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Assessment of the differences in the use of free iliac flap for maxillomandibular defects with patient-reported outcomes

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Abstract

Background: This study investigated the differences from the literature in terms of preoperative and postoperative features, complications, and aesthetic and functional results of patients who underwent a DCIA-based free iliac flap for large maxillomandibular bone defects in our clinic.

Methods: A total of 25 patients who underwent maxillomandibular reconstruction with a free iliac flap were included in the study. The patient files were retrospectively analyzed in terms of perioperative features. Complications and management strategies were reviewed. The functional and aesthetic results of the patients were evaluated with functional and facial appearance evaluation questionnaires.

Results: The average age was 42, and the male-to-female ratio was 19:6. The most common indication (11 patients) was gunshot wounds. Mandibular body (B) defects, neck skin (C^{N}), inferior alveolar nerve ($N^{İA}$), and buccal (B) mucosal defects were the most common defects. Fourteen osteotomies were applied to 11 flaps. Blood transfusion was 1.28 units, operation time 305 minutes, intensive care follow-up time 0.68 days, and hospitalization time was determined as an average of 13.3 days. Twenty-four recipient site and 8 donor site complications were observed. During the functional evaluation of 25 patients, it was observed that 19 patients could be fed a normal diet, 22 had speeches that were easily understood, and the social activity of 4 patients was found to diminish. In the aesthetic evaluation survey of 21 patients, 42.51% of the patients evaluated themselves as excellent/good, 33.3% as acceptable, and 23.8% as bad. When the evaluations were made by plastic surgeons, the patients were evaluated as excellent (19.04%), good (42.85%), acceptable (23.83%), bad (9.52%), and, very bad (4.76%).

Conclusion: Free iliac flap can be preferred as the first choice for the reconstruction of the orofacial region, especially in trauma patients when its applicability to varied defects in terms of shape, size, content, flap viability, suitability of donor and recipient sites for aesthetic evaluations, and complication rates are considered.

Keywords: Free iliac flap, mandible, maxilla, orofacial reconstruction.

Introduction

The free iliac flap, which can be lifted as osseous, osteocutaneous, osteomuscular, and osteomusculocutaneous, is among the reconstruction options suitable for complex defects of the orofacial region. [1] Free vascularized iliac flap or DCIA (deep circumflex iliac artery) flap was first described by Daniel and Taylor. [2][3] The iliac flap is most commonly used in the head and neck, especially in mandible reconstruction, and can successfully imitate the natural contour of the mandible. [1]

Deficiencies in the complex three-dimensional structure of the region can lead to a major deterioration in the patient's quality of life and loss of social functions. Ensuring the structural and functional integrity of the recipient site and minimal morbidity in the donor site should be the main goals. [4] The most common indication for its use was found to be malignancies in the literature. Various defect classifications have been proposed. [5][6]

Materials and Methods

This study was planned as a retrospective examination of cases who underwent free vascularized iliac flap to reconstruct maxillomandibular tissue defects between 2010 and 2021 at the Department of Plastic, Reconstructive, and Aesthetic Surgery. The necessary approvals for the study were obtained from the local Clinical Research Ethics Committee (2020-401). The necessary permissions were obtained from the patients included in the study and the necessary authorities for using written and visual materials and the questionnaires to be applied.

The demographic characteristics of the patients, flaps and perioperative characteristics (reconstruction timing, flap-defect side, cortex content, tissue types in the flap, recipient artery, vein graft usage, operation time, blood transfusion number, etc.), preoperative and postoperative photographs and radiological images, radiological examinations, and complications were determined. They were scanned in terms of treatment of complications. All data were recorded.

Classification of Defects

In this study, the classification system for orofacial region defects proposed by Urken et al. is utilized.[7] In this classification, bone, soft tissue, mucosa, tongue, and neurological defects are considered separately. In the classification of mandibular bone defects, the letters C for condyle, R for ramus, B for corpus (body), and S for the symphysis area between two canines, the junction between bilateral corpora, were used. If it does not cross the midline, it is assigned S^H. The letter P was used for palatal defects.

In mucosal defects, the labial region was named L, and the buccal area was named B. Soft palate defects were named SP^T, and SP^H, respectively, according to whether they were total or partial. The floor of the mouth (FOM) was specified in the anterior and lateral segments with letters A and L: FOMA and FOML, respectively. Tongue defects were divided into two as mobile tongue T^M and tongue base T^B in circumvallate papillae.

