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Evaluation of the Use of Leftover Graft Materials in Dentistry Procedures

Diş Hekimliği İşlemlerinde Kalan Greft Materyallerinin Kullanımının Değerlendirilmesi

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ABSTRACT

Objective: We evaluated the use of leftover graft materials in dental procedures, the sterilisation methods used, and the storage conditions and durations under which leftover graft materials **(**LGMs) were stored.

Materials and Methods: An online survey of 200 Turkish dentists was conducted. The survey consisted of 14 open-ended and multiple-choice questions. Information was sought about the types of grafts the dentists used, their frequency of use, the use of LGMs, whether such LGMs were sterilized before use, and their preferences regarding storage conditions before use.

Results: Overall, 81.3% of dentists stated that they used LGMs. Of them, 69.6% did not sterilise the material before use. Also, 59.9% of the dentists thought that LGMs could be used after the package had been opened. When the branch distribution and years of practice of the dentists who answered the question "What do they do with the remaining graft materials after the first use?" were evaluated, no statistically significant difference was found between the groups. When the distribution of dentists who answered the question "Do you re-sterilize the graft before use?" was examined according to their branches, no statistically significant difference was found between the groups.

Conclusions: LGMs are frequently used by Turkish dentists after the package has been opened. Future studies should determine the risk of cross-infections and the bioactivity of LGMs.

Keywords: Allograft, autogenous graft, bone graft, xenograft

ÖZ

Amaç: Bu çalışmada diş hekimliğinde ilk kullanımdan sonra arta kalan greft materyallerinin kullanımı, kullanılan sterilizasyon yöntemleri, arta kalan greft materyallerinin (AGM) saklanma koşulları ve sürelerinin değerlendirilmesi amaçlanmıştır.

Materyal ve Metot: 200 Türk diş hekimine yönelik çevrimiçi bir anket yapıldı. Anket 14 açık uçlu ve çoktan seçmeli sorudan oluşuyordu. Diş hekimlerinin kullandığı greft türleri, kullanım sıklıkları, AGM' lerinin kullanımı, bu AGM' lerinin kullanımdan önce sterilize edilip edilmediği ve kullanımdan önce saklama koşullarıyla ilgili tercihleri hakkında bilgi istendi.

Bulgular: Genel olarak diş hekimlerinin %81,3'ü AGM' lerini kullandığını belirtti. Bunların %69,6'sı materyali kullanmadan önce sterilize etmediğini belirtti. Ayrıca diş hekimlerinin %59,9'u AGM' lerinin paket açıldıktan sonra yeniden kullanılabileceğini düşündüğünü belirtti. İlk kullanımdan sonra kalan greft materyallerini ne yapıyorsunuz sorusuna cevap veren diş hekimlerinin branş dağılımı ve tecrübe yılı değerlendirildiğinde gruplar arasında istatistiksel olarak anlamlı bir fark bulunamamıştır. Grefti kullanmadan önce tekrar sterilize ediyor musunuz? sorusuna cevap veren diş hekimlerinin branşlara göre dağılımı incelendiğinde gruplar arasında istatistiksel olarak anlamlı bir fark bulunamamıştır.

Sonuç: Çalışmanın sonuçlarına göre greft materyalleri ilk kullanımdan sonra diş hekimleri tarafından sıklıkla kullanılmaktadır. Bu nedenle ileriki zamanlarda çapraz enfeksiyon riskini ve greftlerin tekrar kullanımdan sonraki biyoaktivitesini belirlemek için çalışmalar yapılmasına ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Allogreft, kemik grefti, ksenogreft, otojen greft

