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"Biologically Driven" Restorative Dentistry

Abstract

Restoration of teeth represents the majority of treatments provided for dental patients. Minimally invasive dentistry has been the essence of our practice for the last few decades. Yet the best practice involves a better understanding of the capacity of dental tissues and their response to different insults within the oral environment. Such understanding would help in minimizing unwanted interventions and compromise of Dental tissues. This article describes the optimal practice guidelines for effectively restoring dental tissues to their normal functional status.

Keywords: biologically driven dentistry, minimal intervention

Introduction

Biologically driven Restorative Dentistry involves the appreciation and integration of dental tissues and their capacity for repair and regeneration during the practice of dentistry. This is multi-faceted, ranging from primary prevention to operative practice with minimal intervention. With a better understanding of dental diseases and effective means of prevention, operational interventions are minimized.

Under a favorable oral environment, the tissues can revert to normal with more resistance to subsequent disease. Rather than undergoing extensive treatment, dental tissues can be treated with medications to elicit a positive response and seal off any invasive fronts, allowing the tooth to function normally. In cases where developmental or acquired defects pose challenges to maintaining healthy teeth, corrections are made to ensure their smooth functioning. Biologically driven restorative dentistry prioritizes the replacement of lost tissues with natural counterparts instead of artificial substances. Operational protocols are designed to minimize the compromise of tissues, providing mutual protection for the remaining tissues without endangering them.

Discussion

Various concepts are used to explain the evolution of the structure and function of biological entities found in living organisms. The widely accepted scientific perspective attributes these changes to modifications and adaptations driven by natural selection. Similarly, the evolution of human teeth includes alterations in morphology and anatomical features. As humans have transitioned to a sedentary lifestyle and increased consumption of refined food over the course of evolution, the morphology of teeth has also changed.

In 1991, Santos and Bianchi introduced the term 'biological restoration,' highlighting a procedure by which fixation of aseptic dental fragments onto teeth exhibiting substantial coronal destruction (1).

The practice of biologically driven Restorative dentistry is approached through-

1. Preservation of the natural oral structure

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2. Usage of biocompatible materials.

3. The techniques adapted to embrace better oral health

4. Improved treatment outcomes, longevity, and patient satisfaction.

It is appreciated that none of the artificial substitutes are superior to the natural tooth structure. Thus, it is always advisable to preserve the maximum amount of tooth substance by adopting minimally invasive techniques that avoid unnecessary tooth structure removal and adapt conservative restorative techniques. Minimally Invasive Dentistry (MID) involves treating teeth while respecting the original tissue as much as possible. This reflects that the dental profession values healthy tissue more than artificial replacements. MID can encompass various aspects of dentistry, with tissue preservation as a key focus. (2–4). The World Congress of MID defines it as techniques that prioritize the health, function, and aesthetics of oral tissues by preventing disease or stopping its progression with minimal tissue loss (5).

Appreciation

The best way of adopting biologically driven practices is to appreciate the capacity of natural tissues. With a better understanding of tooth structure, oral physiology, and the pathogenesis of dental diseases, it is highlighted that human tissues are resilient, can overcome problems easily, and withstand challenges. In most instances, we can facilitate the remineralization of the dental tissues. Additionally, in response to insults, pulp tissue may undergo regression, and it overcomes the effects of these insults by laying a dentinal bridge i.e. tertiary Dentine.

Previously, it was believed that with inflammation of the pulp, the blood supply is terminated, and the total pulp tissue undergoes necrosis. This is not accepted further and learned that the pulp can withstand insults and survive to a greater extent.

We should always appreciate the fact that the dental pulp contains pluripotent stem cells. (DPPSC - Dental Pulp Pluri Potent Stem Cells). The cells have the potential to differentiate into odontoblasts and thereby fight and withstand the challenges by layering secondary, and tertiary dentine.

As technology progresses, researchers are employing pluripotent cells for various clinical purposes beyond their initial applications. For example, for the treatment of motor neuron disease, to slow down muscle degeneration and induce wound healing. This depicts the capacity of these pluripotent cells which can easily help the insulted pulpal tissues to conquer problems. (Figure 1) shows a patient with complicated crown fractures which were treated by partial pulpotomy and immediate re-attachment of the fractured part.

Re-attachment is considered better as the enamel's surface is naturally smooth, has the right shape and color, works well for eating, keeping the healthy part of the tooth, preventing natural wear, and not needing complex restorations (6).

Figure 1: 11,12 and 21 traumatized teeth. Complicated crown fractures of 11 & 12 were treated with partial pulpotomy. Note the re-attachment of all fractured components in 11, 12 & 21.

