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Research Article

BIOMIMICKING THE TOOTH STRUCTURE- A REVIEW

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A B S T R A C T

The evolution of Regenerative Medicine shaped its way by cloning a sheep named DOLLY in Scotland. It's a breakthrough in the science of regenerative technology. We endodontists, deal with hardest (enamel) and delicate tissue (pulp) of human tooth. Though the lost tooth structures are currently being replaced by various restorative materials, none of them match the properties of natural structures, as no material is in par with the lost tooth structure. Thus, emphasis is being made on regeneration of the lost tooth structure. So, it is of utmost importance for us to know and follow the current trend of recent advances in regenerative techniques. It is clear that fluoride treatments are generally effective in remineralising the hard tissues of the tooth. In continuous research in this field, there are evidences of many remineralising agents, but none are as satisfactory in replacing either by speed, volume and mechanical properties. Advanced materials like bone morphogenic protein, bio-ceramics, amelogenin, bio-glass also have limitations inspite of their advantages. There are many recent advances coming up in the case of pulp regeneration by means of pulp revascularization and regenerative endodontics.

This paper reminds the importance of simulating mother nature in getting back the lost tooth structure by enamel remineralisation, reparative dentin formation, regenerative endodontics.

INTRODUCTION

As there is a saying "An Ounce Of Prevention Is Worth A Pound Of Cure", to get back the lost enamel, literally means getting back the lost mineral content in the tooth. Despite the lost mineral content we are working effortlessly to replace the lost tooth structure with an ideal restorative material Unfortunately, there is no ideal restorative material that remineralises the demineralized.

Clinical management of tooth demineralization should focus on early detection and prevention i.e., tooth remineralisation before the destruction leads to cavity formation. As the destruction of tooth structure (caries) starts from enamel surface by losing the ions in dissolution in acidic environment leading to the large deep cavities involving pulp. Much of the destruction including itscause can be controlled by minimizing the loss of ions from the tooth i.e., by remineralisation. Remineralisation is a non-restorative repair. Many new advanced bio-mimetic remineralising agents are emerging day-to-day and some of them include a) Polyamidoamine dendrimer (PAMAM)(chen M *et al*,2014) which is modified by dimethyl phosphate to obtain phosphate-terminated dendrimer (PAMAM-PO3H2) as it has properties similar in function and dimensional scale to that of amelogenin, which plays an important role in the natural process of enamel development. Phosphate group in PAMAM has stronger affinity for calcium ion than carboxyl group and provides strong hydroxyapatite (HA)-binding capability.b) Novamin (Renita Soares *et al*, 2017); a bio-active glass containing calcium sodium phosphosilicate that binds to tooth surface in order to induce remineralisation process. It reacts with saliva leading to sodium ions release which elevates the pH into the range essential for hydroxyl-carbonate appatite (HCA) formation.c) Self-assembling peptide (Renita Soares *et al*,2017);bio-mimetic peptide provides calcium and phosphate ions to the tooth on the account of remineralisation.d) Recaldent; Cpp-Acp (Shila Emamieh *et al*,2015).e)Bio-repair(Claudio Poggio *et al*,2010);consist of Zinc-carbonated hydroxyl apatite crystals that repairs the microcracks in enamel. A world beyond replacement is remineralisation of the lost tooth structure. The lost tooth enamel should be remineralised with the lost ions, as a healthy enamel is the solution for providing a healthy and beautiful smile.

Dentine is a calcified tissue of the body, produced by specialized mesenchymal cells called odontoblasts. Loss of dentin possibly is one of the major losses which retard the integrity of the tooth structure to a significant extent. Either in the coronal or the radicular portion, the dentin loss must be

