

Extracted teeth: clinical waste or treasure? Review and Technical note

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ABSTRACT

In search of a new gold standard graft material with low technique sensitivity, yet possessing the ideal characteristics of osteoconductivity, osteoinductivity, osteogenicity, and biocompatibility, many researchers have focused on human teeth, particularly dentin as an autogenous graft material. A search was done in PubMed and Google Scholar databases for studies done within the last ten years from 2013 to March 2023 using autogenous tooth graft prepared at chairside in various clinical applications. The scientific basis, preparation, clinical applications, histological examination, and limitations of autogenous dentin grafting material are discussed. In addition, the authors' own protocol for chairside preparation of the demineralized dentin graft is described.

INTRODUCTION

Among various graft materials, autogenous bone is considered as the gold standard for its osteogenic potential, and rapid healing time without immune rejection. Its biggest shortcomings, however, are the limited harvest amount, unavoidable bone resorption after grafting, and a second defect generated in the donor area. (1)

Therefore, to overcome such shortcomings, allogenic, xenogenic, and alloplastic graft materials have been used as alternatives, but they have several drawbacks compared with autogenous grafts, such as decreased function, the potential risk of infectious disease, an unsatisfactory resorption pattern, a prolonged healing time, and high cost. (2)

In search of a new gold standard graft material with low technique sensitivity, yet possessing the ideal characteristics of osteoconductivity, osteoinductivity, osteogenicity, and biocompatibility, many researchers have focused on human teeth, particularly dentin as an autogenous graft material. (3)

Although teeth and maxillofacial bones all embryologically originated in the neural crest, and share similar chemical composition, extracted teeth are still considered as medical waste products that require special handling and disposal methods. (4)

In dentin, the inorganic content is 70 - 75%, whereas the organic content is about 20%. In alveolar bone, the inorganic content is 65%, and the organic content is 35%. At least 90% of organic content of dentin is type I collagen, which plays an important role in bone formation and mineralization. (5)

In the organic parts, dentin and cementum include type I collagen and various growth factors such as bone morphogenic proteins (BMPs). About 90% of the organic components of tissues are made up of type I collagen, with the other components being non-collagenous proteins (NCP), biopolymers, lipids, citrate, lactate, etc. NCPs include glycoprotein, sialoprotein, and phosphophoryn, osteocalcin, dentin matrix protein-1, osteopontin (OPN), proteoglycan, osteopontin (OPN), osterix, and Cbfa1 (Runx2). These proteins are known to trigger the bone resorption and generation processes. (6)

An interesting study in 2020 by Gowda et al (7) has revealed that demineralized tooth grafts prepared from teeth of younger persons contain more dense hydroxyapatite crystals and higher calcium/phosphate ratio than older subjects when exposed to inorganic analysis using Energy dispersive X-ray spectroscopy (EDX). Protein content of tooth samples measured by Bradford assay in the same study has shown higher protein in females' teeth regardless of age.

This review discusses studies published in PubMed and Google Scholar during the last ten years about autogenous tooth graft prepared at chairside and its various clinical applications. In addition, the authors present their own protocol for chairside preparation of autogenous tooth graft.

