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Research Article

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Use of Autogenous Dentin Graft in Mandibular Third Molar Extraction Sockets: A Split-Mouth Randomized Double-Blind Study

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ABSTRACT

Aim: Dentin graft has been recently used as a bone substitute in implant surgery. After third molar extraction a distal ridge defect may result. This study aimed to evaluate the effectiveness and complications of using autogenous dentin graft after lower third molars extraction. Materials and methods: The inclusion criteria included patients with mirror-image impacted lower third molars, at least 18 years old, non-smokers, and without any medical disease. Outcomes assessed included pocket depth (PD) at the lower second molars, Recession (MG), Clinical Attachment level (CAL), Pain using visual analogue score (VAS), Swelling, and Healing. PD, MG and CAL were assessed at three time points (point 1: pre-surgery, point 2: one-month post extraction, point 3: three months post extraction). The follow up visits were at 7 days (T1), 42 days (T2), and 92 days (T3) postoperatively. Hypothesis testing was performed using a significance level of 0.05. Results: Ten patients were enrolled in the study but 3 of them failed to follow up and were excluded. Pocket depth was not significantly different between the intervention and control groups at T2 and T3. Gingival recession was significantly lower in the treatment group at T2 (P 0.048) but was not significantly different at T3. The odds of being in a higher category in the dentin graft group at time 3 was 14% the odds in the control arm at time 3 (OR = 0.14, p = 0.09). There was no significant difference between the intervention and control groups for pain VAS, healing, and swelling. Conclusion: Dentin graft is a viable material for bone grafting after extraction of third molar sockets. Although there was no statistically significant difference between tested and control sites, this maybe a result of the small sample size and the nature of the included cases. Clinical significance: Autogenous dentin graft can be used as a cost-effective, safe, and biocompatible bone-substitute after third molar extractions.

Key words: *Bone graft, Dentin graft, Distal ridge defect, Socket preservation, Third molars*

INTRODUCTION

Extraction sockets after dental extractions heal by secondary intention. The amount of bone fill into the bony cavity can be variable and in many occasions is less than desirable. Placement of a bone graft, also known as socket preservation, is a common practice to enhance the amount of bone formed during the healing of extraction sockets. Additionally, guided bone regeneration by application of occlusal membrane can prevent the invasion of the surrounding soft tissues prior to bone formation.

Third molar removal can affect the periodontium of the adjacent second molar negatively. This depends on many factors including preexisting intra-bony defects, level of plaque control, and patient's age [1]. Placement of a bone graft is recommended in high-risk group (age >= 25 years, mesio-angular or horizontal type impaction, attachment loss >= 3 millimeters) [2, 3]. Different types of material are currently used, to improve the outcomes of socket grafting [4]. Each material has its own inherent advantages and disadvantages. These

include autogenous, allogenic, and alloplastic bone grafts [3]. There are limitations on applications regarding some of these materiales due to inadequate mechanical properties [5]. The ideal material should have an osteoinductive and osteoconductive potential with minimal morbidity.

Dentin, cementum, and bone share a strikingly similar composition. By weight, they are composed of, 60% hydroxyapatite, 30% collagen, and 10% fluids and by volume, 70% hydroxyapatite 20% collagen, and 10% fluid. This may explain why avulsed teeth get ankylosed after replantation as a result of fusion of cementum to bone. Some patients are concerned about disease transmission from graft substitutes. Dentin graft presents an attractive option because it is autogenous, biocompatible, and cost-effective. Kim et al has been researching the use of Dentin graft since 1993 and published many promising results [6-9]. It has been used in implant dentistry for site development prior to placement of dental implants [10]. This study aimed to evaluate the effectiveness and complications of using autogenous dentin graft after lower third molars extraction.

MATERIAL AND METHODS

Study Design

This was a split-mouth randomized double-blind clinical trial. The Ethical Research Committee at the Faculty of Dentistry, King Abdulaziz University in Jeddah, Saudi Arabia approved it. The study was conducted in august 2018 to December 2018. Sample size was calculated based on previous studies kim et al and Kugelberg et al. [11, 12] Thirty patients were screened for the study. The inclusion criteria included patients with mirror-image impacted vertical lower third molars, at least 18 years old, non-smokers, and without any medical disease. Patients with decayed or acutely infected lower third molars were excluded. Ten patients met the study criteria. Each patient filled a written informed consent about the study prior to enrollment.

