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Allogenic versus autogenic iliac bone grafting in atrophic anterior mandible

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ABSTRACT

Aim: Bone grafting plays a pivotal role in reconstruction of atrophic ridge in dental implants. This study made a comparison of the efficacy of allogenic and autogenic (iliac) bone grafting using the same technique (interpositional bone grafting) in increasing the mandibular anterior height.

Materials and Methods: Ten partially edentulous patients who required vertical bone augmentation of the anterior mandible (having a residual ridge with 10 to 12 mm) were randomly allocated to autograft (iliac) and allograft groups. The heights of ridges were measured at three points (Right, Left, and Middle) using preoperative panoramic radiography three and six months following grafting.

Results: The heights of ridges increased in all patients, but there was no significant difference between the two groups.

Conclusion: This study indicated autograft and allograft had similar effects on vertical augmentation.

Keywords: Mandibular atrophy; Vertical ridge augmentation; Autograft; Allograft; Interpositional bone graft.

Introduction

Bone grafting is a crucial part of a surgeon's armamentarium to achieve successful treatment outcomes in dental implants. In the United States alone, over one million bone grafting procedures are carried out annually, accounting for 13% annual rise and a market approaching $1 billion a year [1]. The enhanced insight into successful implant therapy has indicated no significant difference in implant survival rate between bone grafting and implants placed in native bones [2,3]. Although short implants have been proposed as an alternative treatment, some researchers have argued short implants with a length of 7-10 mm may be accompanied by a certain degree of permanent loss of nerve sensitivity [4]. These reconstructive procedures are intended to yield a three-dimensional room to support and preserve gingival contours in a foreseeable manner [5].

In general, if the bone height is less than 15 mm in the mandibular anterior region, vestibuloplasty cannot be applied because the ridge height has to be initially enlarged and then vestibuloplasty be performed [6]. Autogenous bone is the "gold standard" for grafting because it has all the essential characteristics of an ideal graft substance [7,8]. The former studies have concentrated on the application of iliac bone grafts for the treatment of the maxillary and mandibular edentulous atrophy [3].

However, some studies have argued that autogenic grafts have more major side effects; hence, allogenic grafts are an appropriate substitute to autogenic grafts which have fewer side effects [9]. Most of the complications caused by autogenic or allogenic grafts involve infections following grafting or graft rejection. Further, 17% of the patients with a residual bone height of <6 mm have been reported to undergo graft rejection during the first three years [10]. An alloplast with osteogenic potential will be a desirable addition to a surgeon's cure of the defects of the localized alveolar ridge. Several studies have presented conflicting reports about the superiority of autogenous bone grafts, indicating that bone replacements, alone or together with other substances, are as efficacious as autogenous bone [11]. Alloplasts are synthetic biocompatible bone graft substances like calcium phosphate (derived hydroxyapatite), calcium carbonate (coral-derived), or bioactive glass ceramics [12]. Vertical augmentation of the bone in a predictably successful manner is considered an ideal technique. Several methods such as different vertical guided bone regeneration (GBR) techniques [13,14], alveolar distraction osteogenesis [15,16], and onlay bone grafting are currently being used [16]. It has been reported that vertical augmentation of bone ca be performed by various techniques; however, there are still too many complications and failures in the augmentation procedures (well over 20%) to suggest the extensive use of such procedures [17]. Another possible method is using an interpositional bone graft [18,19].

Materials and Methods

This randomized, blinded, clinical trial was conducted in the Implant Unit of the Dentistry School of Tehran University of Medical Sciences and Shariati hospital from 2016 to early 2018. The samples were chosen by random sampling using quadruple blocks. The inclusion criteria consisted of systemically healthy patients (ASA l) and lack of physical deformities. Preoperative Panoramic Radiography (OPG) was utilized to quantify the height of the bone available in the anterior mandible to determine whether the patients were eligible for inclusion in the study. Study models were used to plan how much the patients needed vertical augmentation. The height of the anterior segment in the mandible was between 10 and 12 mm (mean: 11 mm), and there was no problem in the width of the segment. Before starting the study, informed consent was taken from all participants and the need for a six-month follow-up after treatment was explained to all patients. An experienced operator carried out all surgical interventions. Having selected the patients, they were randomly allocated to two groups: autogenic iliac grafts in group A and allogenic grafts in group B.

