



## The Success Rate of Implants Placed in Reconstructed Alveolar Ridges Using Iliac Bone Graft Compared to Non-augmented Jaw

Bijan Movahedian Attar<sup>1</sup>, Saman Jokar<sup>2\*</sup>, Navid Naghdi<sup>2</sup> and Alireza Ghassemi<sup>3</sup>

<sup>1</sup>Department of Oral and Maxillofacial and Surgery Dental Implant Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.

<sup>2</sup>Department of Oral and Maxillofacial Surgery, Resident of Oral and Maxillofacial Surgery, Isfahan University of Medical Sciences, Isfahan, Iran.

<sup>3</sup>Department of Oral, Maxillofacial and Plastic Facial Surgery, University Hospital of Rheinisch-Westfälische Technische Hochschule, Aachen, Germany.

### Authors' contributions

This work was carried out in collaboration between all authors. Author BMA contributed in conception and design of study, surgical procedures, final approval and guarantor of manuscript. Author SJ contributed in literature search and analysis and interpretation of data. Author NN contributed in analysis and interpretation of data and article preparation and revision. Author AG contributed in conception of study and final approval and guarantor of manuscript. All authors read and approved the final manuscript.

### Article Information

DOI: 10.9734/BJMMR/2015/18216

Editor(s):

(1) Emad Tawfik Mahmoud Daif, Professor of Oral and Maxillofacial Surgery, Cairo University, Egypt.

Reviewers:

(1) Luciana de Barros Correia Fontes, Departamento de Clínica e Odontologia Preventiva, Universidade Federal de Pernambuco, Brazil.

(2) Maen Mahfouz, Orthodontics and Pediatric Dentistry Department, Arab American University Jenin, Palestine.  
Complete Peer review History: <http://sciencedomain.org/review-history/9787>

Original Research Article

Received 10<sup>th</sup> April 2015  
Accepted 11<sup>th</sup> May 2015  
Published 16<sup>th</sup> June 2015

### ABSTRACT

**Aim:** This study is aimed to investigate the success rate and clinical outcome of placed implants in reconstructed alveolar ridges using iliac cortico-cancellus bone graft compared to normal non-augmented alveolar ridge.

**Materials and Methods:** In this clinical trial study, 30 patients who were selected and assigned in case and control groups. The case group included patients with severe alveolar bone loss, who needed bone grafting. The control group included patients with sufficient alveolar ridge and no

\*Corresponding author: Email: [saman.jokar@yahoo.com](mailto:saman.jokar@yahoo.com);

need for bone grafting. The prosthesis was placed on implants after 3 to 8 months. Plaque index, bleeding, pocket depth, mobility, pain, pus secretion and bone loss were evaluated after 24 month. Data were analyzed by SPSS 13. *P*-value less than 0.05 was considered as significant.

**Results:** Out of 30 patients, two were excluded due to their requirements. Totally 97 implants were placed in patients, which included 52 implants in control group and 45 implants in case group. All of the implants were successfully osseointegrated and loaded. There was no significant difference between the success of inserted implants between both groups ( $P=0.05$ ). The mesial and distal bone losses were significantly more in patients without iliac bone graft ( $P=0.05$ ). There was no statistically significant difference between measured outcomes including plaque, bleeding, pocket depth, mobility, pain, and pus secretion ( $P=0.05$ ).

**Conclusion:** Inserted implant in free non-vascularized iliac bone graft has high rate of success compared to non-augmented alveolar ridges and has shown to be a reliable method for reconstruction of severe atrophic jaws.

*Keywords:* Dental implant; bone graft; iliac crest; peri-implant bone loss.

## 1. INTRODUCTION

The use of dental implants in edentulous patients with narrow and short alveolar ridge has been formidable problem. Many different techniques and approaches have been introduced to handle the problems of compromised ridge and to promote bone formation around implant sites including guided bone regeneration (GBR), onlay/veneer grafting, interpositional inlay grafting, distraction osteogenesis (DO), osteotomy techniques and ridge splitting, free and vascularized autografts [1–5]. Recent implant procedures often challenge these original conceptions by placing implants in areas with inadequate bone volume and insufficient ridge height.

Bone graft is a solution to make bone with appropriate shape and mass that may be used from mandibular ramus and symphysis, calvaria, ribs, and iliac crest [5–9]. MacIntosh and Obwegeser introduced the use of the Ilium crest [10]. In other hand, Davis et al. reported 42% rate of resorption in the first two years. During next two years resorptions were 56%. They concluded that 34% of the augmented bone is retained for an extended period [8].