Skin defects were categorized as cheek (C^{CH}), neck (C^{N}), mentum (C^{M}), and lips (C^{L}). The lips were examined in two subclasses: upper lip (C^{LU}) and lower lip (C^{LL}), according to the lateral oral commissure.

Evaluation of Functional and Aesthetic Results

Patients were evaluated both aesthetically and functionally with questionnaires.[8] The functional and aesthetic (facial appearance) results of the patients were evaluated by the patients themselves and their facial appearance also by the surgeons working in our department.

Results

Patients Demographics and Perioperative Findings

25 consecutive patients treated from 2011 to 2021 were included in this study. The male/female rate was 19/6. Mean follow-up 30,5 months (3-84). The main cause of bone and soft tissue defects in our patients was trauma in 13 patients. Eleven of them were due to gunshot injuries (Figure 1). Two of them had a mandible defect due to falling from a height (Figure 2), and the other had a multiple fragmented mandible fracture and non-union after a motor vehicle accident. The demographic data of the patients are summarized in table 1.

The bone defects mostly were in the mandible and especially in the body. Two patients had anterior and lateral maxillar dentoalveolar arc defects. Findings of the classification of defects are summarized in table 2.

The mean Hb difference between pre- and postoperative was 2,91. The mean erythrocyte suspension transfusion was 1.28 units. Perioperative findings and features of the iliac flaps are summarized in Tables 3 and 4 respectively.

Complications Related to Donor and Recipient Sites

Complications observed in donor and recipient sites are summarized in Table 5. Among 5 arterial and 3 venous problems seen early postoperatively, total flap failure was seen in 3 patients. In these patients, bone tissues were saved by removing the soft tissues of the flap, and satisfactory bony tissue reconstruction was accomplished in these patients at the end. Hematoma and seroma were seen in 4 patient donor sites.

Four of the patients who underwent resection due to osteosarcoma and ameloblastoma were reconstructed primarily. Tumor recurrence was observed in 2 of the patients who underwent primary reconstruction. In a patient with osteosarcoma, the entire flap had to be removed when the iliac flap was infiltrated with tumorigenic cells during the follow-up period. The other patient with recurrence was diagnosed with ameloblastoma, and the recurrent area was partially resected.

Nine of the patients included in the study had dental restorations, and a total of 36 implants were placed in the vascularized iliac flap area used in the reconstruction. The number of losses from these implants is 3 in total in two

patients.

Evaluation of Functional and Aesthetic Results

Twenty-one patients were included for the functional and aesthetic evaluation of their reconstructions. The last four patients were excluded from facial appearance because there was not enough follow-up period for evaluation. The evaluation parameters and their results are summarized in Table 6.

Discussion

In the literature, studies with free bone flaps used for the reconstruction of the orofacial region are generally carried out in oncology centers. Therefore, SCC, osteosarcoma, ameloblastoma, salivary gland tumors, osteoradionecrosis, and osteonecrosis due to bisphosphonate use are the leading indications. [9][10][11] When the indications were examined, it was observed that this study differed from the literature in terms of the majority of patients being trauma patients.

The free iliac and fibula flaps are predominantly used in the reconstruction of the orofacial region.[9][10][11][12] The free fibular flap is generally seen as the first-line reconstructive option. [6][9][10][12][13] The free iliac bone flap, on the other hand, remains in the background due to the shorter pedicle attributed to the fibula flap, longer flap recovery, the opinion that osteotomy will damage the flap vascularity, the rough skin structure of the flap is not mobile enough, and donor site complications such as incisional hernia. [14][15] However, in a meta-analysis, the free vascularized iliac flap was recommended as the first choice in the reconstruction of patients with mandibular angulus and corpus defects and patients with large soft tissue defects. [15] Other than total mandibular reconstructions the free iliac flap was used as the first choice regardless of the need for osteotomy in our series.

Politi et al. in the article in which the free iliac and fibula flaps were compared, it was observed that the iliac flap was superior to the fibula flap in terms of donor site aesthetic appearance and can be closed primarily. [16] In our clinic, one of the reasons for the preferential selection of the iliac flap is the superiority of the iliac flap in the concealability of the donor site scar.

