Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1487467
J Health Sci Med. 2024;7(4):371-377

Evaluation of the success of anterior iliac crest harvested bone graft in reconstruction of different jaw defects: a retrospective study

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Cite this article as: Kaba YN, Demirbaş AE, Eren C, Soylu E, Bilge S, Alkan A. Evaluation of the success of anterior iliac crest harvested bone graft in reconstruction of different jaw defects: a retrospective study. *J Health Sci Med.* 2024;7(4):371-377.

Received: 21.05.2024 ◆ **Accepted**: 05.06.2024 ◆ **Published**: 30.07.2024

ABSTRACT

Aims: The aim of this study was to evaluate the success of bone grafts obtained from the anterior iliac crest, the recipient and donor site complications in the reconstruction of jaw defects caused by different etiologies in maxillofacial surgery.

Methods: A retrospective cohort study was conducted at the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Erciyes University between 2012-2022. It included patients with iliac crest harvested bone grafts due to jaw defect with full records. The primary predictive variable was the type of jaw defect. The primary outcomes were the presence of complications at donor and recipient sites. Secondary outcomes were length of hospital stay and type of complications at donor and recipient sites. The obtained data were analyzed with Kruskal Wallis Test, Pearson's chi-square test and Fisher's exact test.

Results: This study included 104 (44 female, 60 male) patients. Complication rate was 21.15%. There was no statistically significant relationship between the type of jaw defect and the success of iliac bone grafts (p=0.257). The most common recipient site complication was resorption in alveolar atrophy groups, the dehiscence in alveolar cleft groups, infection in other reason groups. There was no statistically significant relationship between type of jaw defect and complication types (p=0.524).

Conclusion: The results of the study demonstrate that general success rate was 78.85% in jaw reconstruction with anterior iliac crest harvested bone grafts. The major complication rate causing total graft loss was 13.46%. There was no statistically significant relationship between the type of jaw defect and the success of iliac bone grafts.

Keywords: Jaw defects, iliac crest, reconstruction

INTRODUCTION

Autogenous bone grafts are frequently used for the reconstruction of jaw defects. Autogenous bone grafts are considered the "gold standard" for their osteo-induction, osteo-conduction and osteogenesis features.[1] Donor site selection is usually determined by the size of the defect area. Extraoral donor sites such as the anterior iliac crest are more preferred in the reconstruction of large defects.[2] The anterior iliac crest harvested bone graft is usually preferred to reconstruction of severely atrophic jaws due to tooth loss or old age, post-surgical defects after large cyst or tumor surgery, and the treatment of alveolar clefts.[3,4] Access to the anterior iliac crest is relatively easy and operation time can be shortened with a double surgical team. In addition, large amounts of cortical and cancellous bone can be harvested from the anterior iliac crest.[5] Although the morbidity rate is low, numerous complications related to both the donor and recipient sites have been documented in association with iliac bone grafting. The most frequent complications arising from the donor site encompass persistent pain, sensory alterations, infections, hernias, ileus, disruptions in gait, fractures of the ilium, bleeding, seromas, and hematomas.[6] Complications documented at the recipient site comprise infections, dehiscence, graft resorption, and graft loss.[7] There are different studies in the literature about donor and recipients site complications in reconstruction of the jaw with iliac crest harvested bone grafts.[2] However, there is no study that deals with the reasons for the application of bone grafts harvested from the anterior iliac crest in oral and maxillofacial surgery. The authors hypothesised that autogenous bone grafts from the anterior iliac crest can be successfully used in the reconstruction of different jaw defects with minimal complications at the donor and recipient site. The aim of this study was to evaluate the success of bone grafts obtained from the anterior iliac crest, and the recipient and donor site

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complications in the reconstruction of jaw defects caused by different etiologies in oral and maxillofacial surgery.

METHODS

Study Design and Participants

The study was designed as a retrospective cohort study involving patients who underwent reconstruction with bone grafts harvested from the anterior iliac crest at Erciyes University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, during the period from 2014 to 2022. Erciyes University Clinical Researches Ethics Committee (Date: 29.03.2023, Decision No: 2023/207) approved the study. All procedures followed were conducted in accordance with the 1975 Helsinki Declaration Guidelines for Human Research, revised in 2008. Inclusion criteria were jaw reconstruction with bone grafts from the iliac crest for different reasons (alveolar atrophy, cleft repair, tumour, cyst, trauma and orthognathic surgery, etc.) and complete medical records. Patients with systemic diseases affecting bone metabolism such as chronic renal failure, hyperparathyroidism, Paget's disease, corticosteroid and/or antiresorptive drugs and patients with incomplete medical records were excluded.

