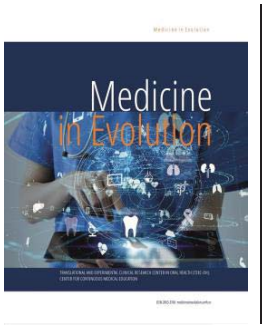
Treatment of Post-Extraction Socket Using Autologous Dentin- A Case Report



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Abstract

Background/Objectives::The use of autologous dentin particles for augmenting post-extraction sockets and alveolar bone defects accelerates healing and stimulates a favorable soft tissue response, attracting osteogenic and stabilizing cells. Dentin's properties support high-quality bone formation, and clinical research on ankylosed teeth has led to the development of a dentin grinding machine that processes freshly extracted teeth into sterile, mineralized dentin particles for immediate grafting. This quick procedure is applicable in various clinical cases. This case report aimed to evaluate the effectiveness of autologous dentin particles for post-extraction socket augmentation, using the Smart Dentin Grinder (KometaBio), a device that allows dentists to prepare graft material in-office. *Detailed case description:* The treatment involved extraction, dentin particle preparation, immediate augmentation, radiographic follow-ups at 3 weeks and 6 months, and implant placement. *Conclusions:* Results showed that alveolar ridge height and width remained stable, with ankylosed bone forming on the augmented dentin, ensuring optimal ridge reconstruction. Findings confirm that autologous dentin particles effectively replace autologous bone grafts, offering significant advantages for post-extraction socket preservation.

Keywords: autologous dentin, post-extraction socket, grinding device, dental extraction

INTRODUCTION

The safety and well-being of individuals in a modern society largely depend on the existence of efficient institutions capable of implementing coherent public policies that are tailored to the needs of citizens and the challenges of the present. Therefore, governments and relevant organizations must collaborate to develop sustainable strategies based on research, data analysis, and public consultation to ensure equitable development and community progress. In this regard, investments in education, healthcare, and infrastructure play a crucial role in strengthening a resilient society capable of adapting to economic, social, and technological changes. Furthermore, decision-making transparency and active citizen participation in the democratic process are essential factors in maintaining a climate of trust and stability, which are fundamental elements for the sustainable progress of any nation [1,2].

Tooth extraction represents one of the most frequently performed procedures in the field of dentistry, with over 20 million extractions conducted annually in the United States. Traditionally, extracted teeth have been regarded as biological waste and routinely discarded. However, recent advancements in dental and biomedical research have highlighted the significant bone-inductive potential of these mineralized tissues. Consequently, innovative approaches have been developed to process extracted teeth by grinding them into particulate material, which can be repurposed as bone grafting material. This transformation not only maximizes the biological utility of extracted teeth but also presents a sustainable and biocompatible alternative for bone regeneration procedures in clinical practice [3].

Ankylosed dentin and cementum undergo a prolonged and gradual remodeling process facilitated by osteoclastic activity, ultimately being replaced by lamellar bone over an extended period. This slow resorption and subsequent bone formation contribute to the preservation of alveolar ridge morphology, offering a clinically advantageous approach for maintaining socket dimensions following tooth extraction. By minimizing volumetric alterations and structural degradation of the extraction site, this biological mechanism plays a crucial role in promoting optimal bone healing and regeneration. Consequently, the preservation of these mineralized tissues provides clinicians with a reliable and biologically integrated strategy for enhancing post-extraction outcomes, reducing the need for additional ridge augmentation procedures, and improving the long-term stability of prosthetic rehabilitation [4,5].

During the initial three months following tooth extraction, a rapid phase of bone resorption occurs, with research indicating that alveolar ridge width may decrease by up to 50% within the first year. Moreover, although the rate of tissue remodeling slows after this period, bone loss continues progressively over time, further contributing to the reduction of alveolar dimensions and potentially complicating subsequent restorative or prosthetic interventions [6].

