ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 4, Issue – 1, January - 2021, Page No. : 129 - 137

Efficacy of Autogenously Bone Ring Augmentation with Simultaneous Implant Placement In Inadequate Socket

[1]Ashish Gupta, Intern, Rajiv Gandhi Cancer and Research Hospital, Rohini, New Delhi.

[2]N Srinath, Prof & HOD, Dept. of Oral & Maxillofacial Surgery & Oral Implantology, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka.

[3]Mahadeepa Kar, Intern, Dept. of Head and Neck Oncology, Vedant Hospital, Thane, Mumbai.

[4]Umashankar DN, Prof, Dept. of Oral & Maxillofacial Surgery & Oral Implantology, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka.

[5]Haris Ali Bhat, Senior Lecturer, Dept. of Oral & Maxillofacial Surgery & Oral Implantology, Sri Sai College of Dental Surgery, Vikarabad, Telangana.

[6]Ankita Dahiya, Resident, Dept. of Oral & Maxillofacial Surgery & Oral Implantology, Krishnadevaraya College of Dental Sciences, Bangalore, Karnataka.

Corresponding Author: Ashish Gupta, Intern, Rajiv Gandhi Cancer and Research Hospital, Rohini, New Delhi.

Citation of this Article: Ashish Gupta, N Srinath, Mahadeepa Kar, Umashankar DN, Haris Ali Bhat, Ankita Dahiya, "Efficacy of Autogenously Bone Ring Augmentation with Simultaneous Implant Placement In Inadequate Socket", IJDSIR- January - 2021, Vol. – 4, Issue - 1, P. No. 129 – 137.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To evaluate the efficacy of autogenous bone ring augmentation with simultaneous implant placement in inadequate socket.

Materials and Methods: 10 patients were recruited in the study who required immediate replacement of their decayed or mobile teeth with bone defect. All the patients were subjected to immediate extraction followed by autologous bone ring harvesting and placement with immediate implantation. The operators comfort, instrument assessment, primary stability, the graft quantity to fill the defect**,** assessment of graft quality and success of graft was evaluated.

Results: The comfort level of the operators ranged from excellent to good. The assessment of the wound healing showed minimal pain and swelling post operatively, primary stability ranged from excellent to good. Graft quantity harvested to fill the defect found to be fairly adequate by all operators.

Conclusion: Bone ring augmentation technique is an effective alternative option in reducing the treatment duration for implants placed in extremely defective sockets. It must, however, be noted that patient selection and primary stability of implant bone ring complex play a crucial role in the success of bone ring implants. Furthermore, a total tension-free closure and rounded

margins of ring graft are important to prevent any soft tissue dehiscence at recipient site.

Keywords: Bone Ring Augmentation, Implant Placement, Autogenous Bone

Introduction

The replacement of a lost natural tooth by an osseointegrated implant represents one of the most significant advancements in dentistry. The dental implants provide a realistic treatment alternative for rehabilitation of patients with lost teeth. Due to the advantages provided by the implant supported prosthesis, like improved esthetics, improved hygiene accessibility, osseous preservation and reduced future maintenance, implant supported restorations not only allows the patient to function with confidence but also helps to enjoy a better quality of life.[1,2] Immediate placement protocol is advantageous as it helps in reduction of treatment time and surgical interventions as well as helps in preservation of hard and soft tissues.[3-5]

In cases of severely defective sockets, a new technique was introduced to augment the defective socket three-dimensionally with autologous bone rings and immediate implant placement in a one-stage procedure.[6] With this technique, the patient's treatment time is considerably reduced when compared with classical bone block augmentation. Autogenous bone ring grafts can be taken from intraoral or extra-oral donor sites and might be free cancellous or corticocancellous. Autogenous grafts contain a variety of living cells and growth factors that have osteoinductive, osteoconductive and osteogenic effects.[7-10] Before implant placement, bone augmentation procedures are routinely needed, so the horizontal and vertical extent of the defect plays a vital role in the use of the bone augmentation.[11]

