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Review Article

Biological restorations: an underrated modality of pediatric restorative dentistry

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ABSTRACT

Early childhood caries (ECC) is an infectious disease of the primary teeth in children which leads to severe destruction of the teeth and results in damage to their permanent successors if not treated promptly and efficiently. Untreated carious primary teeth not only cause pain and difficulty in chewing but also lead to functional disharmony, development of deleterious habit and can affect the permanent tooth buds. Satisfactory restoration of these teeth, improving esthetics, along with the management of space and function has always been a challenge for pediatric dentist. In an attempt to widen as biologically and conservatively as possible, several authors have suggested the use of tooth fragments or extracted human teeth called as biological restorations as a restorative material to rehabilitate severely destroyed teeth. This technique allows the preservation of sound tooth structure and provides excellent aesthetics and comparable wear resistance with opposing tooth. This paper aims to review the evolution, methods and uses of these biological restorations in pediatric dentistry.

Keywords: Biological restoration, Dental caries, Rehabilitation, Tooth bank, Whole crown replacement

INTRODUCTION

Early childhood caries (ECC) is an infectious disease of the primary teeth in children which leads to severe destruction of the teeth and results in damage to their permanent successors teeth if not treated at an early stage.[1]

Although largely preventable by early examination, identification of individual risk factors, parental counselling and education, and initiation of preventive care procedures such as topical fluoride application, the progressive nature of dental disease can quickly diminish the general health and quality of life for the affected infants, toddlers, and children. Failure to identify and prevent dental disease has consequential and costly long-term adverse effects. As treatment for ECC is delayed due to the child uncooperative behaviour and low socioeconomic status, the child's condition worsens and becomes more difficult to treat, the cost of treatment increases, and the number of clinicians who can perform the more complicated procedures diminishes.[2]

Recently there has been a paradigm shift in the mindset of parents which has arisen a large portion of society who have become more determined to hold the primary teeth in their children's oral cavity as long as they naturally last. In the past, many researchers have searched for ideal restorative materials and dental manufacturers have created a wide variety of products such as amalgam, glass ionomer cement, composite cement, full coverage restoration like stainless steel crown in the market which mimic the properties of natural tooth to some extent. However, till date no restorative material has been more effective than the properties of natural teeth themselves. Thus, in an attempt to widen, as biologically and conservatively as possible, several authors have suggested the use of tooth fragments or extracted human teeth as

biologic restorative material to rehabilitate severely destroyed tooth crowns.[3]

Conventionally restorative procedures for grossly mutilated teeth require metallic restoration for posterior teeth and aesthetic restoration for anterior teeth. With the growing awareness most of the children even as young as 3 years are becoming conscious of their appearance. Biological Restoration is defined as an adequate restorative alternative for the high-quality reconstruction of extremely damaged teeth with the help of natural teeth which meets up to the aesthetic and structural standards of the healthy teeth.[4] There are several advantages of this technique such as favourable aesthetics, resulting from enamel's natural surface smoothness, anatomic contouring and color match, functional and masticatory effectiveness, preservation of sound tooth structure, prevention of the physiological wear, cost effective and no need for complex material resources.[5]

This technique does not require retentive cavity preparation, allows the preservation of remaining tooth structure, provide natural results in terms of anatomical shape, surface shine, smoothness of the enamel and also provides excellent esthetics compared to composite resins and stainless-steel crowns, especially regarding translucency. The present article is a brief review on 'biological restoration its advantages, disadvantages and clinical use.

PROCUREMENT AND PREPARATION OF BIOLOGICAL RESTORATIONS

Obtaining the tooth

The donor tooth can be procured from natural source such as teeth that are extracted, avulsed or exfoliated due to any reason and a small fragment of tooth can be reused in some or the other way in dental practice.

Preparation

Cleaning

The cleaning comprises the removal of blood; debris and tissues adhered to the extracted teeth. The cleaning efficacy is directly associated to the reduction of the microbial load on the EHT surface to be disinfected and/or sterilized, decreasing the occupational risk, that is, the contact with the patients' fluids and contamination during the manipulation.

Removal of organic and inorganic tissues (pulp extirpation)

After the cleaning stage, both caries and defective restorations are removed with the aid of high and low speed handpieces. Also, scaling and removal of the organic tissues are executed (calculus and bone remnants). To assure the quality of the residue removal, a visual inspection with the aid of an image intensifier magnifying glass or electronic microscope must be executed. At this stage, it is possible to detect the debris which eventually has not been removed and which can interfere in the further procedures of disinfection and/or sterilization.

