RESEARCH

Hard tissue preparation prior to dental implant placement: A four-year retrospective study

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ABSTRACT

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Background: The purpose of this study was to investigate incidence for the requirements of hard tissue preparation prior to dental implant placement.

Methods: In this retrospective study, the records of 1086 patients who referred to Mustafa Kemal University, Faculty of Dentistry, Periodontology and Oral and Maxillofacial Surgery clinics between 2011 and 2015 were investigated. The received frequency of patients' onlay grafting, autogenous block grafting, socket preservation, guided bone regeneration, external sinus lifting, ridge split osteotomy, alveolar distraction osteogenesis, inferior alveolar nerve repositioning were evaluated in any process of the dental implant.

Results: 3186 dental implants in 1086 patients were included to the study. Among 295 patients, it was observed that the number of men was 144 (48.8%) and number of implants was totally 309 (47.2%) implants, while the number of grafted implants in women of 151 (51.2%) was 346 (52.8%). The numbers of grafting procedures for augmentation are as follows; 286 (43.7%) onlay grafting, 23 (3.5%) socket preservation, 9 (1.4%) guided bone regeneration, 271 (41.3%) open sinus lifting, 62 (9.5%) alveolar ridge splitting, 2 (0.3%) alveolar nerve repositioning and 2 (0.3%) distraction osteogenesis.

Conclusion: In this study, it was observed that the different augmentation procedures were applied to place the dental implant.

KEYWORDS

Bone augmentation, dental implant, descriptive statistic

ÖZ

Dental implantasyondan önce sert doku hazırlığı: dört yıllık retrospektif bir çalışma

Amaç: Bu çalışmanın amacı dental implant yerleştirilmeden önceki sert doku hazırlığı gereksinimlerininin insidansını araştırmaktır.

Gereç ve yöntem: Çalışmamızda, 2011-2015 yılları arasında Mustafa Kemal Üniversitesi Diş Hekimliği Fakültesi, Periodontoloji ve Ağız, Diş ve Çene Cerrahisi kliniklerine başvuran 1086 hasta incelendi. Dental implantasyon öncesi veya sırasında yapılan onlay greftleme, otojen blok greftleme, soket koruma, yönlendirilmiş doku rejenerasyonu, eksternal sinus lifting, ridge-split osteotomisi, alveolar distraksiyon osteogenezi, inferior alveolar sinir repozisyonu işlemleri her bir implant için ayrı ayrı kaydedildi.

Bulgular: 1086 hastada 3186 implant değerlendirildi. 295 hastada (% 27.1) 655 implantın herhangi bir augmentasyon prosedürü ile yerleştirildiği saptandı. Augmentasyon prosedürlerinden en az birini alan 295 hastanın 144'ü erkek iken 151'i kadındı. Erkeklerde 309 implant kadınlarda ise 346 adet implantın augmentasyon prosedürü ile yerleştirildiği saptandı. Augmentasyon prosedürü uygulanan 286 implant için onlay greftleme, 23'ü için soket koruma, 9'u için yönlendirilmiş kemik rejenerasyonu, 271'i için eksternal sinus tabanı yükseltme girişimi, 62'si için ridge-split osteotomisi, 2'si için inferior alveolar sinir repozisyonu, 2'si için distraksiyon osteogenezi şeklinde dağılım gösterdiği gözlendi.

Sonuç: Bu çalışmada, implant yerleştirme işlemi öncesi veya sırasında çeşitli greftleme prosedürlerinin uygulandığı gözlendi.

ANAHTAR KELİMELER

Kemik augmentasyonu, dental implant, tanımlayıcı istatistik

Due to absence of the stimulation of periodontal fibres in process after tooth extraction, alveolar bone resorption begins naturally. In the first year, there is a decrease of 25% in the total bone width depending on the bone resorption caused by advanced periodontal diseases, endodontic lesions and/or trauma.[1,2] Also, it has been reported that the proportion of bone loss within the first year was greater than that of the following years.[3,4] Sometimes, progressing quickly in women and in early tooth loss, the resorption may result in the complete loss of alveolar bone. In addition, the alveolar bone resorption is faster in the mandible compared to the maxilla.[5] Apart from the physiologic resorption of the alveolar ridge, fragmental bone loss might cause by traumatic tooth extraction procedures.[6]

Titanium dental implants have been used in the treatment of partial and total edentulous individuals a time for more than 40 years.[7] The most important things to be taken into consideration at the placement of dental implant are: the amount and quality of the pre-existing bone. The pre-existing bone is defined as the amount of bone in the edentulous area. In the past,

