

PRESERVATION OF DISTAL BONE DEFECT AFTER SURGICAL EXTRACTION OF IMPACTED THIRD MOLAR

Bunjamin XHAFERI, Jeton NEZIRI, Marija MITEVA, Aleksandar GAVRILOV

*Department of Oral surgery, Ss. Cyril and Methodius University in Skopje Faculty of Dentistry – Skopje
Corresponding author e-mail: jeton.neziri@unite.edu.mk

Abstract

Extracted teeth are still considered a clinical waste and therefore being discarded. It is evident that obtained and prepared autogenous dentin graft (ADG) may be used for guided bone regeneration (GBR) because of similar biochemical characteristics to human bone.

Aim: To present a novel procedure in a clinical setting that employs freshly extracted teeth that are processed into a bacteria-free particulate dentin, and then grafted immediately into extraction sites or bone defects. Monitoring the clinical and radiological parameters in the postextraction defects of the alveolar ridges for a period of 6 months, proving the rapid healing capacity of ADG on the bone and soft tissue structures in the jaw bones.

Methods: Clinical measurements were performed using a questionnaire for monitoring the postoperative clinical manifestation, bone measuring calipers and for measuring the horizontal changes of the alveolar ridge and a graduated probe for measuring vertical dimensional changes, also paraclinical-radiological examinations to follow-up bone density.

Results: During the follow period of six months, clinical measurements of post-extraction dimensional changes of the alveolar ridges shows minimal horizontal and vertical bone resorption with preserved alveolar ridge volume, with an accelerated bone regenerative process without special postoperative complications.

Conclusion: Dentin particulate grafted immediately after extractions should be considered as the gold standard due to its osteogenetic, osteoinductive and osteoconductive effects on bone tissue regeneration.

Keywords: autologous dentin graft, bone substitutes, socket preservation, Smart dentin grinder.

1. Introduction

Different biomaterials (autograft, allograft, xenograft or alloplastic) have been used to stimulate or improve bone gain at post-extraction sites. Autogenous bone continues to be considered as golden standard in bone augmentation, as it is the only option that fulfills the criteria of osteogenesis, osteoconduction and osteoinduction^{1 2}. Nevertheless, it suffers several disadvantages due to its limited availability, unpredictable early resorption and associated morbidity at the donor site. To avoid the disadvantages of other graft materials, an alternative idea came to use their own extracted teeth to obtain a graft material that is completely identical to the bone autologous graft. Both alveolar bone in maxillofacial region (Intramembraneous bones-develop via osteoblasts or odontoblasts) and teeth embryologically are derived from the same neural crest cells and has similar biochemical contents and characteristics to human bone³.

The tooth as a complex organ is a rich source of stem progenitor cells, collagen fibers, metal ions, growth and development factors (BMPs, IGF, PDGF, TGF, etc). Dentin is present in 85% of the total tooth mass, in essence dentin is an acellular matrix unlike bone containing osteocytes. Although the tissue structures of bone and dentin are different, the ratio of components is similar (mineral 70%, collagen 20%, body fluid 10% by weight)⁴.

The first clinical case used in human body was sinus lifting - described in 2003 from Korean scientist Masaru Murata. From 2008 it has been used mainly for guided bone regeneration (GBR) in dental implants' osteointegration⁴.

Recycled teeth “**GREEN DENTISTRY**” can make the best overall graft material with best economical, clinical and biological value which are shown in this table:

<i>ECONOMIC VALUE</i>	<i>CLINICAL VALUE</i>	<i>BIOLOGICAL VALUE</i>
low cost graft matter	no immune reaction	Low resorption
Reduce graft inventory	Painless procedure	Excellent osseous ankyloses
Reduce no. of visits	Easy and simple process	Osteogenic,
Recycle teeth-Green Dentistry	“doggy bag” graft for future use	Slow release of GF over a long time
Graft volume/3 x	bacteria free/no disease transmission	Hard “cortical like” graft quality
Easy to explain	Quicker prosthetic restoration	Attract progenitor cells and contains stem cells

2. Methodology

PROTOCOL AND PROCEDURE FOR OBTAINING AND PREPARATION OF MINERALIZED DENTIN MATRIX (BASED ON ISRAELI BIOLOGICAL SCIENTIST ITZHAK BINDERMAN)

The process from tooth extraction until grafting takes approximately 15 minutes. Vital teeth without root canal fillings that are extracted due to advanced periodontal bone loss or other indications like wisdom teeth or orthodontics indications, are prepared for immediate grafting. Immediately after extraction, dental restorations, endodontic fillings should be removed. Also carious lesions remnants of periodontal ligament (PDL) and calculus should be reduced by a low or high speed handpiece and a tungsten burs or manually with a curette. Clean teeth including are dried by air syringe and sterile bandage, put into a grinding sterile chamber of a ‘Smart Dentin Grinder’®. SDG is capable in 3 seconds to grind the roots and then by vibrating movement of the grinding chamber for 20 seconds the particles of less than 1200 µm fall through a sieve to a lower chamber that keeps particles between 300-1200 µm. In the collecting drawer chamber dentin particles between 300-1200 µm are collected with various quantity of 1 - 2.5 g depending on which tooth serves as a source of receiving dentin graft material.

