OPEN ACCESS at journalijcir.com

Review Article ISSN: 2395 -5775

JOURNEY TOWARDS PERIODONTAL REGENERATION

Neetha J Shetty and Swati*

Abstract

Periodontitis is an infectious disease that causes destruction of the attachment apparatus of the tooth. Regeneration has been defined as the reproduction or reconstitution of lost or injured part of the body in a way that the function and architecture of the lost tissue is restored. In terms of periodontal regeneration, the structure and function of the gingiva, alveolar bone, root cementum and periodontal ligament must be restored. There are a broad range of treatment options which bring about regeneration, bone grafts, root biomodification, guided tissue regeneration to name a few. This review paper gives an insight to the various options available for periodontal regeneration and the clinical effectiveness of each of them.

Key Words: periodontal regeneration, bone grafts, guided tissue regeneration

INTRODUCTION

Periodontal disease is an inflammatory condition affecting the periodontal tissues that lead to pathological alterations in the supporting tissues that potentially leads to tooth loss. The major challenge of periodontal therapy has been to restore and reestablish the lost attachment, which has been termed regeneration. Thus, regeneration in terms of periodontal regeneration is the establishment of soft tissue attachment to the newly formed cementum on the root surface and to also restore the lost bone.

Though a lot of research has been carried out to attempt for periodontal regeneration, complete regeneration of the damaged periodontium has still not been achievable. The various approaches used for periodontal regeneration are either conductive or inductive in nature, cell based therapy, gene based therapy and RNA based therapy.

Root biomodification

A periodontally affected tooth surface is exposed to bacterial products and bacterial endotoxins which contaminate the surface. Decontamination of such surface is brought about by scaling and rootplaning, but this leaves behind a smear layer. This smear layer ranges 2 to 15µm and serves as a physical barrier that inhibits new connective tissue attachment to the root surface. Conditioning of the root surface after scaling and root planing with various acids has been advocated for removal of this smear layer in order to detoxify, decontaminate and demineralize the root surface. Various chemical agents that have been used are citric acid, tetracycline hydrochloride, fibronectin, laminin, EDTA (Ethylene Diamine tetra acetic acid) and chlorhexidine with varying results. Apart from these, growth factors and Lasers have also been tried. (Hanes PJ, Poison AM *et al* 1985, Sucheta A, Darshan BM *et al* 2011)

However, histological and clinical studies evaluating the effects of these agents have suggested no benefit for regeneration. (A Mariotti 2003) The best method to ascertain the clinical efficacy of conditioning the root surface would be to conduct randomized controlled clinical trials. Though the benefits are not proven, in practice it is an accepted one, with no harm.

Bone replacement grafts

Bone tissue has the capacity to regenerate unlike most other tissues. As the native bone grows, it replaces the graft material. The principle mechanisms of grafting include osteogenesis, osteoconduction and osteinduction. Osteogenesis is a process when osteoblasts originating from the bone graft material contribute to new bone formation. Osteoinduction is a chemical process where in the osteoprogenitor cells are stimulated to differentiate into osteoblasts that form new bone. Osteoconduction is a physical process where the graft material serves as a scaffold for new bone formation perpetuated by the native bone.

Department of Periodontology, Manipal College of Dental Sciences, Manipal University, Mangalore
Correpondence and Reprint Requests: Swati
Received: August 20, 2015 | **Accepted:**September 12, 2015 | **Published Online:** September 28, 2015

Conflict of interest: None declared | **Source of funding:** Nil

Types of bone grafts (Hanes P 2009)

- Autografts: bone for grafting is derived from the individual receiving the graft. They can be harvested from extra oral sites such as illiac crest or from intra oral sites such as the mandibular symphysis or anterior mandibular ramus (for block grafts), edentulous area, exostoses, tori, ledge or extraction socket (for particulate graft). Particulate graft can be put to use for periodontal defects either as osseous coagulum or bone blend. When autograft for grafting is considered, it is the cancellous portion of the bone which is important in successful regeneration because of its vascularity, whereas the cortical portion provides the support. Autografts have the advantage of being osteogenic, Osteoconductive and Osteoinductive. A negative aspect is that an additional surgical site will be required in case of block grafts, as well as the quantity obtained from particulate grafts may be less.
- Allografts: are grafts derived from different individuals of the same species. It is taken from cadavers which is sourced from a bone bank. This graft is obtained within 24 hours after the death of the donor. The obtained graft is defatted, cut into pieces and washed with alcohol and then deep frozen, and is called freeze dried bone allograft (FDBA), which is osteoconductive in nature. Demineralization of this graft, by treating it with cold, diluted hydrochloric acid will expose the molecules of bone matrix called bone morphogenetic protein (BMPs). This bone graft is now termed demineralized freeze dried bone allograft (DFDBA), which is osteoinductive in nature.
- Xenografts: are grafts from species other than humans. They can ne equine, porcine or murine. These grafts are osteoconductive in nature.
- Alloplasts: these are synthetic non bone graft materials. They include sclera, dura, cartilage, cementum, dentin, plaster of Paris, plastic materials, ceramics and coral-derived materials.