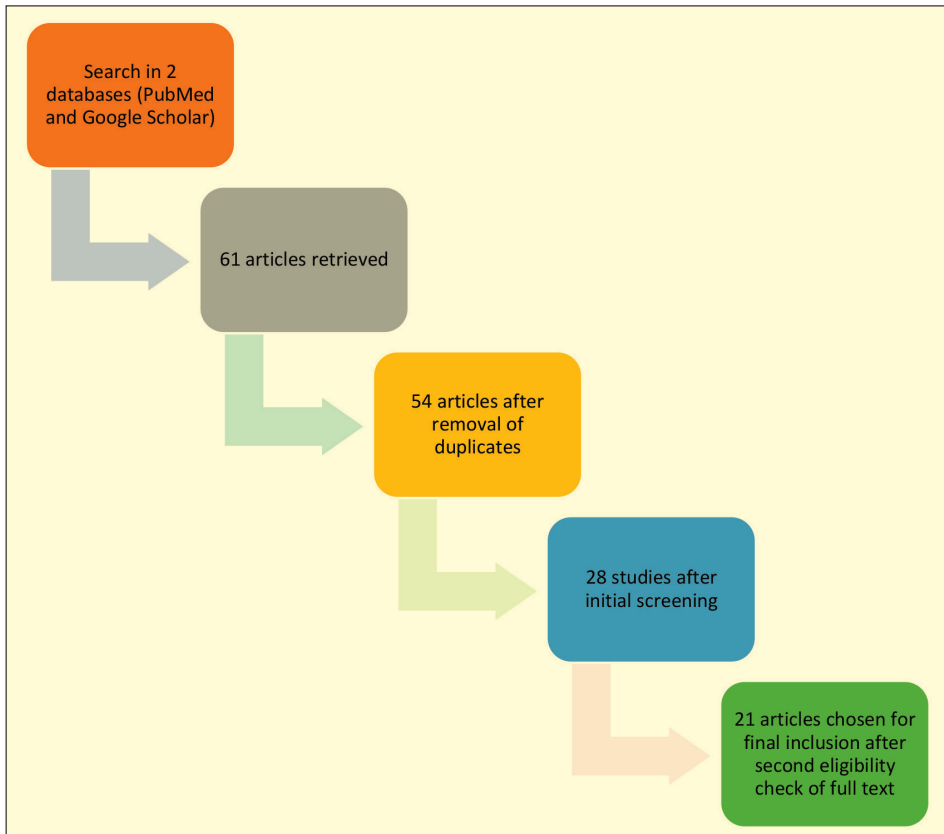


FIG. 1
Flowchart of results after application of search strategy

MATERIALS AND METHODS

Search strategy

A search was done in PubMed and Google Scholar databases for studies using autogenous tooth graft prepared at chairside in various clinical applications.

The search was limited to studies in English language published within the last ten years (from 2013 to March 2023). Randomized controlled trials, clinical trials, cohort studies, and case series were included. Reviews, letters, in vitro studies, case reports and book chapters were excluded.

The following keywords were used for the search "autogenous tooth graft" OR "autogenous dentin graft" AND "chairside". Terms have been searched for in the title and abstract fields. After screening of the title and abstract, if no sufficient information could be yielded, the full text was obtained to determine the validity of the study for inclusion in our review.

RESULTS (fig. 1)

A total of sixty-one articles have been retrieved: fifteen studies were obtained from the PubMed database search and forty-six studies from Google Scholar search. After removal of duplicates and thorough screening, only twenty-one studies (8-28) which fulfilled the eligibility criteria, have been selected for inclusion in our review. Their summary is presented in table 1.

DISCUSSION

Based on the potentials of osteoconduction, osteoinduction, and osteogenesis through growth factors in tooth and similar histogenesis between tooth and bone, multiple research projects were conducted to standardize the process of autogenous tooth graft preparation. (22, 24, 29, 30)

The process of graft preparation should produce sterile autogenous graft material that retains most of the original properties of dentine and improves its osteoconductive, osteoinductive potential through mechanical and chemical processing. The mechanical processing aims at removal of old restorations, caries, and cementum followed by grinding of the tooth substance to nearly uniform particle size. The chemical processing aims at sterilizing and demineralizing the graft particles to expose the dentine organic matrix containing bone morphogenic protein type 1 and bone regulating proteins.(22, 24)

Different techniques for autogenous tooth graft preparation

Different methods of dentine graft preparation either in the form of blocks or particles has been described throughout the literature. (31) Generally, the preparation methods fall within three main categories: mineralized, partially demineralized, and demineralized. (32)

All preparation methods usually start with removing any caries, old restorations, periodontal ligament, and cementum followed by grinding and sieving the tooth particles to the desired size. (31, 32)