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the condition of the pre-existing bone would affect the position and size of the implant. Whereas, both hard and soft tissue have to be adequate in volume and quality for the ideal placement of an implant. Therefore, bone augmentation should be done according to the size and number of the planned implant. The grafting of extraction socket, guided bone regeneration, horizontal and vertical ridge augmentation and sinus lifting are some of the methods used for the bone augmentation. In order to maximize the results in these applications, different techniques such as particle grafting, membrane usage, block grafting, and distraction osteogenesis, either alone or in combination, could be used.[8,9] Moreover, the ridge splitting technique showed that it would be successfully used as an alternative method for horizontal ridge expansion.[10] In cases of which augmentation is contraindicated as a result of excessive resorption of the posterior mandible, alveolar nerve repositioning procedures might be required to provide the necessary space for the placement of implant.[11] In the light of these data, the aim of our study was to investigate retrospectively incidence of the requirements of hard tissue augmentation for the dental implant placement.

MATERIALS AND METHODS

The records of patients who referred to the Periodontology and Oral and Maxillofacial Surgery clinics between 2011 and 2015 years for dental implantation were examined. Follow-up charts of the patients including age, sex, type of augmentation technique, implants received any augmentation procedure were screened retrospectively. The applications including onlay grafting (particle and autogenous block grafting), socket preservation, guided bone regeneration, open sinus lifting, ridge splitting osteotomy, alveolar distraction osteogenesis, and inferior alveolar nerve repositioning, which they had been performed by different surgeons, were recorded in this study. The number of procedures was determined according to whether it is required the augmentation for the implantation. For instance, when a horizontal ridge augmentation was performed with one piece of autogenous block graft on a crest, the number of onlay autogenous block grafting were calculated twice if two implants were placed in the same area. When considering an implant for inclusion criteria, it had to be loaded with dental prosthesis. Implant loaded was confirmed by clinical records and/or radiography. The cases augmented which placement of dental implant has not been performed yet were excluded from the study.

RESULTS

The records of 1086 patients who applied to our centre between 2011 and 2015 were reached. In the 4-year period, 3186 dental implants were placed in these patients, of which the average age was 45.92 years (Table 1). Augmentation or grafting procedures were applied by using different methods for the 655 (20.5%) of the 3186 implants, and the distributions of the number of implants with or without augmentation according to the number and age of the patients, are shown in Table 1. The average age of the 295 patients received any graft application was 44.8. Among these patients, it was observed that the number of men was 144 (48.8%) and number of implants was totally 309 (47.2%) implants, while the number of grafted implants in women of 151 (51.2%) was 346 (52.8%) (Table 2).

Table 1.

Number of patients and implants included to the study

	Age (mean)	Number of patients	Number of implants
Male	47,63	524 (48,3%)	1478 (46,4%)
Female	44,21	562 (51,7%)	1708 (53,6%)
Total/Average	45,92	1086 (100%)	3186 (100%)

Table 2.

Number of patients and implants with augmentation

	Age (mean)	Number of patients	Number of implants
Male	46,39	144 (48,8%)	309 (47,2%)
Female	43,31	151 (51,2%)	346 (52,8%)
Total/Average	44,8	295 (27,1%)	655 (20,5%)

Considering that the number of grafting procedures, while the number of onlay grafting were 286, others were 9 for guided bone regeneration, 23 for socket preservation, 271 for open sinus lifting, 62 for alveolar ridge splitting, 2 for alveolar nerve repositioning and 2 for distraction osteogenesis. The ratios and percentages of the numbers of implant according to the grafting method are shown in Table 3.

Table 3.

Number and percentages of bone augmentation techniques

	Onlay grafting	Socket preservation	Guided bone regeneration	Sinus lifting	Ridge splitting	Alveolar nerve reposition	Distraction osteogenesis	Implant number
n	286	23	9	271	62	2	2	655
%	43,7	3,5	1,4	41,3	9,5	0,3	0,3	100

"n" shows number of grafted implants with any of augmentation technique. "%" shows frequency of the augmentation technique reviewed in present study.

DISCUSSION

Nowadays, the developments in the treatment of partial and total edentulous cases have made a breakthrough in dentistry. Especially, the dental implants are often preferred and used worldwide for this reason.[12,13] When a conventional or an implant prosthesis is planned to replace a tooth lost by trauma or congenital causes, the alveolar ridges in the edentulous area must be evaluated. This is very important in terms of ensuring the adequate bone volume and aesthetic appearance.[14] The several studies showed that it need to be at least 1 to 1.5 mm-width bone plate in lingual and buccal of the implant for a good result. In case of being less than 5 mm of alveolar bone thickness in bucco-lingual direction, the augmentation of the alveolar ridge would have great importance in order to provide minimally 1-mm-width alveolar bone which is surrounding any dental implant.