Study Variables

The primary predictable variable was the type of jaw defect. The type of jaw defect was classified as alveolar atrophy (Figure 1A, B), alveolar cleft (Figure 1C, D), tumor-cyst surgery (Figure 2A, B), orthognathic surgery (Figure 2C), temporomandibular joint surgery (Figure 2D), trauma. Covariates were age, sex and systemic disease.

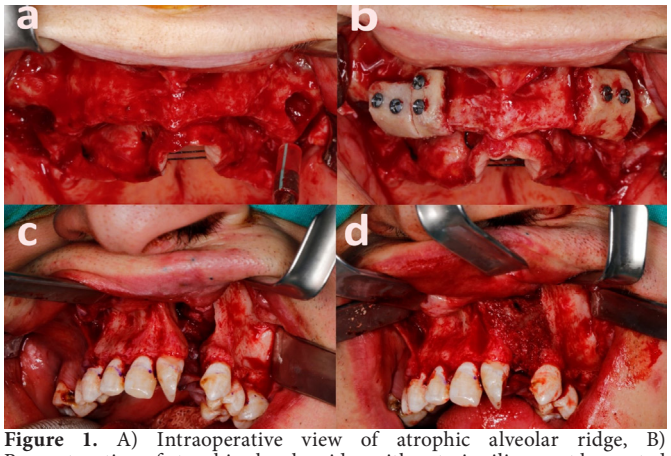

Figure 1. A) Intraoperative view of atrophic alveolar ridge, B) Reconstruction of atrophic alveolar ridge with anterior iliac crest harvested bone block, C) Intraoperative view of alveolar cleft, D) Reconstruction of alveolar cleft with anterior iliac crest harvested cancellous bone

The primary outcomes were the presence of complications at the donor and recipient sites. The data of patients who had iliac graft surgery in our faculty were obtained from patient records. All complications related to the donor and recipient sites were recorded up to the 3rd postoperative month. The secondary outcomes were length of hospital stay and the type of complications in the donor and recipient sites. Total loss of the block or particulate graft was considered as a major complication. Simple debridement, or patients who had an implant with particle grafts at the implant session were considered minor complications. Demographic information such as age, sex, systemic diseases, and length of hospitalization stay, type of jaw defect was obtained from hospital registry software (MedData Tic. ve San. Ltd. Şti., Ankara, Turkiye). All collected data were recorded in a data set created in Excel file.

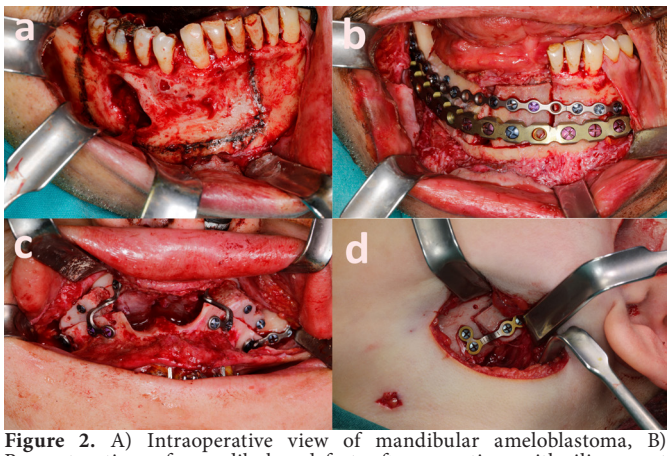

Figure 2. A) Intraoperative view of mandibular ameloblastoma, B) Reconstruction of mandibular defect after resection with iliac crest harvested bone blocks, C) Intraoperative images maxillary down grafting and advancement with anterior iliac crest harvested bone block, D) Reconstruction mandibular ramus after TMJ ankylosis with anterior iliac crest harvested bone block