Disinfection and sterilization

The Centres for Disease Control and Prevention (CDC), which aim to the infection control, has recommended sterilization through saturated steam under pressure, for 40 minutes as this method does not alter the physical properties of the dental tissues and does not compromise the goals and/or results of the application of these teeth in teaching, research or therapeutics.[9]

The use of saline solution, water, and disinfectants such as formalin, sodium hypochlorite, glutaraldehyde and thymol are practical and saving media, recommended by CDC, but they did not disinfect safely the external surface and the internal pulp tissue. [9] Immersion of biological tooth in 10% formalin for 7 days and autoclavation at 115ºC for 40 minutes at 20 psi (1.38 bars) are the most efficient methods.[10]

Storage

The storage medium can contribute to the maintenance of the chemical, physical and mechanical properties of extracted human teeth tissues and influenced on the outcomes of the researches.[11] There are several medium for storage of extracted teeth such as distilled water, sodium chloride, sodium hypochlorite, chloramine, formalin, eye lens solution, coconut water and glutaraldehyde.[11]

CLASSIFICATION OF BIOLOGICAL RESTORATION BASED ON USES

Srivastava and Rana in the year 2021 classified extracted human teeth which serve as biological restoration on the basis of origin as 4 types (Table 1).

Table 1: Nikhil and Rana's classification of biological restoration.[12]

Origin	Classification
Autogenic- homodontic	Tooth fragment of the same tooth attached on to the same tooth of the same person. E.g. reattachment of fractured central incisor with composites
Autogenic- heterodontic	Tooth fragment of one tooth attached on to another tooth of the same person. E.g. carious 1st permanent molar restored with the tooth fragment of exfoliated primary molar of the same person using adhesive capabilities of the composites

Continued.

Origin	Classification
Allogenic- homodontic	Tooth of a person restored with the help of same tooth of another person. E.g. extensively carious 2nd primary molar restored by attaching the tooth fragment of the extracted 2nd primary molar, obtained from a tooth bank using composites
Allogenic- heterodontic	Tooth of a person restored with the help of different tooth of another person. E.g. use of the root of the extracted lateral incisor, obtained from a tooth bank to restore the fractured central incisor using post and core preparation

APPLICABILITY IN PEDIATRIC DENTISTRY

Fragment reattachment

Uncomplicated and complicated crown fracture is the most common traumatic dental injury to permanent teeth. Most dental injuries involve just one tooth, and the majority of the affected teeth are maxillary central incisors. This may be attributable to their anterior position and protrusion caused by the eruptive pattern. One of the options for managing coronal tooth fractures, especially when there is no or minimal violation of the biological width, is the reattachment of the dental fragment when it is available. Tooth fragment bonding offers the advantage of being a highly conservative technique that promotes preservation of natural tooth structure, good aesthetics and acceptance by patients, who receive a psychological benefit from amelioration of the mutilation (Figure 1).

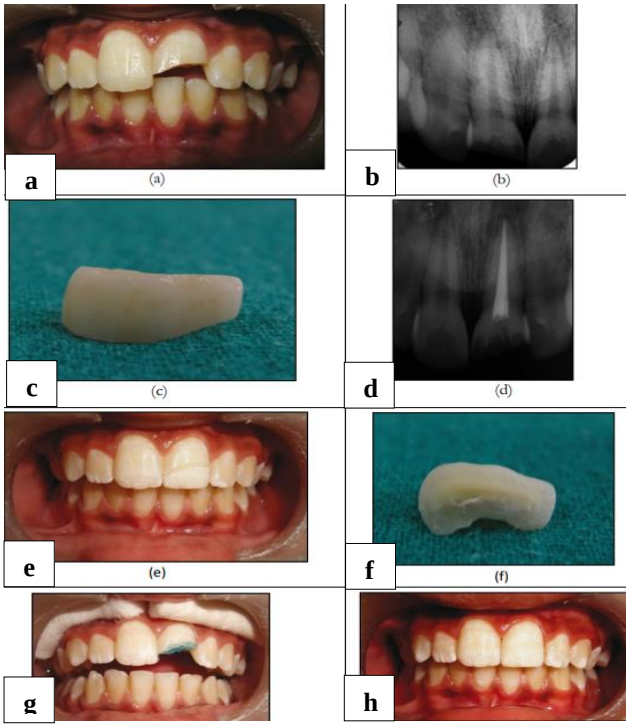

Figure 1: Reattachment of tooth fragment (a-d): (a) Ellis class III fracture; (b) IOPA showing coronal fracture; (c) the fractured fragment; (d) IOPA showing endodontic intervention; (e) circumferential enamel bevel; (f) internal dentinal groove; (g) enamel etching; and (h) post treatment – reattached tooth fragment.