Author(s)	Year	Type of autogenous tooth graft	Number of participants	Aim of study	Parameters measured	Results
Kim ES	2015	autogenous fresh demineralized tooth (auto-FDT) graft [blocks or chips]	38 patients	Evaluation of the clinical usefulness of autogenous fresh demineralized tooth (auto-FDT) graft prepared at the chairside for alveolar bone grafting during dental implant surgery	<ul style="list-style-type: none"> Clinical findings Implant success rate Histological evaluation 	<ul style="list-style-type: none"> Favourable wound healing with minimal complications Good bone support for the implants. No implant was lost after 12 months of function following prosthetic rehabilitation. Histological examination revealed new bone formation induced by the graft material.
Wushou et al	2022	Autogenous tooth graft powder prepared chairside from extracted mandibular third molar	5 patients (split-mouth pilot study)	Introduction of a novel method for repairing the distal osseous defects of M2 after the surgical removal of M3 with autogenous tooth graft powder (ATGP)	<ul style="list-style-type: none"> Wound healing Trismus and swelling Bone filling of the defect Probing pocket depth 	<ul style="list-style-type: none"> Primary wound healing without complications achieved in all the patients. Greater tendency for swelling of the cheeks and trismus at the experimental site on the third postoperative day. Compared with the control site, the experimental site exhibited progressive bone filling and ossification in the sixth postoperative month. probing pocket depth of the experimental site lower than that of the control site.
Upadhyay P et al	2019	Autogenous tooth graft prepared at chairside from a freshly extracted tooth	3 patients, with at least one mandibular molar with Class II furcation involvement (a total of 5 sites)	Clinical evaluation of autogenous tooth graft (ATG) as a novel bone graft material in the treatment of Class II furcation defects.	<ul style="list-style-type: none"> Mean reductions in horizontal probing depth. Mean gains in linear bone-fill 	At 9 and 12 months: <ul style="list-style-type: none"> The mean reductions in horizontal probing depth were (1.40 ± 0.57 mm) and (1.52 ± 0.59 mm), respectively. The mean gains in linear bone-fill were (3.90 ± 0.15 mm) and (5.33 ± 0.10 mm), respectively.
Dwivedi A and Kour M	2020	Autogenous fresh mineralized tooth graft prepared at the chairside.	30 patients	Alveolar ridge preservation using autogenous fresh mineralized tooth graft prepared at chair side	<ul style="list-style-type: none"> Radiographic evaluation of alveolar ridge preservation was performed using a 3D imaging technique. Histological evaluation 	<ul style="list-style-type: none"> statistically significant differences in mean alveolar height and alveolar width on pre- and post-operative CBCT scans. histological semi-quantitative analysis revealed 34–66% of new bone formation in 40% of cases.
Wu D et al	2019	Autogenous tooth bone made from the extracted teeth by chair-side	30 patients	Comparison of the efficacy of the autogenous tooth bone and xenogenic bone grafted in immediate implant placement in anterior teeth with bone defect.	<ul style="list-style-type: none"> Clinical examination Radiographic assessment of the horizontal bone change in the level of 0 mm, 3 mm and 6 mm below the implant neck and the marginal bone loss immediately, 6 and 12 months after implant placement. Questionnaire of the feelings about the surgery at the time of removing the sutures 	<ul style="list-style-type: none"> All implants achieved the success criteria without any complications The percent of the horizontal bone change and the marginal bone loss at 6 and 12 months were almost the same between two groups (P > .05). The horizontal bone loss at the 6 mm level was less than the 0 mm and 3 mm levels at 6 and 12 months (P < .05). Patients seem more satisfied with the autogenous tooth bone
Li P et al	2018	Autogenous DDM (Demineralized Dentin matrix) granules from the extracted tooth	40 patients	Evaluation of the clinical efficacy of autogenous DDM versus Bio-Oss granules in guided bone regeneration (GBR) for immediate implantation in periodontal post-extraction sites	Immediately, at 6 and 18 months after surgery: <ul style="list-style-type: none"> Implant stability Marginal bone resorption 	There was no statistically significant difference between the 2 groups in implant stability quotient values and marginal bone resorption.
Kim ES et al	2015	autogenous fresh demineralized tooth (block, chip, or powder)	4 cases	Evaluation of the clinical relevance of autogenous fresh demineralized tooth (Auto-FDT) prepared at chairside immediately after extraction for socket preservation	<ul style="list-style-type: none"> Radiographic evaluation Histological evaluation of 2 samples 	<ul style="list-style-type: none"> Radiographs showed good bony healing. Histologic sections showed good new bone formation and resorption pattern of the autogenous fresh demineralized tooth (Auto-FDT).