The selected participants included four males and six females with the mean age of 54.5 yrs. After inducing general anesthesia with 2% lidocaine and epinephrine 1:100,000, the operative procedure was carried out. Both groups underwent osteotomy by segmental sandwich technique [7]. To perform osteotomy in the mandibular anterior segment, a mucosal incision was made in the depth of the vestibule from the premolar region to the opposing premolar region. A linear incision was also made 4mm above the mucogingival junction. After performing subperiosteal dissection, access was made into the bone region. The anterior segmental osteotomy was performed relative to the mental hole. Then, osteotomy was done by a saw, and two vertical and one horizontal incisions were made in a U-shaped manner. Next, finalization of the osteotomies and mobilization of the bony segment were done by chisels. Care was taken to prevent damage to the lingual mucosa. The upper mobile segment was moved upwards for about 8-10 mm and was fixed by two miniplates. Then, the space between the mobile segment and the basilar part of the anterior mandible was filled with an autogenic or allogenic graft and fixed by two miniplates (Figs. 1 and 2). Patients in group A (n=5) were cured under general anesthesia, and autogenous bone block was harvested from the medial surface of the anterior iliac crest. A local anesthetic (lidocaine 1%) was used to infiltrate the iliac crest donor site and a non-scalpel-bearing hand was utilized to medially displace the skin before making the incision. Next, 1cm behind the anterior superior iliac spine, a 3-cm-long incision was made into the displaced skin directly over the crest.

Dissection was kept on directly over the crest following the axis of the iliac crest into the subcutaneous tissues, Scarpa's fascia and periosteum. The dissection of periosteum and the overlying muscles on top of the crest and on the medial aspect of the ilium was performed. The medial portion of the anterior iliac crest was corticotomized by a fissure bur or a reciprocating saw. Two vertical cuts defined a 2-cm-long bone portion. These two vertical cuts (about 1cm long) were connected by a horizontal cut along the medial portion above the iliac crest and a second horizontal cut below the medial surface of the iliac bone (Fig. 3). The cancellous portion was osteotomized by chisels, which yielded a monocortical-cancellous rectangular block. The wounds were drained routinely for two days and the overlying soft tissues were closed with three lay-

ers of sutures. Based on the randomization results, the autogenous bone was completely modelled to fill the sites to the intended height and shape. Based on the randomization schedule, the gaps in the vertical osteotomies were filled with a particulate autogenous bone from the iliac crest. All patients in group B were treated under local anesthesia. Having prepared the receptive zone, it was filled with allograft bone (CenoBone Tissue Regeneration Corporation). The grafted areas in both groups were covered with a resorbable barrier (CenoMembrane 2*3). Panoramic radiographs were taken from all patients before surgery (Fig. 4), immediately after surgery (Fig. 5), and during the three- and six- month follow-ups (Fig. 6). Then, four months following the surgery, the patients returned with a control OPG and underwent the surgical removal of miniplates. The bone had desirable consistency in the receptor site in all ten patients during the removal of the screws and plates.

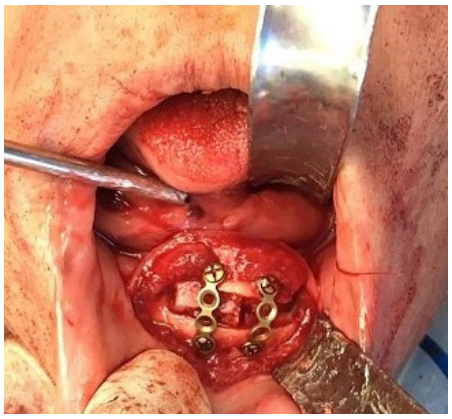

Fig 1. Autogenic graft.

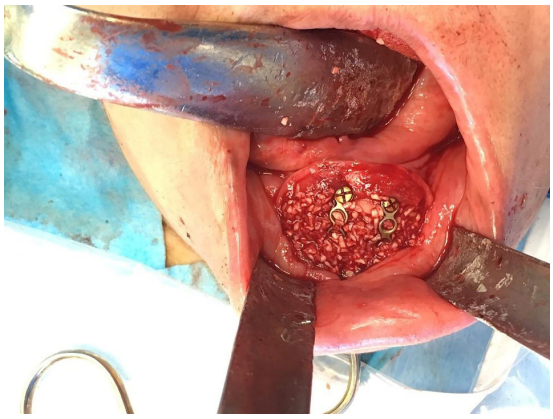

Fig 2. Allogenic graft

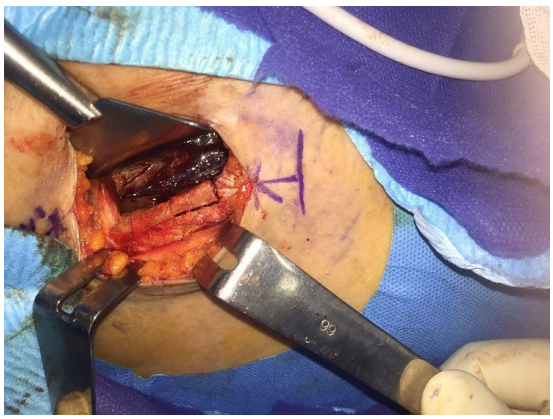

Fig 3. Iliac graft.