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substituted with an artificial material, which can re-establish the physiological integrity of the tooth structure. From past few decades, we have been trying to stimulate pulp-dentin complex for the formation of reparative dentin with materials such as calcium hydroxide, Mineral Trioxide Aggregate(MTA) etc. The reparative dentine formed acts like a dentinal bridge that helps in protection of the pulp from the external environment. But after a prolonged research in this field, some materials are found to bio-mimic dentin with similar physical and chemical properties like Biodentine and Tideglusib. a) Biodentine (Ozlem Malkondu *et al*,2014) is a calcium-silicate based material and has the resemblance to dentin in various aspects like composition, compressive strength, micro hardness, bondstrength etc. Unlike other dentin substitutes, Biodentine application does not require any conditioning of the dentin surface. The sealing of biodentine is by micromechanical retention as it penetrates into the dentin tubules forming tag-like structures (Imad About, 2016).b) Tideglusib (Victor.C.M.Neves *et al*; 2017)is a gsk3 inhibitor that simulates formation of dentin as a whole when placed on an exposed pulp. A clinically approved collagen sponge which is biodegradable, is used to deliver low doses of small molecule glycogen synthase kinase (GSK-3) antagonists that encourages the natural processes of reparative dentine formation to fully restore dentine.

Pulp undergoes an irreparable damage for various reasons making it necessary for endodontic treatment. Since, decades there is a rapid progress in the science of endodontics. There is a meteoric advancement in the therapeutic procedures. Now-a-days even the necrotic pulp can be revivified through stem cells and scaffolds which unleashed the potential in the formation of Pulp-Dentin Complex. Pulp space is replaced with Gutta Percha as there is no better option. Despite the case of just removal of deep caries and obturating the canal with GP, the current status of treatment is more challenging. So, let's just not stop and get satisfied with some Gutta percha cones in the canal. It's time for the newer advances that gets back the blood supply to the tooth-Revascularisation and Regeneration. Revascularization is a new treatment for immature necrotic permanent teeth. Till now, apexification procedures were applied for these teeth, using calcium dihydroxide or MTA to form an artificial apical barrier. On the other hand, the pulp revascularization allows the stimulation of the apical development and the root maturation of immature teeth. Two pulp revascularization procedures are used in the literature, one using calcium dihydroxide and the second using a triple antibiotic paste (Melanie Namour & Stephaina Theys,2014).Regenerative endodontics aims to replace inflamed/necrotic pulp tissues with regenerated pulp tissue to revitalize teeth and improve life quality. Traditionally, three elements, namely stem cells (M.Nakashima &K.Iohara,2011), scaffolds, and signaling molecules (e.g., growth factors), were used to achieve pulp regeneration. Regeneration of pulp with the stem cells from exfoliated deciduous teeth is the aspect of interest in recent days.The most common dental stem cells are Dental pulp stem cells(DPSCs), Periodontal ligament stem cells(PDLSCs), Stem cells from apical papilla(SCAP cells), Dental follicle precursor cells(DFPCs). The scaffold provides a micro environment for cell growth and differentiation which helps in regeneration. Scaffold should be successful for transport of nutrients, oxygen and waste and be able to support and guide the cell growth and the development of new tissues. Scaffolds may be natural or synthetic, biodegradable or permanent. Growth factors are polypeptides or proteins that bind to specific receptors on the surface of target cells (e.g., bone morphogenetic protein [BMP] receptors) that affect a wide range of cellular activities involving migration, proliferation, differentiation, and apoptosis of all dental pulp cells, including progenitor cells(Kinjal M. Gathani *et al*,2016).Tissue engineering (Sarang Sharma *et al*,2010) process involves developing an engineered model in the laboratory, which is preceded by segregating stem cells from the body, expanding them in a culture and seeding these cultured cells on to nanofibrous scaffolds in culture medium added with growth factors. Inspite of restorating a tooth with suitable material in case of caries involving enamel, dentin and obturating the root canal in case of pulpal involvement we have come a long way through enamel remineralisation, reparative dentin formation and regeneration of pulp.

Adding some more newer advancements to this list of bio-mimic materials i.e, such as a)Bio-glue, a tissue adhesive is gaining more popularity now-a-days composed of gluteraldehyde and purified bovine serum albumin, binds covalently to tissue surface proteins applied in wound healing, haemostasis and various surgical procedures b) Biomimetic hydrogel for dental enamel restoration, caries prevention and as an injectable carrier in pulpal regeneration is well popularized which is biocompatible, biodegradable and has unique adhesion properties important for dental applications. It may protect repaired enamel from secondary caries and erosion due to apparent antimicrobial and pH-responsive properties.

