Original Paper

Frequency of Bone Augmentation Materials Use in a General Dental Practice

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ABSTRACT: This retrospective study aimed to evaluate the frequency of bone augmentation materials used for implant or periodontal surgical treatment depending on the age and sex of the patients from a dental practice in Essen, Germany, but also the implants dimensions and respectively the stage and progression grade of the periodontitis. The analysis of the data showed that bone augmentation materials are used much more frequently in the implant surgical cases (43,33%) compared to periodontal surgical cases (13,33%). While the correlations with sex and age were less obvious, the use of bone augmentation materials in the implant surgical cases was correlated with the use of shorter implants, while their use in the periodontal surgical cases was correlated with the stage 3 periodontitis.

KEYWORDS: *Dental materials, bone augmentation, dental implant, periodontitis.*

Introduction

Bone augmentation materials have long been used in many medical fields such as orthopedics, neurosurgery or maxillofacial surgery [1].

The first symptoms of bone loss in dentistry occur in periodontal disease and lead over time to tooth mobility.

Although local mechanical treatment is the first and most important step in treating periodontal disease, the use of bone augmentation materials improves the results of regenerative periodontal therapy [2].

However, lately, the use of bone augmentation materials in dentistry has experienced a special evolution due to the extraordinary development of implantology [3] and the need for the existence of a favorable bone substrate [4].

Although the use of bone augmentation materials is often correlated with more complex surgical techniques [5], they have also begun to be used in general dental practices both to increase the quality of the implant bone substrate especially immediately after a tooth extraction [6], but also because any case may become more complicated, and the use of augmentation materials to become a necessity [7].

Today it is considered that any dentist who performs an extraction must perform a cost/benefit analysis and determine the ideal regeneration and preservation of bone volume in accordance with the patient's situation [8], so that a dental implant can be subsequently placed in a correct position according to the principles of implant prosthetics [9].

If in 2006 in the USA it was already estimated that over 50% of the inserted implants were placed by general dentists [10], periodontal surgical procedures are performed less often by general dentists, a survey from 2019 showing that only 21% of surveyed dentists in Saudi Arabia performed such procedures [11].

The aim of this study was to survey the activity in a general dental practice in order to establish the frequency of bone augmentation materials use both in implant surgical cases and periodontal surgical ones.

Materials and Methods

For this study a datasheet was completed with retrospective data regarding the patients who received an implant or a periodontal surgical treatment, data obtained from the activity of the general dental practice Zahnarztpraxis Zahn und Zähnchen Essen Heisingen, Zahnärzte Elena und Andrei Caracas, Essen, Germany.

A number of 60 patients were selected, from which 30 patients received an implant surgical treatment, while the other 30 patients received a

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periodontal surgical treatment between 1.01.2020 and 30.06.2021.

All patients signed a written informed consent for participation in this study.

There were registered data regarding the bone augmentation and membrane materials used, the age and sex of the patients, the location of the surgical interventions, but also the implants dimensions and respectively the stage and progression grade of the periodontitis.

To facilitate the statistical analysis of the collected data, 5 age groups were created (30-39 years, 40-49 years, 50-59 years, 60-69 years, 70-79 years).

For the implant surgical cases there were mentioned five types of interventions and combinations of materials used (BioOss L+BioGide Compressed, BioOss S+BioGide Compressed, External sinuslift BioOssL+FRIOS Bone-Shield Membran Friadent, Internal sinuslift BioOss S+BioGide Compressed, Internal sinuslift BioOss S).

Regarding the materials used for the periodontal surgery cases, 2 options were identified: BioOss S+BioGide Compressed and BioOss S+Mucograft Membrane.

The information obtained were statistically processed using the Chi square test for independence and the resulting data were presented in the form of graphs and tables.

Statistical analysis was performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA), together with the XLSTAT add-on for MS Excel (Addinsoft SARL, Paris, France).

P <0.05 was deemed statistically significant.

Results

The data of the present study showed a use of bone augmentation materials in 43.33% of implant surgical cases, but also a large variation of the analyzed materials and combinations even if only a single range of synthetic augmentation materials was used (Bio-Oss, Geistlich Pharma AG, Wolhusen, Switzerland) (Figure 1).