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INTRODUCTION

In dentistry, bone grafts are used in many areas, such as the treatment of trauma, periodontal defects, and bone defects after tooth extraction, to increase the amount of adequate bone before dental implant surgery, and to repair various types of defects during dental implants.[1,2] Bone-grafting procedures are valid and reliable treatments for replacing missing bone and bone augmentation.[3,4] Although autogenous bone grafts are still considered the gold standard, their use is limited due to several disadvantages, such as requiring a second surgical site to harvest the graft and the need to harvest a minimal amount of tissue, often resulting in an insufficient amount of material.[4-6] Because of these limitations, dentists frequently prefer allografts, xenografts and synthetic grafts when appropriate.[7-9] Allografts and xenografts undergo processing to remove organic materials and are sterilised to eliminate antigens, bacteria, and viruses.[10,11] Common sterilisation techniques include exposure to gamma radiation, treatment with ethylene oxide, and other chemical processing methods to prevent cross-infection risks from donor organisms.[12,13] After sterilisation, these products undergo stringent safety tests before being commercially available.[14] Bone grafts are typically sold in sterile packaging, and manufacturer guidelines dictate that each package should be used for a single patient. Once opened, any remaining graft material should be discarded to prevent contamination and cross-infection.[15] Therefore, it is important to investigate the current use of such materials and the conditions under which they are used.

This study aimed to evaluate the frequency of LGM use in dental procedures, dentists' awareness of the associated risks, the storage practices employed, and the length of storage (after opening the original package) before use.

MATERIALS AND METHODS

Ethics Committee Approval: Ethical approval was received from Karamanoglu Mehmetbey University, Faculty of Medicine Local Scientific Medical Research Ethics Committee (Date: 30.05.2024, decision no: 06-2024/09). The study adhered to the ethical guidelines of the Declaration of Helsinki.

Data collection: A self-administered and online (14 questions in three parts; Table I), prepared using Google Forms (Google, Inc., 2017, California, USA) and was randomly sent to 200 dentists via email and text. To develop the survey, we first conducted a literature review and prepared 14 questions about LGM use in routine medical practice; this was emailed to three experts for verification of the content and assessed using a five-point Likert scale. Each question was evaluated and deemed appropriate for use.

The first 6 questions in the survey consisted of the following questions: age, gender, the institution they work for, how many years they have been a dentist, areas of expertise and whether they use graft material.

The questions in the second part consisted of questions about how many packages of grafts dentists use annually, what type of graft material they use, and whether they reuse the graft after the first use. The questions in the third section consisted of questions measuring whether the graft was re-sterilized before use, if so, what method they used for sterilization, under what storage conditions they stored leftover graft material before using, how long the package was used from the date it was first opened, and questions about using leftover graft.

The survey consisted of open-ended and multiple-choice questions. Participants who answered "I want to participate" on the consent form in the first part proceeded to the second part and participated in the study by answering the questions. The first part of the survey stated that participation was voluntary, and dentists who chose not to participate could refrain from completing it. The survey was sent to a total of 200 dentists, and the answers of 187 dentists who accepted and participated in the survey were used in the study.

Statistical Analysis: All data were analyzed using SPSS Statistics Version 21.0 (IBM Corp., New York). Chi-square analysis was used to evaluate the relationships between categorical variables. The threshold for statistical significance was set at $p<0.05$.

RESULTS

The results are given in Table 1. In the study, 57.8% of the participants identified as male, 41.7% as female, and 0.5% chose not to disclose their gender. Most were 25-35 years old and worked at universities. Most of the participants (43.9 %) were periodontology specialists and had about 10 years or more of professional experience. Most of the participants (39.6 %) had 0-5 years of experience using grafts, and 11.2 % had never used grafts. Among graft users, 41.6 % used 0-10 packages of graft material each year, 25.9 % used 10-20 packs, and 33.5 % used more than 20. The participants used xenografts at the highest rate (42.8 %), followed by allogeneous grafts (24.7 %) and other grafts. After opening a package and using graft material the majority of participants (81.3 %) reported using it again; only 18.7 % stated that they do not use LGMs. While the majority of reusers, 69.6 %, stated that they did not sterilize the graft again before use, 30.4 % stated that they sterilized the graft before

use. The majority of those who sterilize before reuse (70.7 %) sterilize by autoclave but less frequently use other sterilization methods. The vast majority (62.2 %) stored LGM in a cupboard at room temperature, about 37 % kept it in a refrigerator and only 0.7 % stored it in a deep freezer. Nearly all participants used leftover material within 1-6 months, with only about 5.2 % of dentists using it after more than 6 months of storage. Most participants (59.9 %) felt that LGM could be used later, 25.7 % felt that it should not be used again, and 14.4 % had no opinion.