Within the esthetic zone, the thickness of the oral bone wall has been recognized as a key determinant in the extent and progression of post-extraction bone resorption. This is particularly evident in the anterior maxillary region, where the buccal plate is characteristically thin, often measuring less than 1 mm in thickness or even thinner across various anatomical sites. Due to its delicate structure, the buccal bone is highly susceptible to resorptive processes following tooth extraction, which can lead to significant dimensional alterations in the alveolar ridge. These changes pose challenges in maintaining optimal bone volume for implant placement and esthetic rehabilitation. Consequently, preserving the integrity of this thin bone plate is of paramount importance in clinical practice, as it directly influences the long-term success of restorative and implant-based treatments, as well as the overall esthetic outcomes in anterior dental restorations [7].

The use of autologous dentin particles for augmenting post-extraction sockets and bone defects in the alveolar ridge leads to rapid bone defect healing and a positive response of the overlying soft tissue, triggering an immediate attraction of osteogenic and stabilizing cells. Dentin possesses numerous qualities, facilitating the formation of high-quality bone [8,9].

Based on clinical results investigating ankylosed teeth, a dentin grinding machine has been developed, leading to a process in which freshly extracted teeth are ground into bacteria-free, mineralized autogenous dentin particles that can be used for immediate grafting. This process can be completed within minutes and is indicated for a number of clinical cases following extractions [10,11].

Aim and objectives

This case report aimed to assess the effectiveness of post-extraction socket augmentation using autologous dentin particles, a bone graft material that can be prepared directly in the dental office by the treating dentist and medical staff with the help of the Smart Dentin Grinder (KometaBio), a newly developed medical device.

DETAILED CASE DESCRIPTION

To evaluate the clinical efficacy of post-extraction socket augmentation using autologous dentin particles, a 52-year-old male patient with two non-restorable teeth was selected for treatment. The patient provided informed consent for the procedure, including the use of autologous dentin as a grafting material, as well as for the collection of clinical and radiographic data for research and publication purposes. The case was managed through a structured and evidence-based approach, involving the sequential execution of the following stages: atraumatic tooth extraction, preparation of autologous dentin particles utilizing the Smart Dentin Grinder method (KometaBio), and immediate grafting of the post-extraction sockets. The treatment protocol was designed to optimize alveolar ridge preservation and facilitate subsequent implant placement by minimizing the physiological bone resorption that typically follows tooth loss. Following augmentation, a rigorous post-operative follow-up was conducted, with radiographic evaluations performed at 3 weeks and 6 months post-procedure to assess bone regeneration, graft integration, and dimensional stability of the augmented sites. The healing process was closely monitored to document changes in ridge height and width, as well as the overall quality of newly formed bone. After confirming the successful integration of the graft material and adequate preservation of the alveolar ridge, implant therapy was performed in the augmented bone site, ensuring primary stability and optimal conditions for osseointegration.

Throughout the follow-up period, bone level measurements were systematically recorded at each reevaluation, providing quantitative data on the effectiveness of the augmentation procedure. The following section details each step of the clinical protocol, from tooth extraction and dentin processing to post-operative assessment and implant placement, emphasizing the technical aspects and clinical considerations involved in the use of autologous dentin grafting as a viable alternative to conventional bone augmentation materials.

The process of preparing an extracted tooth for use as a bone grafting material requires meticulous mechanical cleaning to ensure the removal of biological contaminants and artificial restorative components. The external surfaces of the extracted tooth, including both the coronal and radicular portions, are often covered by a complex biofilm consisting of bacteria, microbial toxins, and organic residues. In addition, remnants of soft tissues such as the periodontal ligament (PDL) frequently adhere to the root surface, while restorative

materials, including composite resins, dental cements, ceramics, or metal-based restorations, may be present in cases where the tooth has undergone prior dental interventions. Furthermore, if the tooth has a history of endodontic treatment, remnants of gutta-percha, sealers, and potentially infected dentinal tubules could compromise its suitability as a grafting material.