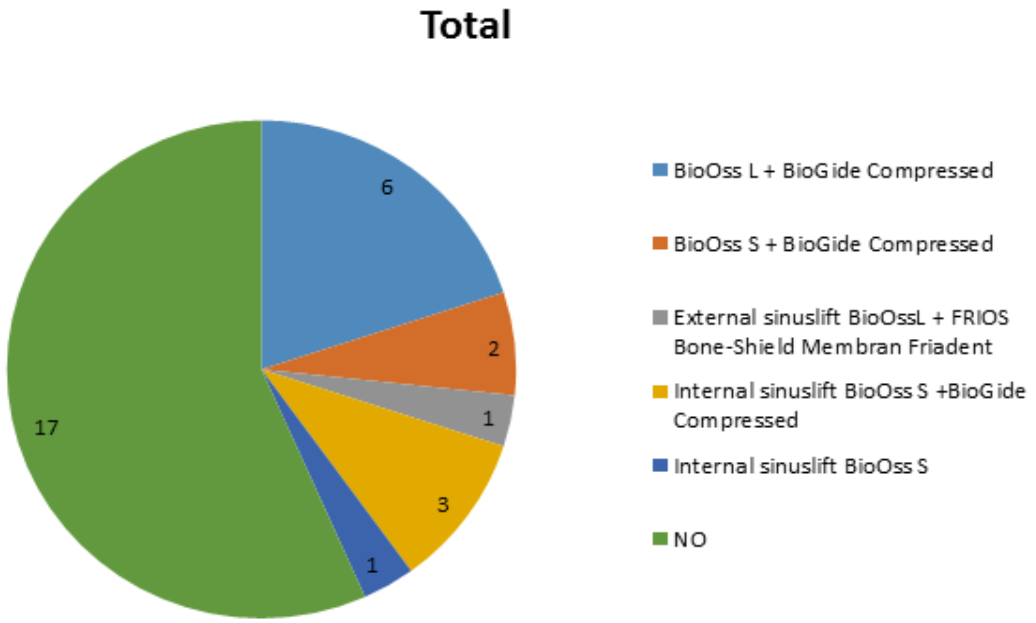

Figure 1. Distribution of the bone augmentation materials used in the 30 implant surgery cases.

The analysis of the used materials distribution by gender showed a more frequent use of them in the case of female patients, 61.5% of those who benefited from an implant surgical treatment also receiving bone augmentation material the result of the Chi square test being p=0.018<0.05 (Figure2).

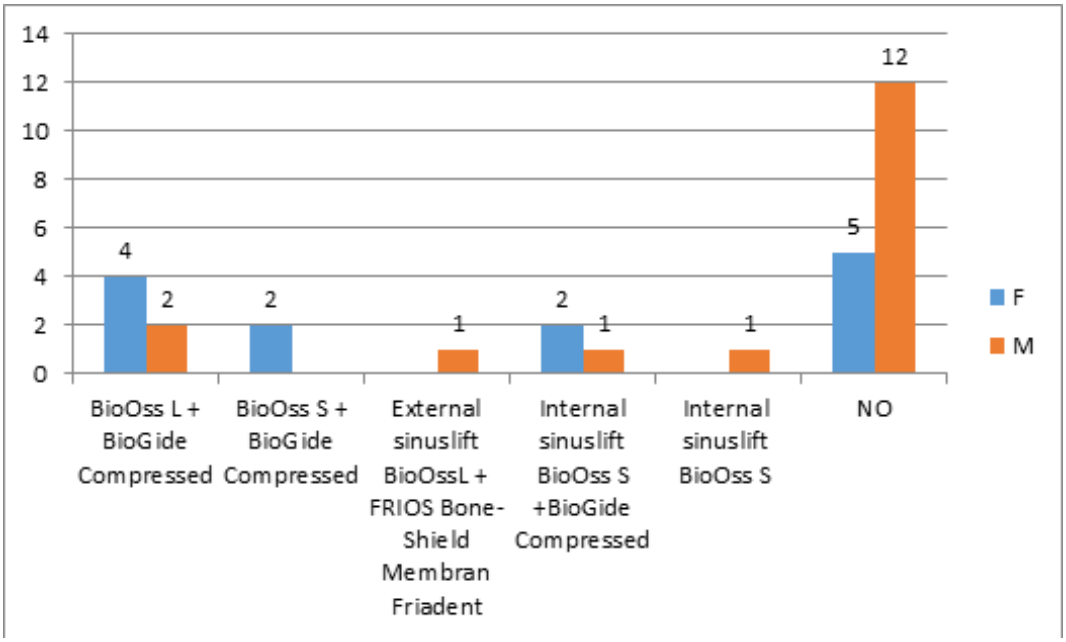

Figure 2. Distribution of the bone augmentation materials used in the 30 implant surgery cases by gender.

The implant surgical treatments that included the use of bone augmentation materials were performed in all age groups, but we must mention the groups 50-59 years and 60-69 years, where in 71.4% and respectively 50% of cases imposed the application of bone augmentation materials (Figure 3).

The frequency of the used materials differed significantly among age groups (p Chi square=0.027<0.05).