In this study, where gunshot injuries were at the forefront, patients fired the rifle by placing the rifle in the lower part of the corpus and symphysis of the mandible for suicide. When the most common defects were examined in an article in which Urken et al. described the classification scheme used, the most common bone defect they faced was BSB encountered in 16 patients.

A total of 14 osteotomies were performed on free vascularized iliac bone flaps in 11 of the 25 study patients (Rate: 0,45). No flap loss due to osteotomy was observed. No malunion or nonunion was observed in the osteotomy sites. In four patients whose bone defects contained symphysis defects were reconstructed with two osteotomies each. Six patients had one osteotomy for symphysis reconstruction (Figure 3).In a study, no flap loss due to osteotomy was observed in mandibular defects reconstructed in the symphysis area. [17] In a review, osteotomy rates in the fibula, iliac crest, radius,

and scapular flaps were compared, and the fibula was stated as the flap with the highest rate and number of osteotomies with 1082 osteotomies applied to 856 flaps; a ration of 1.3. [18]

The lengths of flaps used in the study ranged from 3 cm to 12 cm, with an average of 7,2 cm. In various studies, the iliac bone flap up to 14–16 cm is used. [11][19][20][21]

The mobilization times varying between 6,2 and 10,8 days were found in the literature.[11][21] In our study, the average mobilization time was measured as 2,6 days. The reasons may be the unicortical lifting of the flap, the preservation of ASIS, the intact closure of the donor site, and the majority of the study patients were at young ages.

Considering the length of the operative time shown as a disadvantage of the free vascularized iliac flap, in two studies, the mean operative time measured 531 minutes and 5.8 hours. [22][23] In our study, the mean operation time was measured as 305 minutes. Factors for shorter operation times can be two teams of surgeons, the absence of oncologic resection at the same session, and the simultaneous closure of the donor sites during the anastomoses.

In a study, the average blood transfusion was reported as 3.4 units in patients who underwent reconstruction with the iliac flap and 1.8 units in the fibula flap. [23] In our study, the amount of blood loss was determined by evaluating the preoperative and postoperative results of complete blood count. The mean hemoglobin value decrease was 2,91 mg/dl. The average amount of transfusion was 1,28 units.

The average length of stay in the intensive care unit was measured as 0.68 days. In an article comparing the length of stay in the intensive care unit, the average duration for a free iliac flap was reported as 5 days. [22] The average hospitalization of the patients is 13.3 days. When the literature is examined, it can be observed that the length of stay in the hospital varies between 13.5 and 40 days. [21][22][23][24]

Early vascular problems were intervened by taking the patients to the operating room and anastomose renewal. A venous circulation problem developed in one patient due to a variation in the venous system of the flap. Instead of using a vein graft, the cephalic vein was rotated to the neck, and venous drainage was provided with a single anastomosis.

One of the patients with a gunshot injury. After the bone reconstruction was performed with the iliac bone flap, it was observed that the fistula with flux from the flap area in periodic controls. It was revealed radiologically that the flap lost its bone tissue volume. The second mandible reconstruction was performed with a contralateral iliac flap 2 months after the debridement and reconstruction plate fixation surgery. In this flap, arterial circulation problems were observed again, and the flap was anastomosed to a branch of the thoracoacromial artery using a cephalic vein graft. However, in the patient whose circulation problems continued, the tissues on the iliac bone were stripped on the 5th day, and only bone tissue was left in place as a graft. No complications were found in the patient's controls. The flap size used for the second reconstruction was 8 cm, and it was seen that the graft was completely involved.

Likewise, another patient underwent mandibular reconstruction with an iliac flap (10 cm) and had circulatory impairment. After the 5th postoperative day, in the patient whose circulation disorder could not be eliminated, and the bone tissue was left as a graft. In his follow-up, it was observed that the flap was completely involved in the bone tissue (Figure 4). In these

two patients, it is noteworthy that the defects well above the critical defect size for nonvascular bone graft were kept without any significant loss in the grafted bone tissue after 3-5 days of circulation and ischemia periods. The literature states that 75% loss is observed in grafts larger than 12 cm. Bone grafts are recommended for defects smaller than 6 cm. [25][26] However, cutting the vascular connections of flaps after reconstruction and leaving them as a graft in this way can be considered a salvage method in patients with limited donor site options. We think that this issue requires further studies on ischemic conditioning processes in bone tissue.