The particulate dentin from the drawer is immersed in basic alcohol for 5 - 10 minutes in a small sterile glass container. The basic alcohol cleanser consists of 0.5M of NaOH and 20% alcohol, this solution could defat and dissolve all organic waste and eliminates all types of bacteria, viruses etc. On the end of procedure is hydration and neutralization of pH value = 7.2 with PBS – sterile phosphate buffered saline (the same procedure is repeated twice for 1 min).



Figure 1. Required equipment and materials for obtaining autologous mineralized dentin graft.

The obtained and purified dentin particles are applied in the desired alveolar region with the help of a special instrument - a carrier or with a plastic instrument, the graft material is gently pressed with to condense in the alveoli. Once this has been done, a spongy fibrin-Gelatamp is placed on top to protect the applied graft material (ADG). This is followed by suturing with non-resorbable thread 4/0, which is removed after a period of 7 - 14 day ⁵. After surgery, all patients undergo one-week antibiotic therapy Amoxicillin cum ac.clavullonic 1000 mg, 1 tablet every 12 hours as well as non-steroidal anti-inflammatory analgesics, or Clindamycin 300 mg, 1 capsule every 8 hours. Patients are advised to irrigate the surgical wound daily with 0.2% chlorhexidine solution for 15 days.

CLINICAL PARAMETERS

Patients were evaluated at 1, 3, 7, 15 days and 3 months, postoperatively to assess wound healing. At these appointments, patients were given a questionnaire to evaluate postoperative pain, trismus, swelling and used of NSAID. It is also important to describe possible postoperative complications: infection, swelling, paresthesia, hematoma, dehiscence, etc.

-Measurement of the horizontal dimensions of the alveolar ridge is performed with a special instrument-Bone measuring calipers at 2 and 4 mm below the limbus alveolaris.

- Measurement of the index of apical-epithelial migration - AEM, clinical loss of attachment (distance from the enamel-cement border to the bottom of the sulcus) in the adjacent tooth distal to the second molar. That is, the depth of the formed intrabony-intraosseus defects will be measured during the extraction of the impacted wisdom tooth and at the same time the monitoring of that bone defect after augmentation with ADG. The measurement of the periodontal pocket is done with the help of a graduated periodontal probe.

These clinical measurements of dimensional changes in the alveolar ridge are performed intraoperatively and over a period of 3 and 6 months postoperatively.

PARACLINICAL-RADIOGRAPHIC EXAMINATION

-Panoramic radiographs were performed at 3 months postoperatively to evaluate bone regeneration and to exclude pathologies that might have occurred from surgery. An orthopantomogram was performed in 3 and 6 months postoperatively to measure bone density with Software Image J (version 1.36b issued by the American National Institutes of Health)

used to analyze ROI (numerical area of interest) values from 0-250 in 1 pixel of the image. Also, with the help of digital panoramix, vertical measurements of vertical bone defects are performed distally from the second molar.

3. Case Presentation

AUTOGENOUS DENTIN GRAFTING OF OSSEOUS DEFECTS DISTAL TO MANDIBULAR SECOND MOLARS AFTER EXTRACTION OF IMPACTED MANDIBULAR MOLARS – 38

In our scientific work were included 19 patients, Patient was willing to participate in the study, in good general health, without periodontal disease, and have at least one impacted molar teeth that was mesial inclined in relation to the second molar whereas the roots of the tooth 38 are in direct contact with the mandibular canal. The periodontal status of M2 after surgical extraction of an impacted third molar showed a drastic reduction of PD and intraosseous defect IBDs, starting from the intraoperative value (T1) with AT0 (4.12 ± 0.99 mm); after 3 months AT1 (1.57 ± 0.37 mm) and 6 months AT2 (1.17 ± 0.24 mm). The depth of IBDs on M2 a) AMDG/M2= $\Delta T1$ 4.19 ± 1.36 mm vs. 0.98 ± 0.33 mm vs. $\Delta T2$ 1.26 ± 0.34 mm (2,52 mm Bone Gain)



Figure 6. Pre-operative RTG imaging (mesially inclined 38)



Figure 7. 6 months Post-op, preservation of osseous defects distal to mandibular 2nd molars after extraction of impacted mandibular molars – 38