TABLE 1 Studies included in the review

Yüceer-Çetiner E et al	2021	autogenous dentin graft	57 extraction sockets in 9 patients	Analysis of the effects of autogenous dentin graft and mixture of autogenous dentin graft and platelet-rich fibrin (PRF) applied to the tooth extraction sockets on bone healing process.	<ul style="list-style-type: none"> After 3 months, histological and immunohistochemical evaluations on the samples taken during the implant surgery. Samples obtained from each group examined by scanning electron microscopy. 	<ul style="list-style-type: none"> Histological findings supported by immunohistochemical results showing increased bone morphogenetic protein-2 and Runt-related transcription factor-2 expression in Group DP (PRF+ autogenous dentin graft)
Minetti E et al	2022	autogenous dentin particulate graft	6 patients	Histological comparison of bone after an alveolar ridge augmentation using an autogenous dentin particulate graft with and without a resorbable collagen membrane.	<ul style="list-style-type: none"> Histomorphometric analysis 	<ul style="list-style-type: none"> Membrane group presented 45% of bone volume, 38% of vital bone, and 7% of residual graft. Membrane-free regenerative procedures demonstrated 37% of bone volume, 9% of vital bone, and 27% of non-resorbed graft
Sánchez-Labrador L et al	2020	Autogenous Dentin Graft	15 patients underwent bilateral extraction surgery (30 third molars)	evaluation of autogenous dentin graft in bone defects after lower third molar extraction (a split-mouth clinical trial)	<ul style="list-style-type: none"> Evaluating probing depth at three and six months post-operatively. Bone density and alveolar bone crest maintenance evaluated six months after surgery Pain, inflammation, mouth opening capacity on the second and seventh days after surgery. 	<ul style="list-style-type: none"> Probing depth, radiographic bone density, and alveolar bone crest maintenance showed significant differences between the test and control sides.
Abo-ElSaad M et al	2023	Autogenous demineralized dentin graft	8 patients (split-mouth)	Comparison of autogenous dentin graft versus alloplastic graft combined with socket shield for pre-implant socket preservation	<ul style="list-style-type: none"> Histological analysis Histomorphometric analysis radiographic analysis 	<ul style="list-style-type: none"> The percentage of newly formed bone significantly higher in the dentin group. Radiographically, no significant difference in the mean percentage increase in bone density or change in mean labial bone between the two groups.
Kuperschlag A et al	2020	autogenous dentin graft	13 patients	Evaluation of osseous healing following guided bone regeneration treatment of osseous defects distal to mandibular second molars after surgical removal of impacted mesioangularly or horizontally inclined third molars using the processed third molar as the graft material	<ul style="list-style-type: none"> Clinical and radiological examinations, including panoramic radiographs and probing depths at 3 months and 12 months postoperatively. 	<ul style="list-style-type: none"> At 12 months postoperative the study group showed probing distal to the second molar with a mean depth of 1.15 mm, whereas the control group showed probing with a mean depth of 4.45 mm
Fathy AM et al	2019	mineralized dentin particulate graft	20 patients	Evaluation of the effect of using mineralized dentin particulate graft for socket preservation	<p>CBCT images used to:</p> <ul style="list-style-type: none"> compare horizontal and vertical ridge dimensions. And bone density values immediately post-operative and after 6 months of extraction 	<ul style="list-style-type: none"> Decrease of vertical and horizontal ridge dimensions in control group was statistically significantly higher than that in graft group. Bone density of graft group was statistically significantly higher than that of the control group after 6 months
Gupta PS et al	2022	processed dentin particulate graft	15 patients	Comparison of the efficacy of the dentin autograft with autogenous bone graft for preservation of socket defect after removal of mandibular third molars	<ul style="list-style-type: none"> Clinical and radiographic evaluation 	<ul style="list-style-type: none"> Dentin graft had regenerative properties and showed potential for ridge preservation
Melek LN and El Said MM	2017	Autogenous fresh demineralized tooth graft	10 patients	Evaluation of the use of autogenous tooth bone graft material in combination with injectable platelet-rich fibrin for reconstruction of resorbed maxillary alveolar ridge	<ul style="list-style-type: none"> clinical evaluation radiographical evaluation (bone density, volumetric analysis, and linear measurements of alveolar ridge) 	<ul style="list-style-type: none"> The grafted site showed an increase in the mean volume by 23.47% three months post-operative and 30 % increase in mean bone density after 6 months compared to the base line measurements preoperative. The alveolar ridge after 3 months of grafting showed a significant mean increase in the ridge width and height at the grafted site.