Various flap loss rates have been reported in the literature for free vascularized iliac flaps, ranging from 0% to 14%. [8][11][22][23] In a meta-analysis, the free iliac flap, the rate of loss compared to the radial bone flap was found to be 7.4 times higher. In contrast, no significant difference was found in the loss rate between the iliac and fibula and scapula flaps. [5]

In the study patients, two wound separations were observed due to partial necrosis developing in the recipient area, one on the hematoma and the other on the skin of the osteocutaneous flap. While the separation of the hematoma from these patients was closed with secondary care following hematoma drainage, the separation due to flap necrosis was primarily sutured following necrosis debridement. [20][27][28]

Tumor recurrence was a problem in 2 patients, with severe flap loss in 1 patient. In one patient with osteosarcoma, a large recurrence, including the flap, was encountered in the 1st month after iliac flap reconstruction. Wide resection was performed, including the flap tissue. Subsequently, the resection was enlarged 2 more times due to recurrence, and the patient was reconstructed with a free osteocutaneous fibula flap after chemotherapy and radiotherapy for the defect from one condyle to the other. In a patient diagnosed with ameloblastoma who underwent primary reconstruction, the flap recurred after 7 years, and the recurrent part was partially resected.

Plaque exposure was observed in two patients (8%): one after 3 years following the reconstruction and the other after 2 months. The exposed plaques were removed, and then the open wound was repaired with local mucosal rotation flaps. In the literature, the frequency of plaque exposure ranges from 7.5% to 25%. They stated that risk factors causing plaque removal after mandibular reconstruction are radiotherapy, wound infection, and fistula formation. [29] An orocutaneous fistula was observed in 2 of the study patients (8%). The fistula of this patient was repaired with a mucosal rotation flap. When the literature is reviewed, there are studies indicating fistulas varying between 4.7% and 25%. [18][22][28][30]

In this study, as donor site complications, 2(8%) dehiscence, 2(8%) incisional hernia, 3(12%) hematomas, and 1(4%) seroma were found in 4 patients. In the literature, the frequency of hematoma varies between 0% and 5%. [7][11][23] In this study, a detachment occurred in 2 patients (8%) in the donor site. Wound dehiscence was reported in one donor site in a series of 26, 28, and 62 patients who were reconstructed with an iliac flap. [11][27][31]

A drain was placed in the donor area routinely in reconstruction surgery, as well as in hematoma and seroma evacuation operations. The average withdrawal time of drains was 4.2 days on average. When hematoma, seroma, and wound separation complications are examined, it is seen that the rate in this study is slightly higher than in the literature. Early mobilization can be considered as a reason for this. A soft tissue infection developed at the donor site in only 1 patient and

was treated with the broad-spectrum antibiotic.

The incidence of an incisional hernia has been reported between 2.8% and 9% in patients who underwent mandible reconstruction using a vascularized iliac bone flap. [13][32] In an article comparing the free iliac flaps that were lifted in osteocutaneous or osseous, the herniation rate was 12% in osteocutaneous flaps and 4% in osseous flaps. [24] In the literature, the leading causes of herniation in the donor site are carelessness in closing the donor site, denervation of the transversus abdominis muscle with the inclusion of the internal oblique muscle, and excessively tense closure. [24][32] In addition, factors that increase intra-abdominal pressure, such as obesity, COPD, smoking, insufficient analgesia, vomiting, and postoperative pneumonia, may facilitate hernia development. [27][32] In this study, herniation was observed in 2 patients in the donor site (8%). In one of the patients, the body mass index was 31,2 and an osteocutaneous flap was used for his mandibular defect. No repair was planned because the patient was asymptomatic. In another patient, the herniation was severe and symptomatic, because the donor site closure was performed without bone fixation. Hernia was repaired with fascia and muscle edges were re-approximated with bone fixation by drilling holes in the iliac bone.