Table 1. Responses of the participants to the questions.

Variables	Subcategory	n (%)
1. Gender	Female	78 (41.7)
	Male	108 (57.8)
	I don't want to specify	1 (0.5)
2. Age	25-35	102 (54.5)
	36-45	77 (41.2)
	46 and above	8 (4.3)
3. Which institution do you work for?	University	81 (43.3)
	Private outpatient clinic	43 (23.0)
	Own Clinic	40 (21.4)
	Oral and Dental Health Center	23 (12.3)
4. Branch	Oral and Maxillofacial Surgery	47 (25.1)
	Dentist	58 (31.0)
	Periodontology	82 (43.9)
5. Years of practice	0-5 years	45 (24.1)
	5-10 years	56 (29.9)
	More than 10 years	86 (46.0)
6. How many years have you been using graft material?	I don’t use	21 (11.2)
	0-5 years	74 (39.6)
	5-10 years	48 (25.7)
	More than 10 years	44 (23.5)
7. How many packages of grafts do you use annually?	0-10	69 (41.6)
	10-20	43 (25.9)
	More than 20	54 (32.5)
8. What type of graft material do you use?	Autogenous Graft	16 (9.6)
	Allogeneous Graft	41 (24.7)
	Xenograft	71 (42.8)
	Synthetic Graft	3 (1.8)
	Autogenous Graft, Allogeneous Graft	1 (0.6)
	Autogenous Graft, Xenograft	3 (1.8)
	Allogenous Graft, Xenograft	8 (4.8)
	Autogenous Graft, Allogeneous Graft, Xenograft	13 (7.8)
	Autogeneous Graft, Allogeneous Graft, Xenograft, Synthetic Graft	10 (6.0)
9. What do you do with the remaining graft materials after the first use?	I don’t use it again	31 (18.7)
	I use it again	135 (81.3)
10. Do you re-sterilize the graft before use?	Yes	41 (30.4)
	No	94 (69.6)
11. By what method do you sterilize before use?	Dry Hot Air Sterilization	8 (19.5)
	Autoclave	29 (70.7)
	Gamma Sterilization	4 (9.8)
12. Where do you store the graft until reuse?	In The Cupboard At Room Temperature	84 (62.2)
	Refrigerator	50 (37.0)
	In The Deep Freezer	1 (0.7)
13. How many months do you use the graft from the date the package is first opened?	0-1 Months	43 (31.9)
	1-3 Months	52 (38.5)
	3-6 Months	33 (24.4)
	More than 6 months	7 (5.2)
14. What do you think about the reuse of graft materials after the original package of graft materials is opened?	Should Not Be Used Again	48 (25.7)
	Reusable	112 (59.9)
	I Don't Know	27 (14.4)

When the distribution of branches of dentists ' responded to the question of what do you do with the remaining graft materials after the first use? was examined, no significant difference was found between branches (p>0.05) (Table 2).

When the distribution of years of practice of dentists who responded to the question of what do you do with the remaining graft materials after the first use? was examined, no significant difference was found between the years of practice and their responses to the use of the leftover graft (p>0.05) (Table 3).

When the distribution of the branches of dentists who answered the question of do you re-sterilize the graft before use was examined, no significant difference was found between the branches (p>0.05) (Table 4).

DISCUSSION AND CONCLUSION

In dentistry, grafting procedures are usually performed in local operating rooms. Today, many precautions are taken to minimize the number of microorganisms in these types of local operating rooms. However, these places can never be completely sterilized due to independent risk factors such as the type of surgery, the place of the procedure, and the number of personnel.[16] In addition, the use of tools such as rotary handpieces and ultrasonic handpieces in the process can result in the release of a lot of aerosol into the environment.[17] These aerosols formed during surgical procedures may increase the risk of cross-infection between patients, as well as infect dental implants and biomaterials such as graft materials and membranes used.[18-20] Infection of graft

Table 2. Distribution of branches of dentists who responded to the question of what do you do with the remaining graft materials after the first use.

