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Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

SUCCESSFUL ANTERIOR ILIAC CREST BONE GRAFTING FOR MANDIBULAR DEFECT RECONSTRUCTION: EVALUATION AND OUTCOMES USING NVBG TECHNIQUE IN YEMEN

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Article Info:

Article History:
Received: 1 October 2025
Reviewed: 5 November 2025
Accepted: 11 December 2025
Published: 15 January 2026

Cite this article:
Al-Rahbi LM, Abdulsattar AAA, Al-Shamahy HA, Al-Ashwal AA. Successful anterior iliac crest bone grafting for mandibular defect reconstruction: Evaluation and outcomes using NVBG technique in Yemen. Universal Journal of Pharmaceutical Research 2025; 10(6): 28-33.
http://doi.org/10.22270/ujpr.v10i6.1458

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Abstract

Background and Aims: Bone grafting from the anterior iliac crest is a common and effective method for reconstructing large mandibular defects, as it provides a good source of cortical and cancellous bone. The anterior iliac crest is a preferred donor site due to the large amount of bone available, its anatomical similarity to the mandible, and the possibility of performing a two-team procedure, which reduces overall surgical time. However, potential complications at the donor site include pain, sensory changes, and gait disturbance. This study aimed to evaluate data from 11 patients undergoing mandibular reconstruction using the NVBG technique at our center.

Materials and Methods: There were eleven individuals with mandibular reconstruction. Continuity defect and non-continuity defect patients were separated. Factors influencing success were examined, including immediate repair, smoking habit, medical comorbidities, defect site and size, surgical technique, and use of maxilla-mandibular fixation. Success was defined as the preservation of the bone graft for non-continuity defects (NCD) and the continuity and stability of the bone for continuity defects (CD), as well as the absence of infection at the most recent clinical and radiographic assessment. There were two categories for complications: minor and significant.

Results: Reconstruction was successful in 12 procedures out of 13 procedures. Analyses showed that the size of the defect was strongly associated with failure. Three patients experienced major complications such as bacterial infection and non-union, and eight experienced minor complications.

Conclusion: Non-vascularized iliac crest bone grafts achieve high success in restoring continuity of the mandible in fractures caused by gunshots, bomb explosions and should be considered the first choice for defects less than 6 cm in diameter. No defects larger than 5.5 cm were recorded in current study.

Keywords: Anterior iliac crest, bone grafting, reconstructing mandibular defects, Yemen.

INTRODUCTION

Bone grafting from the anterior iliac crest is a popular and successful technique for reconstruction big mandibular defect as it offers an excellent source of cortical and cancellous bone. The anterior iliac crest is a desirable donor site because of its huge volume of accessible bone, anatomical resemblance to the mandible, and potential for a two-team surgical technique that shortens total surgical time,. However, gait disturbance, altered senses, and problems with disturbance are possible consequences at the donor site[1].

A key component of any type of maxillofacial reconstruction is the restoration of shape and function using comparable tissues. Microvascular tissue transfer was made possible by composite flap. After malignant tumour excision. Although this method has trans-formed the accurate reconstruction of complex craniofacial abnormalities, its use as a cure-all for mandibular bony reconstruction has best much to be desired. Mastication, swallowing, and speech issues can arise from isolated bony abnormalities of the jaws

caused by tumour excision, trauma, infection, or other reasons. The quality of life may be negatively impacted by aesthetic, functional, and social issues if these faults are not properly reconstructed[2,3].

For jaw reconstruction, both vascularised and non-vascularized methods are widely recognised therapeutic approaches. The best kind of bone graft reconstruction for mandibular reconstruction can be determined using a number of factors[4]. Vascularised bone flaps (VBF) are recommended for primary repair of segmental defects, patients receiving preoperative radiation therapy, defects larger than 6 cm, and situations requiring composite hard/soft tissue. Free tissue transfers have many benefits, but they are also time-consuming, linked to donor site morbidity, require longer hospital stays, require larger surgical dissection and surgical airways, require monitoring in the intensive care unit, and put a significant strain on hospital resources[5]. Many defects can be reconstructed using non-vascularized bone grafts (NVBG) if they are shorter (<6 cm), non-continuity, do not require soft tissue, and allow for subsequent restoration[2,4]. These treatments are less time-consuming, enable quicker recovery, and improve dental implant restoration. The anterior and/or posterior iliac crest is a commonly used donor site because it offers a substantial amount of bone and a high concentration of osteocompetent cells to be transplanted. At our institution, VBFs are the preferred treatment for mandibular reconstruction for many larger abnormalities; however NVBG is advised for most defects due to benign disease, trauma, and non-continuity defects. Current study's objectives were to improve treatment approaches and indications while retrospectively assessing the effectiveness and problems of lower jaw restoration using NVBGs at our facility.

