Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

"Transformative Trends: Biological Post and Core in Modern Dental Restoration" – a case report.

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(Received: 27 October 2023 Revised: 22 November Accepted: 26 December)

KEYWORDS

Biomimetic post, Dentin post, Fractured incisor, Intraradicular rehabilitation, Intraradicular post, monoblock.

ABSTRACT:

Introduction: Ideal coronal reconstruction of a fractured tooth is still a challenge for restorative dentistry. While there are many post systems on the market, none of them fully satisfies all necessary mechanical and biological requirements. Biological posts could be a useful substitute for traditional post systems

Objectives: Proper reconstruction of extensively damaged teeth can be achieved through the fragment reattachment procedure known as "biological restoration."

Methods: A 32-year-old woman in this case study complained of a cracked crown in her right maxillary central incisor. A broken maxillary right central incisor with considerable tooth structural loss that extended into the cervical third of both the crown and root was revealed by clinical and radiographic investigations. The maxillary central incisor that had been endodontically treated for fracture required strengthening using a "Biological post." In this instance, a dentinal post was prepared using a recently extracted human maxillary cuspid, and it was then confirmed into the post space and bonded with dual cure resin cement, followed by core build up and prosthesis placement.

Results: Biological post obtained through extracted teeth from another individual–represent a low-cost option and alternative technique for the morphofunctional recovery of extensively damaged anterior teeth, satisfying most of the mechanical as well as biological needs.

Conclusions: Since biological dentin posts offer superior adhesion, strength and retain internal dentin walls, they can be regarded as a good substitute for traditional post systems. This is because they closely resemble the structure found in natural teeth.

1. Introduction

Fractures of anterior teeth often stem from various sources, such as sports-related incidents, road traffic accidents, leisure activities, and caries lesions [1]. These incidents not only jeopardize oral health but also contribute to functional, social, and psychological disruptions, significantly impacting the overall quality of life for the affected individuals[2]. Onetto et al. [3] highlighted that a noteworthy percentage, ranging from

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JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

16% to 30%, of children and adolescents experience dental trauma on multiple occasions. The prevalence of fractures in anterior teeth due to traumatic dental injuries is documented at 8.1 cases per 1000 individuals.

Dentistry has undergone substantial evolution since its inception, marked by numerous technological advancements from the early extraction theories. Contemporary practices emphasize the preservation of any remaining tooth structure, even when only a small fragment persists. Achieving a coronary reconstruction that ensures both satisfactory aesthetics and functionality for teeth undergoing endodontic treatment or facing extensive damage remains a significant challenge in dentistry. In cases of severely compromised anterior teeth, the creation of intra-canal retention is crucial for enhancing the stability and retention of tooth fragments. This retention can be accomplished through the utilization of either custom-made or prefabricated Posts [1-2].

The choice of post material significantly influences the biomechanical performance of teeth undergoing endodontic treatment. In the ideal scenario, the chosen post material would form a strong connection with the root dentin and share physical characteristics of the dentin, such as modulus of elasticity, compressive strength, thermal expansion, and aesthetics [4]. Posts can be classified as either prefabricated or custom-made, rigid or non-rigid, stiff or resilient, or esthetic or non-esthetic, and they can be made of metals like titanium, nickel-chromium, cobalt-chromium, and stainless steel, or non-metals like ceramic, composite, polymeric, zirconia, and fiber-reinforced posts [5]. However, no commercially available post meets all biological, esthetic, and mechanical requirements. Dentin itself emerges as the only material possessing these properties, earning it the designation of a "Biological post" due to its biomimetic nature. The concept of biological restoration, introduced by Santos and Bianchi in 1988, involves using dentin to reconstruct extensively impaired teeth, providing resilience, excellent adhesion, stress-free dentin promotion, preservation of internal dentin walls, biocompatibility, and easy adaptation to root canal configuration [4-8]. Dentin-based posts were used by Kaizer et al. (2008) [7] to rebuild the weaker roots.

This case study documents a conscientious effort to repair a middle-aged female patient's seriously fractured maxillary central incisor. The methodology entails the creation and application of an adhesive cement to a "biological post."

CASE REPORT

A 32-year-old female presented to the Department of Conservative Dentistry and Endodontics, KIDS, Bhubaneswar, Odisha, with a fractured crown complaint in the right maxillary central incisor. The history indicated tooth structure loss resulting from a fall two months prior. Clinical and radiographic examinations unveiled a fractured maxillary right central incisor with significant loss of tooth structure, extending into the cervical third of both crown and root. Additionally, there was an exposed root canal with pulp necrosis and gingival overgrowth on fractured tooth [Figure-1].

Treatment Plan-

The suggested course of treatment calls for gingivectomy after the movable palatal fragment is removed. Following this, post space preparation and standard root canal therapy including the lateral condensation of gutta-percha will be carried out. Post cementation and full crown prosthesis, which restores the damaged tooth structure, are the next phases.