Autologous bone ring grafts can be applied for predictable bone augmentation which is up to 6 mm in horizontal and vertical dimensions.[12,13] The fact that autogenous bone ring grafts have osteoinductive, osteoconductive and volume enhancement properties makes them ideal for the reconstruction of three-dimensional alveolar bone defects. Bone integration, however, requires at least a three-month recovery period after osseous reconstruction. On the one hand, it can be said that the treatment period is raised by a second operation and recovery period when dental implants are taken into consideration. On the other, treatment period and the number of operations is shortened by Autogenous Bone Ring Augmentation technique which is used as single stage augmentation with simultaneous implant placement.[14] Hence, the present study was conducted to evaluate the efficacy of autogenous bone ring augmentation with simultaneous implant placement in inadequate socket.

Materials and Methods

Ten implants were inserted in patients who visited the Department of Oral and Maxillofacial Surgery, Krishnadevaray College of Dental Sciences and Hospital, Bangalore. Patients aged between 18-70 years and those who were willing for extraction and immediate implant placement with prosthetic rehabilitation were enrolled in the study. Patients with adverse habits like smoking and alcohol consumption were excluded. Patients with immunocompromised diseases, underlying metabolic or endocrine diseases, those who have recently undergone radiation therapy, underlying bone diseases like Paget's disease, osteoporosis, and non-willing patients were also excluded from the study.

Surgical Procedure

The procedure was carried under aseptic conditions and under local anesthesia (2% lignocaine with 1:200000 adrenaline). A flap was raised for the extraction of the tooth and removal of the tooth without any fracture of the root or damage to cortical plate. To avoid damaging the

remaining buccal and lingual/ palatal plate care must be exercised not to luxate the tooth buccolingually after tooth removal. Irrigation of the socket with povidine iodine was done. In the interested donor region, an intraoral vestibular incision was made 3 mm below the attached gingiva, then the flap was reflected. The selected area was outlined mono-cortically with a trephine bur of sequentially larger diameter than that utilized in the preparation of the socket up to desired depth. The trephine was slightly torqued to partially loosen the bone disc to facilitate its subsequent removal without fracture. An implant drill was subsequently used to prepare central osteotomies corresponding to the final implant diameter to be placed in the centre of each disc converting it to a bone ring.

Bone augmentation and implant placement

The customized bone ring was introduced into the prepared defective socket under delicate pressure utilizing a small bone mallet. After ring placement and immobilization, the final implant drill was introduced through the central osteotomy of the bone ring to prepare the remaining apical bone of the socket for at least 3 mm. The implant was then screwed passively through the tapped central osteotomy of the harvested ring and firmly into the prepared bone apical to the ring using a torque ratchet. The platform of the implant was positioned 1 mm below the surface of the ring to compensate for the anticipated crestal bone resorption. Finally, the covering screw was secured and the ring margin was rounded using a small round bur. The flap was relaxed through scoring of the periosteum and then advanced and closed. Antibiotics and analgesics were prescribed for the patients for 5 days post operatively along with the chlorhexidine mouth wash for 15 days. Assessment of parameters was done at 3 weeks, 3 and 6 months. Ease of instrumentation was assessed on day of implantation using device performance ergonomics. Assessment of pain assessed by visual analog scale. It is measured intra-operatively, post-operatively (2days,1 week and 2weeks).

Statistical Analysis

The data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) for Windows 26.0 (SPSS, Inc. Chicago, Illinois). Confidence intervals were set at 95%, and a p-value $\leq$ of 0.05 was considered as statistically significant. Descriptive statistics and chi square test were applied to evaluate autogenous bone ring augmentation with simultaneous implant placement.

Results

Mean age of the patients was 37 years. The comfort level of the operators ranged from slightly anxious (60%) to good (40%). The assessment of the wound healing showed minimal pain and swelling post operatively, primary stability ranged from excellent to good. Graft quantity harvested to fill the defect found to be fairly adequate by all operators. There was statistically significant ($p<0.05$) difference seen with bleeding and swelling assessment. There was no statistically significant difference ($p>0.05$) seen with infection.