Surgical Procedure

Patients in which graft was harvested from the anterior iliac crest according to the technique described by Kalk et al.[8] were included in the study (Figure 3A). In patients where only the cancellous bone is needed, the medial cortical portion of the iliac crest is left as a cover and the cancellous bone is accessed (Figure 3B). In this technique, after exposing the anterior iliac crest, the required amount of bi-cortical bone block is removed (Figure 3C). The cancellous bone is then harvested from the donor site (Figure 3D). Haemostasis is achieved in the surgical field and a drain is placed. Subcutaneous tissues and skin are then sutured layer by layer using appropriate methods and the area is closed. All surgical procedures of the included patients were performed by the same surgical team. All patients received 2 g IV amoxicillin and clavulanic acid as preoperative prophylaxis. Antibiotic treatment was continued for 7 days postoperatively.

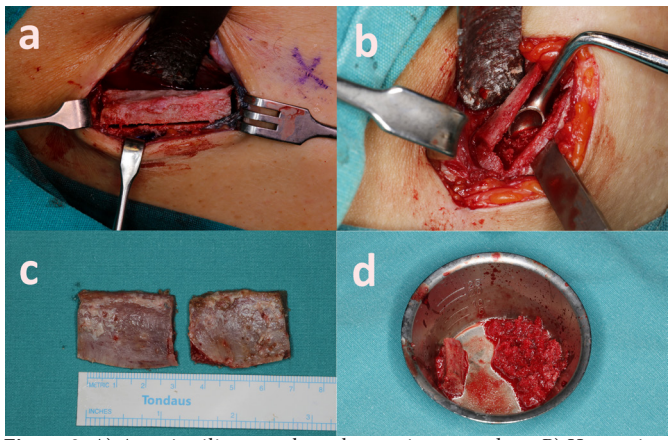

Figure 3. A) Anterior iliac crest bone harvesting procedure, B) Harvesting cancellous bone from anterior iliac crest with cover method, C) Clinical images of anterior iliac crest harvested bone blocks, D) Clinical images of cancellous particle graft from anterior iliac crest

Statistical Analysis

The data obtained in this study were analyzed using the Turcosa Statistics (Kayseri, Turkiye) program. To investigate the normal distribution of variables, Shapiro-Wilk's test was employed due to the small sample sizes. To ensure the accuracy of the statistical analysis, groups with less than 10 samples were combined to complete the statistical analysis. Since the variables did not follow a normal distribution, the Kruskal Wallis Test was used to examine differences between groups. For the analysis of categorical data, Pearson's chi-square test and Fisher's exact test were used. When interpreting the results, a significance level of 0.05 was determined. A p-value of less than 0.05 was considered to indicate a significant difference.

RESULTS

The records of 110 patients previously reconstructed with anterior ilac crest harvested bone graft were scanned through the hospital registry software. Six patients with incomplete records were excluded from the study. The study completed one hundred and four patients who underwent jaw reconstruction with grafts harvested from the anterior iliac crest. Descriptive data was shown in Table 1. The patients consisted of 44 (42.31%) were female, and 60 (57.69%) were male. The mean age of 30.20±16.58 years. Twelve patients had hypertension, four had diabetes, three had asthma, and three had osteoporosis diagnoses. The mean length of hospital stay was 2.75±1.03 days. Sixty-one patients were reconstructed due to alveolar atrophy, thirty patients due to repairing alveolar cleft, eight patients following tumor resection, two patients due to maxillary downward grafting, two patients due to post-trauma defects, and one patient due to temporomandibular joint surgery. Donor site complications were not observed in one hundred one patients, while three patients developed postoperative iliac bone fractures. One of the fracture cases occurred due to osteotomy during surgery, the other two cases after falling in the postoperative period. Three patients were followed conservatively without the need for surgical treatment for fractures. Recipient site complications were not observed in eighty-two patients while was observed in twenty-two patients. These complications were dehiscence in eight (7.69%) patients, graft resorption in eight (7.69%) patients, infections in five (4,81%) patients and fixation loss in one (0.1%) patient (Table 1). Minor complications were observed in eight (7.69%) patients and a major complication requiring reoperation in 14 (13.46%) patients. Minor complications were partial graft loss due to resorption and dehiscence. It was resolved simple debridement and using particle grafts during implant surgery. In patients who developed major complications, all block or particulate grafts in the relevant region were removed.