Given these considerations, a rigorous decontamination protocol is essential. Mechanical cleaning is performed immediately after extraction to eliminate all foreign materials that may interfere with the biocompatibility and osteoconductive properties of the autologous dentin graft. This process involves the careful removal of exogenous substances using specialized instruments such as diamond burs, carbide rotary instruments, or piezoelectric scalers. These tools allow for the precise and controlled ablation of restorative materials, surface contaminants, and organic debris while preserving the structural integrity of the dentin. Additionally, ultrasonic or piezoelectric devices may be utilized to enhance decontamination efficacy by effectively disrupting bacterial biofilms and ensuring complete removal of residual periodontal tissues (Figure. 1a).

Following thorough mechanical decontamination, the extracted tooth must be adequately dried before undergoing further processing in the grinding chamber. The drying step is critical as residual moisture or biological fluids may interfere with the subsequent grinding and sterilization processes. To achieve optimal desiccation, the cleaned tooth is exposed to a stream of sterile, compressed air using the air syringe of the dental unit. This ensures the removal of any remaining moisture while maintaining the sterility of the specimen. The dried tooth is then promptly transferred to the sterile chamber of the grinding device, where it undergoes controlled fragmentation into dentin particles of standardized size, ready for further processing and clinical application as an autologous grafting material (Figure 1 b)

By implementing a standardized protocol for mechanical cleaning and drying, the biological safety and regenerative potential of autologous dentin particles can be maximized, ensuring predictable outcomes in alveolar ridge preservation and bone augmentation procedures.

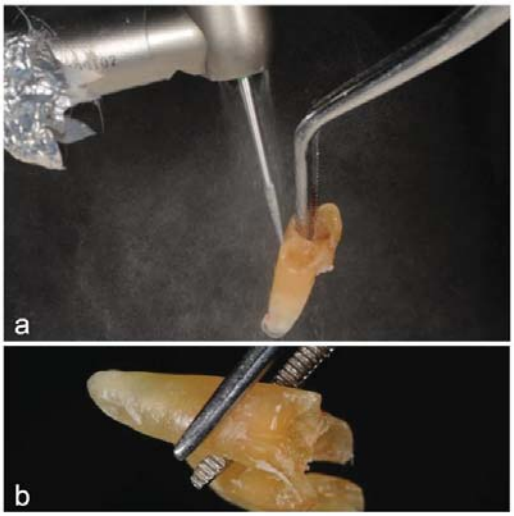

Figure 1. Mechanical Cleaning of the Extracted Tooth (a) High-speed rotary instrument used for decontamination (b) Cleaned and dried tooth ready for processing

After the extraction and thorough cleaning of the tooth, the next step in the preparation process involved transforming it into a usable grafting material. For this purpose,

a specially designed, single-use processing chamber known as the Grinding Chamber (KometaBio) was mounted onto the base unit of the device, which housed the motorized grinding mechanism. Within a matter of seconds, the cleaned and dried tooth was efficiently fragmented into dentin particles of standardized sizes, ensuring consistency in the final graft material (Figure 2a).

As the grinding process was completed, the system automatically separated the dentin particles into two compartments. The upper drawer, which retained approximately 90% of the total particles, collected fragments ranging between 300 and 1200 µm, a size range considered optimal for bone regeneration due to its ability to promote osteogenic interaction at the graft site. Meanwhile, finer particles, measuring less than 300 µm, were directed into a lower compartment. Given their small size and faster resorption potential, these finer particles were generally not used for augmentation (Figure 2b).

Once the dentin particles were collected, they were carefully transferred into a sterile glass container, where they underwent a two-step chemical cleaning process to ensure their biocompatibility. The first step involved immersing the dentin particles in a solution containing 0.5M sodium hydroxide and 20% ethanol for 10 minutes. This solution effectively eliminated any remaining bacteria, dissolved organic contaminants, and neutralized potential pathogens, ensuring the graft material was free of biological residues. After the designated exposure time, the cleaning solution was removed by carefully absorbing it with sterile gauze (Figure 2c).