Discussion

Loss of bone can occur as part of physiological process or it can occur secondary to trauma, pathology, metabolic bone disorders, congenital anomalies or due to trans-alveolar extractions, prolonged edentulism & periodontal diseases as in the maxilla and mandible. If the loss of bone hinders the function & esthetics in a patient, it becomes imperative to restore the lost bone. The ability to procure autogenous bone with a minimally morbid technique, as well as obtaining an adequate quantity & quality of bone graft has always been a challenge to the maxillofacial surgeons. Autogenous bone grafts have always been the gold standard in bone reconstruction. Harvesting bone grafts by hand instruments has not only been cumbersome

but is also associated with certain degree of morbidity. There are 8 factors which induce bone formation called Bone Morphogenetic Proteins (BMP), these are BMP 2-8 & transforming growth factor. Grafted bone can be cortical, cancellous or corticancellous. Grafted autogenous bone heals in three phases; The first phase, the osteogenic cells that survive in the graft forms an osteoid by osteogenesis. This occurs within 4 weeks. Second phase, osteoinduction occurs between 2-6 weeks after grafting and up to 6 months. New blood vessels and connective tissues are established from the host site. The graft is remodeled by resorption and new bone formation. BMPs are released and are resorbed by osteoclasts mainly from the cortical bone. In phase three, the inorganic matrix acts as a scaffold for the osteoconductive part. The graft matrix is replaced by new bone It is unlikely that there would be a rejection to the autograft as the tissue is native to the patient's body. However, there are a number of disadvantages, the patient will have a second surgical site, donor site morbidity and postoperative pain. Although autogenous is the best material for osteogenesis there are a number of substitutes/alternatives that can be employed. Initially, Brånemark prescribed a protocol for implant placement in which a healing period of 6–8 months was necessary between tooth extraction and implant placement to allow for better primary stability at implant placement. However, following extraction, subsequent bone resorption of alveolar ridge may result in a loss of height as well as upto 50% of width[13] that might negate the placement of dental implants. With the continuing research, to overcome this drawback, immediate placement protocol was introduced where the implant is installed in conjunction with tooth extraction. The ideal extraction site for immediate implant placement is one with little or no periodontal bone loss on the tooth that is to be extracted.[14] However, defective sockets resulting from either periodontal disease or surgical trauma during extraction may have an insufficient quantity of bone for successful implant placement. Several classification systems have been proposed for classifying such defects.[15-18] Several approaches reported in the literature for augmentation procedure includes bone augmentation with barrier membrane technique, particulate bone grafting technique, block grafting approaches, membranes used in combination with block grafts and/or particulate graft materials, ridge split technique, and distraction osteogenesis.[19] However, to reduce the overall treatment time and difficulties in the management of severely defective sockets, a new technique was introduced by Stevens et al. To augment the defective socket three-dimensionally with autologous bone rings and immediate implant placement in a one-stage procedure.[20] All autologous bone ring grafts were harvested from symphysis region using vestibular degloving incision. Symphysis region was chosen as the donor site because it can be easily accessed, avoids cutaneous scars, has low morbidity, provides membranous bone so shows less resorption and early revascularization as compared to endochondral bone, has ample supply of corticocancellous bone as compared to other intraoral sites, and there is no need for hospital stay.[21-30] Symphysis region is easily accessible to harvest autogenous block graft, and a low degree of morbidity and minimal graft resorption is observed on the region.[31] More limited amount of bone can be harvested from symphysis region than ramus region and postoperative sensitivity can be monitored in mandibular anterior teeth. Though there are studies that show postoperative complications of ramus grafts are lower than those of symphysis grafts, no complication was observed as a result of harvesting symphysis graft.[32,16] Mark Stevens et al. Placed three-dimensional bone ring block graft with combined dental implant on the sockets in