In nine patients who underwent dental restoration with an implant, a total of 36 implants were placed, and 3 implant losses were observed. Other patients preferred basic prosthetic rehabilitation without implants because the Social Security Institution did not pay for implants. Implant loss rates after free iliac flap reconstruction vary between 0% and 27% in the literature. [15][23][33][34] In a meta-analysis, the number of implants placed in the fibula bone flap was found to be 3.11, while the implant loss rate was 5.3%. For the iliac flap, the number of implants placed was found to be 4.15 on average, and the loss rate was reported as 1.7%. [15]

When the parameters used in the functional evaluation were examined for maxillomandibular reconstructions in 25 patients, it was understood that 6 patients were fed a soft diet, and 19 patients were fed a normal diet. While the speech of 22 patients was found to be easily understandable, the speech of 3 patients was difficult to understand. The social activities of 4 patients were found to be restricted, and the social activities of 21 patients were evaluated as normal. When satisfaction with facial appearance was questioned in 21 patients, 9 of the patients were rated as excellent/good (42.51%), 7 patients as acceptable (33.3%), and 5 patients as poor (23.8%). According to the evaluation made by 14 surgeons working in our department, 19.04% (4 patients) of the patients were *excellent*, 42.85% (9 patients) were *good*, 23.83% (5 patients) were considered *acceptable*, 9.52% (2 patients) were *bad*, and 4.76% (1 patient) were *very bad*.

The results were more positive in evaluations of surgeons than patients. Because during the evaluation, surgeons concentrated on the optimal result, and the patients concentrated on the perfect result or the pre-pathology situation. Patients who were fed a soft diet and could not have dental restorations were observed. There were two patients whose speech was not difficult to understand. He was a patient with limitations in his mandibular and lingual movements secondary to trauma. It consisted of patients who lost their eyesight due to a gunshot injury in 3 patients stated to have restricted social activities.

Vayvada et al. [8] obtained 82% excellent/good and 18% acceptable results in the evaluation of the patients. In the evaluation of the surgical team, 100% excellent/good result was stated. In a meta-analysis, although there was no statistically significant difference, it was reported that the iliac flap group had higher scores in the parameters of

deglutition, chewing function, and speech. [16] In addition, it was stated that the iliac flaps obtained higher scores in terms of functionality, regardless of the defect location. It has been stated that the height of the fibula flap is generally not sufficient for bone-integrated implants, thus negatively affecting chewing function. On the contrary, it has been stated that the iliac flap provides sufficient bone and is more ideal for dental implantation than the fibula flap. [16] In another study in which patients who underwent reconstruction using iliac and fibular flaps were evaluated aesthetically, the rate of patients was reported as 52% and 64%, respectively. Again, in the same study, the iliac flap is recommended in composite and en bloc defects due to the limitation in the amount of skin and muscle tissue provided by the fibula flap. [23]

Conclusions

Except for some publications in the literature, the free vascularized iliac bone flap is among the reconstruction options after the fibular flap. When this study and meta-analysis, as well as review articles in the literature, are examined concerning the ease of changing flap design of the free vascularized iliac bone flap according to the defect reconstruction, applicability to large and different defects, flap success, ability to imitate the natural mandible contour, operation time, perioperative blood loss, intensive care stay compared to other flaps used in orofacial reconstruction, it can be easily observed as having equivalent or superior results in terms of duration, hospitalization time, mobilization time, donor site complications, recipient site complications, availability in terms of bone stock, and quality for dental implant applications. We are of the opinion that the free vascularized iliac bone flap should be a reliable flap that should be preferred as the first choice in most maxillomandibular reconstructions.

Conflict of Interest

There is no conflict of interest.

Tables

Table 1. Demographic data of the patients.

AGE AVERAGE (RANGE)	42 (20-69)
GENDER RATIO (M/F)	19/6
SMOKING RATE (AVERAGE)	5/25 (5,2 Packs / Year)
DEFECT SITE	
Mandible	23/25
Maxilla	2/25
PRIMARY DIAGNOSIS	
Trauma	**13/25**
Gunshot Injury	*11/13*
Falling from high	*1/13*
In-Vehicle Traffic Accident	*1/13*
Tumors	**9/25**
Ameloblastoma	*5/9*
Osteosarcoma	*2/9*
Oral SCC	*2/9*
Infection	**2/25**
Osteomyelitis	*2/2*
Congenital	**1/25**
Large alveolar defect (Bilateral Cleft Lip and Palate)	*1/1*

Table 2. Classification of defects and contents. (ADA anterior dentoalveolar defect, LDA lateral dentoalveolar defect).