For long-term success of implant, bone mass should be sufficient in implant site [11,12]. Alveolar ridge atrophy less than 5 and 4 mm crestal height and width respectively can cause generalized or localized defects leading to insufficient bone mass [11,13–15]. According to large number of localized and generalized alveolar ridge defects, a surgical reformation is essential.

Regarding the aging and increasing rate of dental trauma and injury that would result in more need to dental implants, long-term success of implants with preparing sufficient bone mass is crucial. Some investigations suggested that bone grafts with intra membranous origins are more stable compared to bone grafts with endochondral origins. On the other hand the iliac crest -as a source of endochondral originated bone graft- is the best option when a large volume of autologous bone is needed [16,17].

Thus the aim of present study was to evaluate the success rate and clinical outcomes of implants placed in reconstructed alveolar ridges using iliac crest bone grafts compared to normal alveolar ridge.

## 2. MATERIALS AND METHODS

### 2.1 Trial Design and Participants

Among 567 patients who referred to the Dental Implant Center, School of Dentistry, Isfahan University of Medical Sciences, Iran between 2009 to 2013, 30 patients were selected based on matching criteria. Panoramic radiograph and cone beam CT-scan were prepared for patients. Treating vertical defects are more unpredictable due to soft and hard tissue management. So patients with proper vertical dimension were selected to reduce the confounding variables. According to horizontal dimension of alveolar ridge, participants were assigned into two groups. Patients with extremely narrow alveolar ridges who needed more than 5 mm horizontal bone augmentation were categorized as case group. Patients with adequate horizontal bone dimension for implant placement without bone

expansion/splitting and augmentation were assorted as control group. So a 4 mm width was considered as minimum. Each group included 15 patients. A sample size of 15 was calculated to provide 80% power ( $\alpha = 0.05$ ) to detect a 16% significantly difference of success rate between groups. The patients placed in case and control groups were matched for age, sex, implant location, and prosthesis type (crown or bridge).

## 2.2 Inclusion and Exclusion Criteria

Inclusions criteria were healthy patients older than 18 years, with ASA class I and moderate to severe horizontal alveolar bone loss (more than 5 mm) needing augmentation of ridge for implant placement. Smoking, systemic disease, pregnancy, using immunosuppressive or chemotherapy drugs and radiotherapy were considered as exclusion criteria.

## 2.3 Randomization and Blinding

Owing to surgery requirement (iliac bone graft) for one group, present study was performed as non-randomized trials. Neither the patients nor surgeon were also blinded. The surgery procedure was completely explained to patients and informed consent was taken from them.

All surgical procedures were performed by one Surgeon. Only the data collectors, outcome assessors and data analysts were blinded.

## 2.4 Intervention (Surgical Procedure)

After clinical examination and radiography, the case group that required ridge reconstruction designated for iliac crest surgery. Under general anesthesia, sufficient amount of bone was harvested from iliac crest. The alveolar bone was prepared through a crestal incision and a full thickness mucoperiosteal flap. After fitting bone blocks, the grafts were fixed with titanium miniscrews (Synthes; Synthes GmbH, Solothurn, Switzerland) and remaining spaces were filled with iliac harvested cancellous bone. The recovery period for bone grafts were four to six months. After the healing period, the grafted alveolar ridge was exposed under local anesthesia to remove the screws and insert the implants (BioHorizons Implant Systems Inc, Birmingham, Ala). A similar procedure for implant placement was performed in control group. For both groups, the prosthesis was placed on implants after 4 to 8 months of healing period. The outcome indices were evaluated after 24 months.

## 2.5 Outcome Measurements and Follow Up

The outcome measures included plaque index (mesiobuccal, buccal, lingual, and distolingual), bleeding index (up to 20 seconds after probing), pocket depth (by periodontal probe parallel to vertical axis of implant in mesiobuccal, buccal, lingual, and distolingual points), mobility index, pain index, pus formation, and bone loss (according to panoramic radiography from alveolar crest to first thread of implant). Radiographic examination was done during the study for determination of horizontal bone loss in mesial and distal region of implants. Two panoramic radiographies were prepared in each group after implantation and during follow-up period.