TABLE 1 Studies included in the review

Shoeib et al (preprint)	2022	Demineralized dentin particles	16 patients	Evaluation of soft tissue aesthetics around immediate dental implants with dentin chips versus xenograft in thin buccal bone.	<ul style="list-style-type: none"> • Pink aesthetic scores on loading at 6 months & after 1 year of implant insertion. • Buccal bone and crestal bone resorption measured using CBCT at 6 months & one year. • Implant stability measured immediately on implant insertion & before loading. 	<ul style="list-style-type: none"> • The overall difference between the control and the intervention groups showed no statistical significance.
El-Said et al	2017	autogenous fresh demineralized tooth (AFDT) graft	10 patients	Evaluation of the efficiency of autogenous fresh demineralized tooth (AFDT) graft prepared at the chairside for alveolar bone grafting in fresh extracted sockets for dental implant surgery	<ul style="list-style-type: none"> • Clinical evaluation • Radiological evaluation • Histological evaluation 	<ul style="list-style-type: none"> • Histologically the osteoconductive, osteoinductive and Biodegradation of (AFDT) graft was evident. • Clinically 100 % success rate of implants was achieved. • CBCT have shown increase of bone density at the graft site and preservation of marginal bone level around implants.
Gabr et al	2022	autogenous fresh tooth graft	12 patients	comparison between autogenous fresh tooth graft with/ without platelet rich fibrin around immediate dental implant.	<ul style="list-style-type: none"> • Peri-implant probing depth. • Implant stability • Radiographic evaluation of vertical and horizontal dimensional changes 	<ul style="list-style-type: none"> • There was a statistically significant difference between the two groups in favour of the graft/PRF combination group.

TABLE 1 Studies included in the review

Mineralized dentine graft preparation method will maintain the mineral content of the tooth graft and limit the chemical processing to graft disinfection using absolute alcohol and sodium bicarbonate. (33)

While partial demineralization method will expose the dentine particles to diluted acids to remove part of the mineral content of the tooth graft to expose organic dentine matrix that contains osteocalcin and osteonectin and other bone regulating proteins. (34, 35)

Total demineralization of dentine graft will require prolonged exposure of dentine graft to diluted acids under vacuum to eliminate most of the inorganic components of the graft keeping only the organic dentine matrix. (12) The graft particles then can be used alone or in combination with other materials like injectable PRF as a scaffold for bioengineering. (12, 22)

The authors' protocol for autogenous tooth graft preparation (18, 24, 36) [Figs. 2 - 3]

The pulp tissue, cementum, periodontal ligament, cavities, and any restorations are first eliminated. Then, using a 330 bur, 0.3 mm holes are created along the whole tooth surface. Using a pulverise grinder, the tooth is ground for three to ten seconds (Laymax grinder China). Then, tooth fragments are sieved to a particle size of 300 to 1200 microns using a Gilson stainless steel wire sieve made in the USA.

To get rid of any bacteria and smear layer, the sorted particles are submerged in 70% ethanol (EIGomhouria CO., Egypt) for 10 minutes in a sterile container (defatting and sterilization). After that demineralizing the tooth fragments with 2% HNO₃ (EIGomhouria CO., Egypt) for 20 minutes is done, and the dentine organic matrix is revealed. Peracetic Acid 5% (EIGomhouria CO., Egypt) which is a



FIG. 2 Extracted tooth preparation and grinding.



FIG. 3 Sieving for particle size selection followed by chemical processing to obtain the graft in its final form

highly biocidal oxidizer agent, is used to sterilize the graft particles at room temperature for 10 minutes to remove any remaining bacterial contamination. The bacteria-free particulate dentin is finally washed with phosphate buffered saline (El-Gomhouria CO., Egypt) twice for 5 minutes to restore the pH balance to 7.4. This protocol applied as a chairside procedure has revealed relative higher safety, less cost and better feasibility than other techniques used for preparation of autogenous tooth graft. (22, 24)

Microbiological examination of the graft by the authors

We performed a laboratory-based microbiological examination using twenty specimens to confirm sterility and suitability of the graft for immediate use after preparation. All microbial cultures were negative for microbial growth. This is most probably attributed to the use of peracetic acid which has a strong oxidizing action that helps to inhibit microbial growth by oxidizing the outer cell membranes of microorganisms including gram positive and gram-negative bacteria, fungi, and yeasts. (37)