Figure 1: Initial clinical presentation of maxillary anterior (11) Fractured tooth (a)Labial view and (b)Occlusal view, (c)Preoperative radiograph.

Plan of Treatment for Post-Endodontic-

To address the loss of coronal tooth structure (core build-up), a decision has been made to place an intraradicular biological post. This involves creating the post by cutting the root of an extracted and properly sterilized canine,

Journal of Chemical Health Risks
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JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

followed by adapting the post to the maxillary central incisor.

Consent-

The patient was informed about the positives and negatives of biological restoration as well as the potential therapy options. The patient approved the recommended course of therapy and signed the necessary consent form. It was made clear that sterile, removed teeth that had undergone the usual autoclaving procedures would be used to make the post.

Emergency Treatment-

Under local anaesthesia the mobile palatal segement was removed and gingivectomy done to have proper accessibility for Root canal treatment. [figure-2]

Figure 2- a&b) Fractured palatal Segment intra-oral image and in CBCT c) After removal of Palatal segment d) After incising gingival Overgrowth.

Root Canal Treatment-

After clinical and radiographic examination, nonsurgical endodontic treatment was planned for tooth 11. The patient was then administered with 2% lidocaine with 1:80,000 epinephrine (La-Force, Vishal, India) to achieve local anesthesia. Rubber dam isolation was done and access opening was made using Endo Access Bur (Dentsply Sirona, UK). The working lengths was estimated by means of an electronic apex locator (J Morita Root ZX II, USA) and were found to be 21 mm, which was then confirmed radiographically (figure 3). rotary instrumentation with NiTi HyFlex CM files (Coltene, Switzerland) to a size of 30, 0.06 taper. The canals were irrigated with one milliliter of 2.5% sodium hypochlorite (NaOCl) (Prime Dental Pvt Ltd, Maharashtra, India) per canal per instrument change. An Endoactivator tip (Dentsply Sirona, UK) was selected that fit loosely within 2 mm of working length and was activated, using a pumping motion in short 2-mm strokes for 1 min. Normal saline was used to flush out the NaOCl,following which 17% ethylenediaminetetraacetic acid(EDTA) (Prevest Denpro, Jammu, India) was used for smear layer removal. A 30-gauge open-ended needle was used for irrigation, slightly short of the working length, such that it did not bind in the canal. Irrigants were then activated by an Endoactivator. The canals were dried with paper points. All the canal walls were then coated with AH Plus sealer (Dentsply Sirona, UK) and obturated using a lateral condensation technique with the Gutta-Percha of corresponding sizes of the rotary files used.The restoration process started with the root canals being prepped for post space using size 4 Gates-Glidden drill and leaving 5 mm of remaining filling. Next, the prepared space was directly molded using silicone impression material. [Figure-3].

Figure 3: Working Length, Master Cone, Obturation, Post-space Prepared.

The Fabrication of Dentin Posts-

The extracted canines that were provided were autoclaved for 15 minutes at 121°C after the master cast was obtained from the impression. After that, the tooth's long axis was mesiodistally sectioned and with the use of a diamond disk. Each tooth segment was meticulously split to make a "biological post" after the cementum was removed by abrasion with diamond drills. [9] [Figure-4].

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JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

Figure 4: a) Anterior region Impression mold with addition-type silicone, b) Extracted maxillary canine, c) Vertically sectioned, d) Post ready after cutting e) Post prepared in adaptation with master cast

Post Adaptation and Cementing into Root Canal-

After shaping and adapting the intraradicular post to the master cast, following a 30-second conditioning process with 37% phosphoric acid, they were cleaned, dried, and then the adhesive system (Adper Single Bond 2, 3M ESPE, CA, USA) was applied. The inner portion of the canal received a 15-second conditioning with 37% phosphoric acid. After that, the post was coated with the adhesive system, and it was left to polymerize. Using a paste carrier, dual-cured resin cement (RelyX Unicem-3M ESPE) was applied to both the post's surface and the inner portion of the canal. After inserting the post into the canal and applying steady digital pressure, a radiograph was taken for the adaption experiment[figure-5]. The tooth structure's core build-up was accomplished using dual-cure core build-up material (Ivoclar Vivadent Multicore Flow Core Build-up Material). After the tooth was prepared, more silicone was used to create an impression, and the same dual-cure resin cement was used to fabricate and bond a metal-free ceramic crown. [Figure-6].

Figure 5: Post were adapted to the a) master cast, b) Tooth trial, c) Radiograph.

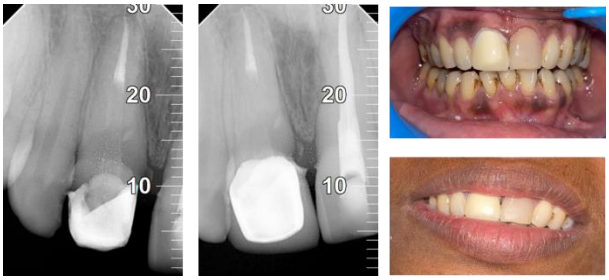

Figure 6: Core build up, Crown, Post-operative radiograph and clinical.