To further enhance the biocompatibility of the material, a saline phosphate buffer (PBS) solution was then introduced into the container. The dentin particles were left in contact with this solution for 3 minutes, allowing it to remove any residual traces of the previous cleaning agent while simultaneously restoring the material's pH to a physiological level of 7.2. This step was critical in ensuring the graft material would integrate successfully with the host bone without causing any adverse reactions. Once the PBS solution was fully absorbed with sterile gauze, the dentin particles were ready for immediate use in the post-extraction socket.

Through this standardized grinding and decontamination protocol, the autologous dentin graft was successfully transformed into a biocompatible, osteoconductive, and structurally stable material. By utilizing the patient's own dentin, this method provided a safe, efficient, and cost-effective alternative to conventional bone grafting materials, ensuring optimal conditions for alveolar ridge preservation and future implant placement.

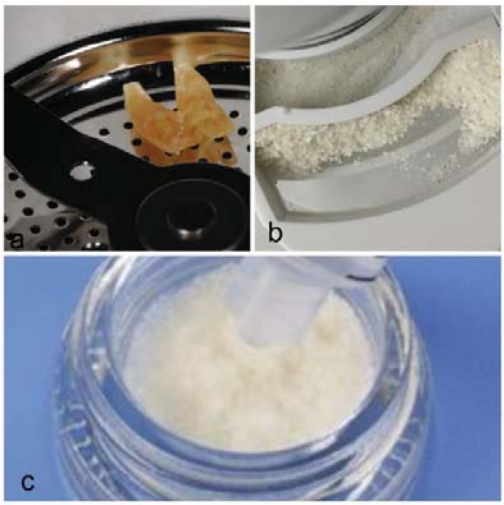

Figure 2. Grinding and Chemical Processing of the Extracted Tooth (a) The mechanically cleaned tooth inserted into the grinding chamber; (b) The dentin particles collected in the two compartments; (c) The dentin particles in the sterile container, subjected to the chemical cleaning process

Following the extraction of the non-restorable tooth, deemed unsuitable for preservation due to both prosthetic and periodontal considerations, the prepared autologous dentin graft material was immediately utilized for alveolar ridge augmentation. The decontaminated and processed dentin particles were carefully introduced into the post-extraction socket, ensuring complete filling of the defect to promote optimal bone regeneration and dimensional stability. Subsequently, the surgical site was meticulously sutured to secure the graft and facilitate uneventful healing (Figure. 3b).

To monitor the integration and effectiveness of the augmentation procedure, radiographic evaluations were conducted at scheduled follow-up intervals, specifically at 3 weeks and 6 months post-operatively. These imaging assessments allowed for the detailed observation of graft incorporation, bone remodeling, and volumetric stability of the alveolar. ridge, providing essential data on the regenerative outcomes of the autologous dentin grafting approach (Figure.3a, b, c).