Outcomes Assessment

Outcomes were assessed at the distobuccal and distolingual of the lower second molars because they are the most commonly affected sites after third molar extractions. It included pocket depth (PD), Recession (MG) (negative value indicates the gingiva is higher than it is normal position and vice versa), Clinical Attachment level (CAL), Pain, swelling and healing were recorded using visual scores on the 7th,15th and 90th days (Table 1). PD, MG and CAL were assessed at three time points (point 1: pre-surgery, point 2: one-month post extraction, point 3: three months post extraction).

Table 1. Measurement of pain, swelling and healing

Scale	Score	Variables
Pain (VAS)	0	None
	0.1 - 3.0 cm	Mild
	3.1 - 6.0 cm	Moderate
	6.1 – 10 cm	Severe
Swelling	0	None
	1	Mild
	2	Moderate
	3	Severe
Healing	0	Healed
	1	Inflamed
	2	Collapse
	3	Recession

Surgical Procedure

All third molars were extracted by the first author under local anesthesia. Both control and test side were extracted in the same visit. The flap design was an envelope flap with a small distobuccal release. The grafted site was randomly chosen by a coin toss by a general dentist. It was blinded to patients, surgeon, and the evaluator. The extracted tooth of the study side was cleaned from the granulation tissue and processed using the Smart Dentin Grinder™ (Fig.1-2) following the manufacturer recommendations. It grounded tooth (Fig.3) was then packed loosely in the study side extraction socket then sutured using 4/0 chromic gut.

The control side was irrigated and sutured in a similar fashion without any grafting material. All patients received Amoxicillin 500 mg every 8 hours orally for one week and non-steroidal anti-inflammatory

medications as needed for pain. Patients were instructed to rinse with 0.12% Chlorohexidine mouthwash twice a day for seven days. The follow up visits were at 7 days (T1), 42 days (T2), and 92 days (T3) postoperatively. Pocket depth and gingival recessionoutcomes are continuous variables. Linear mixed model was used to assess the association between the intervention (vs. control) and the outcome of interest at various time points. Site, time and treatment were included as fixed effects while subjects were treated as random variables to consider the split-mouth design used.

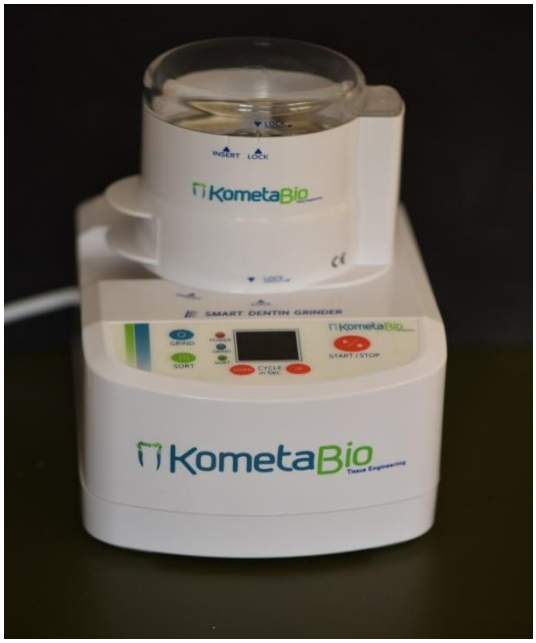

Figure 1: Smart Dentin Grinder by Kometabio Tissue engineering

Figure 2: Tooth after cleaning from the granulation tissue in the grinder.

Figure 3: the grounded tooth prior packing

Data Analysis

Hypothesis testing was performed using a significance level of 0.05. Two tailed hypothesis testing was performed. Mixed models assumptions such as normality of residuals (using Q-Q plot and histograms) were checked to ensure that no assumptions were violated. Pain score, Swelling, and healingwere compared using paired Wilcoxon signed-rank test.