Clinical applications of autogenous tooth graft

Ridge augmentation

The alveolar process is a tooth-dependent tissue developing in conjunction with the eruption of the teeth and continuously altered throughout life to adapt to functional and physiological variations. The inevitability of alveolar bone resorption both in vertical and horizontal directions following tooth extraction has been well established throughout the literature. These catabolic changes are initiated by the resorption of the bundle bone that lines the extraction socket which has a thickness of 0.2–0.4 mm and is a tooth-dependent structure deriving its blood supply from the periodontal ligament. (38)

The bundle bone resorption is triggered by disruption of the blood supply from the periodontal ligament following extraction, which subsequently leads to significant osteoclastic activity. (39) The width of the alveolar ridge was found to be reduced by 50 % during the first 12 months after tooth extraction (about 5 to 7 mm), and two thirds of this bone loss occurs in the first three months after tooth extraction. (38, 39)

Within the first three months following recovery, the alveolar ridge undergoes the majority of its dimensions change, with a corresponding vertical bone loss of 0.9 to 3.25 mm. (40) Alveolar ridge augmentation using bone grafts has allowed the placement of dental implants in locations previously considered unsuitable or in more functional and esthetic positions.

Dwivedi and Kour (11) have used autogenous fresh mineralized tooth graft in alveolar ridge preservation, and revealed that a statistically significant difference has occurred in mean alveolar bone width and height.

Similarly, one of our previous studies (2017) employing autogenous tooth graft for alveolar ridge augmentation in cases of maxillary ridge deficiencies, has demonstrated a

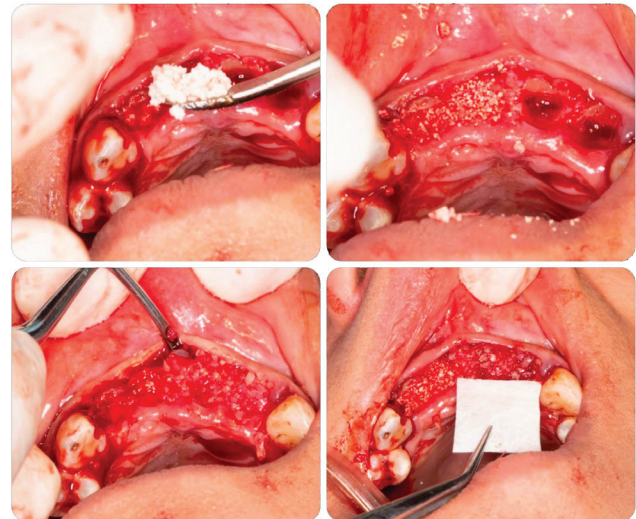


FIG. 4 Autogenous dentin graft versus alloplastic graft in addition to socket shield technique for pre-implant socket preservation prior to delayed implant placement.

[Gad BSF. Evaluation of implant placement in preserved socket using socket shield technique with autogenous dentin graft versus preserved socket using socket shield with alloplast (controlled clinical and radiographic study) [Master Thesis]. Faculty of Dentistry: Alexandria University; 2022]

considerable improvement in ridge breadth and height, rise in bone density, and increase in the mean volume of the grafted region compared to preoperative values. (22)

Socket preservation prior to delayed implant placement

Using autogenous demineralized tooth graft for socket preservation has proved to provide increase of bone density at the grafted site and good primary stability of dental implants inserted using delayed implant placement protocol. These clinical results indicate the occurrence of adequate biodegradation, and effective replacement of the graft by newly formed bone. (24)

Elfana et al (2021) have compared autogenous whole tooth graft to autogenous demineralized tooth graft in socket preservation both clinically and histologically. Both grafts have shown good results for socket preservation with the demineralized dentin graft exhibiting better remodeling, more pronounced osteoinductive properties and more favorable integration with the host tissues than the whole tooth graft. (41)

Implants done after a dual technique of socket preservation (socket shield + autogenous dentin graft) have shown the most favorable stability results for delayed implants with minimal bone loss versus other synthetic bone grafts. (36) [Figure 4]

As a grafting material with immediate implants

A study examining the effect of fresh demineralized dentin graft in guided bone regeneration around immediate delayed dental implants has shown a promising outcome especially when combined with concentrated growth fac-

tor (CGF). (42) Other studies have also emphasized the favorable outcome of autogenous tooth graft in immediate implant placement. (12, 13)

As an adjunct grafting material for healing of bone defects

In an experimental study on rabbits, autogenous tooth graft combined with platelet-rich fibrin has significantly contributed to enhanced bone regeneration in calvarial bone defects. (43)

Also, autogenous dentin combined with injectable platelet rich fibrin has been used successfully for reconstruction of maxillary ridge defects.(22)

Moreover, the role of autogenous tooth graft in healing of bone defects resulting after surgical removal of mandibular third molars has been clearly demonstrated in several studies. (9, 17, 19)

As a grafting material for maxillary sinus augmentation

Autogenous tooth graft has been used for maxillary sinus augmentation by Minetti et al(44) in a multicenter study where sinus lifting, and grafting was done followed by implant placement 6 months later in a staged approach. After one year of follow up, the survival rate of implants and prostheses was 97.5% and 100% respectively.