METHODS

Patients who had iliac crest bone grafting for mandibular reconstruction in order to treat ablative abnormalities of the mandible resulting from trauma, gunshot, or bomb explosion were included in the study. Reconstruction was intended to restore mandibular continuity in cases of continuity defects and to strengthen the native mandible or enable dental rehabilitation in cases of non-continuity abnormalities. Patients with less than six months of clinical and radiological follow-up.

Variables

Patient characteristics, surgical factors, transplant success, and complications were among the parameters assessed. Demographics, oral health, pathologic disorders, medical co-morbidities such as regular smoking, Qat chewing, sniffing habit, diabetes, and defect size and location were among the patient variables. Surgical considerations include the surgical technique, the type of reconstruction (immediate vs. delayed), Complications were categorised as either mild (requiring just medical care, such as antibiotics or a simple office procedure) or significant (requiring a return to the hospital or operating room).

Data analysis

The graft's success was assessed both radiographically and clinically. Based on a comparison of preoperative, immediate postoperative, and final postoperative visits, clinical assessments, restoration of mandibular continuity, and consolidation of CT scan and plain film panoramic radiography, success was defined radiographically as maintaining more than 85% of the graft. Progressive ossification of the interface between the native mandible and the graft, no increased radiolucency at the graft/native mandible interface, no increase in radiolucency surrounding fixation, or other indications of hardware failure to show lack of continuity were all requirements for radiographic consolidation. The absence of infection, full mucosal closure, no interfragmentary motion during examination, restoration of mandibular shape, and understandable speech were all considered indicators of clinical success. Epi Info version 6 (CDC, Atlanta, USA) was used to analyze the data. While the categorical variables were summarized using frequencies and proportions and displayed as tables, the continuous variable (age) was summarized using mean and standard deviation.

Ethical consideration

The Medical Ethics and Research Committee of the Military Hospital granted ethical permission for this project (No. 19 dated September 25, 2024). Every process complied with the review committee's ethical standards. Consent was also obtained from each participant, who was told that participation was entirely optional and that they might decline at any time for any reason.

RESULTS

Table 1 shows the age distribution of maxillofacial fracture patients who underwent mandibular bone grafting at the military hospital. The study included 11 patients aged 20–38 years, with a mean age of 29.9±8.4 years. 36.4% were under 25 years old, 27.3% were 25–29 years old, and 36.4% were 30 years old or older. Total 11 male patients underwent mandibular bone grafting at the military hospital. All patients were males.

Table 1: Age distribution of patients with jaw fractures who underwent anterior iliac crest bone graft in the mandible (n=11).

Age group	N (%)
Less than 25 years	4 (36.4)
25-29 years	3 (27.3)
≥30 years	4 (36.4)
Mean age	29.9 years
SD	8.4 years
Mode	21 years
Median	28 years
Min to Max	20-38 years
Total	11 (100)

Table 2 shows the locations of bone defects in 11 patients with maxillofacial fractures who underwent mandibular bone grafting at the military hospital. No defects were recorded in the Ramus (0.0%), while

27.2% of defects were in the angle of the mandible. On the body 45.4% of defects occurred. In cases of parasymphysis, 18.2% of defects occurred, while only 9.1% of bone defects were found on the symphysis. Table 3 illustrates the causes and modes of fracture in patients who underwent bone grafting in the mandible at the military hospital.

Table 2: Locations of bone defects in patients with mandibular fractures who underwent bone grafting from AICBG (n=11).

Location	N (%)
Rmus	0 (0.0)
Angle	3 (27.3)
Body	5 (45.4)
Parasymphsis	2 (18.2)
Symphysis	1 (9.1)
Total	11(100)

Traffic accidents, falls from heights, and pathological fractures accounted for 0% of fractures in this study. Gunshot wounds comprised 63.6% of injuries, followed by bomb explosions at 27.2%, and ballistic injuries at 9.1%.

Table 3: Causes and methods of fracture occurrence in patients who underwent mandibular bone grafting from AIC (n = 11).

Mode of injury	N (%)
Road traffic accidents	0 (0.0)
Fall from height	0 (0.0)
Gunshot	7 (63.6)
Bomb explosion	3 (27.2)
Ballistics	1 (9.1)
Pathological fractures	0 (0.0)
Total	11 (100)

Table 4 shows the bone fracture sizes in patients who underwent mandibular bone grafting at the military hospital. A total of 16 fractures were recorded in 11 patients. The fracture size was 2-3 cm in 45.5% of cases, 3.5-4 cm in 36.4%, and 4.5-5 cm in 18.2%. No fractures larger than these were recorded. Chewing Qat was the most common habit among our patients, accounting for 72.7% of the total, followed by sniffing at 45.5%. All patients were non-smokers. Table 5 shows the preoperative clinical assessments of patients who underwent mandibular bone grafting at the military hospital. Infection was found in 45.5% of all patients, and plate exposure was present in 54.5%. Facial asymmetry was found in 100% of patients, facial nerve injury in 27.2%, and wound contracture in 90.9%.