This test was chosen due to the ordinal nature of these three variables which makes Wilcoxon signed-rank test more suitable than paired t-test. For VAS, Confidence interval of the difference between both groups was calculated. Statistical analysis was performed using R v3.4. Cumulative link mixed model was used to model the relationship between clinical attachment and the interventions used.

RESULTS

Ten patients were enrolled in the study with a mean age of 24 years. Each patient acted as their own control. Three patients failed to show up for follow up visits and were excluded. Teeth were extracted at the same time from both the left and right side of the mandible, and two sites, DB and DL, were chosen from each tooth for comparison.

Preoperative mean values of PD, GR and CAL in the test and control groups were comparable. There was also no statistical difference between the sites of two groups (Table 2). A statistically significant decrease in PD and CAL was observed in both groups at 1- and 3-month postoperatively compared to preoperative baseline (Table 3). There was no statistical difference in GR between test and control group at all the time points. (Table 3)

There was no significant difference between the test and control groups for pain VAS, healing, and swelling (table.4) which indicate the using dentin graft has no negative effect on the patient comfort.

Table 2. Sitewise Comparison of PD, GR and CAL in Test and Control Groups Preoperatively and 1 and 3 Months Postoperatively

Site	Time	PD		GR		CAL	
		Control	Test	Control	Test	Control	Test
		$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)
DB	t1	4.43 (0.79)	4.71 (1.38)	-2.14 (1.21)	-2.29 (1.25)	2.29 (1.25)	2.43 (1.9)
	t2	2.71 (1.38)	2.86 (0.69)	-0.86 (2.19)	-0.71 (1.89)	1.86 (1.35)	1.57 (1)
	t3	3.14 (1.06)	2.71 (0.76)	-2.14 (1.77)	-2 (1.53)	1 (1.54)	0.714 (1.25)
DL	t1	5.29 (1.6)	5.43 (0.98)	-2.14 (1.21)	-2.29 (1.5)	3.14 (2.28)	3.14 (0.9)
	t2	3.29 (0.95)	3 (1.15)	-1.57 (1.62)	-2.14 (1.46)	1.71 (1.25)	1.41 (1.57)
	t3	3.43 (0.79)	2.86 (0.9)	-2.29 (1.25)	-2.86 (0.9)	1.14 (1.57)	0 (0)

Abbreviations: $\bar{x}$, mean; SD, standard deviation; PD, pocket depth; GR, gum recession; CAL, clinical attachment level; DB, Distobuccal; DL, Distolingual; t1, pre-surgery; t2, 1-month post-surgery; t3, 3-months post-surgery.
(*) Statistically significant (P<0.05).

Table 3. Pre- and Postoperative Comparison of PD, GR and CAL in Test and Control Groups

Time	Groups	PD		GR		CAL	
		Mean Difference	*P* Value	Mean Difference	*P* Value	Mean Difference	*P* Value
t1 – t2	**Control (n = 7)**	5.28	< 0.001*	-1.91	0.26	1.84	0.14
t1 – t3		4.47	< 0.001*	0.15	1	3.25	0.01*
t2 – t3		-0.81	0.70	2.05	0.26	1.41	0.16
t1 – t2	**Test (n = 7)**	6.09	< 0.001*	-1.76	0.26	2.4	0.08*
t1 – t3		6.50	< 0.001*	0.29	1	4.81	< 0.001*
t2 – t3		0.41	0.91	2.05	0.26	2.4	0.08*

Abbreviations: PD, pocket depth; GR, gum recession; CAL, clinical attachment level; t1, pre-surgery; t2, 1-month post-surgery; t3, 3-months post-surgery. (*) Statistically significant (P<0.05)

Table 4. Pain VAS score, healing and swelling in control and dentine graft groups (n = 7)

Outcome	Response	Controls		Test		
		n	%	n	%	P value
Healing	**0**	2	28.57	6	85.71	0.1344
	1	1	14.29	0	0	
	2	2	28.57	0	0	
	3	2	28.57	1	14.29	
Swelling	**0**	2	28.57	2	28.57	0.7728
	1	3	42.86	2	28.57	
	2	1	14.29	2	28.57	
	3	1	14.29	1	14.29	
VAS		5 [4 – 6.5]		6 [5 – 7]		0.2