the same session with the removal of maxillary anterior 4 tooth. At the same time all the implants were successfully osseointegrated. During the healing period, after the operation, no complications or problems like infection or bone resorption were observed.[12] Likewise, we decided to use a one-stage protocol, and bone augmentation with implant osseintegration was successfully performed without any postoperative complications. While harvesting graft from symphysis region, it is very important to be take the thickness of graft and the distance to mandibular anterior teeth into account. Because limited amount of graft can be harvested, it might be broken or may lead to contour disorder on the mentum if harvested in excessive amount.[33,34] While determining the donor site boundaries, they have to be 5 mm away from the roots not to damage the roots of anterior teeth. Similarly, in this investigation, we inserted ring block graft boundaries minimum 5 mm away from the teeth with trephine bur. In order for autogenous block graft to be successfully performed, its stabilization on recipient site is vital. Such methods as screw or plate fixation are applied to have successful stabilization of block grafts harvested from block intra-oral or extra-oral site, and these materials have to be removed through the second surgical operation. In our technique, autogenous bone prepared in suitable size for the defect in recipient site and it was adapted by tapping onto the defect region. Its primary stabilization was performed by fixing on defect region through implant placement. Various complications are reported in the literature with the use of vestibular degloving incision such as temporary mental nerve paresthesia, lip ptosis, wound dehiscence. However, in this study, no such complications were encountered. This could be as our incision was given unilaterally at least 1 cm away from the mucogingival junction and a pressure dressing was applied postoperatively. Pommer et al. have recommended to leave at least 8 mm of bone from the apices of lower anterior teeth.[28] However, in this study, no damage to neurovascular bundle was found after maintaining only 5 mm safety margin from teeth apices.[35-37] Dimension of the graft ring was determined using the exact dimension of the socket and the implant to be placed. Outer diameter of the ring should match the dimension of the socket and inner diameter should match the diameter of the implant. Further, recipient site was prepared using a trephine bur to accommodate the graft with a snug fit. This provided for the absolute stability of the implant bone ring complex which was essential for the early healing and decreased resorption of the graft. Furthermore, this preparation provides access for trabecular bone blood vessels to the graft and accelerates revascularization. Surgical trauma created also allows for the regional acceleratory phenomenon to occur, which results in tissue healing two to ten times faster than normal physiologic healing.[24]

Another important factor is that the harvesting of a bone ring from the chin region is more convenient than from other intraoral donor sites, and such rings can be utilized universally for intraoral augmentation of up to 6 mm or more in three dimensions. An end-cutting trephine bur design was used and the trephination protocol that was followed prevented heat damage to the bone and allowed safe graft harvesting. During the outlining of the chin ring it is extremely important to adjust the longitudinal axis of the trephine bur to be perpendicular to the outer cortex of the chin in order to obtain an absolutely cylindrical bone ring. Another important factor is to

ensure that the centralization of the implant osteotomy in the ring is parallel to the longitudinal axis of the ring. Both of these factors, together with proper angulation of the trephine bur during preparation of the tooth socket walls, ensures proper implant placement in relation to the opposing dentition.

Conclusion

In our study all operators felt ease of instrumentation was good to satisfactory. Primary stability was good to average in most of the cases. There was significant reduction of pain post-operatively. Inflammation/mucositis around the implant after long term follow-up was minimal. All cases showed optimum soft tissue healing at the grafted socket with minimal signs of infection in some patient or wound dehiscence which is managed by antibiotic course and wound toilet. Bone ring augmentation technique is an effective alternative option in reducing the treatment duration for implants placed in extremely defective sockets. It must, however, be noted that patient selection and primary stability of implant bone ring complex play a crucial role in the success of bone ring implants. Furthermore, a total tension-free closure and rounded margins of ring graft are important to prevent any soft tissue dehiscence at recipient site. However, extensive research involving a larger sample size and longer follow-up periods are necessary to increase its range of application.