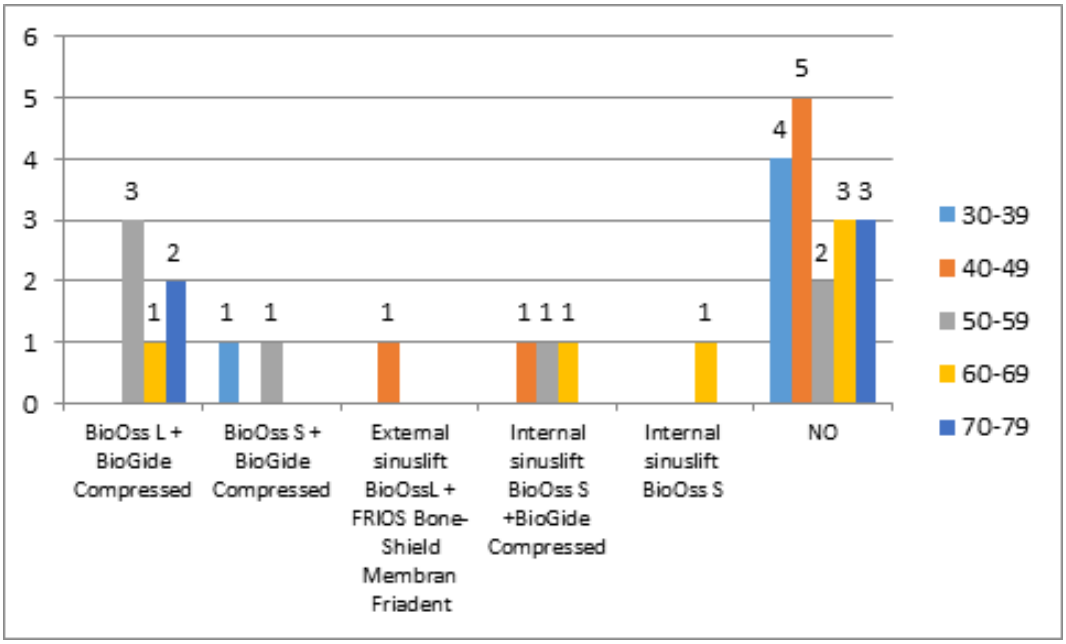

Figure 3. Distribution of the bone augmentation materials used in the 30 implant surgery cases depending on the age group.

Regarding the length of the implants used, the data collected are in accordance with the indications for clinical use of augmentation materials in implant surgical therapies.

Thus, the cases in which bone augmentation materials were used, there were most frequently cases with a reduced ammount of native bone, which required the use of short implants of 8, maximum 10mm (Figure 4).

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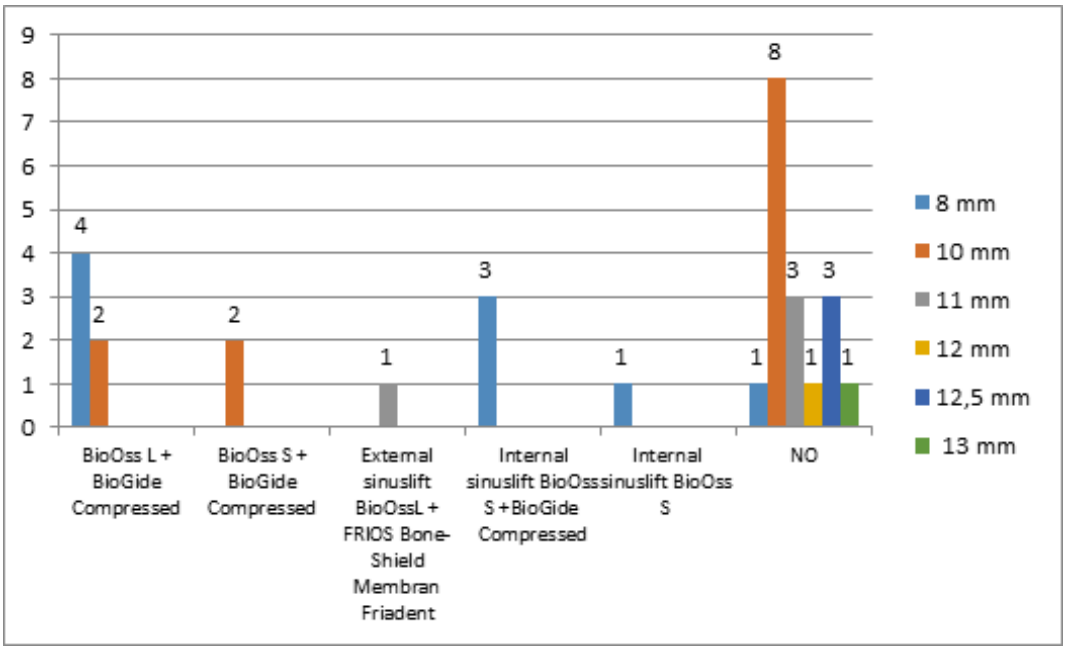

Figure 4. Distribution of the bone augmentation materials used in the 30 implant surgery cases depending on the implant length.