Bone graft materials have been widely used in the treatment of periodontal osseous defects. They can be used in the treatment of intrabony defects as well as grade II furcation involvement. The results of various clinical studies have indicated that, bone grafts increase bone level, reduce crestal bone loss, increase clinical attachment level and reduce the probing pocket dept. histological studies provide evidence that DFDBA supports formation of new attachment in intrabony defects.

The basic problem with the use of bone grafts is their inability to regenerate lost connective tissue attachment. The efficacy of these grafts is proven in conjunction with the use of barrier membranes.

Guided tissue regeneration (GTR)

This procedure uses barrier membranes to direct the growth of new bone and soft tissue, as it was assumed that periodontal ligament cells are the only cells to have the potential for regeneration. The barrier membrane used prevents the epithelial migration into the wound, and also favors the repopulation of the wounded area by periodontal ligament and bone cells. Resorbable and non resorbable membranes are available. The resorbable membrane improves problems with the non-resorbable membrane, such as frequent exposure of the membrane, and secondsurgery to remove the membrane. (Klokkevold PR, Newman MC *et al* 2006)

Enamel matrix derivative

Enamel matrix derivative or enamel matrix protein, mainly *amelogenin,* is secreted by Hertwig's epithelial root sheath during tooth development. It is a semipurified protein which contains a mixture of low molecular weight proteins. It was first introduced and marketed as Emdogain in 1996. Evidence suggests that EMD when applied onto root surfaces, gets absorbed into the hydroxyapatite and collagen fibers, in which they induce cementum formation followed by periodontal regeneration. EMD alone or in combination with graft materials provide clinical outcome and long term clinical stability. (Espsito M, Grusovin MG *et al* 2009)

Growth factors

These are molecules that regulate events in wound healing, and function in either an autocrine or paracrine manner. These growth factors, primarily secreted by macrophages, endothelial cells, fibroblasts, and platelets, include platelet-derived growth factor (PDGF), insulin-likegrowth factor (IGF), basic fibroblast growth factor (bFGF), bone morphogenetic protein (BMP) and transforming growth factor (TGF). These biologic mediators have been used to stimulate periodontal wound healing (e.g.,promoting migration and proliferation of fibroblasts forperiodontal ligament formation) or to promote the differentiation of cells to become osteoblasts, thereby favoring bone formation.

rhPDGF-BB has been safely used for periodontal

regeneration. The advantages of this being, there is no barrier membrane used and also there is consistency in the concentration of rhPDGF-BB delivered to the regenerative site which will result in consistent results. (Richar T Kao, Salvador Nares *et al* 2015). The success of a regenerative therapy is widely dependent on the identification and management of patient related factors as well as the site related factors.

The patient related factors that influence periodontal regeneration

- Diabetes mellitus: studies that demonstrate the physiologic effect of diabetes on periodontal regeneration are lacking. However, Chang PC *et al* 2012 andShirakata Y *et al* 2013 have confirmed in their animal studies the detrimental effects of diabetes on periodontal tissues and the poor regenerative capacity.
- Smoking: clinical trials have confirmed that smokers have less reduction in pocket depth, smaller gains in clinical attachment level, less bone fill and greater membrane exposure (GTR) when compared to smokers. (Stavropolous A, Mardas N *et al* 2004; Yilmaz S, Cakar G *et al* 2010; Patel RA, Wilson RF *et al* 2012)
- Biofilm control: poor plaque control and residual periodontal infection are associated with negative outcomes after regenerative therapy. (Cortellini P, Paolo G *et al* 1996)