CONCLUSION

Despite the limitations of biomimic materials being cost – effective and the need of creating micro-environment when placed even supra gingivally and the time required for the regeneration, the use of these materials and a wide range of knowledge on bio-mimic materials eliminates the need of restorative materials and their complications associated. All of us should aim to preserve the tooth but simulating mother nature plays a vital role in getting back the lost tooth structure. This idealogy on remineralisation and regeneration with advanced materials and techniques will definitely move dentistry to the next higher levels as 'Regeneration Is More Worthier Than Replacement.'

References

1. Chen Mei, Jiaojiao Yang, Jiyao Li, Kunneng Liang, Libang He, Zaifu Lin, Xingyu Chen,Xiaokang Ren, Jianshu Li,2014. Modulated regeneration of acid-etched human tooth enamel by a functionalized dendrimer that is an analogof amelogenin. Acta Biomaterialia,Volume 10, Issue 10, Pages 4437-4446.
2. Claudio Poggio, Marco Lombardini , Marco Colombo , Stefano Bianchi2010. Impact of two toothpastes on repairing enamel erosion produced by a soft drink: An AFM in vitro study. *Journal of dentistry*,vol 38,Issue 11, Pages 868–874.
3. Imad About , 2016. Biodentine: from biochemical and bioactive properties to clinical applications. Giornale Italiano di Endodonzia 30, 81—88.

4. 4)Kinjal M. Gathani and Srinidhi Surya Raghavendra, 2016.Scaffolds in regenerative endodontics: A review. Dent Res J (Isfahan). Vol 13(5): 379–386.
5. Melanie Namour and Stephanie Theys,2014.Pulp Revascularization of Immature Permanent Teeth: A Review of the Literature and a Proposal of a New Clinical Protocol. *The Scientific World Journal*. Review Article (9 pages), Article ID 737503, Vol 2014.
6. M. Nakashima and K. Iohara,2011.Regeneration of dental pulp by stem cells.Adv Dent Res23(3):313-319.
7. Ozlem Malkondu, Meric Karapinar Kazandag, and Ender Kazazoglu,2014. A Review on Biodentine, a Contemporary Dentine Replacement and Repair Material.BioMed Research International.Review Article (10 pages),Article ID 160951,Vol 2014
8. Renita Soares,Ida de Noronha de Ataide, Marina Fernandes, Rajan Lambor,2017.Assessment of Enamel Remineralisation After Treatment with Four Different Remineralising Agents: A Scanning Electron Microscopy (SEM) Study. Journal of Clinical and Diagnostic Research. Vol-11(4): ZC136-ZC141.
9. Sarang Sharma,Vimal Sikri, Neel Kamal Sharma, Vivek M. Sharma,2010. Regeneration of tooth pulp and dentin: trends and advances. Annals of Neurosciences, Vol 17, No 1.doi: 10.5214/ans.0972.7531.2010.170109
10. Shila Emamieh, Yosra Khaterizadeh, Hossein Goudarzi, Amir Ghasemi, Alireza Akbarzadeh Baghban, and Hasan Torabzadeh, 2015.The effect of two types chewing gum containing casein phosphopeptide-amorphous calcium phosphate and xylitol on salivary Streptococcus mutans. J Conserv Dent. Vol 18(3): 192–195.
11. Thouseef Ch,Nithin Suvarna, Harish K Shetty, Vidhyadhara Shetty and Dhiyouf Ali,2017.Scaffolds in regenerative endodontics: a review. Int. J. Adv. Res. 5(9), 415-423.
12. Vitor C. M. Neves ,Rebecca Babb, Dhivya Chandrasekaran & Paul T. Sharpe, 2017.Promotion of natural tooth repair by small molecule GSK3 antagonists. Scientific Reports | 7:39654 | DOI: 10.1038/srep39654.

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