BONE DEFECTS	No	%	SKIN DEFECTS	No	%	MUCOSA DEFECTS	No	%	NEUROLOGIC DEFICITS	No	%
B	1	4	C^{N}	13	52	B	11	44	N^{IA}	22	88
BS^{H}	5	20	C^{M}	8	32	L	8	32	N^{F}	2	8
BS	4	16	C^{LL}	8	32	FOM^{A}	10	40	No Defect	3	12
BSB	2	8	C^{LU}	5	20	FOM^{L}	14	56			
RB	5	20	C^{CH}	6	24	T^{M} 1/2	4	16			
RBS^{H}	3	12	No Defect	11	44	No Defect	7	28			
RBS	1	4									
RBSB	1	4									
$CRBS^{H}$	1	4									
ADA	1	4									
LDA	1	4									

Table 3. Features of the iliac flap.

RECONSTRUCTION	4/25	21/25
TIMING	Primary	Secondary
AVERAGE DEFECT SIZE	7,2 cm (3-12 cm)	
FLAP RAISING		
Flap-Defect	16/25 Ipsilateral	9/25 Contralateral
Cortex Content	19/25Bicortical	6/25Monocortical
Tissue Content		
Osseoz	18/25	
Osteomuscular	1/25	
Osteocutaneous	5/25	
Osteomusculocutaeous	1/25	
Osteotomy Number and Rate	14 (11 Flaps) (0,45)	
RECIPIENT ARTERY		**%**
Arteria Facialis	16	64
Arteria Thyroidea Superior	5	20
Arteria Temporalis Superficialis	3	12
Arteria Lingualis	1	4

Table 4. Postoperative follow-up findings.

Perioperative Follow-up	***Average***	***Range***
Preop. Hgb (*gr/dl*)	***13,8***	*10,5-16,2*
Postop. Hgb (*gr/dl*)	***10,9***	*6,6-14,3*
Eritrosit Transfusion (*Unit*)	***1,28***	*0-5*
Hospital Stay (*day*)	***13,3***	*7-35*
Operation Time (*min.*)	***305***	*240-480*
Drain Removal (*day*)	***4,5***	*0-14*
Nasogastric removal (*day*)	***7,9***	*0-30*
Intensive Care Unit Stay (*day*)	***0,68***	*0-3*
Mobilization time (*day*)	***2,8***	*1-4*
Follow-up (*month*)	***30,5***	*3-84*

Table 5. Complications encountered in the postoperative recipient and donor sites.

RECIPIENT SITE	Early period		Late Period		
	Arterial Circulatory Problem	5 (%20)	Dehiscence	5 (%20)	
	Venous Circulatory Problem	3 (%12)	Plaque Exposure	5 (%20)	
	Total Flap Failure	3 (%12)	Infection	1 (%4)	
	Partial Flap Failure	3 (%12)	Orocutaneous Fistula	2 (%8)	
			Tumor recurrence	2 (%8)	
DONOR SITE	**Early period**		**Late Period**		
	Hematoma	3 (%12)	Incisional Hernia	2 (%8)	
	Seroma	1 (%4)			
	Dehiscence	2 (%8)			

Table 6. The table shows the questionnaire information for evaluating the functional and aesthetic results of the face after reconstruction with the iliac flap.

FUNCTIONALITY	Number of patients	(%)	FACIAL APPEARANCE	Number of patients	(%)
DIET			***EXCELLENT***		
Normal	19	76	Patient	-	
Soft	6	24	Surgeons	4	19,04
ORAL CONTINENCE			***GOOD***		
Normal	11	44	Patient	9	42,85
Light leak	10	40	Surgeons	9	42,85
Severe leak	4	16	***ACCEPTABLE***		
SPEECH			Patient	7	33,3
Easily understood	22	88	Surgeons	5	23,83
Difficult to understand	3	12	***BAD***		
Unintelligible	-	-	Patient	5	23,83
SOCIAL ACTIVITY			Surgeons	2	9,52
Normal	21	84	***VERY BAD***		
Decreased	4	16	Patient	-	
			Surgeons	1	4,76

Figures

Figure 1. The patient with defects in the mandible and soft tissues and zygoma fractures after gunshot injury is seen preoperatively (a). In the first operation, zygoma fractures were repaired with miniplates and screws, and the wound was washed with saline and closed primarily and mandible reconstruction was left into the second operation. CT 3D image and patient's view after the first operation (b, c,d). In the second operation, the mandible reconstruction was performed with a free iliac bone, muscle, and skin flap.

Patient’s face view after reconstruction of bone and soft tissues (e, f) and dental restoration (g).CT 3D image after healing (h).