Data on the relationships between demographic data and the type of jaw defect are given in Table 2. Due to the small number of patients with tumors, cysts, trauma, and orthognathic surgery, they were combined as other jaw defects for statistical analysis. The alveolar atrophy group had a mean age of 43.30±10.50 years, 14.8±8.06 years in alveolar cleft group and 28.31±16.35 years in others group. There was statistically significant difference between the groups in terms of mean age (p<0.001). Thirty-two female and twenty-nine male patients in alveolar atrophy group, eight female and twenty-two male patients in alveolar cleft group, four female and nine males in other reason group. There was statistically significant relationship between the groups in terms of sex (p=0.044). Female patients were more common in the alveolar atrophy group while male was more common in other groups. There was no statistically significant relationship between the groups in terms of presence DM (p=0.694).

Table 1. Descriptive data

Variable	Total n=104
Age (years)	33.20±16.58
Gender	
Female	44 (42.31%)
Male	60 (57.69%)
Systemic disease	
No	75 (72.12%)
Yes	29 (27.88%)
HT	12 (11.54%)
DM	4 (3.85%)
Peptic ulcer	5 (4.81%)
Asthma	3 (2.88%)
LOS (day)	2.75±1.03
Type of jaw defect	
Alveolar atrophy	61 (58.65%)
Alveolar cleft	30 (28.85%)
Tumor	8 (7.69%)
Orthognathic surgery	2 (1.92%)
Trauma	2 (1.93%)
TMJ	1 (0.96%)
Donor site complication	
No	101 (97.12%)
Yes	3 (2.88%)
Recipient site complication	
No	82 (78.85%)
Yes	22 (21.15%)
Dehiscence	8 (7.69%)
Graft resorption	8 (7.69%)
Infection	5 (4,81%)
Fixation loss	1 (0.1%)

Data was expressed as n (%), mean±standard deviation, Abreviation, HT: Hypertension, DM: Diabetes mellitus, TMJ: Temporomandibular joint, LOS: Length of hospital stay

Of the twenty-two cases that developed recipient site complications, eleven were in the alveolar atrophy group, six were in the alveolar cleft group, and five were in the other reasons group. There was no statistically significant relationship between the groups in terms of development recipients site complication (p=0.257). The distributions of the recipient site complication were shown according to type of jaw defect in Table 3.

The relationship between demographic data and development of recipient complications is shown in Table 4. The mean age

Table 2. Relationship between demographic data and type of jaw defects					
Variable	**Alveolar atrophy n=61**	**Alveolar cleft n=30**	**Other jaw defects n=13**	**Total n=104**	**p**
Age (years)	43.30±10.50[a] 43 (37-50)	14.8±8.06[b] 12.5 (11-16.5)	28.31±16.15[c] 24 (17.5-44.5)	33.20±16.58	<0.001[ŋ]
Sex					
Female	32 (52.45)	8(26.66)	4 (30.76)	44 (42.30)	0.044[‡]
Male	29 (47.54)	22 (73.33)	9 (69.23)	60 (57.69)	
DM					
No	58 (95.08)	29 (96.67)	13 (100)	100 (96.15)	0.694[‡]
Yes	3 (4.92)	1 (3.33)	0 (0)	4 (3.85)	

Data are expressed as mean±standard deviation, n (%), and median (first-third quartile). Key; DM: Diabetes mellitus, [ŋ]: Kruskal-Wallis test, [‡]: Pearson's chi-square test

of patients with recipient site complications was 37.36±15.60 years, and the mean age of patients without complications was 32.09±16.75 years. In addition, there was no significant relationship between the cases with and without recipient site complications regarding the age distribution (p=0.170), sex (p=0.262) and DM (p=0.196).