References

1. Flanagan D. Rationale for Definitive Mini Dental Implant Treatment. J Oral Implantol. 2020 Jul 14.
2. Vandeweghe S, Hattingh A, Wennerberg A, Bruyn HD. Surgical protocol and short-term clinical outcome of immediate placement in molar extraction sockets using a wide body implant. J Oral Maxillofac Res. 2011;2(3):e1.
3. Mello CC, Lemos CAA, Verri FR, Dos Santos DM, Goiato MC, Pellizzer EP. Immediate implant placement into fresh extraction sockets versus delayed implants into healed sockets: A systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2017;46(9):1162-1177.
4. Chrcanovic BR, Martins MD, Wennerberg A. Immediate placement of implants into infected sites: a systematic review. Clin Implant Dent Relat Res. 2015;17 Suppl 1:e1-e16.
5. Tekin U, Kocyigit DI, Sahin V. Symphyseal bone cylinders tapping with the dental implant into insufficiency bone situated esthetic area at one-stage surgery: a case report and the description of the new technique. J Oral Implantol. 2011;37(5):589-94.
6. Mcallister BS, Haghighat K. Bone augmentation techniques. J Periodontol. 2007;78:377-96.
7. Stevens MR, Emam HA, Alaily ME, Sharawy M. Implant bone rings. One-stage three-dimensional bone transplant technique: a case report. J Oral Implantol. 2010;36(1):69-74.
8. Misch CE, Dietsh F. Bone-grafting materials in implant dentistry. Implant Dent. 1993;2(3):158-67.
9. Marx RE. Clinical application of bone biology to mandibular and maxillary reconstruction. Clin Plast Surg. 1994;21(3):377-92.
10. Cordaro L, Amadé DS, Cordaro M. Clinical results of alveolar ridge augmentation with mandibular block bone grafts in partially edentulous patients prior to implant placement. Clin Oral Implants Res. 2002;13(1):103-11.
11. Yuksel O, Giesenhagen B. Vertical augmentation and implant placement in just one operation: a case report. Tissue Care NEWS 2010;1:1-6.
12. Stevens MR, Emam HA, Alaily ME, Sharawy M. Implant bone rings. One-stage three-dimensional bone transplant technique: a case report. J Oral Implantol. 2010;36(1):69-74.
13. Dimitriou R, Jones E, McGonagle D, Giannoudis PV. Bone regeneration: current concepts and future directions. BMC Med. 2011;9:66.

14. Caplanis N, Lozada JL, Kan JY. Extraction defect assessment, classification, and management. J Calif Dent Assoc. 2005;33(11):853-63.
15. Tinti C, Parma-Benfenati S. Clinical classification of bone defects concerning the placement of dental implants. Int J Periodontics Restorative Dent. 2003;23(2):147-55.
16. Misch CM, Misch CE, Resnik RR, Ismail YH. Reconstruction of maxillary alveolar defects with mandibular symphysis grafts for dental implants: a preliminary procedural report. Int J Oral Maxillofac Implants. 1992;7(3):360-6.
17. Abdel-Wahed N, Hamdy RM, Abdel-Latif ZA. Measurements of jaw bones for implant site assessment using cone-beam computed tomography: interobserver and intraobserver agreement. Egyptian J Oral Maxillofac Surg. 2012;3:62–9.
18. Apse P, Zarb GA, Schmitt A, Lewis DW. The longitudinal effectiveness of osseointegrated dental implants. The Toronto Study: peri-implant mucosal response. Int J Periodontics Restorative Dent. 1991;11(2):94-111.
19. Nkenke E, Schultze-Mosgau S, Radespiel-Tröger M, Kloss F, Neukam FW. Morbidity of harvesting of chin grafts: a prospective study. Clin Oral Implants Res. 2001;12(5):495-502.
20. Zins JE, Whitaker LA. Membranous versus endochondral bone: implications for craniofacial reconstruction. Plast Reconstr Surg. 1983;72(6):778-85.
21. Pikos MA. Mandibular block autografts for alveolar ridge augmentation. Atlas Oral Maxillofac Surg Clin North Am. 2005;13(2):91-107.
22. Clavero J, Lundgren S. Ramus or chin grafts for maxillary sinus inlay and local onlay augmentation: comparison of donor site morbidity and complications. Clin Implant Dent Relat Res. 2003;5(3):154-60.
23. Moy PK, Lundgren S, Holmes RE. Maxillary sinus augmentation: histomorphometric analysis of graft materials for maxillary sinus floor augmentation. J Oral Maxillofac Surg. 1993;51(8):857-62.
24. Gapski R, Wang HL, Misch CE. Management of incision design in symphysis graft procedures: a review of the literature. J Oral Implantol. 2001;27(3):134-42.
25. Cordaro L. Bilateral simultaneous augmentation of the maxillary sinus floor with particulated mandible. Report of a technique and preliminary results. Clin Oral Implants Res. 2003;14(2):201-6.
26. Hunt DR, Jovanovic SA. Autogenous bone harvesting: a chin graft technique for particulate and monocortical bone blocks. Int J Periodontics Restorative Dent. 1999;19(2):165-73.
27. Ozaki W, Buchman SR. Volume maintenance of onlay bone grafts in the craniofacial skeleton: micro-architecture versus embryologic origin. Plast Reconstr Surg. 1998;102(2):291-9.
28. Pommer B, Tepper G, Gahleitner A, Zechner W, Watzek G. New safety margins for chin bone harvesting based on the course of the mandibular incisive canal in CT. Clin Oral Implants Res. 2008;19(12):1312-6.
29. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent. 2003;23(4):313-23.
30. Juodzbalys G, Sakavicius D, Wang HL. Classification of extraction sockets based upon soft and hard tissue components. J Periodontol. 2008;79(3):413-24.

