Autogenous demineralized dentin graft sited immediately after dental extraction

Deval Mehta[1], Jigar Dhuvad[2,*]

[1]Dean, [2]Assistnat Professor, [1]College of Dental Science and Research Centre, Ahmedabad, Gujarat, [2]Governemnt Dental College and Hospital, Ahmedabad, Gujarat, India

***Corresponding Author:** Dr. Jigar Dhuvad
Email: drjigardhuvad1981@gmail.com

Abstract

Introduction: To evaluate the clinical usefulness of autogenous fresh demineralized dentin (DDM) graft prepared at the chair side for alveolar bone grafting immediately after dental extractions.

Material and Methods: Under local anesthesia after clean extraction, caries or soft tissue debris were removed from extracted tooth. After removal of enamel, cementum, and pulp tissue, the clean and dry tooth mainly dentin, was immediately grinded with a help of 'mortar and pestle'. The demineralized dentin particulate of 0.5-2mm was immersed in basic alcohol cleanser in a sterile container to dissolve all organic debris and bacteria for 10 minutes. Then, the particulate was washed by sterile phosphate buffered saline (PBS). The bacteria-free particulate dentin was ready for immediate grafting into extraction sites.

Results: Gradual absorption of DDM granules and remodelled into new bone formation in the Orthopantomograph (OPG) showed favourable wound healing with excellent bone formation.

Conclusions: Chair side preparation of autogenous fresh demineralized dentin graft after extraction can be a useful alternative to the use of autogenous bone or other graft materials for the immediate reconstruction of alveolar bone defects to facilitate the future prosthesis and save the cost of graft to a patient which are commercially available in market.

Keywords: Dentin graft, Dental extraction, Bone Density, Autogenous graft.

Introduction

Tooth extraction is one of the most widely performed procedures in general dentistry and extracted sockets are usually left untreated for physiological healing all over the world. It has been well documented that inadequacy or failure of bone healing in the extraction sockets may occur due to absence of bone graft material. It is therefore not surprising that placement of a graft can accelerate the bony healing.[1] Tooth and bone shows similar chemical composition, therefore with the aim of clinical usefulness of socket preservation using autogenous fresh demineralized tooth (Auto-FDT) prepared at chair side in tooth extraction site.[2]

Material and Methods

To evaluate the efficacy of autogenous demineralized dentin graft in formation of new bone during the healing of extraction sockets. After taking written informed consent from patient who underwent tooth extraction was made to gargle with 0.1% chlorhexidine solution right before extraction and was instructed to gargle after every meal for 10 days following surgery.

After cleaned tooth extraction by a single operating surgeon, any soft tissue remnants adherent to the tooth root was removed using a surgical blade. Socket was irrigated with normal saline to remove bone debris/any follicle and the socket was prepared for the placement of graft. Carious lesions, restorations like crowns and fillings, discoloured dentin and calculus were reduced by airotor. The pulp tissue from the root canal(s) was removed. The teeth were washed with sterile normal saline. The clean and dry tooth, dentin, were immediately grinded (0.5-2mm) with a specially designed 'mortar and pestle' (Fig. 1), and then dentin particles were immersed in basic alcohol for 10 minutes in a sterile glass container for defatting, dissolving all organic debris, bacteria and toxins of the dentin particulate. The basic alcohol cleanser consisted of 0.5M of NaOH and 30% alcohol (v/v). After decanting the basic alcohol cleanser, the particulate was washed thrice, in sterile phosphate buffered saline. The PBS was decanted leaving wet particulate dentin ready to graft into freshly extracted sockets. The wound was closed primarily with 3–0 black braided silk. Osseous regeneration was evaluated with the help of standardized digital panorama radiographs at immediate after extraction and placement of graft, 1 month, 3 months and 6 months follow-up.