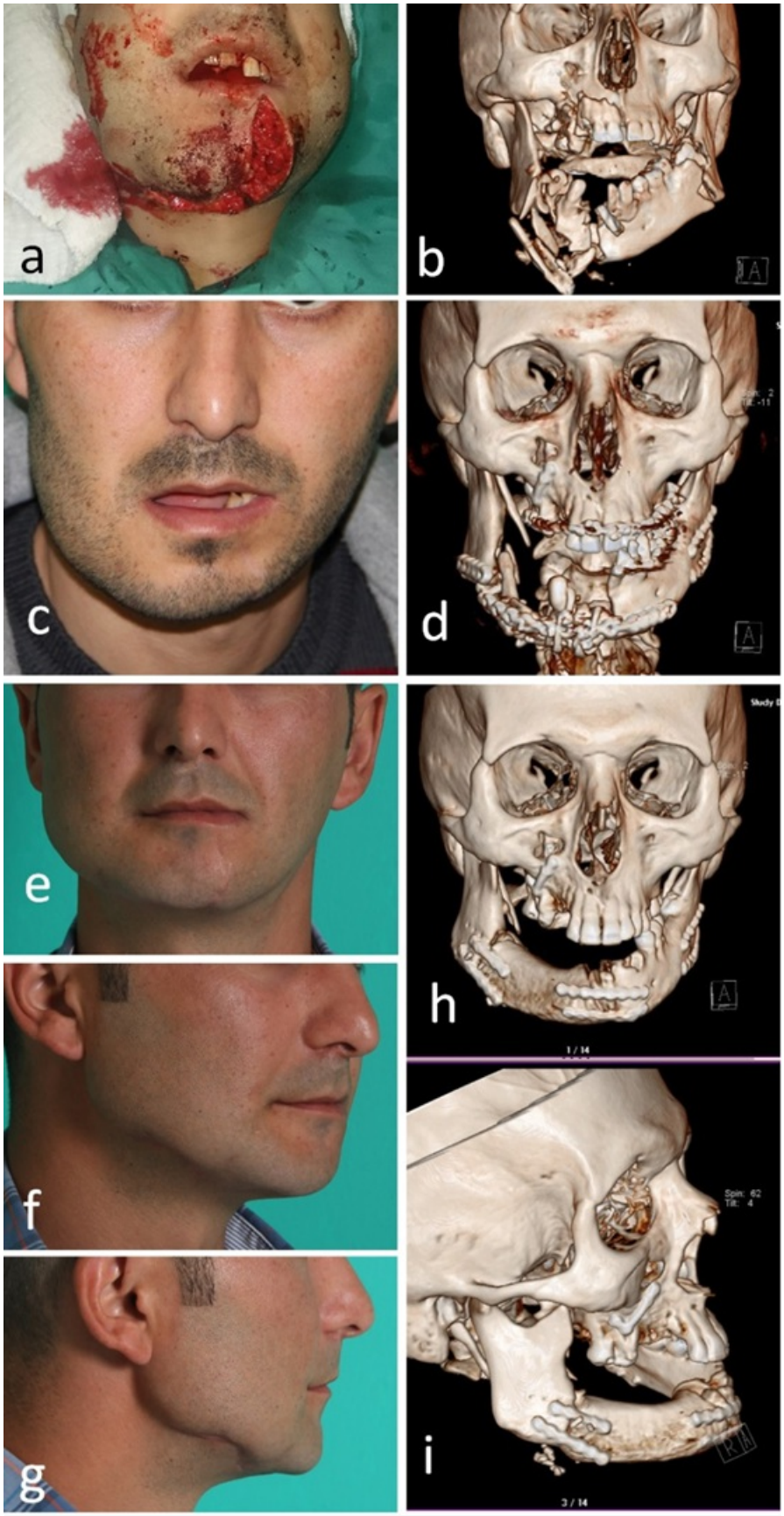

Figure 2. The patient was injured after falling from a height. Preoperative images of the lower face and 3D CT scan (a, b). Multiple paired fractures of the mandible were fixated with wires, mini and reconstruction plates, and screws in the first operation. Patient's and 3D CT images before the second operation (c, d). The mandibular defect was reconstructed with a free iliac

bone flap. After healing, the patient's front, oblique and lateral views (e, f,g) and 3D CT scan images (h, i).