Dental tissues can undergo functional adaptations. This is a phenomenon that is not observed in non-living objects. The Radiograph shows a crown constructed on a molar tooth following root resection. The single root can bear the excessive forces adapting to the functional requirement. (Figure 2)

As a response to demand, dento-alveolar compensation takes place. The radiograph shows the formation of bone tissue over the coronal part (head) of the implant. This shows the capacity of healing in dental/ alveolar bone. (Figure 3)

The carious process is also in an equilibrium where there is a balance between demineralization and remilitarization. When the surrounding oral environment facilitates remineralization, dental tissues can recover from their vulnerable status and function as healthy counterparts.

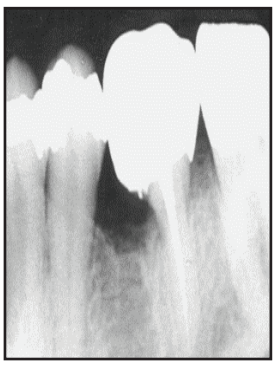


Figure 2: Distal root is supporting the 36 crown following resection of the mesial root advocating the adaptability of tooth and supporting structures

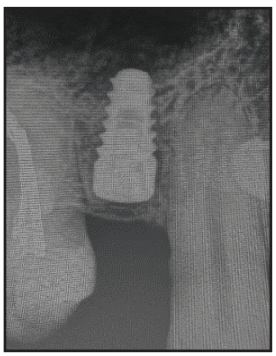


Figure 3: Formation of bone over the head of an implant and around the apical part in the antrum.

Facilitation

Once the natural tissues are facilitated with an environment that helps to recover from insults, tissues respond positively. For example, where proximal demineralization is noted in the absence of cavitation, the reverse of these lesions can be facilitated by introducing better cleansing of the surfaces.

In instances, a thin layer of carious tissues in the inner quarter of the dentine can be left during excavation, and calcium hydroxide or Mineral Trioxide Aggregate (MTA) lining can be placed facilitating secondary dentine formation. This can be done as a single-stage procedure with selective caries removal. In teeth with deep caries and reversible pulpitis, this treatment preserves the tooth structure and prevents over-treatment, sparing time and expenditure (7). Alternatively, it is also taught to do stepwise excavation to prevent potential damage to the pulp and facilitate the natural healing process.

Caries in dentine could be removed selectively and then other methods like photo activation and laser therapy can be utilized to destroy remaining bacteria and remove organic debris. In addition, it will oxidize caries and speed up remineralization.

Direct pulp capping is recommended following pinpoint pulp exposure during caries excavation. Partial pulpotomy is done in instances where the most coronal part of the pulp is infected/ inflamed. After removal of the biofilm and the inflamed part, hemostasis is obtained and disinfect the surface by using 0.5 to 5% sodium hypochlorite following which it is recommended to use calcium silicate cement directly on the pulp. European Society of Endodontics in their position statement recommends such treatment under strict isolation and good vision under the microscope (7).

Hall technique is another method where "facilitation" is applied. The readymade crown is cemented with Glass Ionomer Cement (GIC) after removing gross debris without removing the decomposed carious dentine in deciduous molars (8). It is expected the caries to be arrested and induce self-healing by limiting access to nutrition for the entrapped bacteria.

Regenerative Endodontics is gaining popularity by demonstrating promising results. The treatment is carried out in non-vital immature permanent teeth (9). The objective is to induce the filling of the immature root canals by natural tissues.

It is always necessary to facilitate or create a conducive environment for the natural tissues to heal by themselves. Horizontal root fractures are treated using Calcium hydroxide dressing up to the fracture line later to be replaced by MTA. Thereby formation of a barrier is induced, to unite the apical and the coronal portions of the root (figure 4)

MTA is used to induce the formation of a biological barrier on many occasions. In instances where large periapical lesions are present, MTA will maintain an alkaline environment which promotes bone formation and long-term healing. (Figure 5)

Replacement resorption is a pathological process by which the formation of bone takes place. Though it is not intended to have root to be resorbed it is far better than other types of resorption where the hard tissue volume is significantly reduced. The bone formed is beneficial in maintaining the volume of the alveolus and can be later utilized for the placement of implants.

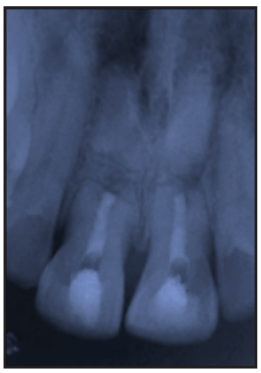


Figure 4: Horizontal root fracture of 11 and 21 managed with MTA placement up to the fracture lines. Note the healing and the union at fracture lines

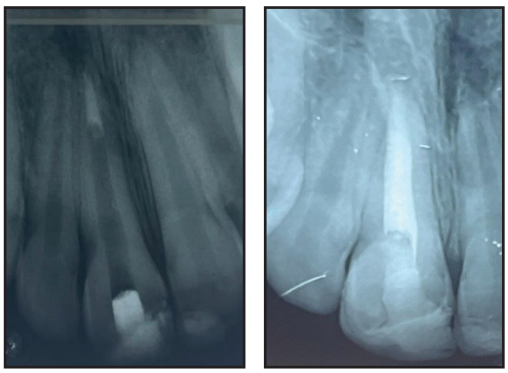


Figure 5: MTA root end fillings to manage a large periapical lesion. Note the healing of the Periapical lesion.