Many methods have been developed to increase the bone volume.[15] Of which, the onlay grafting technique has been frequently used especially in the treatment of small defects by using autografts, allografts, xenografts, and alloplasts.[8,9]

It was reported that significant levels of success could be achieved in the horizontal and vertical bone augmentations when the iliac block graft applied for the purpose of implant rehabilitation.[16] In addition to the extra-oral graft sources such as tibia, fibula, and costa, there are regions in the mouth for harvesting of bone graft, which are symphysis, ramus, and bone exostosis etc.[17,18] In our retrospective study, the choice of both individuals and physicians was the iliac bone among the autogenous block grafting methods. The reason for this may be the presence of large defects and resorption areas; because it easily provides the desired shape during the application of the graft; easy manipulation; and additionally to collect the desired amount of particle grafts.

Another factor complicating the implantation is the expansion of the maxillary sinus in the posterior maxilla. The insufficient bone quantity frequently encountered in the posterior maxilla is derived from maxillary sinus pneumatisation and bone atrophy after tooth extraction.[8,19] Maxillary sinus augmentation, which is used to increase the bone height in the atrophic posterior maxilla, is a procedure allowing the placement of dental implant. It is divided into two procedures: open and closed.[20-22] We included the open cases to this retrospective study in which open sinus lifting was applied to 271 (41,3%) of the 655 grafted implants. The hypothesis of "inorganic bovine bone and its combination with autogenic bone have an important difference in terms of bone healing" could not be confirmed but also not be denied because of insufficient evidence. As a result, there is no a strong data about which graft material is the best in maxillary sinus augmentation. In this retrospective study, the allograft, xenograft or alloplastic particle graft materials were used in cases of open sinus lifting.[20,23]

On the basis of this information, we can say that a larger portion of the augmentation techniques in the maxilla consisted of maxillary sinus lifting procedures.

The cause of alveolar crest resorption after tooth loss was mentioned above. According to a systematic review, alveolar bone loss occurs in a range of 2.46–4.56 mm for the control sites (without intervention) compared to a loss of 1.14–2.50 mm for test sites applied socket preservation. Also, there was a range from 0.9–3.6 mm for control sites versus a gain of 1.3 to a loss of 0.62 mm in test sites.[24] These results have supported that the bone resorption decreased in the areas where the socket preservation was applied.[25] The reason for the decreased socket preservation rates in this study was attributed to the reason that the patients had their teeth already extracted when they applied to our clinic or they expressed a willing to take some time for decision making on implant treatment option, which a result caused a loss of valuable time needed for a proper healing of the socket post-extraction.

In alveolar ridge insufficiency, block graft, guided bone regeneration, distraction osteogenesis, alveolar ridge splitting or expansion methods can be used alone or in combination.[26] The ridge splitting procedure is very advantageous for implant placement and augmentation applications because of shortening the treatment time for implantation. The crest width to be subjected to ridge splitting must be

at least 3.5 mm[4]. In the 1970s, over 5000 implants were placed to the maxillary anterior area by Tatum, using the ridge splitting method. All of the implants were placed by expanding atrophic ridges thicker than 3 mm in the same session.[27]

Scipioni et al. observed that the survival rate of implants placed with ridge expansion was 98.8% even after 5 years of follow-up.[28] Although the ridge splitting method can be used in both jaws, the best results are seen in the maxilla[4]. The ridge splitting procedure has been preferred in the maxilla because its spongy structure allows the ease of application. According to our data, 45 (72.5%) of 62 implants were placed to the augmented maxilla simultaneously with split osteotomy.

The resorbable and/or non-resorbable membranes are used for guided bone regeneration. However, the resorbable membranes might not provide the stabilization of applied particle graft material, whereas the non-resorbable membranes are not affected by soft tissue pressure. Titanium mesh forms an excellent truss for bone augmentation, and the desired successful results can be obtained.[15,29] In this study, among the reasons of low number of guided bone regeneration might be included such as high cost, risk of exposure, and requiring of a second surgical stage can be counted.