Swelling and healing scores were summarized as counts/ percentages

VAS score was summarized using median/IQR. Statistical analysis was performed using Sign-rank test

DISCUSSION

Bone grafting is a common procedure after teeth extraction (also known as socket preservation) specially in preparation for dental implants. A bone defect may result distal to the second molar after the extraction of third molars. Grafting the socket of third molars remains controversial in the literature. A task force by the American association of oral and maxillofacial surgeons published a paper reviewing pertinent literature related to third molar extraction. They concluded that guided tissue regeneration and use of bone powder might be beneficial for periodontal health if there was pre-existing attachment loss and in deep impaction [1].

Some randomized clinical trials found no difference between Dentin grafts and ungrafted sites [13], while others found it to be as effective as other bone substitutes [14, 15]. This variability in the literature maybe due to the diversity in the production technique of dentin grafts. They can be obtained from autogenous, xenogenic, or allogenic teeth. The variables in the production process include using blocks or particles, particles size, demineralization or without demineralization, and technique of sterilization before use [16]. We used demineralized particles in this study following the manufacturer's instructions.

Autogenous dentin graft ground from extracted teeth immediately in extraction socket was found as a suitable material in dogs proven by histologic examinations 3 months after grafting [17]. It was also tested and found biostable in calvarial bone defect in rabbits [18] and alveolar defect in rats [19]. Kim et al used dentin plaster of Paris to repair bone defects around dental implants [9]. Composite non-demeneralizedxenogenic dentin graft mixed with beta tricalcium phosphate putty was found enhanced bone formation more than using tricalcium phosphate alone in an alveolar cleft model in rabbits [20].

Up to our knowledge, this is the first clinical trial to evaluate the use of autogenous dentin graft after third molar extraction. A specific challenge that might be encountered with using denting graft is needed to section the tooth into multiple parts during the extraction which may limit the amount of tooth structure remaining for grafting. A possible solution for this issue is to use the upper third molar which if frequently removed while removing the lower third molar for grafting.

Our results didn't show a significant difference between the grafted and non- grafted side in the measured outcomes. This maybe due the small sample size and due to the controversy in the need of grafting in general after third molar extraction where many times sockets heal uneventfully without grafting.

The resorption and remodeling time of dentin grafts is variable in the literature ranging from 2 weeks to 6 months [16]. Different histologic studies of the grafted sites showed the formation of dentin-bone complex surrounded by newly-formed bone [21-24]. The remaining graft ranged from 6.15% [14] to 29% [25] at 6 months.

Complications reported in the literature from dentin graft include wound dehiscence, premature graft exposure, separation of the mineralized block graft, hematoma, failure of implant integration [16]. There were no complications related to the use of the autogenous dentin graft. The healing of these extraction sockets was uneventful.

Limitation of this study includes small sample size. Future studies should includea larger sample size and focus on impacted third molars with high risk for development of distal ridge defect (pre-existing attachment loss, age >25 years, deep impactions).

CONCLUSION

Dentin graft is a viable material for bone grafting after extraction of third molar sockets. Although there was no statistically significant difference between tested and control sites, this maybe a result of the small sample size and the nature of the included cases.

Declarations

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Availability of data and materials

The datasets used and/or analyzed during the current study are availablefrom the corresponding author on reasonable request.

Authors' contributions

TZ and MN contributed to data collection, interpretation of data, designing the study and writing the manuscript. All authors have revised the manuscript and have approved thefinal manuscript prior to its submission.

Ethics approval and consent to participate

This study adhered to CONSORT guidelines and was conducted in accordance with the World Medical Association Helsinki Declaration (Version 2013). The study protocol was approved by the Institutional Review Boards (IRBs) at King Abdulaziz University (proposal ID 085-10-17), All the participants were informed of the objectives, interventions, and possible risks and benefits of the study prior to enrollment, and written consent was obtained.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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