On the other hand, the use of bone augmentation materials in periodontal surgical cases was much less frequent (13,33%) compared to implant surgical cases (Figure 5).

The distribution by gender of the periodontal surgical cases was balanced (p Chi square=0.308>0.05-non-significant difference), with a slight predominance for the male gender both in the total number of cases and in the frequency of use of augmentation materials in these cases (Figure 6).

The distribution by age group of the periodontal surgical cases was also balanced, all age groups being represented in a similar way, with the mention that in 3 of the 4 cases in which bone augmentation materials were used, the patients were over 60 years old (Figure 7).

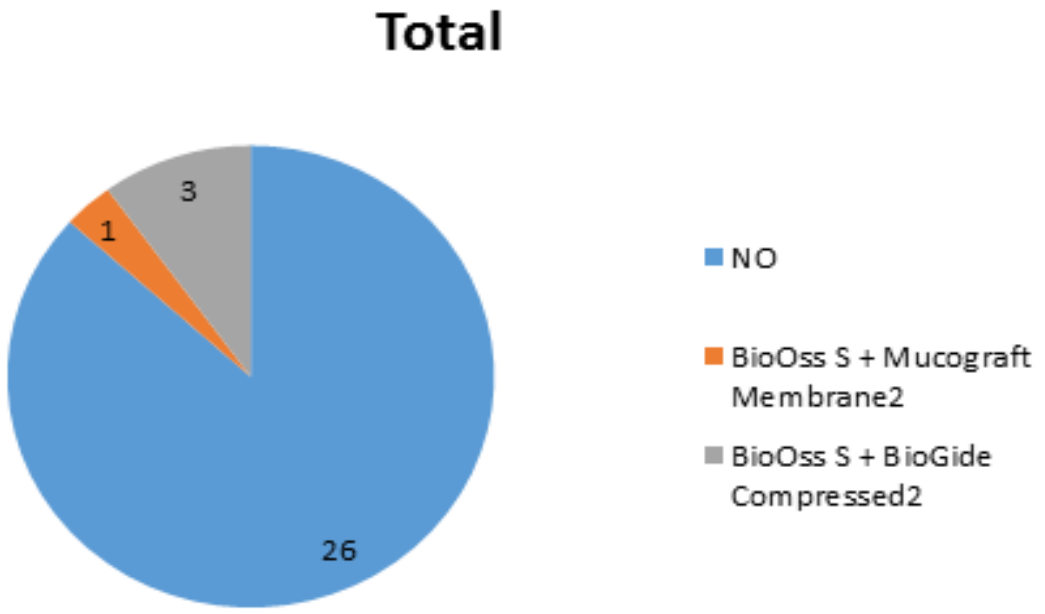

Figure 5. Distribution of the bone augmentation materials used in the 30 periodontal surgery cases.

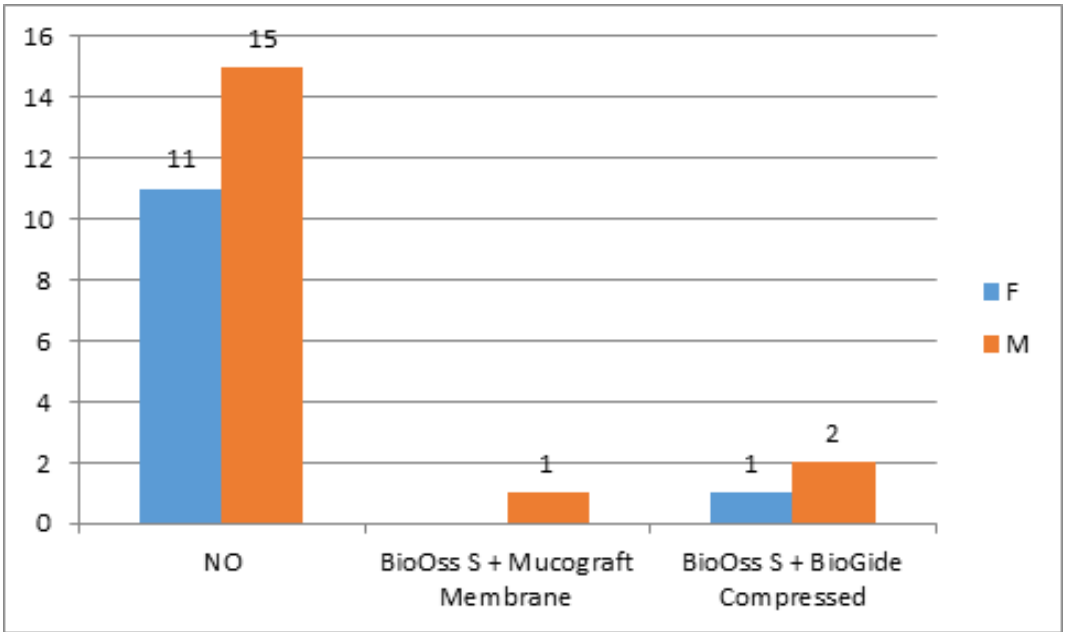

Figure 6. Distribution of the bone augmentation materials used in the 30 periodontal surgery cases by gender.