Table 4: Bone fracture size in patients who underwent mandibular bone grafting hospital (n=11).

Size	N
From 2-3 cm	5 (45.5)
From 3.5 -4 cm	4 (36.4)
From 4.5- 5 cm	2 (18.2)
From 5.5 -6 cm	0 (0.0)
From 6.5 -9 cm	0 (0.0)
More than cm	0 (0.0)
Total	11 (100)

Table 5: Preoperative clinical assessments of patients who underwent bone grafting in the mandible (n=11).

Assessments	N (%)
Infections	5 (45.5)
Plate exposure	6 (54.5)
Facial asymmetry	11 (100)
Facial nerve injury	3 (27.2)
Wound contraction	10 (90.9)
Total	11 (100)

Table 6 illustrates the postoperative complications in patients who underwent mandibular bone grafting at the military hospital. The most common complication was wound shrinkage, which occurred in 81.8% of patients at the fourth week postoperatively, rising to 100% at two and four months of follow-up, and then decreasing to 90.9% at six and nine months. The second most common complication was bone loss, which occurred in 9.1% of patients at the fourth month postoperatively and persisted in 9.1% at six and nine months. The third most common complication was nonunion, which occurred in 9.1% of patients at the fourth month postoperatively. Infection occurred in 9.1% of patients at four months postoperatively, decreasing to 9.1% at six months, and then to 9.1% at nine months. Plate exposure occurred in 9.1% of patients at week four, persisted in 9.1% of them until six months postoperatively, and then decreased to 0.0% after nine months.

Table 6: Postoperative complications in patients who underwent anterior iliac crest bone grafting in the mandible (n = 11).

Complications	After 2 weeks N (%)	After 4 weeks N (%)	After 2 months N (%)	After 4 months N (%)	After 6 months N (%)	After 9 months N (%)
Infections	0 (0.0)	1 (9.1)	1(9.1)	2 (18.2)	1(9.1)	0 (0.0)
Plate exposure	0 (0.0)	1(9.1)	1(9.1)	1(9.1)	1(9.1)	0 (0.0)
Facial asymmetry	11 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Facial nerve injury	4 (36.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Wound contraction	0 (0.0)	9 (81.8)	11(100)	11(100)	10 (90.9)	10 (90.9)
Bone loses	0 (0.0)	0 (0.0)	0 (0.0)	1(9.1)	1(9.1)	1(9.1)
Non-Union	0 (0.0)	0 (0.0)	0 (0.0)	1(9.1)	1(9.1)	1(9.1)
Malunion	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Wound dehiscence	1(9.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Antibiotics	11(100)	0 (0.0)	1(9.1)	0 (0.0)	0 (0.0)	0 (0.0)
Total	11					

Table 7: Size of mandibular continuity defect relative to success rate.

Size of fracture	Total N (%)	With success N (%)	With failure N (%)
From 2-3 cm	5 (45.5)	5 (100)	0 (0.0)
From 3.5 -4 cm	4 (36.4)	4 (100)	0 (0.0)
From 4.5- 5 cm	2 (18.2)	1 (50)	1 (50)
From 5.5 -6 cm	0 (0.0)	(0.0)	(0.0)
From 6.5 -9 cm	0 (0.0)	(0.0)	(0.0)
More than 9 cm	0 (0.0)	(0.0)	(0.0)
Total patients, n=11	11(100)	10 (90.9)	1 (9.1)

Facial asymmetry occurred in 100% of patients at week two of follow-up, and then decreased to 0.0% thereafter. Facial nerve injury occurred in 36.3% of patients at week two of postoperative follow-up, then decreased to 0.0% thereafter until nine months of follow-up. Table 7 shows the success rate and the size of the mandibular continuity defect compared to the success rate. The overall success rate was 90.9% (10 out of 11 patients). The success rate was 100% for fractures between 2 and 3 cm, and was 100% for fractures between 3.5 and 4 cm, and was 50% for fractures between 4.5 and 5 cm. No fractures larger than 5 cm were recorded among our patients.

