesial root along with the part of crown resected using vertical cut method followed by furcationplasty and prosthetic replacement. They determine to retain and not to remove the natural teeth if periodontal disease molars >50% of bone support at the remaining root. Performed hemisectioning in endodontically treated mandibular first molar which presented Grade II furcation defect followed by fixed partial denture. They concluded that the root resection can successfully treat specific furcation defects that cannot be resolved by any other approach. They supported that complications with these procedures are not rare but can be avoidable when interdisciplinary guidelines are followed strictly.

Advanced Furcation Defects or Grade IV Furcation Defects

These furcation defects are considered to be hopeless case and extraction is always advised.

Indications:

- Where periodontal bone loss is jeopardizing the adjacent tooth and the furcation cannot be definitely treated.
- Discomfort that is unlikely to be relieved by periodontal therapy.
- The furcated first molar is bordered by a sound, second molar and second pre-molar.
- Stated tooth extraction as the last option for advanced furcation involvements such as for Grade IV furcation defects.

Discussion

Molars are shown to be more susceptible to furcation involvement because of the anatomical factors.

That mean CEJ to root groove distances ranged from 1.35 to 1.65 mm and 1.16 to 1.22 mm for maxillary and mandibular first molars respectively which dictates regenerative periodontal therapy in case of short root trunk could be compromised especially if developmental concavities and grooves present on the root trunk.

The treatment of furcation involved teeth has been grouped into non-surgical and surgical therapy. Grade I and buccal and lingual grade II furcation lesion is easily resolved by conventional non-surgical approach if patient demonstrating satisfactory plaque contro.[80] whereas Initial Grade II furcations treated by odontoplasty with or without osteoplasty. Moderate Grade II furcation can be solved by mucogingival technique or by regenerative with various results in the term of pocket depth reduction, clinical attachment gains and defect fill, whereas advanced grade II lesions require often either severe alteration of inter-radicular bone or even Hemisection or root amputation in order to make the area accessible for plaque control or making it feasible by eradication of diseased root surface.

Non-surgical subgingival scaling root planning and gingival curettage can lead to improve the prognosis of class III furcation involved mandibular molars. GTR also attempted in Grade III furcation involvement of mandibular molars, to stabilize the wound area and allow periodontal regeneration, sometimes by employing citric acid conditioning or decalcified freeze dried bone allografts in combination with e-PTFE membranes or coronally repositioned flaps which dictates that in certain cases, especially with a small area of the furcation entrance, some degree of closure of mandibular degree III furcation might occur. Bone morphogenic proteins and amelogenic protein matrix has provided a new focus for this kind of treatment. These products can be used alone or in combination.

Root resection can be meaningful treatment with saving periodontally diseased molars by removing the deposited periodontal bacteria and calculi as well as unfavorable anatomic features, which can act as a future bacteria

reservoir. In addition, bone defects, such as hemiseptal bone defects and deep infrabony defects, can be resolved by healing after removing involved root, and a positive architecture can be achieved.

Tunnel technique is mainly indicated in advanced Grade II and Grade III lesions to permit the access of an interproximal brush to the fornix of the furcation, basically the furcation lesion is made larger to allow better hygiene.[86,87] The main risk associated with this treatment include the covering of the tunnel by gingival growth, the appearance of secondary caries, the generation of thermal hyperesthesia, the need to undertake endodontic treatment due to the presence of an accessory canal, and the need for osteotomy, tunneling keeps creates an ecological habitat that is difficult to clean: food remains and bacteria therefore accumulate, generating inflammation.

Tooth extraction is the last resort for the advanced furcation involvement, if unopposed molar represting the terminal tooth of the arch, a single mobile distal abutment, if affected tooth does not show the overall improvement after repeated treatment plan, if furcation would result in an area that is inaccessible to the patient for oral hygiene maintenance.

Conclusion

The specific treatment decision for periodontally affected furcation depends up on local factors- Tooth anatomy, amount of attachment loss, crown root ratio, inter arch or intrarch-occlusal relationship, tooth mobility, degree or grade of involvement, strategic dental evaluation retention or removal; patient factors - Systemic health/post immunity, importance of teeth to the patient , patients participation and commitment , both in the term of time and money; clinician factor- Diagnostic and Treatment planning skill , awareness of therapeutic options and clinical skill of the operator, the strategic importance of particular tooth and patient's preference and compliance. So, a multidisciplinary approach is always considered for correct treatment planning.

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