Table 3. Relationship between type of jaw defects and recipient site complication			
Variable	**Recipient site complication**		**p**
	Yes (n=22)	**No (n=82)**	
Alveolar atrophy	11 (18.03)	50 (81.97)	0.257[†]
Alveolar cleft	6 (20)	24 (80)	
Other jaw defects	5 (38.46)	8 (61.54)	

Data are expressed as n (%), [†]:Fisher exact test

Table 4. The relationship between demographical data and presence of recipient site complications			
Variable	**Recipient site complication**		**p**
	Yes (n=22)	**No (n=82)**	
Age	37.36±15.60 37.5 (24-50.5)	32.09±16.75 32.5 (14-47)	0.170[&]
Sex			
Female	7 (31.82)	37 (45.12)	0.262[†]
Male	15 (68.18)	45 (54.88)	
DM			
Yes	2 (9.09)	2 (2.44)	0.196[†]
No	20 (91.91)	80 (97.56)	

Data are expressed as mean±standard deviation, n (%), and median (first-third quartile), DM: Diabetes mellitus, [&]: Mann-Whitney u test, [†]:Fischer exact test

The relationship between the type of jaw defect and the type of complication were given in Table 5. In the alveolar atrophy groups, the most prevalent recipient site complication was resorption. The dehiscence was most common complication in alveolar cleft groups. The most common complication was infection in other reason groups. There was no statistically significant relationship between type of jaw defect and complication types (p=0.524).

Table 5. Relationship between type of jaw defects and complication type of recipient site					
Variable	**Complication type n=22**				**p**
	Dehisens (n=8)	**Fixation Loss (n=1)**	**Infection (n=5)**	**Resorption (n=8)**	
Alveolar athropy	4 (50)	1 (100)	1 (20)	5 (62.5)	0.524[†]
Alveolar cleft	3 (37.5)	0 (0)	1 (20)	2 (25)	
Other jaw defects	1 (12.5)	0 (0)	3 (60)	1 (12.5)	

Data are expressed n (%). Key; [†]:Fischer exact test

DISCUSSION

Autogenous bone is still considered one of the most popular materials for jaw reconstruction procedures. Especially, bone grafts harvested from the anterior iliac crest have been regarded as the gold standard for bone grafting in cases of atrophic alveolar ridges and the treatment of alveolar clefts.[3] The aim of this study was to evaluate the success of bone grafts obtained from the anterior iliac crest, and the recipient and donor site complications in the reconstruction of jaw defects caused by different etiologies in oral and maxillofacial surgery. In the literature, there are studies evaluating the complications and morbidities of anterior iliac grafts in the reconstruction of jaw defects. Tosun et al.[9] evaluated postoperative recipient and donor site complications in 86 patients who underwent grafting for alveolar atrophy. Hynes et al.[10] evaluated the efficacy of grafts harvested from the iliac crest in alveolar cleft repair in 58 patients. In our study, we evaluated 104 patients who underwent jaw reconstruction with bone grafts harvested from the anterior iliac crest for different reasons such as alveolar atrophy, alveolar cleft and trauma in terms of postoperative recipient and donor site complications. Sixty-one patients (58.65%) were reconstructed due to alveolar atrophy, 30 (28.85%) patients due to repairing alveolar cleft, eight (7.69%) patients following tumor resection, two (1.92%) patients due to maxillary downward grafting, two (1.93%) patients due to post-trauma defects, and one (0.96%) patient due to temporomandibular joint surgery. Recipient site complications were not observed in eighty-two (78.85%) patients while was observed in twenty-two (21.15%) patients. These complications were: dehiscence in eight (7.69%) patients,

graft resorption in eight (7.69%) patients, infections in five (4,81%) patients and fixation loss in one (0.1%) patient. Of the twenty-two cases that developed recipient site complications, eleven were in the alveolar atrophy group, six were in the alveolar cleft group, and five were in the others jaw defect group.