DISCUSSION

There is a trend towards studying oral problems in Yemen, where the results of three-dimensional reconstruction in the orbital region were studied after a long follow-up period[7], initial stability of short dental implants with deep threads in the posterior maxilla during the early healing period[8], comparison of aesthetic results between the Millard and Fisher techniques in unilateral cleft lip repair[9], prevalence of long styloid process in the population of Sana'a[10], comparative radiographic study of bone density and thickness between open and closed fixation of comminuted mandibular fractures[11], efficacy of a modified occlusal splint in the treatment of orofacial dystonia in a sample of Yemeni patients[12], single-point insertion technique guided by the anterior thumb and posterior index finger for mandibular anesthesia[13], types of maxillofacial fractures and their management [14], assessment of sensory neurosensitivity and recovery from hypochondral and inferior alveolar nerve weakness after maxillofacial fractures[15], prevalence of oral reactive hyperplasia lesions and their associated risk factors[16]. However, no study has discussed the success of anterior iliac crest bone grafting for mandibular defect reconstruction, and current study is the first to discuss this topic in Yemen.

Current study's specific goal was to assess the effectiveness of non-vascular bone grafting for the restoration of mandibular continuity defects in cases with different sizes, locations, phases, and indications. The procedure's overall success rate in the current study was 90.9%, and for successive fractures over 11 surgical sites, it was 90.9%. 100% of fractures measuring 2 to 3 cm, 100% of fractures measuring 3.5 to 4 cm, and 50% of fractures measuring 4.5 to 5 cm were successful; no fractures larger than 5 cm were noted. These findings are consistent with earlier reports that showed successive rates ranging from 80 to 90% and that patients with severe fractures accounted for the majority of failures[1].

The right side of the Symphysis had 9.1% of bone defects in the current investigation; this was an instance of unsuccessful bone grafting. Given the different muscle attachments and varied vectors of soft and hard tissue motion, symphysis failure is multi-factorial. Many researchers believe that VBF can effectively treat symphysis related defects; if NVBG is to be used in this area, success rate and predictability increase with the use of any kind of osteoconductive failure that supports and prevents micromotion of the graft particles during early healing phases. When choosing a course of treatment for mandibular reconstruction, timing and indication must be carefully taken into account. Immediate reconstruction is one of VBG's primary advantages[1,17]. Major and mild problems resulting from NVBG mandibular reconstruction were evaluated in this study. Significant problems occurred in three patients. One patient had a bacterial infection and needed to return to the operating room for drainage, and three of these needed to have necrotic tissue removed. Plate exposure, face asymmetry, and wound contracture were among the minor side effects.

Grafting outcomes have been linked to a number of medical and surgical parameters. Blood loss/volume replacement, smoking, diabetes, postoperative antibiotics, problems at the grafting site, fixation, and drain insertion are some of these[3,18-20]. As has been the case in earlier research[6,19,20]6, non-smoking was linked to grafting success in current study to varied degrees in addition to the previously mentioned characteristics. The remarkable grafting success rate in the current study can be explained by the fact that all of the patients did not smoke. According to Osborne *et al.*[1], non-smokers had a higher grafting success rate (90% vs. 75%).

For optimal graft success, several researchers advise following the Carlson procedure because they have discovered that intraoperative tissue perforation does not result in reconstruction failure[21,22]. When planning for mandibular reconstruction, airway selection is an important consideration, especially when benign diseases are involved. For the majority of vascularised bone grafts, elective tracheal perforation is advised, particularly when bilateral neck architecture and lateral defects are present[23]. Regardless of the aetiology of the disease, tracheotomy is advised in many institutions across the world when utilising VBG for reconstruction; however, it is not advised in the case of NVBG unless specific postoperative airway protection is

anticipated. Device failure, inability to reconstruct, infection, donor site difficulties, the necessity for body reduction, and frequently an extended hospital stay are among the well known consequences of VBG[4,24,25].

Limitations of the study

This study's primary drawback is that it is a retrospective examination of a small patient population. Its strength is in emphasising the advantages of non-vascular grafts both on their own and in combination with implant surgery, which has proven to be successful. When choosing the right kind of mandibular reconstruction for different kinds of continuity and discontinuity defects, this study provides a number of considerations, benefits, and criteria to take into account. Having many tools in the restorative types is crucial.

CONCLUSIONS

Non-vascularized iliac crest bone grafts have achieved considerable success in restoring mandibular continuity in traumatic injuries, such as gunshot wounds and blast injuries, and are recommended as the first-line treatment for defects less than 6 cm in diameter. Based on the experience of many researchers, their success is less predictable for defects larger than 9 cm. Complications and morbidity associated with iliac crest dysplasia syndrome have been relatively mild and within acceptable limitsin this study.

ACKNOWLEDGEMENTS

The authors express their gratitude to the Military Hospital in Sana'a city, for their kind assistance.

AUTHOR'S CONTRIBUTIONS

Abdulsattar AAA: formal analysis, conceptualization, data organization, clinical and laboratory examinations. **Al-Rahbi LM:** conceptualization, data organization, supervision. **Al-Ashwal AA:** critical review, supervision. **Al-Shamahy HA:** critical review. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The empirical data used to support the study's conclusions are available upon request from the corresponding author.

CONFLICT OF INTEREST

None to declare.

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