Fig. 1: Morter and Pestle to prepare DDM graft

Results

Immediately after tooth extraction till tooth preparation, demineralisation, washing and shifting of a

graft into sterile container takes approximately 18-20 minutes. (Fig. 2) The healing and recovery after surgical procedure and grafting was without complications. No signs of microbial infection, exudation, or dehiscence of the wound were observed. Probing was normal 1-2 mm in depth. A follow-up revealed a gradual absorption of DDM granules and remodelled into new bone formation in the OPG in the illustrated case of impacted tooth presence, its removal and follow-up. (Fig. 3-6)

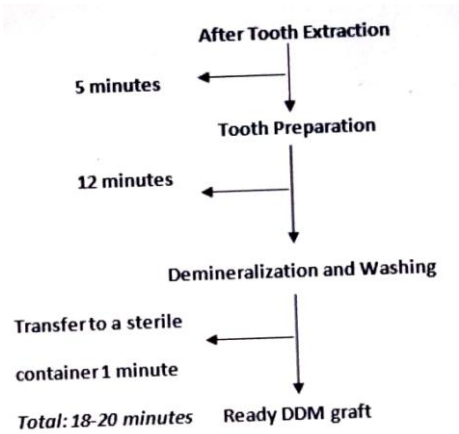

Fig. 2: Flow chart of time duration from tooth extraction up to ready graft (DDM)

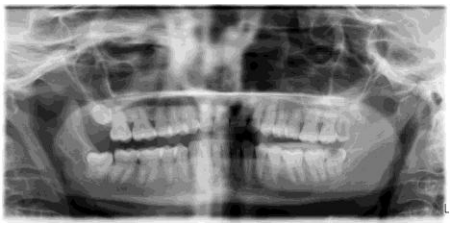

Fig. 3: Preoperative OPG shows lower left impacted tooth

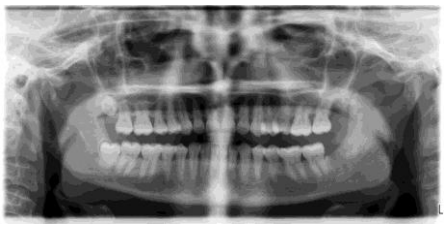

Fig. 4: Extraction sockets

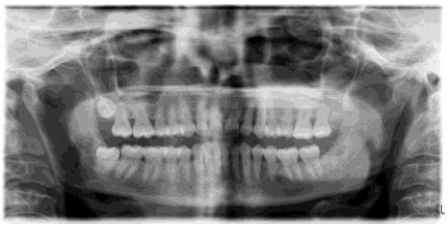

Fig. 5: Immediately after placement of Dentin Demineralized graft into extraction socket

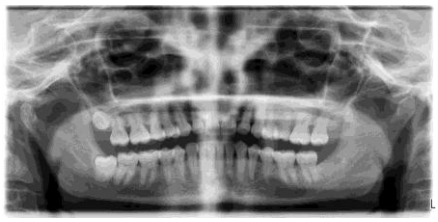

Fig. 6: Postoperative six month follow up

Discussion

Healthy non-functional teeth extracted from humans are considered as infective dental waste worldwide. Extracted sockets are usually left untreated for physiological healing all over the world. The postextraction bone loss, a physiological phenomenon takes place with alveolar resorption and the subsequent formation of bone within the socket.[3] During natural healing after extraction, reductions in width 2.6 - 4.6 mm and in height 0.4 - 3.9 mm were observed,[4] studies also have documented that the bone volume following extractions decreased by 50% within 12 months, and 2/3 of this resorption took place during the first 3 months.[5,6] This bone resorption results in a loss of socket width three-dimensionally that subsequently results in narrowing and shortening of the residual ridge hampering the native alveolar ridge contour.[7,8] Therefore, maintaining 3-dimensional alveolar bone volume is mandatory for ideal esthetic and functional outcomes.