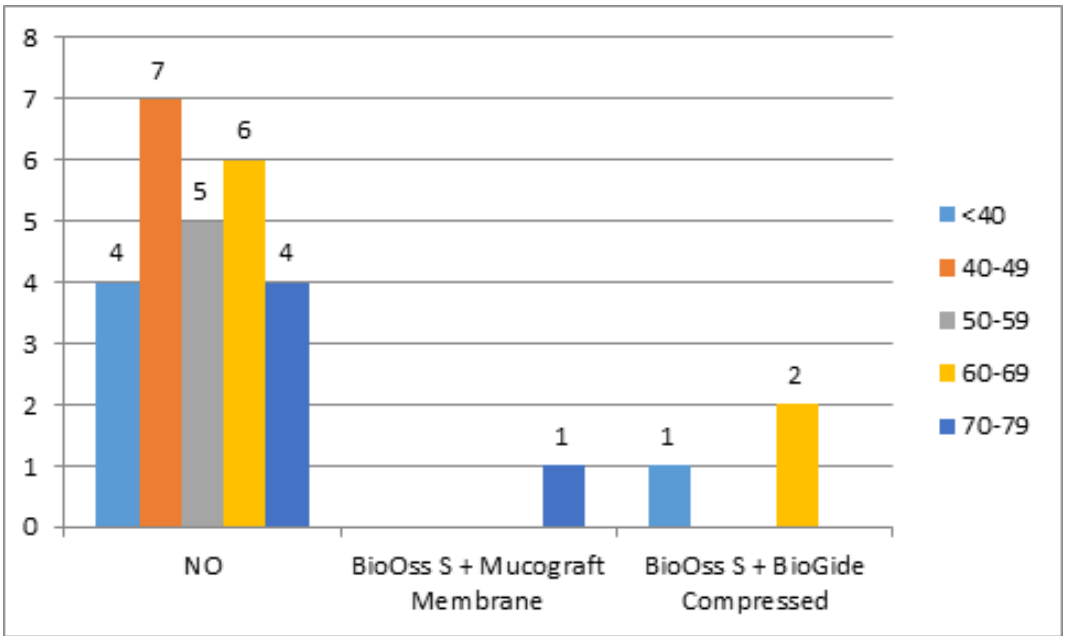

Figure 7. Distribution of the bone augmentation materials used in the 30 periodontal surgery cases depending on the age group.

All patients who received periodontal surgical therapies had periodontitis in stage 3 (16,66%) or 4 (83,33%).

However, 80% of patients who could be intercepted in stage 3 of the disease could benefit from more complex periodontal surgical treatments that included the use of bone augmentation materials this creating a significant difference, p Chi square=0.0057<0.05, between stage 3 and stage 4 in regards of the use of this type of materials (Figure 8).

Regarding the degree of progression of periodontal disease, all patients who were selected to receive periodontal surgical treatment were classified with grade B or C of periodontitis progression, with a fairly balanced partition between the 2 categories (p Chi square=0.615>0.05-non-significant difference).

3 of the 4 patients for which bone augmentation materials were used were diagnosed with grade C of the periodontitis progression (Figure 9).

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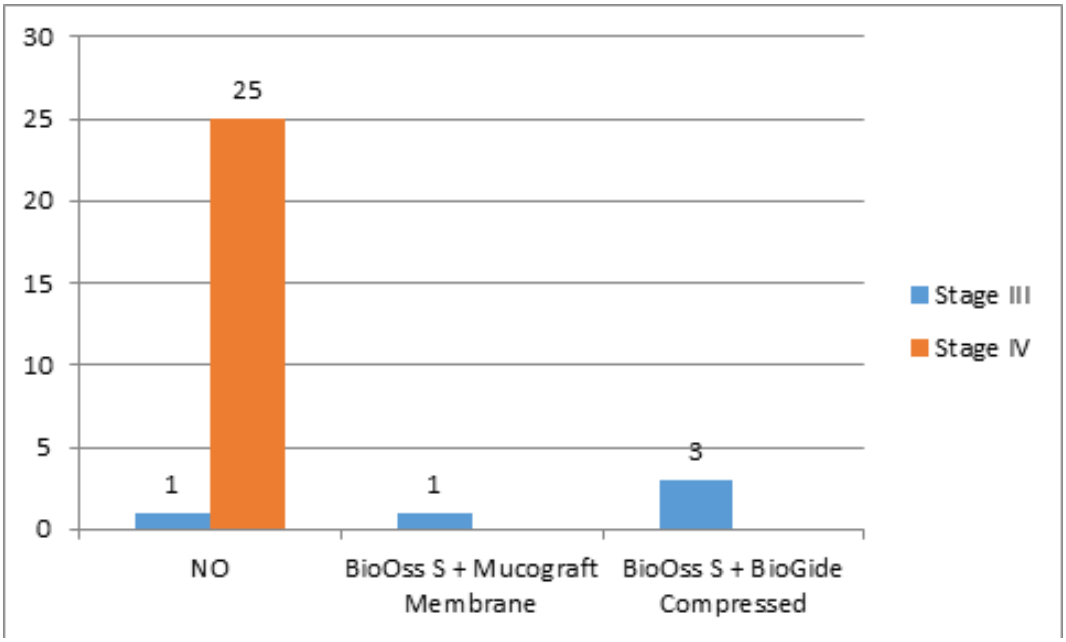