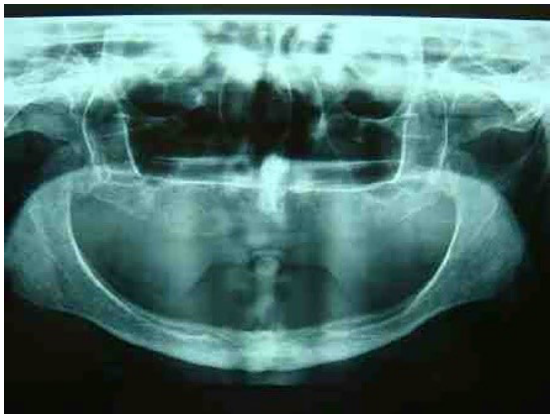

Fig 4. Before surgery.

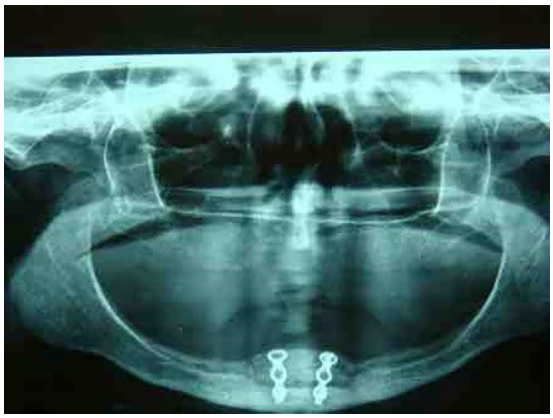

Fig 5. Immediately after surgery.

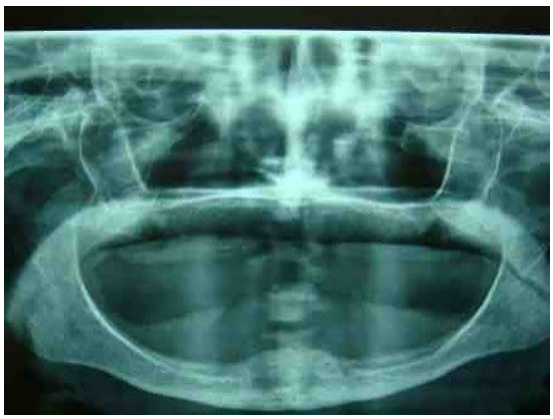

Fig 6. Six months after surgery.

Results

The general liner model was used to compare the mean values between the allograft and autograft materials. There was no significant difference between the two techniques with respect to alterations in the ridge height augmentation (P=0.317). The average height of the mandibular ridge in the selected left point (L) was 10.89±0.63 in all patients before grafting, which significantly increased to 20.38±1.42 immediately after surgery and 20.05±1.07 mm six months after the allogenic bone graft (Table 1). Moreover, it significantly increased to 21.31±0.85 immediately after surgery and 20.54±1.03 mm six months after the autogenous graft in group B (Table 2). Furthermore, the ridge height changes in the left point six months after grafting were statistically significant in both allogenous and autogenous grafts (P=0.001). Yet, there was no significant difference between the two techniques in terms of ridge height augmentation (P=0.128). Furthermore, the average mandibular ridge height in the selected right point (R) in all patient was 10.37±0.85 before grafting, which significantly increased to 20.16±1.79 immediately after surgery and 20.08±0.85 mm six months after the allogenic graft (Table 3).

Further, the ridge height significantly increased to 21.24±1.53 immediately after surgery and 21.16±0.87 mm six months after the autogenic graft. Although the changes in both allogenic and autogenic techniques were statistically significant in the R point six months after grafting (P=0.003), there was no significant difference between the two techniques with regard to the inferior ridge height augmentation (P=0.332). As for the M point, the average mandibular ridge height in all patient was 10.24±1.15 before operation, which significantly increased to 20.26±1.58 immediately after surgery and 20.14± 0.66 mm six months after allogenic graft surgery (Table 5). Moreover, the ridge height significantly increased to 21.64±1.79 immediately after surgery and 21.32±1.50 mm six months after graft surgery in group B.

Discussion

Interpositional method is rather simple and provides satisfactory results in terms of both surgical success and predictability [20–21]. This surgical method is foreseeable because the four walls of the graft have contact with the live tissues, which enhances vascularization and reduces resorption [22]. A box-style gap opens between the segments bordering on an open bone marrow cavity on both sides. This space provides desirable conditions for graft vascularization and bone healing. Hence, a temporary prosthesis can be utilized in the early postoperative period. Since the publication of that first report, several studies have been conducted on the research outcomes and technological progress, revealing good results about this technique. This technique is now considered a good treatment of choice for correction of vertical defects before placing dental implants [20,21]. On the other hand, alveolar augmentation is dependent on the experience of the operator and is sensitive technically [23].