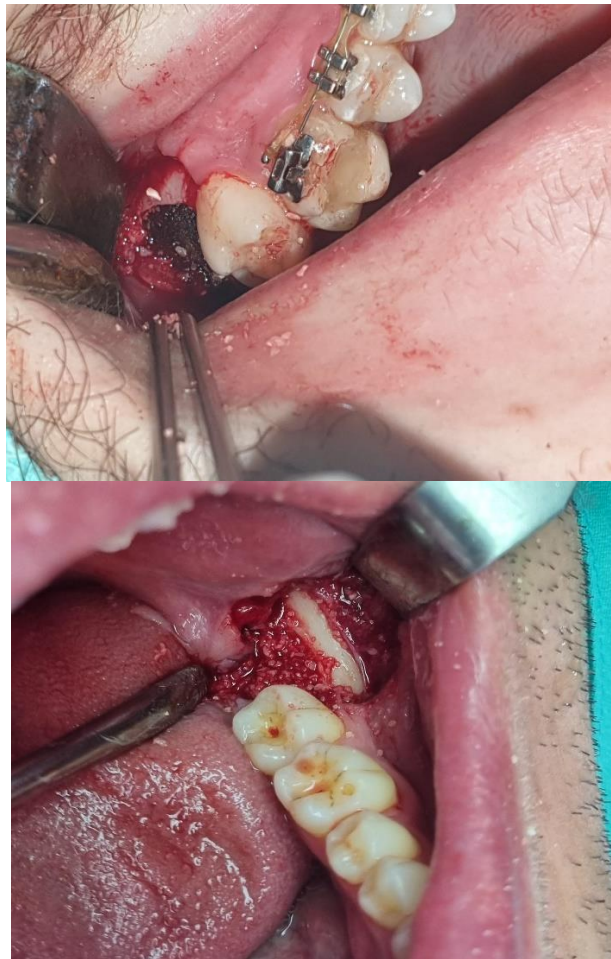


Figure 8, 9. Intra-op presentation of the preservation of osseous defect distal to the mandibular 2nd molars

After a period of 6 months, the index of AEM-apical epithelial migration of the adjacent tooth distal to the second molar during preservation with ADG measured with a graduated probe shows a value of 1 mm, ie there is complete coverage of the infrared defect created by osteotomy of the impacted mandibular molar. There is no possibility of damage to the

periodontium of the adjacent tooth 37 and increased sensitivity of the same. The roof of the mandibular canal was covered with autologous dentin graft.

Temporary paraesthesia of the left lower lip was observed postoperatively for a period of 3 weeks. Kugelberg and colleagues found that 2 years after surgery, 43.3% of cases exhibited probing pocket depths exceeding 7 mm, and 32.1% showed IBDs (infrabone defects) of more than 4 mm ⁶.

4. Discussion

A treatment option to reduce the risk of future periodontal pathology mesial to the IMMT surgical site is the use of osseous grafting to preserve the distal aspect of the second mandibular molar. Use of commercially available osseous grafting products, however, increases the cost of treatment for the patient, which may lead to refusal for that additional procedure. An ADG has been documented as a reliable graft source when socket preservation is being performed and for other osseous grafting applications, as it has been noted that large amounts of new woven bone formation were generated after 60 days of healing, and small amounts of lamellar bone were seen after 90 days.

Resorption of the ADG particles is slow (because of mineralized structure), which, therefore, assists in lamellar bone formation with stability of the resulting bone over time. Studies have supported that cortico-cancellous bone that formed was maintained successfully with an implant after an average follow-up of 5 year.

The use of autologous dentin graft significantly minimizes the resorption of the residual alveolar ridge as seen in our cases. This is confirmed by the thesis of Vittorini et al. who concludes that the preservation of the alveolar ridge is a significantly better treatment than in the cases without preservation, where there is less loss of vertical and horizontal bone. He specifically points out the need to preserve the alveolar ridge in highly aesthetic zones where the thickness of the buccal lamina is less than 1.5 mm – 2 mm, and in cases where anatomical structures such as the maxillary sinus and mandibular canal are in close proximity.

Impacted third molar extraction surgery, is a very common procedure for prophylactic orthodontic or therapeutic in the field of oral surgery ⁸. The frequency of impaction lies between 66% and 77% (Ge, J, 2017). Statistically, it's estimated that 20 million teeth are extracted each year just in USA 30% of teeth are extracted because of periodontal support and mobility 10 % of extracted teeth are wisdom teeth/impacted/. In most instances we dispose of these extracted teeth as biological waste instead to take advantage of the fantastic properties they possess. Standard surgical impacted third molar extraction could lead to a compromised periodontal status of the adjacent second molar, which might necessitate additional future surgical treatment.