Figure 8. Distribution of the bone augmentation materials used in the 30 periodontal surgery cases depending on the periodontitis stage.

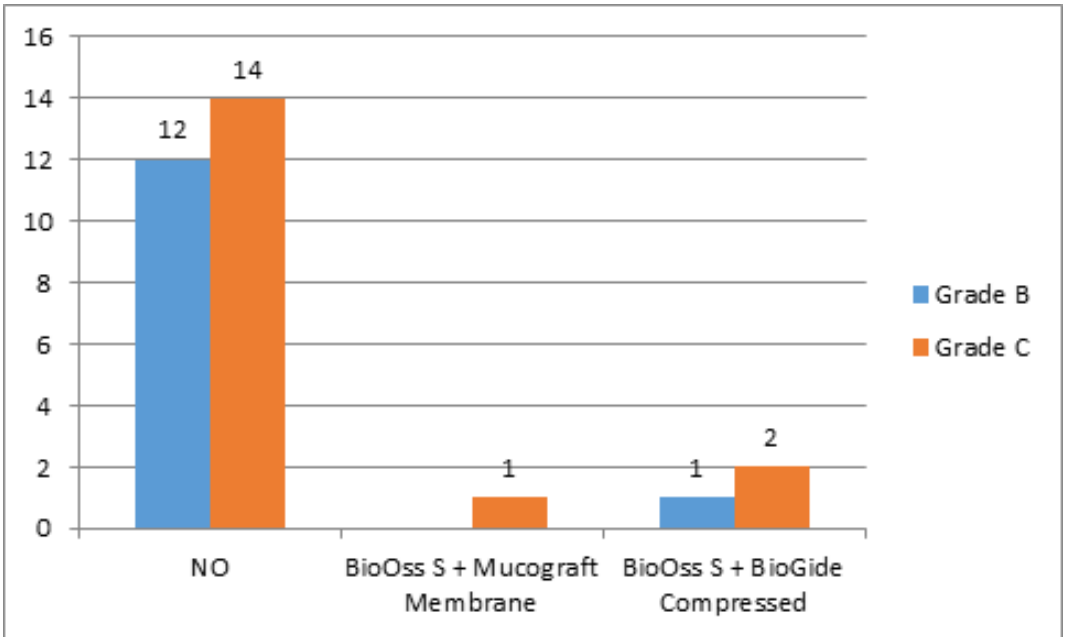

Figure 9. Distribution of the bone augmentation materials used in the 30 periodontal surgery cases depending on the periodontitis grade.

Discussions

Our study revealed a use of bone augmentation materials in 43.33% of implant surgical cases, which coincides with data from the literature considering that currently almost 50% of implant surgery interventions requires the use of bone augmentation materials to improve the receiving bone qualities [12], considering that the number of these interventions will increase significantly in the coming years [13].

We cannot say that there is currently an ideal bone replacement material, but currently the range of bone augmentation materials is constantly evolving, being developed new materials with improved properties [14] that are close to the golden standard represented by the autologous bone [15].

A network meta-analysis in a systematic review identified 25 bone substitution materials used in dental practices for an immediately ridge preservation after tooth extraction and although, in general, bone substitution materials have been

shown to be effective in reducing alveolar changes after tooth extraction, each material has yielded different results in terms of the amount of bone maintained after tooth extraction, even in the case of materials from the same category (e.g. xenograft) [16].

The materials used in the analyzed dental practice come from the Bio-Oss range, an inorganic bovine bone, considered to be a biologically inert osteoconductive composite, the gold standard of the xenografts [17], the most evaluated dental bone augmentation material especially for the sinus lifting techniques [18].

The data of our study showed an increased frequency of use of implants with a minimum length of 8 10mm in cases where bone augmentation materials were used, which shows that they were used especially in cases where the amount of bone naturally it was close to the 10mm length limit required for the application of a dental implant [19].