The iliac crest not only offers the greatest bone source for reconstruction of jaw but also has the highest morbidity of any donor site. Postoperative pain in the hip is normally the most prevalent complaint [24]. Although acute postoperative pain can be important, using a local anesthetic infusion device can exceptionally control the pain that goes beyond the duration of pharmacologic activity [26,25]. The authors were specifically interested in evaluation of the patient's preference since bone harvest from the iliac crest needs general anesthesia and hospitalization is technically challenging and time-consuming and may be painful and costly. On the other hand, there is little information about the clinical efficacy of bone replacements [27]. Further, a case series on interpositional grafts on the ramus in the posterior mandible showed that all eight treated patients experienced some post-operative impaired sensitivity, the longest of which lasted for six weeks [28].

In contrast, two other small studies on six patients [29,30] indicated no signs of postoperative impaired sensitivity in the posterior mandible after interpositional iliac crest grafting among the patients. In a systematic review in 2016, Motamedian et al. evaluated the success rate of implants in the autogenic and allogenic block bones and reported the success rates of 73.8%-100% and 72.8%-100% in autogenic bone grafts, respectively. These figures for allogenic bones were found to be 93.3%-100% and 93.7%-100%. However, no definite conclusion was made due to the need for further studies with a longer duration [31]. Draenert et al. carried out a study on the vertical bone augmentation by GBR, local autogenic block, piezosurgery modification techniques, and pelvis bone block. They reported the high popularity of the GBR technique and autogenic bone block with a minimum cortex thickness and a large volume of particulate material [32]. Felice et al. assessed the vertical ridge augmentation of posterior mandible with interpositional block grafts by iliac graft and allograft. They reported good results

for both techniques. However, the sides undergoing vertical augmentation with a bone substitute block recovered their sensitivity faster than those cured with autogenous bone block from the iliac crest [33]. The study of Razmara et al. on the vertical ridge augmentation of atrophic anterior mandible by Tibia grafts versus allogenic grafts showed no significant difference between the two methods in the success rate and recovery time [34].

Average changes in the ridge height with allograft	*Time interval after surgery (month)*	*P-value*
20.38±1.42	*Immediately*	*P<0.05*
20.15±0.58	*After 3 months*	*P<0.05*
20.05±1.07	*After 6 months*	*P<0.05*

Table 1. Mean and 95% confidence interval, ridge height at the L point and its values following allogeneic grafting 3 and 6 months after surgery.

Average changes in the ridge height with autogenic grafting	*Time interval after surgery (month)*	*P-value*
21.31±0.85	*Immediately*	*P<0.05*
20.79±1.42	*After 3 months*	*P<0.05*
20.54±1. 03	*After 6 months*	*P<0.05*

Table 2. Mean and 95% confidence interval, ridge height at the L point and its values following Autogenic grafting 3 and 6 months after surgery.

Average changes in the ridge height with allograft (mm)	*Time interval after surgery (month)*	*P-value*
20.16±1.79	*Immediately*	*P<0.05*
20.14±1.52	*After 3 months*	*P<0.05*
20.08±0.85	*After 6 months*	*P<0.05*

Table 3. Mean and 95% confidence interval, mandibular ridge height at the R point and its values following allogeneic grafting 3 and 6 months after surgery.

Average changes in the ridge height with autogenic graft(mm)	*Time interval after surgery (month)*	*P-value*
21.24±1.53	*Immediately*	*P<0.05*
21.19±1.12	*After 3 months*	*P<0.05*
21.16±0.87	*After 6 months*	*P<0.05*

Table 4. Mean and 95% confidence interval, mandibular ridge height ta the R point and its values following autogenic bone grafting 3 and 6 months after surgery.

Average changes in the ridge height with allograft (mm)	Time interval after surgery (month)	P-value
20.26±1. 58	Immediately	P<0.05
20.16±1.28	After 3 months	P<0.05
20.14±0.66	After 6 months	P<0.05

Table 5. Mean and 95% confidence interval, ridge height in the M point and its values following allogeneic grafting 3 and 6 months after surgery.

Average changes in the ridge height with autogenic graft (mm)	Time interval after surgery (month)	P-value
21.64±1.79	Immediately	P<0.05
21.52±0.87	After 3 months	P<0.05
21.32±1.23	After 6 months	P<0.05

Table 6. Mean and 95% confidence interval, mandibular ridge height at the M point and its values following autogenic bone grafting 3 and 6 months after surgery.

Conclusion

This study indicated autograft and allograft had similar efficacy in vertical augmentation. Considering the possible complications of using iliac autograft , allograft is preferred over autograft. However, autograft has less resorption than allograft in the long run.

Conflict of Interest

There is no conflict of interest to declare.

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