Post and core

Restoration of severely mutilated anterior teeth is a challenging job and over the years many clinicians have tried various procedures to restore them. In cases of severe loss of tooth structure, intracanal posts become mandatory. Recent developments in restorative materials, placement techniques, and adhesive protocols facilitate these restorations. However, these procedures turn out to be expensive and technique sensitive, and also require expertise of operator.

Therefore, a biological restoration seems to be a successful cost-effective alternative approach for treating such cases. However, the patient acceptance of a biological restoration is an important issue and donor selection from siblings could be a more acceptable alternative. Literature suggested that research into new materials should focus on those systems with an elastic modulus close to dentin and strength equal to or higher than dentin. The biological post core and crown made of dentinal structure is most suitable (Figure 2).[12]

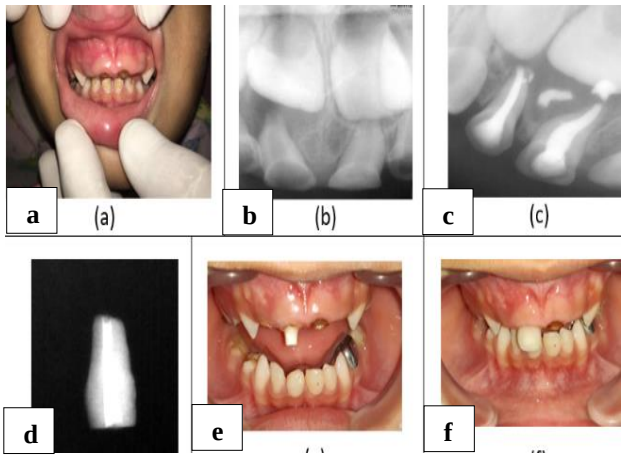

Figure 2: Biological restoration as a post and core (a-f): (a) preoperative picture; (b) preoperative radiograph; (c) pulpectomy performed w.r.t 51; (d) biological post preparation; (e) biological post cementation w.r.t 51; (f) and post-operative strip crown restoration w.r.t 51.

As a restorative material

Restoration of extensively destroyed carious teeth has always been a challenge to pediatric dentist. The aim of restorative dentistry is to recreate the anatomy of the

affected tooth through the replacement of the lost tissue, thereby re-establishing shape, chewing function, speech and esthetics. In this technique the extracted tooth with similar dimension and colour is selected and is prepared extraorally on the stone cast. Coronal adjustment is done using articulating paper and the prepared tooth is then cemented using dual cure resin cement (Figure 3).[15]

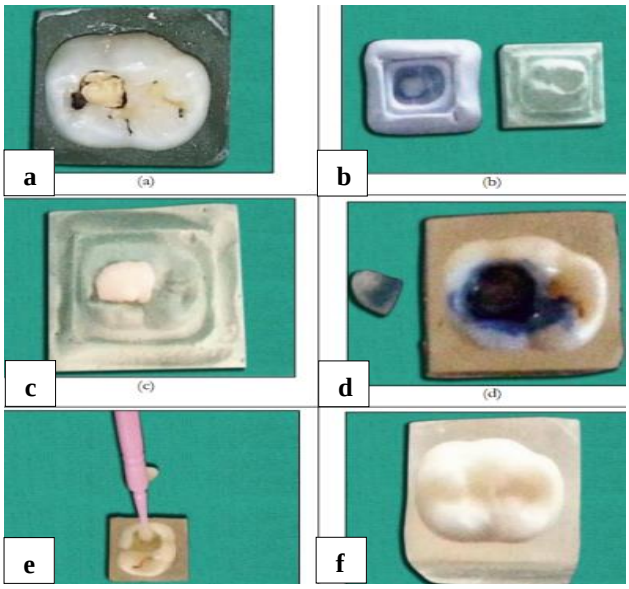

Figure 3: Biological restoration as an inlay (a-f): (a) primary molar with carious lesion; (b) impression and working model; (c) selected tooth is adjusted to fit the prepared cavity on the model; (d) application of etchant; (e) application of bonding agent; and (f) post-operative finished restoration.