The iliac crest is a commonly used donor site for bone harvesting, commonly employed for grafting atrophic jaws or filling intraoral defects resulting from cyst enucleation or traumatic bone loss.[11] While its advantage over other donor sites remains a subject of debate, the anterior iliac wing is favored by numerous surgeons for augmentation and reconstruction procedures.[6] The anterior iliac crest boasts several advantages: it can yield substantial quantities of cancellous bone, it is easily accessible, and it possesses a high ratio of cancellous to cortical bone, along with a rich concentration of pluripotent or osteogenic precursor cells that promote osteogenesis.[8] Pain at the donor site has been identified as a significant drawback of harvesting iliac bone grafts.[6] The literature has documented the morbidity linked to this bone graft harvesting. Nevertheless, assessing the morbidity of anterior iliac crest bone graft removal poses challenges due to the variety of techniques employed for harvesting and variations in the measurement of complications.[12] Iliac crest bone can be extracted using either an open approach or a trephine. Certain authors have expressed apprehension regarding the postoperative morbidity linked to conventional open harvesting, which has prompted the exploration of less invasive techniques for bone procurement.[13] Postsurgical complications may include stress fractures of the anterosuperior iliac spine, limping or other gait irregularities, noticeable scarring, deficits in bone contour, superficial infections or delayed formation of iliac abscesses formation, seromas, hematomas, persistent pain lasting more than three months and temporary meralgia paraesthetica or hypoesthesia.[14] The incidence of these complications varies, ranging from 10% to 40%.[15] Temporary sensory loss of sensation, most commonly related to the lateral femoral cutaneous nerve, has been reported in up to 10% of patients in the literature.[16] In our study, no permanent sensory loss was observed in any of the patients after the surgery, and this issue could not be evaluated when temporary sensory loss was not recorded. As a donor site complication, Iliac bone fracture occurred intraoperatively in one patient and postoperatively in two patients due to fall. No infection, wound dehiscence, and walking problems were noted in any of the patients.

The highest recipient site complication rate was in the other jaw defect (38.6%) group in this study. This was followed by the alveolar cleft (20%) and alveolar atrophy (18.03%) group. But there was no statistically significant relationship between the groups in terms of development recipients site complication($p=0.257$). For shorter defects (<6 cm), non-continuous defects, defects that do not necessitate soft tissue intervention, and cases where secondary reconstruction is feasible, many defects can be effectively reconstructed using non-vascularized bone grafts.[17] Non-vascularized bone grafts are the preferred choice for the majority of defects caused by benign pathology, trauma, and non-continuous issues. The anterior and/or posterior iliac crest is a frequently selected donor site because it provides a substantial quantity of bone and a high concentration of osteo-competent cells for transplantation.[18] Osborn et al.[19] evaluated non-vascularised iliac crest bone grafts for mandibular continuity reconstruction in 60 patients without cancer and concluded that they showed a high success rate and should be considered as the primary option for defects smaller than 9 cm. Furthermore, they proposed that symphysis involvement may not lead to a lower success rate if patients for bone grafting are selected based on the criteria mentioned, provided that there is adequate quality and quantity of soft tissue. Their study evaluated both major and minor complications resulting from non-vascularized bone grafts for mandibular reconstruction. Out of the total, four patients experienced major complications. Three of them required additional surgeries for debridement, while one developed a seroma that necessitated a return to the operating room for drainage. Minor complications included dehiscence in seven recipient sites and one donor site, persistent hip pain in three cases, and temporary facial nerve paresis in seven patients. In this study, five patients in the "other jaw defects" group developed complications, all of which involved jaw defects less than 6 cm in size and were localized in the mandible. Graft loss was observed due to dehiscence in one patient and infection in three patient and resorption in one patient. Block Grafts were fixed with miniplates and mini in this case. These losses may be related to inadequate fixation. In addition, the soft tissue defects in tumor patients may increase the risk of dehiscence.

The alveolar cleft is treated at 8-12 years old generally. Secondary alveolar bone grafting is considered the most appealing and widely accepted approach for addressing alveolar clefts. Typically, it is recommended when the root of the canine tooth is approximately halfway developed. During this stage of root development, the tooth displays accelerated and active eruption. Moreover, a significant portion of midface growth and development is typically finished by this time. This aligns with a chronological age range of 9 to 12 years.[10] In this study there was statistically significant difference between the groups in terms of age distribution ($p<0.001$). The mean age was lowest in alveolar cleft and followed by other jaw defect group. Tumor, trauma and orthognathic surgery patients generally consist of patients between the ages of 2-40, and patients with alveolar atrophy generally consist of patients over 40 years of age. Therefore, the difference in the mean age may be associated with this situation.