Histological examination of the autogenous tooth graft

The histological and histomorphometric examination of biopsy specimens of autogenous tooth graft used in maxillary sinus augmentation has shown good remodeling (graft resorption and new bone formation), effective integration with surrounding tissues and no inflammatory reactions. (44)

In a previous study by the authors(24), bone specimens taken at time of implant placement from previously preserved sockets using autogenous tooth graft have displayed evident graft biodegradation, replacement with newly formed

bone, bone remodeling, mature lamellar bone formation and highly vascularized bone marrow.

Clinical and histological performance of autogenous tooth graft in comparison to other grafting materials

Santos et al (2021) have compared the clinical and histological/histomorphometry outcomes of using autogenous mineralized dentin graft versus xenograft granules in alveolar ridge preservation after tooth extraction. The clinical findings were similar in both groups including implant stability; however, histomorphometry analysis has revealed that the sockets preserved with mineralized dentin matrix had greater amount of newly formed bone and less amount of residual graft compared to those preserved by xenograft.(45)

Our recent study comparing the autogenous dentin graft prepared by chairside technique to alloplastic graft (Beta tricalcium phosphate) in pre-implant socket preservation has revealed thicker and more mature bone trabeculae in the dentin group. Also, a significantly higher percentage of newly formed bone was detected by histomorphometric analysis compared to the alloplast group.(18)

Limitations of using the autogenous tooth graft

Both autogenous bone and autogenous dentin graft share the same problem of limited availability. Limitation of the dentin graft quantity is attributed to small dentin volume after removal of caries, restorations, cementum, and enamel, in addition to discarding the unsuitable size of dentin particles after grinding. On the other hand, an important privilege of dentin graft is the absence of donor site morbidity as it is acquired from unrestorable teeth.

Another limitation of the chairside technique is the need for extra hands to help in dentin graft preparation and chemical processing.

Recommendations from the authors

Further research focused on the potential of dentin graft as a vehicle or scaffold for stem cells and growth factors for regeneration of bone defects is recommended.

Also, effective, and safe ways to preserve the patient's own extracted teeth for further use in the future are needed as this will provide an autogenous graft option that is effective, economic, and free from immune response, or reaction to a foreign material.

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Authors declare that there is no conflict of interest.

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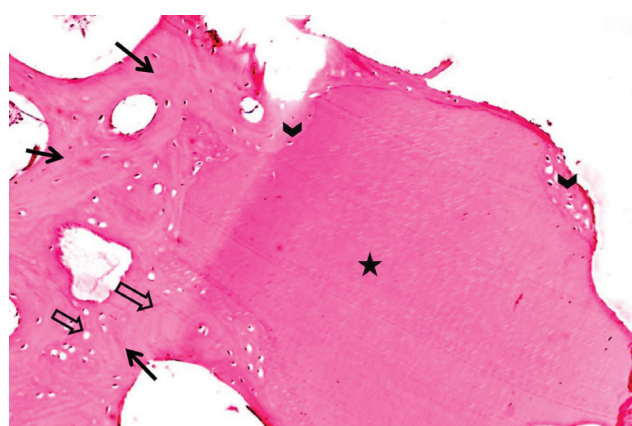


FIG. 5 LM of bone specimen showing well-formed bony trabeculae (arrows) surrounding the AFDT graft (asterisk). Note: the marginal scalloping of the AFDT graft and deposition of new bone in the resorbed areas (arrow heads). Reversal lines can also be seen (hollow arrows). (H&E $\times 100$)

[El-Said MM. Evaluation of autogenous fresh demineralized tooth graft prepared at chairside for dental implant (clinical and histological study) [Master Thesis]. Faculty of Dentistry: Alexandria University; 2016]

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