Despite the high incidence of the periodontal disease [20], but also the extensive research done in recent years and the development of new biomaterials with potential applications in periodontal surgical therapies [21], their use is still limited in the clinical activity [22] at least among general dentists, as shown also by the results of our study.

For the periodontal use, the current clinical practice guideline put in the first place for regenerative therapy, the use of either barrier membranes or enamel matrix derivative with or without the addition of bone-derived grafts, while when there is also a Class II furcation involvement the most important seems to be enamel matrix derivative alone or bone-derived graft with or without resorbable membranes [23].

In the periodontal regeneration procedures, an important place is currently occupied by the use of membranes that have proven to be effective regarding clinical attachment gain, probing depth reduction and defect bone filling [24].

Regarding bone augmentation materials, there is a very small number of clinical studies on their use in periodontal surgical therapies, compared to implant surgical techniques [25].

Also here, however, the materials from the Bio Oss range used in the analyzed dental practice remain among the most studied ones [26,27].

Although the use of bone augmentation materials seems at first sight similar in the case of implant surgical treatments and periodontal surgical treatments, with the common goal of restoring the bone volume, there are some peculiarities for each of these indications [28].

Thus for periodontal therapies the augmentation materials must create space, but should suffer a complete resorption in 3-6 months after insertion [29], while for implant therapies the materials must have a slow resorption rates, especially in cases with large volumes reconstituted as is in the case of sinus lifting techniques to provide primary stability to the implant [30].

Conclusions

In the present study, which analyzed the activity of a general dental practice, the frequency of bone augmentation materials use was 43.33% of the implant surgical cases and 13,33% of the periodontal surgical cases.

The distribution by gender was balanced, with a slight predominance of the female gender for the implant surgical cases and of the male gender for the periodontal surgical cases.

The bone augmentation materials were used in all the age groups, with a higher frequency in the 50-59 years group for the implant surgical cases and over 60 years for the periodontal surgical cases.

The use of bone augmentation materials in the implant surgical cases is correlated with the use of shorter implants, while their use in the periodontal surgical cases is correlated with the stage 3 periodontitis.

Conflict of Interest

None to declare.

References

1. Fernandez de Grado G, Keller L, Idoux-Gillet Y, Wagner Q, Musset AM, Benkirane-Jessel N, Bornert F, Offner D. Bone substitutes: a review of their characteristics, clinical use, and perspectives for large bone defects management. J Tissue Eng, 2018, 9:2041731418776819.
2. Swami RK, Kolte AP, Bodhare GH, Kolte RA. Bone replacement grafts with guided tissue regeneration in treatment of grade II furcation defects: a systematic review and meta-analysis. Clin Oral Investig, 2021, 25(3):807-821.
3. Elani HW, Starr JR, Da Silva JD, Gallucci GO. Trends in dental implant use in the U.S., 1999-2016, and projections to 2026. J Dent Res, 2018, 97(13):1424-1430.
4. Zhao R, Yang R, Cooper PR, Khurshid Z, Shavandi A, Ratnayake J. Bone grafts and substitutes in dentistry: a review of current trends and developments. Molecules, 2021, 26(10):3007.