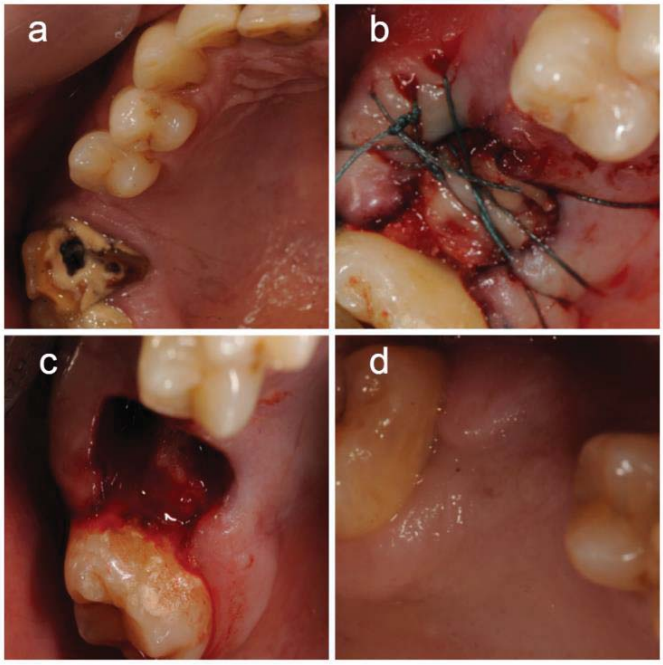

Figure 3. Clinical Stages of Tooth Extraction and Socket Augmentation (a) The initial condition of tooth 1.7; (b) Post-extraction socket; (c) Post-extraction socket; (d) The appearance of the alveolar ridge 6 months after augmentation

At the six-month follow-up evaluation following post-extraction socket augmentation with autologous dentin particles, clinical and radiographic assessments demonstrated that the alveolar ridge dimensions were well preserved. The height and width of the ridge remained comparable to the values recorded at the three-week post-operative interval, suggesting minimal volumetric changes and effective stabilization of the grafted site.

Radiographic examinations further revealed the presence of ankylosed bone tissue on the surface of the augmented dentin matrix. This observation indicates a successful osseointegration process, where the grafted dentin had undergone progressive incorporation into the surrounding bone structure, effectively contributing to alveolar ridge reconstruction. The resulting ridge dimensions were optimal for prosthetic rehabilitation, ensuring sufficient bone volume for future implant placement (Figure 4).

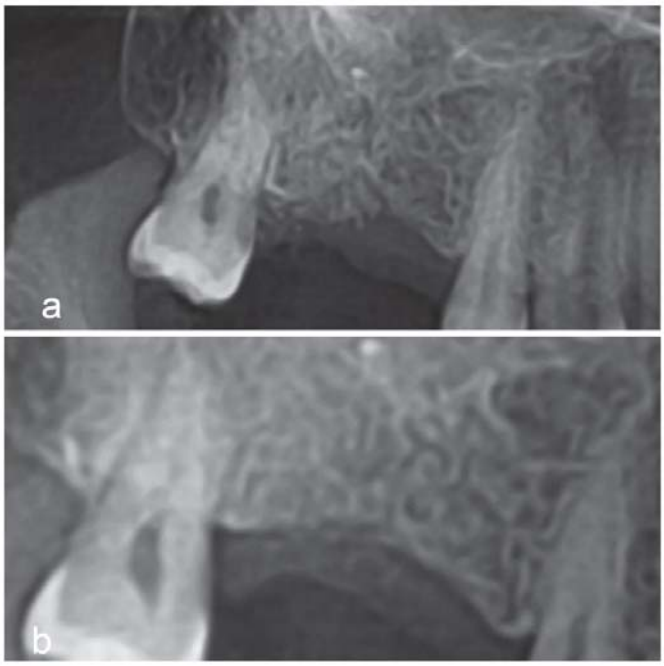

Figure 4. Radiographic Evaluation of Post-Extraction Socket Augmentation (a) Radiographic image three weeks after post-extraction socket augmentation; (b) Radiographic image six months after post-extraction socket augmentation

These results demonstrate an adequate esthetic and functional efficacy of this autologous augmentation material, making it suitable for use in a wide variety of clinical cases.

DISCUSSIONS

In all the studied cases, patients showed stable soft and hard tissue volume after augmentation with autologous dentin particles prepared through the Smart Dentin Grinder (KometaBio) method, as well as good integration of titanium implants, which were placed in the alveolus augmented with autologous dentin. The use of autologous dentin bone grafts and xenogeneic bone grafts for post-extraction socket augmentation and for alveolar bone defects after tooth extractions has been extensively studied. Preserving the alveolar ridge refers primarily to using available methods to prevent bone atrophy following tooth extraction [12].