Sometimes, the height of alveolar bone decreases depending on resorption, which results in the aesthetic and functional problems. In these cases, although vertical augmentation could be applied in combination with block graft and non-resorbable membranes, but it has high rate of exposure. Therefore, the distraction osteogenesis called method of moving together the bone segment with the soft tissues should be used for increase the bone crest.[30] The proximity of the alveolar nerve to the bone crest is one of the challenging factors for implantation in mandible. In case of decreasing vertical distance between dental implant and alveolar nerve, the alveolar nerve repositioning is indicated in order to preserve the vital tissues. It is needed that the distance is the range of 5-8 mm for this procedure. Thus, the better results can be obtained in terms of the biomechanical conditions, providing the ideal crown-root ratio.[31] In our retrospective study, we observed one alveolar nerve repositioning for two dental implants.

Various augmentation techniques applied for implant placement are more common in women than in men.[5] Ella et al. used synthetic bone grafts together with the horizontal ridge splitting method in mandibular crest expansion; 59% of the 32 patients were women and 41% of them were men.[32] Huumonen et al. evaluated 326 patients radiographically, and resorption occurred in the jaw crests of 211 women, showing a higher frequency than in men.[33] In another study, 19 of the 22 patients planned augmentation prior to their dental implants were women.[34] Our records were in agreement with these reports.

In conclusion, this study showed that many augmentation procedures were performed in order to place dental implant

REFERENCES

1. Eratalay K, Demiralp B, Akincibay H, Tozum TF. Localized edentulous ridge augmentation with upside down osteotomy prior to implant placement. Dent Traumatol 2004; 20: 300-4.
2. Bernstein S, Cooke J, Fotek P, Wang HL. Vertical bone augmentation: where are we now? Implant Dent 2006; 15: 219-28.
3. Leong DJ, Oh TJ, Benavides E, Al-Hezaimi K, Misch CE, Wang HL. Comparison between sandwich bone augmentation and allogenic block graft for vertical ridge augmentation in the posterior mandible. Implant Dent 2015; 24: 4-12.
4. Mechery R, Thiruvalluvan N, Sreehari AK. Ridge split and implant placement in deficient alveolar ridge: Case report and an update. Contemp Clin Dent 2015; 6: 94-7.
5. Karkazis HC, Lambadakis J, Tsichlakis K. Cephalometric evaluation of the changes in mandibular symphysis after 7 years of denture wearing. Gerodontology 1997; 14: 101-5.
6. Tomlin EM, Nelson SJ, Rossmann JA. Ridge preservation for implant therapy: a review of the literature. Open Dent J 2014; 8: 66-76.
7. Kola MZ, Shah AH, Khalil HS, Rabah AM, Harby NM, Sabra SA, et al. Surgical templates for dental implant positioning; current knowledge and clinical perspectives. Niger J Surg 2015; 21: 1-5.
8. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol 2007; 78: 377-96.
9. Damlar I, Erdogan O, Tatli U, Arpag OF, Gormez U, Ustun Y. Comparison of osteoconductive properties of three different beta-tricalcium phosphate graft materials: a pilot histomorphometric study in a pig model. J Craniomaxillofac Surg 2015; 43: 175-80.
10. Crespi R, Bruschi GB, Gastaldi G, Cappare P, Gherlone EF. Immediate Loaded Implants in Split-Crest Procedure. Clin Implant Dent Relat Res 2015; 17 Suppl 2: e692-8.
11. Barbu HM, Levin L, Bucur MB, Comaneanu RM, Lorean A. A modified surgical technique for inferior alveolar nerve repositioning on severely atrophic mandibles: case series of 11 consecutive surgical procedures. Chirurgia (Bucur) 2014; 109: 111-6.
12. Doonquah L, Lodenquai R, Mitchell AD. Surgical techniques for augmentation in the horizontally and vertically compromised alveolus. Dent Clin North Am 2015; 59: 389-407.
13. Lee HJ, Lee J, Lee JT, Hong JS, Lim BS, Park HJ, et al. Microgrooves on titanium surface affect peri-implant cell adhesion and soft tissue sealing; an in vitro and in vivo study. J Periodontal Implant Sci 2015; 45: 120-6.
14. Singh A, Daing A, Anand V, Dixit J. Two dimensional alveolar ridge augmentation using particulate hydroxyapatite and collagen membrane: A case report. J Oral Biol Craniofac Res 2014; 4: 151-4.
15. Rakhmatia YD, Ayukawa Y, Furuhashi A, Koyano K. Current barrier membranes: titanium mesh and other membranes for guided bone regeneration in dental applications. J Prosthodont Res 2013; 57: 3-14.
16. Castagna L, Polido WD, Soares LG, Tinoco EM. Tomographic evaluation of iliac crest bone grafting and the use of immediate temporary implants to the atrophic maxilla. Int J Oral Maxillofac Surg 2013; 42: 1067-72.
17. Güvenç D, Gökbuget YA, Çintan S, Çifcibaşı EY, Kara G, Akkuş GÖ. İmplant öncesi otojen blok greft ile lokalize alveolar kret ogmentasyonu: bir olgu sunumu. J Istanb Univ Fac Dent 2008; 42: 51-7.
18. Altan A, Damlar I. Dental implant cerrahisinde kullanılan ağız dışı otojen kemik greftleri. Mustafa Kemal Üniv Tıp Derg 2016; 7: 46-52.
19. Lundgren S, Moy P, Johansson C, Nilsson H. Augmentation of the maxillary sinus floor with particulated mandible: a histologic and histomorphometric study. Int J Oral Maxillofac Implants 1996; 11: 760-6.
20. Meloni SM, Jovanovic SA, Lolli FM, Cassisa C, De Riu G, Pisano M, et al. Grafting after sinus lift with anorganic bovine bone alone compared with 50:50 anorganic bovine bone and autologous bone: results of a pilot randomised trial at one year. Br J Oral Maxillofac Surg 2015; 53: 436-41.
21. Schaudy C, Vinzenz K. Osteoplastic reconstruction of severely resorbed maxilla by stack plasty: combining sinus augmentation with lateral and vertical onlay bone grafting. Br J Oral Maxillofac Surg 2014; 52: 647-51.
22. Vina-Almunia J, Maestre-Ferrin L, Alegre-Domingo T, Penarrocha-Diago M. Survival of implants placed with the osteotome technique: an update. Med Oral Patol Oral Cir Bucal 2012; 17: e765-8.
23. Jensen T, Schou S, Stavropoulos A, Terheyden H, Holmstrup P. Maxillary sinus floor augmentation with Bio-Oss or Bio-Oss mixed with autogenous bone as graft: a systematic review. Clin Oral Implants Res 2012; 23: 263-73.
24. Morjaria KR, Wilson R, Palmer RM. Bone healing after tooth extraction with or without an intervention: a systematic review of randomized controlled trials. Clin Implant Dent Relat Res 2014; 16: 1-20.
25. Kim YK, Yun PY, Um IW, Lee HJ, Yi YJ, Bae JH, et al. Alveolar ridge preservation of an extraction socket using autogenous tooth bone graft material for implant site development: prospective case series. J Adv Prosthodont 2014; 6: 521-7.

