REVIEW ARTICLE

ENAMEL MATRIX PROTEINS IN PERIODONTAL REGENERATION

Ipshita Narayan[1]

ABSTRACT

Periodontal therapy is aimed at regenerating oral tissue injured by chronic, inflammatory periodontal disease. During the current era, various treatment protocols, strategies and products have been introduced for new regeneration of periodontal deficiencies. One of these involves the regeneration of tissues under guidance using enamel matrix derivatives (EMDs) or combinations of these. EMDs being mainly comprised of amelogenins, is the most common biological agents used in periodontics. Multiple studies have been reported the role of EMD in periodontal tissue regeneration; however, the extensive mechanism remains elusive. EMDs could promote periodontal regeneration mainly through inducing periodontal attachment during tooth formation. EMD are also said to mimic the biological processes that occur during periodontal tissue growth. During root development, enamel matrix proteins are formed on the root surface by Hertwig's epithelial root sheath cells, initiating the process of cementogenesis. This article tried to review and ennumerate the challenges and recent advances in preclinical and clinical applications of EMDs in periodontal regeneration. The current evidence on the mechanisms of action of EMDs in the regeneration of periodontal tissues is also mentioned here.

INTRODUCTION

Periodontitis is a chronic disease causing inflammation and destruction of the gingiva and supporting structures. The disease progressively worsens over time causing supporting bone loss and eventual loss of tooth. Hence, treatment modalities are being researched to prevent periodontitis and the eventual loss of tooth.

Periodontitis is characterized by inflammation of soft tissue and and loss of alveolar bone. Dental plaque biofilm is considered to be the primary causative agent. The other risk factors include trauma from occlusion, genetics, diabetes, and smoking. Regenerative periodontal treatment modality aims to restore the lost alveolar bone or damaged cementum while also ensuring further loss of attachment of the periodontal apparatus. This modality includes use of bone graft, membrane, guided tissue regeneration or enamel matrix proteins. Growth and differentiation factors have been shown to play a key role in wound healing, and it has been suggested that they could enhance the regenerative process.

ENAMEL MATRIX DERIVATIVES

While it is known that the majority of the tooth structure is formed from dentin, enamel is present superficially in the crown while the cementum serves to cover the root. The enamel structure is complex and consists of apatite crystals parallel to the enamel prisms.[1] Enamel is laid down by the ameloblasts prior to the eruption of tooth. In the mid-1990s, however, it was discovered that a very thin layer of enamel actually exists between the dentin and cementum on the roots of teeth. Hence, it was concluded that enamel matrix proteins (or EMPs) laid down by Hertwig's epithelial root sheath are precursors to acellular cementum during cementogenesis. The presence of acellular cementum signals the development of periodontal ligament (PDL) fibers, followed by new alveolar bone, thus leading to the formation of the tissues of the periodontium.

Thus, enamel matrix proteins were introduced in the 1990s. A commercially prepared and purified extract of enamel matrix proteins from porcine teeth, EMD is composed primarily of amelogenin(90%)[2] and has been shown to promote PDL fibroblast proliferation and growth. This was marketed by Biora as Emdogain. Enamel matrix regulates the initiation, progression, termination, and maturing of hydroxyapatite crystallites.

Amelogenins induce attachment of the periodontium at the time of tooth formation. Other proteins include ameloblastin, tuftelin, amelotin, and enamelin. This class of proteins is known to induce the growth and proliferation of cells of the periodontal ligament, which has propylene glycol alginate (PGA) as a vehicle with an important antibacterial action. Emdogain gained approval in 1996 for clinical usage in cases of recession and periodontal defects. Emdogain is said to play a key role in odontogenesis by upregulation of various transcription factors like Runx.[2,3]

1. MDS

Corresponding Author
Dr. Ipshita Narayan
Consultant Periodontist, Clove Dental

Enamelin is the second largest part of EMD. Enamelins contain serum proteins. Early studies have not been able to identify growth factors in EMD. However, immunological studies have identified transforming growth factor â1 , BMP-2 and BMP-4. EMD is thus shown to enhance the expression of alkaline phosphatase, osteocalcin and collagen. Thus, helping with periodontal regeneration.

USES OF ENAMEL MATRIX PROTEINS

EMD has shown positive clinical features such as root coverage and promoting the stimulation of soft and hard tissues that surround the tooth in the scope of regeneration. EMD is considered frequently for applications in orthodontics as it has been used for over two decades in the field with positive results. EMD has been employed to improve the regeneration of alveolar bone, periodontal ligament, and new cementum.[4]

EMD has an inhibitory effect on dental plaque. It is said to promote early wound healing and reduce inflammation. Thus, EMD is used in conjunction with bone grafts or as an adjunct in repositioned flaps for root coverage procedures. It promotes keratinised tissue development in such cases, and promotes periodontal regeneration in Class II furcation involvement cases. 5

In surgical periodontal therapy, the use of a minimally invasive surgical technique with EMD promotes significant improvements in clinical parameters, with minimal pain/discomfort and maximum esthetic satisfaction in the treatment of intrabony defects. No additional clinical benefits have been apparent when using Emdogain in comparison with sites treated with a placebo (the Emdogain carrier alone) in deep and wide intrabony defects.

CONCLUSION

Application of enamel matrix proteins in the form of Emdogain has established a new and highly prospective line of treatment for periodontal regeneration therapy. Surgical periodontal treatment of deep intrabony defects with EMD promotes periodontal regeneration. Surgical periodontal treatment of deep intrabony defects using EMD may lead to significantly greater improvements in clinical parameters compared with open flap debridement alone. The effect of treatment with EMD is similar with that for GTR and can be maintained over a long duration of time. The combination of EMD and some types of bone graft/bone substitute may result in the soft and hard tissue parameters compared with treatment with EMD alone. Further studies are being done and are required to clarify and conclude the possible advantage of combination therapy using EMD and bone grafts/ bone substitutes in relation to single therapies. Application of EMD seems to provide better long-term results than coronally repositioned flaps alone. Application of EMD may enhance periodontal regeneration in mandibular class II furcations, comparable with that obtained using GTR.

REFERENCES

1. **Fan L, Wu D.** Enamel Matrix Derivatives for Periodontal Regeneration: Recent Developments and Future Perspectives. J Healthc Eng. 2022 Apr 11;2022:8661690. doi: 10.1155/2022/8661690. PMID: 35449833; PMCID: PMC9017460.
2. **Andrei M., Dinischiotu A., Didilescu A. C., Ionita D., Demetrescu I.** Periodontal materials and cell biology for guided tissue and bone regeneration. Annals of Anatomy - Anatomischer Anzeiger . 2018;216:164–169. doi: 10.1016/j.aanat.2017.11.007
3. **Wang Y., Zhao Y., Ge L.** Effects of the enamel matrix derivative on the proliferation and odontogenic differentiation of human dental pulp cells. Journal of Dentistry . 2014;42(1):53–59. doi: 10.1016/j.jdent.2013.10.020.
4. **Losada M., González R., Garcia À. P., Santos A., Nart J.** Treatment of non-contained infrabony defects with enamel matrix derivative alone or in combination with biphasic calcium phosphate bone graft: a 12-month randomized controlled clinical trial. Journal of Periodontology . 2017;88(5):426–435. doi: 10.1902/jop.2016.160459.
5. **Seshan H.** The Role of Enamel Matrix Protein Derivatives in Periodontal Tissue Regenetation: Revisited.