Rejuvenation

This involves strengthening the existing tissues to resist disease. Examples are the application of fluoride varnish following demineralization and resin infiltration where Triethyline Glycol Di Methacrylate (TEGDMA-based resin) is infiltrated on the surface where demineralization is evident. Once placed it will help in maintaining the natural structures whilst making it more resistant to subsequent disease.

Modulation

This concept is to alter the compromised tissues which will make the surrounding environment and tissues to be more resistant to disease and maintain good health. Once the modulation is performed the natural tissues will be maintained without any hassle or risk of subsequent disease.

One good example is the elimination of developmental lateral periodontal grooves (figure 6). Preservation of the extracted socket and implant site development is another modulation. This will facilitate and maintenance of the height and width of the alveolar bone.

Figure 6.1: Developmental lateral periodontal groove.

Figure 6.1: Odontoplasty and elimination of the groove with GIC

Emulation/ imitation

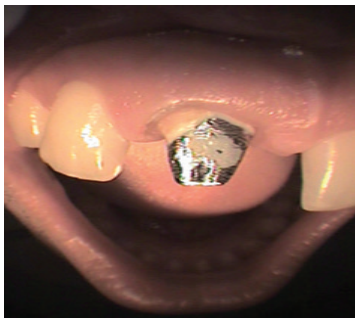
This involves the replacement of missing structures using materials that are biocompatible and have properties similar to their natural counterparts. One of the reasons for amalgam restorations to fail in the long run is their rigidity (figure 7). Resin restorations prevent unnecessary stress to the tooth during function as they match the modulus of elasticity of the natural tooth substances compared to Amalgam. This helps in preventing subsequent fracturing of the tooth. We can further enhance the protection and minimize the forces by cuspal coverage restoration. It is always important to practice, minimally invasive dentistry without compromising the tooth structure. Certain aesthetic demands can be met by simple bonded restorations, instead of opting for advanced and invasive techniques (figure 8).

Figure 7: "Proud" amalgam restorations. Note the fracturing of the tooth & ditching of the restorations.

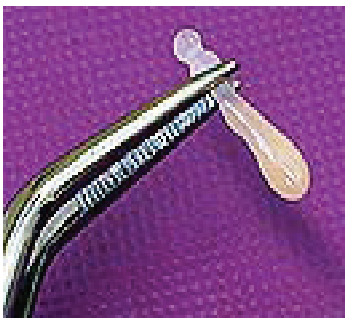
Figure 8: Improved esthetics following simple composite restorations.

Instead of metal posts and dowel cores used previously, now we use fiber posts, which will not transmit unnecessary forces to the root increasing the incidence of fracture (10). (Figure 9). Fiber posts are aesthetically pleasing, done at once, no laboratory cost is involved, and less invasive. Wherever possible wear and tear loss has to be replaced with bonded, restorations, which will hold the remaining structures together, increasing longevity (11). (Figure 10) Bleaching is another non-invasive technique where tooth structure is maximally, preserved, and natural appearance will be produced sparing time and expenditure (12).

9.1: Failed metal post retained restoration



9.2" A dowel core



9.3: A fiber post with resin cement, just before inserting into the canal.

Figure 9

Figure 10: Fiber post retained direct composite restoration.

Benefits

Biologically driven restorative dentistry preserves tooth structure by minimizing extensive preparations leading to better strength and integrity. These restorations are long-lasting thereby the risk of complications and replacement needs is minimal. With less incidence of replacement, the number of restorative cycles is reduced thus preserving the tooth in the long run by enhancing the life span. In addition, these restorations have better aesthetics, and translucency, and are seamless as they integrate well with the surrounding natural tissues.

Conclusion

Biologically driven restorative practice should be adopted by all practitioners whenever they treat patients. This is a mere adaptation of the evidence-based practice aimed at preserving the natural tooth structure to the maximum. Applying conservative methods & and appreciating the capacity of natural tissues does not intend to collaborate less with the patient. Careful and frequent assessment following the active phase of treatment is indispensable. Dentists should always be conversant about the pathogenesis of dental diseases and optimal use of dental materials.

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