		Branch			p-value
		Oral and Maxillofacial Surgery	Dentist	Periodontology	
I don't use it again	n	10	6	15	0.37
	% within branch	25.0	13.0	18.8	
I use it again	n	30	40	65	
	% within branch	75.0	87.0	81.2	
Total	n	40	46	80	
	% within branch	100.0	100.0	100.0	

Table 3. Distribution of years of practice of dentists who responded to the question of what do you do with the remaining graft materials after the first use.

		Years of practice			p-value
		0-5 years	5-10 years	More than 10 years	
I don't use it again	n	6	12	13	0.58
	% within years of practice	18.8	23.1	15.9	
I use it again	n	26	40	69	
	% within years of practice	81.2	76.9	84.1	
Total	n	32	52	82	
	% within years of practice	100.0	100.0	100.0	

Table 4. Distribution of the branches of dentists who answered the question of do you re-sterilize the graft before use.

		Branch			p-value
		Oral and Maxillofacial Surgery	Dentist	Periodontology	
Yes	n	8	12	15	0.73
	% within branch	26.7	30.0	23.1	
No	n	22	28	50	
	% within branch	73.3	70.0	76.9	
Total	n	30	40	65	
	% within branch	100.0	100.0	100.0	

materials, implants and membranes used during procedures for various reasons may cause the applied treatment to fail, resulting in additional treatment applications and additional costs for patients and dentists.[17,21]

For these reasons, manufacturers do not recommend using commercially produced graft materials after they have been opened.[15] However, 81.3% of the dentists who participated in our study and stated that they used graft materials stated that they used the remaining graft material. In addition, when the reuse of dentists was evaluated according to the branches and years of practice, no significant difference was found in our study. This situation showed that there was a tendency towards the reuse of graft materials, regardless of the content and quality of the education received and the experience of the dentists over the years.

There are very few studies on the use of LGMs. Only one study evaluated bacterial contamination of such materials after 1 minute, 10 minutes and 1 hour on the operating table and did not document any contamination.[15] However, there have been no studies on the risk of contamination of an opened package over a longer period. In our study, 68 % of dentists used LGM after more than a month of storage. This situation has highlighted the need for studies examining the risk of infection in graft materials that have been stored for long periods.

About 70% of dentists did not re-sterilize the material before using it. Among those who did re-sterilize, the vast majority did so using an autoclave, and the rest used gamma sterilisation or dry hot air methods. However, the bioactivity and Ca/P ratios of graft materials may change when stored under different conditions and different sterilisation methods.[22] As it is well known, graft materials are sterilized by gamma radiation, treatment with ethylene oxide, and other chemical processing methods to prevent the risk of cross-infection from donor organisms during production.[12,13] However, in our study, the autoclave and dry heat sterilization methods, which dentists often use to re-sterilize the grafts, expose the grafts to high temperatures for long periods. In this case, the biological activities and biological structures of the graft materials may change, which may negatively affect their effectiveness and intended use.

Most participating dentists stored LGM in a cupboard at room temperature, and nearly all others put it in a refrigerator. Manufacturers generally recommend storing graft materials at room temperature, but 37.7% of study participants reported storing remaining grafts in refrigerators and deep freezers.[23] However, no studies have examined the effects of either of these storage conditions on the structure and bioactivity of graft materials in general, much less LGM.

In conclusion, although the use of LGM is not recommended, the vast majority of surviving dentists frequently do so. Therefore, studies should investigate the effects of storage conditions, sterilisation methods, and storage durations after first use on the risk of cross-infection and bioactivity of LGMs. The limitation of this study is that it was conducted only with dentists in Türkiye.

Ethics Committee Approval: Our study was approved by the Karamanoglu Mehmetbey University Faculty of Medicine Local Scientific Medical Research Ethics Committee (Date: 30.05.2024, decision no: 06-2024/09). The study adhered to the ethical guidelines of the Declaration of Helsinki.

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