## 2.6 Statistical Analysis

Data was analyzed by SPSS (version 21) software [Statistical Procedures for Social Sciences; Chicago, Illinois, USA] using Paired and Independent T-test, Mann-Whitney, and Chi-Square tests. *P*-values less than 0.05 considered as significant level.

## 3. RESULTS

Out of 30 patients, two were excluded due to their personal desires to discontinue the study. Between 28 patients 12 were male (42.9%) and 16 were female (57.1%). The mean age of case and control group was  $42.5 \pm 16$  with range of 24 to 63-years-old and  $44.5 \pm 16$  with range of 27 to 60-years-old respectively.

There were no significant differences in age (T-test,  $P=0.66$ ), sex (Chi-Square,  $P=0.61$ ), and follow-up periods (T-test,  $P=0.68$ ) between two groups. However, the mean follow-up period was  $22.25 \pm 7.8$  and  $21.37 \pm 7.0$  months in case and control groups respectively.

Totally 97 implants were placed in patients, which included 52 implants in control group and 45 implants in case group. All of the implants were successfully osseointegrated and loaded; thus the success rate of implants was 100% in both groups. There were no significant differences between the success rate of both groups in similar follow up period ( $P=0.05$ ).

The mesial and distal bone losses were significantly more in control group (T-test,  $P=0.05$ ) (Table 1). Also, there were no

statistically significant differences between measured outcomes including plaque, bleeding, pocket depth, mobility, pain, and pus secretion ( $P=0.05$ ) (Table 2).

**Table 1. Mesial and distal bone losses in two groups (Mean±SD)**

Bone loss	Group	Mean±SD
Mesial	Case	0.31±0.48
	Control	0.57±0.21
Distal	Case	0.30±0.36
	Control	0.61±0.23

#### 4. DISCUSSION

The most critical aspect of creating an implant based restoration is the availability of adequate bone dimension. If the alveolar ridges become atrophic different treatment should be considered depend on factors like age of patient and systemic condition, form and severity of alveolar bone loss, type of implant retained treatment plan, and costs and benefits of each modality. One option is the reconstruction of alveolar ridge using autologous bone grafts from different intraoral or extraoral donor sites. Iliac crest as an available extraoral donor site, offers rich volume of cortical and cancellous bone material. However there are many concerns regarding the amount of bone resorption around the inserted implants in iliac-augmented jaws.

This study was aimed to evaluate the long term stability of transplanted iliac bone graft to reconstruct an atrophic alveolar ridge. In the current investigation the success rate of implants inserted in augmented ridges has been evaluated compared to non-augmented alveolar ridges. Many different studies have been performed to determine the success rate of inserted dental implants in reconstructed ridges including iliac crest. However, there is no comparative study between natural and reconstructed alveolar ridges after implant insertion and integration of prosthesis [15,18–20]. In this study, the background variables were matched between two groups. The results of this study showed no significant difference between two groups regarding the plaque index, bleeding, and pocket depth; in the other hand, pain, pus secretion, and mobility were not seen in two groups. Also all implantation and surgical procedures were performed by single surgeon. All patients in both groups were experienced successful outcomes until follow up period and were satisfied with their final restorations, also no complication was reported.

Nelson et al. [21] evaluated the outcomes of treatment, including 117 implants by iliac bone graft in 19 patients and reported 100% success rate. In the current investigation, all of the implants were successfully osseointegrated and the results conform to the results of Nelson et al. [21] study.

As a systematic review, Clementini et al. [22] were assessed the success rate of implants placed in regenerated alveolar ridges by means of intra oral or extra oral block bone grafts. The success rate of implants in evaluated studies ranged from 72.8% to 97% in 6 months to 10 years follow up periods. Researchers reported similar success rates for implants placed in non-augmented ridges and implants placed in onlay graft regenerated areas.

According to the results of present investigation, the amount of bone loss around the implants in iliac augmented alveolar ridges was less compared to non-reconstructed ridges. Boven et al. [18] assessed peri-implant bone loss in 40 patients with iliac augmented mandibular ridges. The amount of bone loss in the last recall (at least 5 years after implant placement) was  $0.6\pm 0.7$  mm averagely. Although there was no control group in Boven study, authors compared their results with the results of other studies Geertman et al. [23]. They concluded that the amount of peri-implant bone loss in augmented ridges was normal and in the range of implants in non-augmented ridges. The present investigation confirms the result of Boven et al. [18] study, however less bone resorption in current study is due to shorter follow-up period.