A bone graft is an implanted material that promotes bone healing through osteoconduction, osteoinduction, and osteogenesis,[9] in alone or combination. The properties of ideal bone graft material: 1) osteoconduction, which provides scaffolds for bone regeneration; 1 2) osteoinduction, which promotes the recruitment of bone-forming cells, such as undifferentiated cells and preosteoblasts, and formation of bone from these cells;1,2 and 3) osteoproliferation, the induction of cells contained in the graft material to promote bone regeneration.[9,10]

Clinically various bone graft materials including allografts (e.g., demineralized freeze-dried bone allografts and freeze-dried bone allografts); xenografts, (e.g., bovine bone and coral); and alloplasts, (e.g., ceramics for biologic use, b-tricalcium phosphate [b-TCP] and hydroxyapatite) are available.[9] For allogenic and xenogenic bone there is a concern of contagion, and osteogenesis effect that is lower than autogenous bone.[11-13] There can be occult infections such as hepatitis or tuberculosis in the cadaver from which allogenic bone is obtained, while the bovine bone often used as the source of xenogenic bone can carry mad cow disease or other zoonoses. Synthetic bone has no risk of disease contagion as it is a manufactured product, but is capable only of osteoconduction.[14] Only autogenous bone exhibits all three properties therefore autogenous bone grafting is currently considered as the 'gold standard' method.[10] Various autografts according

to donor site from extraoral sites like iliac, fibula, calvarium and tibia, intraoral sites likes maxillary tuberosity, symphysis, coronoid, retromolar areas and zygomatic buttress are available. However, additional surgery is needed at the donor site, presenting a risk of complications such as infection or pain, and the collection amount has a limit.[10]

Teeth, cartilages, nerves, and maxillofacial bones all embryologically originated in the neural crest, sharing identical origin.[2] Teeth and bones share many similarities. Enamel has 96% inorganic substances and 4% water, dentin has 65% inorganic substances, 35% organic substances, and water, cementum has 45-50% inorganic substances, 50-55% organic substances, and water while alveolar bone has 65% inorganic and 35% organic substances. Consequently chemical compositions of teeth, especially dentin and bones, are very similar.

A raw tooth cannot easily induce new bone formation because of its high mineral content, high crystallinity, and low porosity, which may interfere with migration, attachment, and proliferation of vascular and mesenchymal cells. Therefore, decalcification of a tooth is mandatory before using as a bone graft.[15] A problem with demineralized dentin as a graft material is the time it takes to decalcify and produce as a bone graft material from teeth. Therefore, a solution which performs the decalcification faster with efficient bone formation is obligatory.

Bone remodelling continuously proceeds through the delicate regulation of two contrasting procedures: bone resorption by osteoclasts and bone formation by osteoblasts. In particular, tooth blocks require more processing time than tooth chips or powder.[16] The powder type is believed to be resorbed more slowly than the other two types, as the time of demineralization is less than that of the block type, which makes it possible to maintain a space for bone formation.[17]

Bone graft materials with different particle sizes exhibit different bone-healing abilities. Although still controversial, some studies suggest that the smaller the particle size of the material, the greater the formation of bone. The reasons for this are said to be that smaller particles increase the available surface area, and more growth factors of various kinds are secreted to facilitate the formation of new blood vessels and accelerate the differentiation of mesenchymal cells into osteoblasts, thus assisting the process of bone formation.[18, 19] Arafat Kabir et al found newly formed tissues were evident from the 3-month follow-up after using 0.5-2mm of Auto BT powder.[3] In our patients 0.5-2 mm particles size of the demineralized dentin graft had also shown the excellent remodelled bone formation with gradual absorption of DDM granules, which can be appreciated on measuring bone densities at regular time intervals up to 6 months.

Conclusion

Chair side preparation of autogenous fresh demineralized dentin graft after extraction can be a useful alternative to the use of autogenous bone or other graft materials for the immediate reconstruction of alveolar bone defects to facilitate the future prosthesis and save the cost of graft to a patient which are commercially available in market.

