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Biological restorations: Literature review with proposed definition & classification

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***Abstract*---**The need for ideal restorative material in terms of enhanced clinical performance and longevity is a primary requirement, and concern, in contemporary restorative practice. None of the available restorative materials provide with biomechanical properties similar to that of natural enamel and dentin. Therefore the concept of replacing missing or defective tooth structures with natural enamel or dentin termed as "Biological Restorations" has resurfaced. The current review provides an insight into clinical applications with evidence of success, advantages, limitations, ethical and biosecurity risk concerns regarding biological restorations and also makes an attempt to propose a definition and a classification system based on clinical implications.

***Keywords*---**autogenous tooth bonding, biologic restoration, biologically based restoration, bonding dental fragment, fragment reattachment, homogenous tooth bonding.

Introduction

Re-creation and restoration of defective, diseased, missing, or injured tooth structure is of major importance in the field of restorative dentistry. Restorative rehabilitation of tooth aims at re-establishing proper form, function, esthetics & the tooth's relationship with the adjacent periodontal structures, in a healthy

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manner. The role of restorative material is pro-vital in achieving these goals. Advancements are being made in the field of material sciences and clinical techniques but none of the available synthetic materials have similar biomechanical properties to that of natural enamel and dentin. Therefore, various authors have suggested the use of natural tooth structure as a biological and conservative alternative for restoring the damaged tooth.[1-3]

In the year 1964, Chosak and Eidelman reported the first scientific literature on the use of natural tooth fragments for restoration.[4] Later in the year 1991, Santos and Bianchi termed the procedure, where sterile dental fragments were bonded with remaining teeth having large coronal destructions, as 'Biological Restoration'.[5] The exact and elaborated definition of the term Biological Restoration was not cited while reviewing the available literature, therefore the present article attempts to define biological restoration.

'Biological Restorations' can be defined as the procedures in which a sterile natural enamel and/or dentin tissue is used to reinstate the carious, fractured, missing and defective structures of the tooth, so as to re-establish the Bio-functional requirements, and maintain a healthy stomatognathic system. According to a survey published in 2021, clinicians do have knowledge about procedures like fragment reattachments but they were unfamiliar with the basic concept of biological restorations.[6] Therefore, current review provides insight into clinical applications and aspects related to biological restorations and also attempts to propose a definition and classification based on clinical implications.

Clinical Applications

The technique of biological restorations has evolved over the years in terms of better clinical applicability in both primary and permanent dentitions. Various literature citing have reported its practice in the dental procedures with wide area of applications and years of successful follow-up.[7-19] Clinical applications include restoration of carious and cervical defects, tooth fracture (fragment reattachment-complicated & uncomplicated), inlay, veneer, post and core, crowns (anterior, posterior & 4/5th crown) and replacement of missing tooth. [7-19]

Evidence of Success

Clinically success of treatment procedure can be determined on the basis of its years of successful functioning in the oral cavity without any signs of restorative marginal disintegration, structural breakdown, micro-leakage, dislodgement, post operative sensitivity or pain and periodontal break down. Various case reports have been cited in the scientific literature, presenting with successful follow-up ranging from one to 19 years of clinically acceptable restorative solutions based on biological means of restorations utilizing natural enamel and / or dentin. [7-19]

Advantages

Biological restoration provides a simplistic, conservative, cost-effective, time-saving, functional, and bio-esthetic treatment option for restoring defects using natural tooth tissues and also provides restorative solutions which are resistant

to pigmentation and wear, when compared to available synthetic materials.[10] They are compatible with gingival tissues when placed at gingival or sub-gingival levels due to less plaque deposition and better biocompatability.[20] Biological restorations re-establish the form, function, and esthetics in the most natural way, providing patients with utmost emotional, social, and psychological acceptance and satisfaction.[10]

Limitations

The limitations include, requirement of professional expertise, availability and shade matching of a fragment, patient's acceptance, and concerns regarding longevity i.e. fragment debonding.[8,21] Also, biological restorations are exposed to all oral conditions including changes in mineralization cycles and recurrent caries.[18]

Ethical and Biosecurity risk concerns - Sterilization and Storage

Biological restorations present with a major ethical concern and it should be addressed as a matter of prime importance. The patients/parent/guardian should be well informed regarding the procedure especially when extracted tooth from the donor is to be used.[15] Detailed informed consent should be recorded before performing the clinical procedure. Cross contamination appears to be one of the major clinical concerns towards the use of extracted tooth for biological restorations.[6] OSHA (Occupational Safety and Health Administration) has considered the human tooth as potential source of blood borne pathogens.[22,23] The best possible way to eliminate the biosecurity risk is to properly sterilize the extracted tooth. Various methods employed for sterilization of extracted tooth include autoclaving, boiling, treatment with iodine based solutions, formalin, hydrogen peroxide, quaternary ammonium compounds, compound or salts glutaraldehyde, thymol, sodium hypochlorite solution, ethylene oxide, gamma and microwave radiations. According to the literature 10% formalin, 5.25% sodium hypochlorite and autoclaving for 40 minutes have proved to be the most effective methods of sterilizing the extracted tooth. [23, 24]

Bonding

Achieving 'MONO-BLOCK' in dentistry can be clinically challenging and one of the key factors determining the overall prognosis of restorations placed. Evolution in the field of predictable enamel – dentin bonding systems has led to enhancement in the clinical performance and longevity of the biological restorations mainly because of similarity to the bonding substrate, thus creating a mono-block Effect. [25, 26]

Tooth banking system

Clinical application of biological restorations is possible only if the patient's fractured fragment is available in viable state for bonding or patient's willingness towards use of extracted tooth. Natural tooth fragment availability, proper shape and shade matching appears to be a clinically challenging situation and a limitation of the procedure, especially in cases where extracted tooth from the

donor is to be used. Such situations demands for establishment of proper tooth banking systems where cleaning, sterilization and storage can be done.[27] Availability of desired extracted tooth from tooth banks will increase the chances of performing biological restorations as routine dental care procedure.

Proposed Classification

Procedures like fragment reattachment and biological posts are clinically practiced and have been widely tested using in-vitro experiments but till date the only available classification of biological restorations is based on the type of tissue used for rehabilitation or restoration.[28] Authors in the present review have attempted to broadly classify the biologically restorations based on type of dentition, graft, vitality status and clinical application i.e. type of restorative procedure performed.

- Based on Dentition
  - Primary
  - Permanent
- Based on Graft
  - Autograft/Autogenous
  - Allograft/Homogenous
- Based on Tooth Vitality Status
  - Vital tooth
  - Non-vital tooth
- Based on Clinical Applications (Restorations)
  - Carious defects
  - Cervical Abrasion
  - Tooth Fracture (Fragment Reattachment)
    - Uncomplicated
    - Complicated
  - Tooth Fracture (Fragment Reattachment)
    - Supra-gingival
    - Sub-gingival
  - Inlay
  - Veneer
  - Post and core
  - Crowns
    - Anterior
    - Posterior
    - 4/5th Crown
  - Replacement of missing tooth

Conclusion

Biological restoration provides with a viable treatment alternative to reestablish the functional state and similar biomechanical properties to that of the tooth structure. There is a need for creating awareness amongst clinicians and patients/guardians regarding benefits and success of biological restorations. Also there is a need of establishing tooth banking systems for easy and affordable availability of extracted/donor tooth for successfully carrying out the procedure.

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