Clayman et al. [19] among eight subjects with 41 implants had showed 83% persistence rate and a bone loss lower than 0.5 millimeter in majority of implants. Similarly, in the present study better outcomes was reported which maybe as result of shorter follow-up time.

Although in current investigation the amounts of peri-implant bone loss in grafted group were lower than control group, the contributing factors cannot be definitely identified. Despite the oral health education methods were similar for all of the patients; perhaps the compliance of augmented group was better, because of suffering of prior treatment plan. More accurate evaluation in longer follow up periods is needed to making decision regarding the causes of peri implant bone loss.

**Table 2. The frequency distribution of measured outcomes (%)**

	Pain	Fistule	Pocket depth % (Number of implants)				Mobility	Bleeding % (Number of implants)	
			1 mm	2 mm	3 mm	4 mm		0	1
Case (45 implants)	0%	0%	46.6% (21)	35.6% (16)	8.9% (4)	8.9% (4)	0%	93.3% (42)	6.7% (3)
Control (52 implants)	0%	0%	44.2% (23)	32.7% (17)	9.6% (5)	13.4% (7)	0%	90.4% (47)	9.6% (5)

Application of iliac bone graft in alveolar ridge augmentation is associated to limitations, including surgical procedure under general anesthesia and donor site morbidities such as pain and discomfort, scar remaining and sensitive problems [24]. So the method should be limited to cases with significant alveolar bone loss. The predictable outcome of these procedures depends on several biologic principles. Patient selection, diagnosis, treatment planning, good surgical procedure and post-operative follow up are all pivotal factors in success rate.

The complexity of matching process between case and control groups was the main constraint of this study which caused the relatively low number of participating patients. Another limitation includes the relatively short follow up period in comparison to similar investigations, thus further recalls in longer periods are required. Also this study was carried out as non-randomized trial.

## 5. CONCLUSION

The iliac bone graft can effectively be used for reconstruction of atrophic alveolar ridges. Similar success rate was observed in implants placed in augmented ridges compared to the implants inserted in patients with adequate bone dimensions. The following principle should be considered: Stable bone graft that can be achieved by either protecting the graft material or by using fixation instruments. The soft tissue should remain closed over the augmentation site to prevent bacterial contamination. Although the high resorption rate is the most disadvantage of iliac crest bone grafts before implant insertion, but the amount of peri-implant bone loss in iliac augmented ridges is in normal range.

## ETHICAL APPROVAL

This study registered and approved by the Regional Bioethics Committee of Isfahan Province, Iran (#389457).

## ACKNOWLEDGMENTS

We wish to thank Dr. Saber Khzaei (Kermanshah University of Medical Sciences) who kindly read the manuscript and provides helpful suggestions.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Chiapasco M, Casentini P, Zaniboni M. Bone augmentation procedures in implant dentistry. *Int J Oral Maxillofac Implants.* 2008;24:237–59.
2. Rachmiel A, Srouji S, Peled M. Alveolar ridge augmentation by distraction osteogenesis. *Int J Oral Maxillofac Surg.* Elsevier; 2001;30(6):510–7.
3. Aghaloo TL, Moy PK. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement? *Int J Oral Maxillofac Implants.* 2006;22:49–70.
4. Waasdorp J, Reynolds MA. Allogeneic bone onlay grafts for alveolar ridge augmentation: A systematic review. *Int J Oral Maxillofac Implants.* 2009;25(3):525–31.
5. Misch CM. Ridge augmentation using mandibular ramus bone grafts for the placement of dental implants: presentation