Conflict of interest: The authors hereby wish to state that this paper does not have any financial and personal relationships with other people or organisations that could inappropriately influence (bias) their work.
Funding: None

References

1. Binderman I, Hallel G, Nardy C, Yaffe A, Sapoznikov L. A Novel Procedure to Process Extracted Teeth for Immediate Grafting of Autogenous Dentin. J Interdiscipl Med Dent Sci 2014;2:154.
2. Young-Kyun Kim, Junho Lee, In-Woong Um, Kyung-Wook Kim, Masaru Murata, Toshiyuki Akazawa, Masaharu Mitsug. Tooth-derived bone graft material. J Korean Assoc Oral Maxillofac Surg 2013;39:103-11.
3. Kabir MA, Murata M, Kusano K, Akazawa T, Shibata T. Autogenous Demineralized Dentin Graft for Third Molar Socket Regeneration - A Case Report. Dent 2015;5:343.
4. Ten Heggeler JMAG, Slot DE, Van der Wijden GA. Effect of socket preservation therapies following tooth extraction in non-molar regions in humans: a systematic review. Clin Oral Implants Res 2011;23:779 -88.
5. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent 2003;23:313-23.
6. Van der Weijden F, Dell'Acqua F, Slot DE. Alveolar bone dimensional changes of post-extraction sockets in humans: a systematic review. J Clin Periodontol 2009;36:1048-58.
7. Atwood DA, Coy WA. Clinical, cephalometric and densitometric study of reduction of residual ridges. J Prosthet Dent 1971;26:280-95.
8. Watt DM, Likeman PR.Morphological changes in the denture bearing area following the extraction of maxillary teeth. Br Dent J 1974;136:225-35.
9. Monthira Saebe. Mini-review: Dentin as bone graft substitution Songklanakarin Dent J 2014;2(1):21-7.
10. Tomoki Nampo, Junichi Watahiki, Akiko Enomoto, Tomohiro Taguchi, Miki Ono, Haruhisa Nakano, Gou Yamamoto, Tarou Irie, Tetsuhiko Tachikawa,and Koutaro Maki. A New Method for Alveolar Bone Repair Using Extracted Teeth for the Graft Material. J Periodontol 2010;81:1264-72.
11. Quattlebaum JB, Mellonig JT, Hensel NF. Antigenicity of freeze-dried cortical bone allograft in human periodontal osseous defects. J Periodontol 1988;59:394-97.
12. Schwartz Z, Mellonig JT, Carnes DL Jr, et al. Ability of commercial demineralized freeze-dried bone allograft to induce new bone formation. J Periodontol 1996;67:918-26.
13. Sogal A, Tofe AJ. Risk assessment of bovine spongiform encephalopathy transmission through bone graft material derived from bovine bone used for dental applications. J Periodontol 1999;70:1053-63.

14. Han T, Carranza FA Jr, Kenney EB. Calcium phosphate ceramics in dentistry: a review of the literature. J West Soc Periodontol Periodontal Abstr 1984;32:88-108.
15. Yeomans JD, Urist MR. Bone induction by demineralized dentine implanted into oral, osseous and muscle tissues. Arch Oral Biol 1967; 12:999–1008.
16. Eun-Young Lee, Eun-Suk Kim, Kyung-Won Kim. Scanning electron microscopy and energy dispersive X-ray spectroscopy studies on processed tooth graft material by vacuum-ultrasonic acceleration. Maxillofac Plast Reconstr Surg 2014;36(3):103-10
17. Eun-Suk Kim, In-Kyung Lee, Ji-Yeon Kang and Eun-Young Lee. Various autogenous fresh demineralized tooth forms for alveolar socket preservation in anterior tooth extraction sites: a series of 4 cases. Maxillofac Plastic Reconstructive Surg 2015;37:27
18. Borstlap WA, Heidbuchel KL, Freihofer HP, KuijpersJagtman AM. Early secondary bone grafting of alveolar cleft defects. A comparison between chin and rib grafts. J Craniomaxillofac Surg 1990;18:201-05.
19. Kim YK, Kim SG, Oh JS, Jin SC, Son JS, Kim SY, Lim SY. Analysis of the inorganic component of autogenous tooth bone graft material. J Nanosci Nanotechnol 2011;11:7442-45.

Conflict of interest: None

Funding: None

Cite this Article as:
Mehta D, Dhuvad J. Autogenous demineralized dentin graft sited immediately after dental extraction. Natl J Integr Res Med 2018; 9(5):30-33