 10.12865/CHSJ.47.03.16

5. Tolstunov L, Surgical algorithm for alveolar bone augmentation in implant dentistry. Oral and Maxillofacial Surgery Clinics of North America, 2019, 31 (2):155-161.
6. Stumbras A, Kuliesius P, Januzis G, Juodzbalys G. Alveolar ridge preservation after tooth extraction using different bone graft materials and autologous platelet concentrates: a systematic review. J Oral Maxillofac Res, 2019, 10(1):e2.
7. Juodzbalys G, Stumbras A, Goyushov S, Duruel O, Tözüm TF. Morphological classification of extraction sockets and clinical decision tree for socket preservation/augmentation after tooth extraction: a systematic review. J Oral Maxillofac Res, 2019, 10(3):e3.
8. Aribau-Gumà C, Jorba-García A, Sánchez-Torres A, Sànchez-Garcés MÀ. Alveolar ridge preservation: an overview of systematic reviews. Int J Oral Maxillofac Surg, 2021, S0901-5027(21)00210-1.
9. Tischler M, Misch CE. Extraction site bone grafting in general dentistry. Review of applications and principles. Dent Today, 2004, 23(5):108-113.
10. Haggerty C, Vogel C, Fisher R, Simple bone augmentation for alveolar ridge defects, Oral and Maxillofacial Surgery Clinics of North America, 2015, 27(2):203-226.
11. Alblowi JA, Zahid TM. Periodontal services rendered by general dental practitioners in Saudi Arabia. Clin Cosmet Investig Dent, 2019, 11:53-60
12. Cha, HS, Kim, JW, Hwang, JH, Ahn, KM. Frequency of bone graft in implant surgery. Maxillofac Plast Reconstr Surg, 2016, 38(1):19.
13. Ratnayake JTB, Mucalo M., Dias GJ. Substituted hydroxyapatites for bone regeneration: A review of current trends. J Biomed Mater Res Part B Appl Biomater, 2017, 105(5):1285–1299.
14. Haugen HJ, Lyngstadaas SP, Rossi F, Perale G. Bone grafts: Which is the ideal biomaterial? J. Clin. Periodontol, 2019, 46(Suppl 21):92–102.
15. Schmidt AH. Autologous bone graft: Is it still the gold standard? Injury, 2021, 52 Suppl 2:S18-S22.
16. Canellas JVDS, Soares BN, Ritto FG, Vettore MV, Vidigal Júnior GM, Fischer RG, Medeiros PJD. What grafting materials produce greater alveolar ridge preservation after tooth extraction? A systematic review and network meta-analysis. J Craniomaxillofac Surg, 2021, S1010-5182(21)00157-8.
17. da Silva HF, Goulart DR, Sverzut AT, Olate S, de Moraes M. Comparison of two anorganic bovine bone in maxillary sinus lift: a split-mouth study with clinical, radiographical, and histomorphometrical analysis. Int J Implant Dent, 2020, 6(1):17.
18. Canellas JVDS, Drugos L, Ritto FG, Fischer RG, Medeiros PJD. Xenograft materials in maxillary sinus floor elevation surgery: a systematic review with network meta-analyses. Br J Oral Maxillofac Surg, 2021, 59(7):742-751.
19. Rues S, Schmitter M, Kappel S, Sonntag R, Kretzer JP, Nadorf J. Effect of bone quality and quantity on the primary stability of dental implants in a simulated bicortical placement. Clin Oral Investig, 2021, 25(3):1265-1272.
20. Janakiram C, Dye BA. A public health approach for prevention of periodontal disease. Periodontol 2000, 2020, 84(1):202-214.
21. Sheikh Z, Hamdan N, Ikeda Y, Grynpas M, Ganss B, Glogauer M. Natural graft tissues and synthetic biomaterials for periodontal and alveolar bone reconstructive applications: a review. Biomater Res, 2017, 21:9.
22. Aravind K, Ganapathy D, Ramanathan V. Survey on the use of guided tissue regeneration membranes by dental practitioners. Drug Invention Today, 2019, 12(10):2310-2312.
23. Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Beglundh T, Sculean A, Tonetti MS. EFP Workshop participants and methodological consultants. Treatment of stage I-III periodontitis-The EFP S3 level clinical practice guideline. J Clin Periodontol, 2020, Suppl 22(Suppl 22):4-60.
24. Sheikh Z, Qureshi J, Alshahrani AM, Nassar H, Ikeda Y, Glogauer M, Ganss B. Collagen based barrier membranes for periodontal guided bone regeneration applications. Odontology, 2017, 105(1):1-12.
25. Labussiere M, Badran Z, Rethore G, Verner C, Soueidan A, Struillou X. Combination of bone substitutes and vectors in periodontology and implantology: A systematic review. Dent Mater J, 2021, 40(4):839-852.
26. Palachur D, Prabhakara Rao KV, Murthy KR, Kishore DT, Reddy MN, Bhupathi A. A comparative evaluation of bovine-derived xenograft (Bio-Oss Collagen) and type I collagen membrane (Bio-Gide) with bovine-derived xenograft (Bio-Oss Collagen) and fibrin fibronectin sealing system (TISSEEL) in the treatment of intrabony defects: A clinico-radiographic study. J Indian Soc Periodontol, 2014, 18(3):336-343.
27. Zhang C, Zhang H, Yue Z, Miao L, Han Y, Liu K, Hou J. Modified minimally invasive surgical technique plus Bio-Oss Collagen for regenerative therapy of isolated interdental intrabony defects: study protocol for a randomised controlled trial. BMJ Open, 2020, 10(12):e040046.
28. Fukuba S, Okada M, Nohara K, Iwata T. Alloplastic bone substitutes for periodontal and bone regeneration in dentistry: current status and prospects. Materials (Basel), 2021, 14(5):1096.
29. Reynolds MA, Kao RT, Camargo PM, Caton JG, Clem DS, Fiorellini JP, Geisinger ML, Mills MP, Nares S, Nevins ML. Periodontal regeneration-intrabony defects: A consensus report from the AAP Regeneration Workshop. J Periodontol, 2015, 86:S105–S107.
30. Cicciù M, Fiorillo L, Cervino G, Habal MB. Bone Morophogenetic Protein application as grafting materials for bone regeneration in craniofacial surgery: current application and future directions. J Craniofac Surg, 2021, 32(2):787-793.

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