- of a technique. *Pract periodontics aesthetic Dent PPAD*. 1996;8(2):127–35.
6. 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*. Wiley Online Library. 2003;5(3):154–60.
  7. Iizuka T, Smolka W, Hallermann W, Mericske-Stern R. Extensive augmentation of the alveolar ridge using autogenous calvarial split bone grafts for dental rehabilitation. *Clin Oral Implants Res* [Internet]. Blackwell Publishing. 2004; 15(5):607–15. (Cited 2014 Oct 5)  
Available: <http://dx.doi.org/10.1111/j.1600-0501.2004.01043.x>
  8. Davis WH, Martinoff JT, Kaminishi RM. Long-term follow up of transoral rib grafts for mandibular atrophy. *J Oral Maxillofac Surg*. Elsevier. 1984;42(9):606–9.
  9. Carinci F, Farina A, Zanetti U, Vinci R, Negrini S, Calura G, et al. Alveolar ridge augmentation: A comparative longitudinal study between calvaria and iliac crest bone grafts. *J Oral Implantol*. 2005;31(1):39–45.
  10. MacIntosh RB, Obwegeser HL. Preprosthetic surgery: A scheme for its effective employment. *J Oral Surg (American Dent Assoc 1965)*. 1967;25(5):397.
  11. Maestre-Ferrín L, Boronat-López A, Peñarrocha-Diago M, Peñarrocha-Diago M. Augmentation procedures for deficient edentulous ridges, using onlay autologous grafts: an update. *Med Oral Patol Oral Cir Bucal* [Internet]. 2009;14(8):e402–7.  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/19415058>
  12. Buser D, Dula K, Hess D, Hirt HP, Belser UC. Localized ridge augmentation with autografts and barrier membranes. *Periodontol 2000* [Internet]. Wiley Online Library; 1999;19(1):151–63.  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/10321222>
  13. Rocuzzo M, Ramieri G, Bunino M, Berrone S. Autogenous bone graft alone or associated with titanium mesh for vertical alveolar ridge augmentation: A controlled clinical trial. *Clin Oral Implants Res* [Internet]. Wiley Online Library. 2007; 18(3):286–94. (Cited 2014 Oct 3)  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/17298495>
  14. Von Arx T, Buser D. Horizontal ridge augmentation using autogenous block grafts and the guided bone regeneration technique with collagen membranes: a clinical study with 42 patients. *Clin Oral Implants Res* [Internet]. Wiley Online Library. 2006;17(4):359–66. (Cited 2014 Oct 3)  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/16907765>
  15. Chiapasco M, Gatti C, Gatti F. Immediate loading of dental implants placed in severely resorbed edentulous mandibles reconstructed with autogenous calvarial grafts. *Clin Oral Implants Res* [Internet]. Wiley Online Library. 2007;18(1):13–20. (Cited 2014 Sep 27)  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/17224018>
  16. Wong RWK, Rabie ABM. A quantitative assessment of the healing of intramembranous and endochondral autogenous bone grafts. *Eur J Orthod. Eur Orthodontic Soc*; 1999;21(2):119–26.
  17. Zins JE, Whitaker LA. Membranous versus endochondral bone: Implications for craniofacial reconstruction. *Plast Reconstr Surg* [Internet]. LWW; 1983;72(6):778–84.  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/6196801>
  18. Boven GC, Meijer HJA, Vissink A, Raghoobar GM. Reconstruction of the extremely atrophied mandible with iliac crest onlay grafts followed by two endosteal implants: A retrospective study with long-term follow-up. *Int J Oral Maxillofac Surg* [Internet]. Elsevier; 2014; 43(5):626–32. (Cited 2014 Oct 3)  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/24411276>
  19. Clayman L. Implant reconstruction of the bone-grafted maxilla: Review of the literature and presentation of 8 cases. *J Oral Maxillofac Surg* [Internet]. Elsevier; 2006;64(4):674–82. (cited 2014 Oct 3)  
Available: <http://www.ncbi.nlm.nih.gov/pubmed/16546648>
  20. Cordaro L, Amade 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 [Internet]. Wiley Online Library; 2002; 13(1):103–11.  
Available:<http://www.ncbi.nlm.nih.gov/pubmed/12005140>
21. Nelson K, Ozyuvaci H, Bilgic B, Klein M, Hildebrand D. Histomorphometric evaluation and clinical assessment of endosseous implants in iliac bone grafts with shortened healing periods. Int J Oral Maxillofac Implants. 2005;21(3):392–8.
  22. Clementini M, Morlupi A, Agrestini C, Ottria L. Success rate of dental implants inserted in autologous bone graft regenerated areas: A systematic review. Oral Implantol (Rome). CIC Edizioni Internazionali. 2011;4(3-4):3.
  23. Geertman ME, Boerrigter EM, Van Waas MAJ, Van Oort RP. Clinical aspects of a multicenter clinical trial of implant-retained mandibular overdentures in patients with severely resorbed mandibles. J Prosthet Dent. Elsevier. 1996;75(2):194–204.
  24. Kim DH, Rhim R, Li L, Martha J, Swaim BH, Banco RJ, et al. Prospective study of iliac crest bone graft harvest site pain and morbidity. Spine J. Elsevier. 2009;9(11): 886–92.

© 2015 Attar et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://sciencedomain.org/review-history/9787>