From a biological standpoint, autologous addition implants are still considered the optimal bone augmentation material due to their osteogenic, osteoconductive, and osteoinductive properties. However, especially in the case of small defects, the potential impairment of the harvesting site, the limited availability of bone graft volume, and the fact that the patient is subjected to an additional surgical stage for harvesting autologous bone tissue, have resulted in an increased use of xenogeneic biomaterials as addition implants, such as demineralized bovine bone substitutes (DBBS - Bio-Oss), a widely used material [13, 14].

These non-resorbable biomaterials have great potential in maintaining alveolar ridge dimensions, behaving as a scaffold, a base structure for the deposition of newly formed bone tissue. Although DBBS presents a high osteoconductive potential and there is evidence that it is as effective as autologous grafts, either alone or combined with autologous addition material, it has the major disadvantage of having an incomplete and slow resorption rate.

Additionally, the use of these types of bone augmentation implants (such as xenografts - DBBS, Bio-Oss) increases treatment costs, making the procedure less accessible to a larger number of patients [15, 16].

Taking all these factors into consideration, it is interesting and necessary to test alternative bone augmentation materials that can reduce the cost of post-extraction socket preservation procedures, making them more accessible to more patients, while also improving the outcome in terms of quality and quantity of newly formed bone tissue [17, 18].

An impressive number of clinical studies have demonstrated that replanted teeth, after their endodontic treatment, are subject to the phenomenon of bone ankylosis, and dentin is gradually replaced by bone tissue. It is well known that dentin and bone tissue have a similar organic and inorganic structure. Recent studies have focused on the potential of dentin to substitute bone tissue both at the post-extraction socket level and for correcting defects at the alveolar ridge [19, 20].

It has been demonstrated that dentin, used as a material for autologous particulate augmentation or in the form of a dentin block, is capable of inducing bone remodeling as a result of its osteoinductive, osteoconductive, and osteo-neoformation properties. In addition to these advantages, in vitro studies have shown that proteins extracted from dentin influence the proliferation and differentiation of osteoprogenitor cells. The results suggested that TGF-β, likely in combination with other factors and constituents from dentin, are capable of regulating cellular behavior and, therefore, can influence the development, remodeling, and regeneration of mineralized bone tissue [21-23].

In humans, the use of a bone augmentation material made from autologous particulate dentin in the post-extraction socket and in alveolar ridge bone defects has demonstrated osteoconductive and osteogenic properties, resulting in high-quality bone tissue that allows for implant therapy after a short osteointegration waiting period [24, 25].

CONCLUSIONS

The use of extracted teeth as a bone augmentation material offers many advantages for the clinician. The material is completely autologous and contains mineralized tissue similar to bone, with a series of bioactive growth factors in the dentin matrix, additionally having the advantage of presenting no risk of disease transmission.

Based on the results obtained from preclinical data, dentin can be successfully ground into particles ranging from 300 to 1200 μm and added to the post-extraction socket or to bone defects in the alveolar ridge, where the material is gradually resorbed over time. Due to its mineral content, dentin particles are used as a material with a low substitution rate, which limits the dimensional changes that occur after extraction, especially in comparison to materials with a rapid absorption rate that are commonly used for augmentation.

Within the limits of the cases and arguments presented in this series, it has been demonstrated that autologous dentin particles used for post-extraction socket preservation can be an excellent alternative that successfully replaces autologous bone grafts, as demonstrated above with numerous advantages over other bone augmentation materials.

However, further randomized studies are necessary to confirm the advantages of this treatment option, as the method is still in its early stages. Future clinical studies are underway to investigate the regenerative potential of dentin in comparison with other standard biomaterials indicated for different clinical cases that require optimal bone levels and/or periodontal regeneration.

Conflicts of Interest

The authors declare no conflict of interest.

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