It is a known fact that cleft lip and palate are more common in men than women.[20] In this study, the male number was highest in the alveolar cleft group while the female gender was more common in the alveolar atrophy group. There was a statistically significant relationship between the groups in terms of gender distribution ($p=0.044$). Ural et al.[21] observed significant variations in the heights of the mandible and maxilla in edentulous subjects of both genders. Specifically, they found that the height of the edentulous mandible was more pronounced in women compared to men. Ortman et al.[22] reported similar findings. In postmenopausal women, a deficiency of the estrogen hormone can accelerate skeletal bone loss, potentially leading to rapid alveolar bone resorption.

Similar to the literature, the high number of women in the alveolar atrophy group can be explained in this way.

The reported length of stay in hospital after bone is harvested from the iliac crest varies widely. In the literature, there are publications showing that the length of hospital stay varies from same day discharge to almost one week.[23] In our study, the mean hospital stay was 2.75 days. Only one patient who has with iliac bone fracture due to a postoperative fall and recipient site infection was hospitalized for 10 days for follow-up.

Although donor site complications are frequently reported with bone grafts harvested from the anterior iliac crest, information on recipient site complications is limited. The anterior iliac region is usually used for large bone defects that require more bone grafts. The most frequently reported recipient-site complication in the literature is wound dehiscence.[24] Reported rates of graft exposure and resorption after autogenous bone grafting have been as high as 40%.[25] Tosun et al.[9] evaluated 86 patients who underwent alveolar grafting with anterior iliac graft and observed partial graft exposure in 29 patients (33.7%) and total graft exposure in 6 patients (7%). They reported that 13 (44.8%) of 29 patients with partial graft patency had partial graft loss, and five of six patients with total graft patency, one patient experienced total graft loss, and another had partial graft loss.[9] In our study, wound dehiscence was observed in eight (7.69%) patients. Patients with dehiscence, four (50%) were in patients with treated for alveolar atrophy, three (37.5%) were in patients with treated for alveolar cleft and one (12.5%) was in patient treated with other reasons.

Resorption of bone grafts is an important problem, like dehiscence following augmentation procedures. Sbordone et al.[26] reported that the block graft resorption rate as 21.5% in a six-year follow-up. In a retrospective study by Mc Graht et al.[27] including 18 patients, vertical graft resorption was found to be approximately 12%. Also, as evidenced by several authors, resorption decreases mainly after the first six months postoperatively.[25] In our study, graft resorption was seen in eight (7.69%) patients. Resorption was most common in patients with alveolar atrophy, followed by patients with alveolar cleft. The primary complication observed with mandibular block autografts is graft dehiscence, primarily attributed to factors such as soft tissue closure without tension, thin mucosal tissue, or excessive prosthesis contact with the graft site.[28] In our study, wound dehiscence and resorption were seen the most as recipient site complications.

Recipient-site infection is another potential complication that can result in graft loss and treatment failure.[29] Although antibiotics are given to all patients for preoperative and postoperative for prophylaxis, infection may develop.

In a study assessing iliac bone grafting for alveolar atrophy, it was noted that among 30 patients, 2 individuals developed infections that led to partial graft loss.[29] Meredith et al.[30] analyzed 70 cases of mandibular continuity defects, with 68 of them reconstructed using non-vascular iliac bone grafts, and they found a 29% incidence of infection. In our study, infection was seen in 5 (4.81%) patients. Infection was most common in patients who underwent iliac graft for other reasons. Infection was observed more frequently in the mandible and maxilla anterior, especially in the patient whose anterior mandible was grafted after trauma and tumor surgery.

Limitations

This study has some limitations due to its retrospective nature. It is the lack of records of patients regarding oral hygiene, smoking and walking difficulties. The graft resorptions observed in the recipient site were evaluated with subjective rather than quantitative methods and were evaluated according to the information obtained from the surgical records.

CONCLUSION

The results of the study demonstrate that success rate was 78.85% in jaw reconstruction with anterior iliac crest harvested bone grafts. The major complication rate causing total graft loss was 13.46%. There was no statistically significant relationship between the defect type and the success of iliac bone grafts. The highest failure rate was seen in patients who had iliac bone graft reconstruction after tumor resection.

ETHICAL DECLARATION

Ethics Committee Approval

The study was carried out with the permission of Ethics Committee of Erciyes University (Date: 29.03.2023, Decision No: 2023/207).

Informed Consent

Because the study was designed retrospectively, no written informed consent from was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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