31. Misch CM, Misch CE. The repair of localized severe ridge defects for implant placement using mandibular bone grafts. Implant Dent. 1995 Winter;4(4):261-7.
32. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant placement. Int J Oral Maxillofac Implants. 1997;12(6):767-76.
33. Chaushu G, Blinder D, Taicher S, Chaushu S. The effect of precise reattachment of the mentalis muscle on the soft tissue response to genioplasty. J Oral Maxillofac Surg. 2001;59(5):510-6.
34. Raghoebar GM, Meijndert L, Kalk WW, Vissink A. Morbidity of mandibular bone harvesting: a comparative study. Int J Oral Maxillofac Implants. 2007;22(3):359-65.
35. Rubens BC, West RA. Ptosis of the chin and lip incompetence: consequences of lost mentalis muscle support. J Oral Maxillofac Surg. 1989;47(4):359-66.
36. Phillips JH, Rahn BA. Fixation effects on membranous and endochondral onlay bone-graft resorption. Plast Reconstr Surg. 1988;82(5):872-7.
37. Watzak G, Tepper G, Zechner W, Monov G, Busenlechner D, Watzek G. Bony press-fit closure of oro-antral fistulas: a technique for pre-sinus lift repair and secondary closure. J Oral Maxillofac Surg. 2005;63(9):1288-94.

Legend Tables

Table 1: Outcomes of autogenous bone ring augmentation with simultaneous implant placement

Variables	Number (n=10)	Percentage (%)
Patient Comfort during Surgery		
Slightly anxious	6	60
Calm	4	40
Ease of Instrumentation		
Satisfactory	7	70
Excellent	3	30
Graft Quality to fill defect		
Fairly adequate	10	100
Graft Quality Obtained		
Slightly distorted ring	3	30
Complete ring	7	70

Table 2: Bleeding assessment

Bleeding	Intra operative	24 hours	Chi square value	p-value
No Bleeding	0	9	16.44	0.001 (S)
Mild bleeding	8	1		
Moderate bleeding	2	0		
Total	10	10		

S - Significant

Table 3: Swelling assessment at donor site

Swelling	1 Day	3 Days	Chi square value	p-value
No Swelling	6	0	10.50	0.005 (S)
Mild Swelling	3	6		
Moderate Swelling	1	4		
Total	10	10		

S - Significant

Table 4: Assessment of Infection

Infection	1 week	2 weeks	3 weeks	Chi square value	p-value
Present	0	2	0	4.28	0.14 (NS)
Absent	10	8	10		
Total	10	10			

NS – Non-Significant