The site related factors include (Mark A Reynolds, Richard T Kao *et al* 2015)

- Vertical depth: deep intrabony defects have the greatest regenerative potential. Intrabony defects of < 3mm depth can be best treated with non-surgical therapy
- Defect angle/width: narrow intrabony defects are usually self-contained by two or three bony walls and respond to treatment with bone grafts, GTR membrane or biologic agent. However, wider defects require a combination approach.
- Number of bony walls: narrow deep 3 wall intrabony defects require a combination approach for regeneration (bone graft + GTR). One wall defects respond less favorably to regenerative therapy. In a combination 1-wall to 2-3 wall defects, the greatest regenerative potential is associated with the 2 and 3 wall component. No predictable regenerative approaches are currently available for pure 0 wall and 1 wall defects.
- Esthetics: As a proof, various animal histological studies have provided evidence for regenerative potential of the various materials and procedures described above. It should be understood that with the available procedures, only a fraction of the tissue volume lost can be restored, complete regeneration is still an illusion. Techniques like guided tissue regeneration and enamel matrix proteins certainly have a regenerative potential. The clinical outcomes are influenced by patient behavior, surgical approach and also tooth related characteristics. Long term studies have indicated that the results obtained from regenerative therapy can be maintainable for 10 years.

References

1. A Sucheta, BM Darshan, Rohit Prasad, G BharwaniAshit. 2011 Root bio modification-A boonor Bane? *Indian J Stomatol* 2(4): 251-55
2. Angelo Mariotti 2003. Efficacy of Chemical Root Surface Modifiers in the Treatment of Periodontal Disease. A Systematic Review. *Ann Periodontol* 8:205-226
3. Chang PC, Chung MC, Wang Yp, *et al*.2012. Patterns of diabetic periodontal wound repair: A study using micro- computed tomography and immunohistochemistry. *J Periodontol* 83: 644-652
4. Cortellini P, Paolo G, Prato P, Tonetti MS. 1996 Long term stability of clinical attachment following guided tissue regeneration and conventional therapy. *J ClinPeriodontol* 23: 106-111
5. Espsito M, Grusovin MG, Papanikolaou N, Coulthard P and Worhington HV. 2009. Enamel matrix derivative (Emdogain ®) for periodontal tissue regeneration in intrabony defects. Cochrane Database of Systematic Reviews. 4: 3875
6. Hanes P.2009 Bone replacement grafts for the treatment of periodontal intrabony defects. *Oral and Maxillofacial Surgery Clinics of North America*. 19: 499- 512
7. Hanes PJ, Poison AM, Ladenheim S. 1985. Cell and fiber attachment to demineralized dentin from normal root surfaces. *J Periodontol* 65: 752-625
8. Klokkevold PR, Newman MC and Takei HH. 2006Carranza's Clinical Periodontology. Philadelphia: *Elsevier*: 968- 990
9. Mark A Reynolds, Richard T Kao, Salvador Nares *et al*. 2015. Periodontal regeneration-intrabony defects: Practical Applications from

the AAP Regeneration Workshop. *ClinAdv Periodontics*. *5*: 21- 29

10. Patel RA, Wilson RF, Palmer RM. 2012. The effect of smoking on periodontal bone regeneration: A systematic review and meta-analysis. *J Periodontol* 83: 143-155
11. Richar T Kao, Salvador Nares and Mark A Reynolds. 2015. Periodontal regeneration-Intrabony Defects: A systematic review from the AAP regeneration workshop. *J Periodontol* 86 (Suppl.): S77-S104
12. Shirakata Y, Elizer M, Nemcovsky CE, *et al*. 2013. Periodontal healing after application of enamel matrix derivative in surgical supra/infrabony periodontal defects in rats with streptozotocin-induced diabetes. *J Periodontol* Res 49:93-101
13. Stavropolous A, Mardas N, Herrero F, Karring T.2004 Smoking effects the outcome of guided tissue regeneration with bioresorbable membranes: A retrospective analysis of intrabony defects. *J ClinPeriodontol* 31: 945-950
14. Yilmaz S, Cakar G, Ipci SD. Kuru B, Yildirim B. 2010. Regenerative treatment ewth platelet rich plasma combined with a bovine derived xenograft in smokers and non smokers: 12 month clinical and radiographic results. *J ClinPeriodontol* 37: 80 - 87

****