Extracted teeth can no longer be considered as medical waste material due to the fact that in a short period of time can be obtained graft material with great safety and significant biological importance. With the use of mineralized dentin matrix we get maximum utilization of our own biological potential without the use of other artificial graft materials.

5. Conclusion

The use of grafting at the time of surgical extraction of impacted third molars can aid in the prevention of site resorption during healing and has been documented to result in formation of osseous tissues on the distal aspect of the adjacent second molar.

It is a cost-efficient approach for the patient and allows the surgeon to employ autologous bone grafting material, which is often preferable, for GBR (guided bone regeneration).

Clinical process of bone and soft tissue healing is accelerated and with a calm clinical flow without more pronounced edema and pain with relatively preserved vertical and horizontal dimensions of alveolar ridge.

Postoperative X-ray shows early formation of the new bone (trabeculae) with excellent osteointegration of the dental graft in the osseous defects in jaw bones.



MOTO: "BACK TO THE NATURE - USE THE POWER OF NATURE"



References

- [1] Haugen, H. J., Lyngstadaas, S. P., Rossi, F., & Perale, G. (2019). Bone grafts: which is the ideal biomaterial?. *Journal of clinical periodontology*, 46 Suppl 21, 92–102. <https://doi.org/10.1111/jcpe.13058>
- [2] Moussa, N. T., & Dym, H. (2020). Maxillofacial Bone Grafting Materials. *Dental clinics of North America*, 64(2), 473–490. <https://doi.org/10.1016/j.cden.2019.12.011>
- [3] Finkelman, R. D., Mohan, S., Jennings, J. C., Taylor, A. K., Jepsen, S., & Baylink, D. J. (1990). Quantitation of growth factors IGF-I, SGF/IGF-II, and TGF-beta in human dentin. *Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research*, 5(7), 717–723. <https://doi.org/10.1002/jbmr.5650050708>
- [4] Murata M, Akazawa T, Mitsugi M, Kabir MA, UM IW, et al. (2013) Autograft of dentin materials for bone regeneration. In: Pignatello R (Ed.), *Advances in Biomaterials Sciences and Biomedical Applications*. DOI: 10.5772/53665
- [5] Jeschke, M. G., Sandmann, G., Schubert, T., & Klein, D. (2005). Effect of oxidized regenerated cellulose/collagen matrix on dermal and epidermal healing and growth factors in an acute wound. *Wound repair and regeneration : official publication of the Wound Healing Society [and] the European Tissue Repair Society*, 13(3), 324–331. <https://doi.org/10.1111/j.1067-1927.2005.130316.x>
- [6] Kugelberg, C. F., Ahlström, U., Ericson, S., Hugoson, A., & Thilander, H. (1991). The influence of anatomical, pathophysiological and other factors on periodontal healing after impacted lower third molar surgery. A multiple regression analysis. *Journal of clinical periodontology*, 18(1), 37–43. <https://doi.org/10.1111/j.1600-051x.1991.tb01117.x>
- [7] Hayek, E., Aoun, G., Geha, H., & Nasseh, I. (2020). Image-based Bone Density Classification Using Fractal Dimensions and Histological Analysis of Implant Recipient Site. *Acta informatica medica : AIM : journal of the Society for Medical Informatics of Bosnia & Herzegovina : casopis Društva za medicinsku informatiku BiH*, 28(4), 272–277. <https://doi.org/10.5455/aim.2020.28.272-277>
- [8] Coleman, M., McCormick, A., & Laskin, D. M. (2011). The incidence of periodontal defects distal to the maxillary second molar after impacted third molar extraction. *Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons*, 69(2), 319–321. <https://doi.org/10.1016/j.joms.2010.10.011>
- [9] Ge, J., Yang, C., Zheng, J., & Hu, Y. (2017). Autogenous bone grafting for treatment of osseous defect after impacted mandibular third molar extraction: A randomized controlled trial. *Clinical implant dentistry and related research*, 19(3), 572–580. <https://doi.org/10.1111/cid.12466>
- [10] Schropp, L., Wenzel, A., Kostopoulos, L., & Karring, T. (2003). Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. *The International journal of periodontics & restorative dentistry*, 23(4), 313–323.
- [11] Ten Heggeler, J. M., Slot, D. E., & Van der Weijden, G. A. (2011). Effect of socket preservation therapies following tooth extraction in non-molar regions in humans: a systematic review. *Clinical oral implants research*, 22(8), 779–788. <https://doi.org/10.1111/j.1600-0501.2010.02064.x>
- [12] Kubilius, M., Kubilius, R., & Gleiznys, A. (2012). The preservation of alveolar bone ridge during tooth extraction. *Stomatologija*, 14(1), 3–11.