26. Sfasciotti GL, Trapani CT, Powers RM. Mandibular Ridge Augmentation Using a Mineralized Ilium Block: A Case Letter. J Oral Implantol 2015; 42:215-9
27. Tatum H, Jr. Maxillary and sinus implant reconstructions. Dent Clin North Am 1986; 30: 207-29.
28. Scipioni A, Bruschi GB, Calesini G. The edentulous ridge expansion technique: a five-year study. Int J Periodontics Restorative Dent 1994; 14: 451-9.
29. Bunyaratavej P, Wang HL. Collagen membranes: a review. J Periodontol 2001; 72: 215-29.
30. Kim JW, Cho MH, Kim SJ, Kim MR. Alveolar distraction osteogenesis versus autogenous onlay bone graft for vertical augmentation of severely atrophied alveolar ridges after 12 years of long-term follow-up. Oral Surg Oral Med Oral Pathol Oral Radiol 2013; 116: 540-9.
31. Khajehahmadi S, Rahpeyma A, Bidar M, Jafarzadeh H. Vitality of intact teeth anterior to the mental foramen after inferior alveolar nerve repositioning: nerve transpositioning versus nerve lateralization. Int J Oral Maxillofac Surg 2013; 42: 1073-8.
32. Ella B, Laurentjoye M, Sedarat C, Coutant JC, Masson E, Rouas A. Mandibular ridge expansion using a horizontal bone-splitting technique and synthetic bone substitute: an alternative to bone block grafting? Int J Oral Maxillofac Implants 2014; 29: 135-40.
33. Huumonen S, Haikola B, Oikarinen K, Soderholm AL, Remes-Lyly T, Sipila K. Residual ridge resorption, lower denture stability and subjective complaints among edentulous individuals. J Oral Rehabil 2012; 39: 384-90.
34. Korpi JT, Kainulainen VT, Sandor GK, Oikarinen KS. Long-term follow-up of severely resorbed mandibles reconstructed using tent pole technique without platelet-rich plasma. J Oral Maxillofac Surg 2012; 70: 2543-8.

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