DISCUSSION-

Utilizing natural tooth fragments to heal shattered anterior teeth is a result of advancements in adhesive technology and restorative equipment. "Biological restoration" involves reattaching tooth fragments using natural teeth, meeting both esthetic and structural standards. This technique employs a natural post-core that seamlessly fits into a prepared post space with the core, offering a natural esthetic treatment option[9]. Biological restoration can be achieved through autogenous bonding, using the well-preserved patient's own fractured fragment [10][11], or homogenous bonding, using natural extracted teeth from a tooth bank if the original fragment is unavailable [12].

This case report details the restoration of fractured maxillary anterior teeth using biological posts crafted from natural extracted teeth due to the unavailability of the original tooth fragments. Consequently, homogenous biological restorations were carried out employing natural extracted teeth sourced from the department of

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JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

oral surgery. Before their use, these natural extracted teeth underwent proper sterilization following thorough scaling and polishing. In these cases, biological crowns [4] were not feasible, primarily because finding teeth with a suitable color and shape matching the ones to be restored proved challenging. This challenge is attributed to the rarity of extracting healthy anterior teeth. A different approach uses tooth banks, which are non-profit establishments where teeth are meticulously scaled, polished, and extracted, together with any remaining periodontal material and pulpal tissue from the root canals, before being sterilized and stored. Retaining multiple characteristics, including size, color, form, age, and donor identification, these teeth are kept in Hank's balanced salt solution at 4°C [13].

The tooth that was used to prepare the dentin post came from a patient whose intact maxillary canine was about to be extracted because of periodontal disease. The donor had a thorough evaluation of their medical history and regular blood tests, prior to the procedure. Following extraction, the tooth was autoclaved at 121°C, 15 lbs pressure for 15 minutes, in strict accordance with biosecurity guidelines, for comprehensive cleaning, storage, and sterilization [4].

The core build-up serves the essential role of replacing sufficient missing tooth structure to establish optimal retention and resistance form during crown preparation In this instance, intraradicular retention was judged required as coronal damage had reached the cervical third of the tooth. Biological posts were exclusively employed for this retention, as they offer outstanding adherence to canal walls and resin, ensuring the formation of a “monoblock system” [9].

Given that dentin posts are constructed from naturally extracted donor teeth, their benefits include biocompatibility, durability similar to a natural tooth, and outstanding adherence to dental structures and synthetic resins. Additionally, dentin posts are inexpensive. Furthermore, a more uniform distribution of stress throughout the root is made possible by the creation of a monoblock biomechanical system, this is achieved by the dentin post, cementing agent, and dental components adhering to one another. As a result, there is less chance of cohesive and adhesive failure. The risk of tooth fracture under occlusal stresses is increased by steel and titanium posts, which concentrate stress at the tooth restoration interface due to their greater elastic moduli than dentin.

Fiber posts, with a lower elastic modulus, may experience debonding of the post-restoration joint when subjected to similar loads, increasing the risk of spontaneous debonding instead of vertical root fracture [1]. Dentin posts are more fracture resistant than carbon fiber and glass fiber posts, according to study by Ambica et al. [14] and Kathuria et al. [15]. This highlights how innovative it is to restore teeth that have undergone endodontic treatment using dentin posts. Comparing teeth repaired using fiber-reinforced composite posts against those treated with intraradicular solid dentinal posts, Craig et al. [16] found that the former exhibits greater fracture resistance.This heightened fracture resistance of biological posts can be attributed to the physio-mechanical properties of the dentinal post, which closely resemble radicular dentin, leading to a uniform distribution of stress. Additionally, biological posts serve as shock absorbers, transmitting minimal stress to the root dentinal walls [7]. When compared to stainless steel or glass fiber posts, Belli et al. [17] discovered that biological dentin posts showed better stress distribution.

As a cost-effective and patient friendly alternative, biological post and core utilize biological tissue that would otherwise be considered bio-waste. The advantages of this approach include improved force distribution along root canal surfaces, biocompatibility, low cost, resilience, comparable to the structure of natural teeth, strong adherence, and preservation of the internal dentin walls, no promotion of dentin stresses, and easy adaptation to root canal configuration. However, some limitations of biological post and core include challenges in finding teeth with matching color and structure, ensuring an exact fit in the root canal, patient acceptance, and difficulty in retrieval during retreatment [2].

Consent from the patient is very essential especially in light of the possible psychological effects of utilizing teeth that have been taken from other people.

CONCLUSION-

This case study highlights the effective utilization of dentin posts, emphasizing that Biological Posts provide outstanding esthetic, functional, and psychosocial outcomes. Confidently, biological posts emerge as a

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JCHR (2024) 14(1), 1555-1560 | ISSN:2251-6727

lasting and practical alternative, particularly beneficial for economically disadvantaged patients.

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