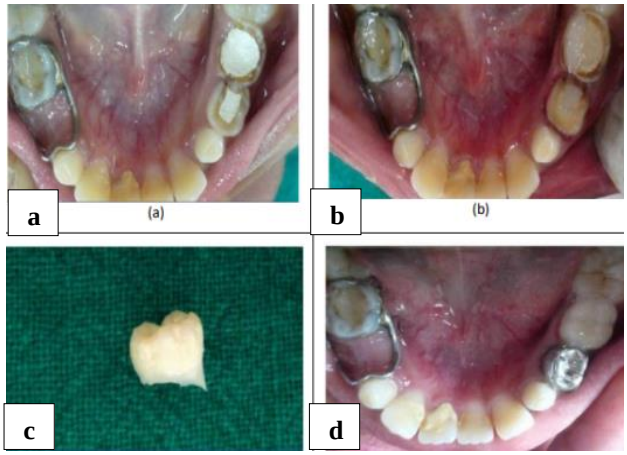

Figure 4: Biological restoration as total crown replacement (TCR) (a-d): (a) pre-operative view; (b) tooth preparation; (c) tooth to be used as biological crown; and (d) post-operative view of 75 restored with biological crown.

Total crown replacement

The primary objective of restoring grossly mutilated tooth is to achieve an esthetic improvement along with good physiological form and function which helps in preventing further deterioration.

To restore and rehabilitate mutilated primary teeth, as conservatively and biologically as possible, several authors have suggested the whole crown structure available from tooth bank as restorative material (Figure 4).[13]

DISCUSSION

The first re-use of human tooth tissue by means of adhesive re-bonding of traumatically fractured tooth parts was reported by Simonsen and Kanca in the year 1979. Following this Santos and Bianchi coined the term "biological restoration" in 1991 for the restoration using sterile parts of extracted human teeth.[5] The concept of human tooth bank (HTB) appeared in 1981, through the execution of a research which required a tooth from a service that assures the quality of the dental organ. The first biological restoration technique in primary teeth was described by Tavares in 1992.[7] Thereafter, several other reports have demonstrated the advantages of this technique such as favorable aesthetics resulting from enamel's natural surface smoothness, anatomic contour and color match, functional and masticatory effectiveness and prevention of loss of sound tooth structure, prevention of the physiological wear and no need for complex material resources.

No synthetic restorative material that can replicate the aesthetic characterization or color stability of the natural tooth structure. Moreover, reattachment of the original tooth fragment gives an emotionally and socially positive response due to the protection of the natural tooth structure. The patient and parents were satisfied of the original fragment being used in the restoration of their fractured tooth. Thus, in an attempt to widen, as biologically and conservatively as possible, several authors have suggested the use of tooth fragments or extracted human teeth as a restorative material to rehabilitate severely destroyed tooth crowns. Apart from the bio-based remediation of extracted teeth, they can also be used as post and core as an affordable solution for restoring badly broken teeth with healthy roots and provide best aesthetic/restorative options. Use of biological restorations as post and core have same modulus of elasticity, similar to the tooth to be restored along with several advantages like no intervention of laboratories, low treatment cost, less risk of galvanic corrosion and strong root canal adhesion.

Biological restoration offers several advantages over conventional restoration: the technique is simple, allows the preservation of sound tooth structure and provides excellent esthetics compared to composite resins and stainless-steel crowns, especially regarding translucency; low cost; using tooth fragments as restorative material offers superficial smoothness, cervical adaptation and physiologic wear compatible with those of surrounding teeth; biological restorations not only mimic the missing part of the oral structures, but are also biofunctional;

clinical chair time for fragment bonding procedures is relatively short, which is very interesting when treating pediatric patients; less subjected to extrinsic pigmentation and plaque accumulation when compared to composite resin; despite of several advantages biological restoration have some limitations; though it requires a short clinical chair side time as any indirect restorations, biological restorations require a laboratorial phase that may become a critical step if not properly handled; inspite of being simple, the technique requires professional expertise to adequately prepare and adapt the natural crowns to the cavity; difficulty in obtaining teeth with the required coronal dimensions; difficulty in matching fragment color with tooth remnant color; also, having fragments from other people's teeth in their mouth is not a pleasant idea for some patients and many of them refuse to receive this treatment; technique is considered difficult for undergraduate (UG) students; the use of very thin fragments where all the dentin is removed lowers the fracture resistance of bonded fragment; and availability of tooth from tooth bank.[8,17-21]

CONCLUSION

Biological restorations are good and viable alternative for restoring grossly mutilated primary molars and anterior teeth which are otherwise indicated for extraction. Biological restorations offer several advantages over conventional restorations and clinicians should have sufficient knowledge and skill for their effective use.

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