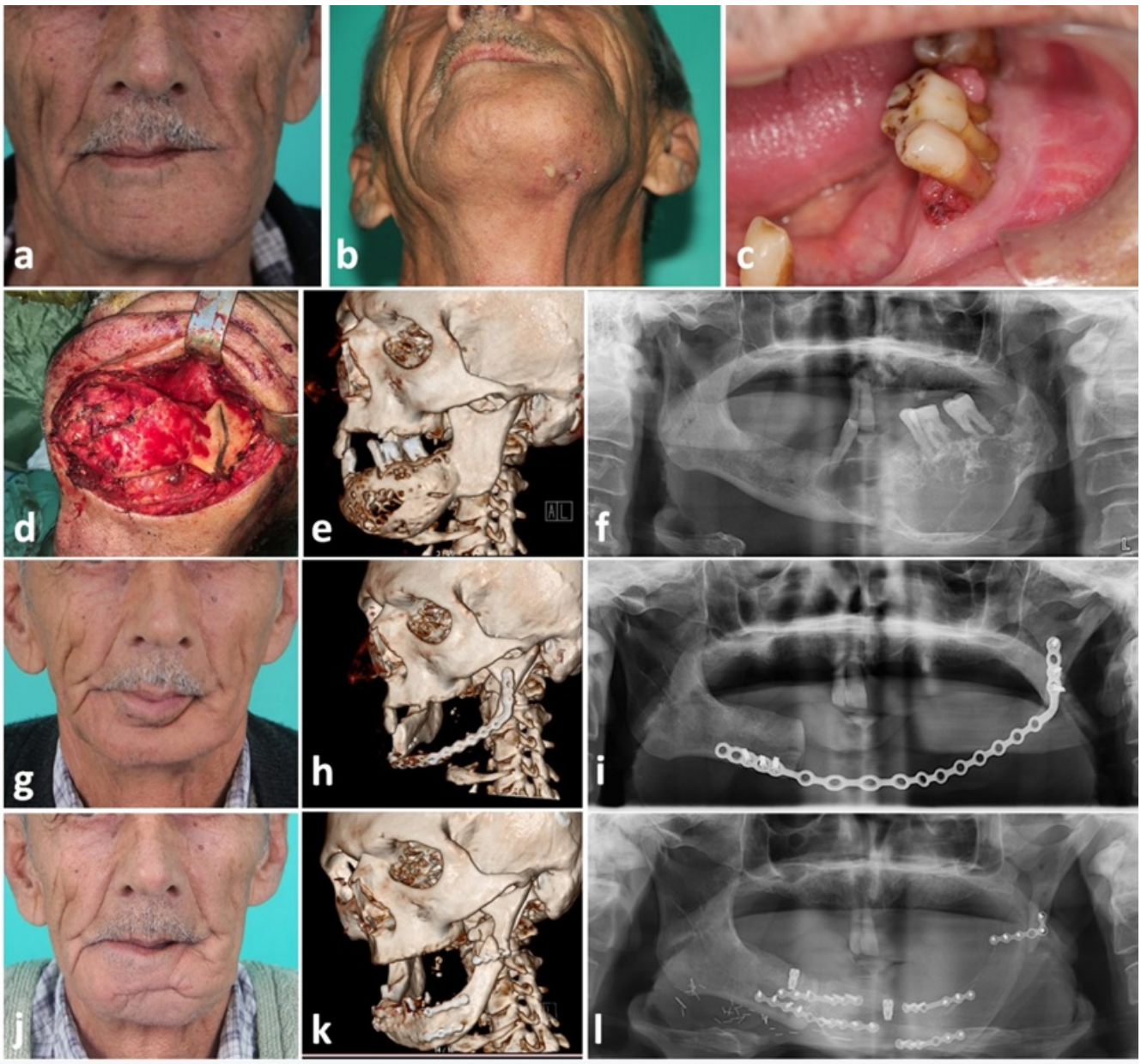

Figure 3. The patient who had ameloblastoma, preoperative view of the face, and intraoral tumor tissue around the teeth (a, b,c). Intraoperative image of the tumor tissue and resection boundary lines (d), and preoperative radiologic imaging- 3D CT and panoramic views (e, f). After tumor resection and reconstruction with a plate, the patient's front view and radiologic images (g, h,i). In the second operation, the mandible defect was reconstructed with a free iliac bone flap. Postoperative front view of the patient and 3D CT and panoramic views (j, k,l).

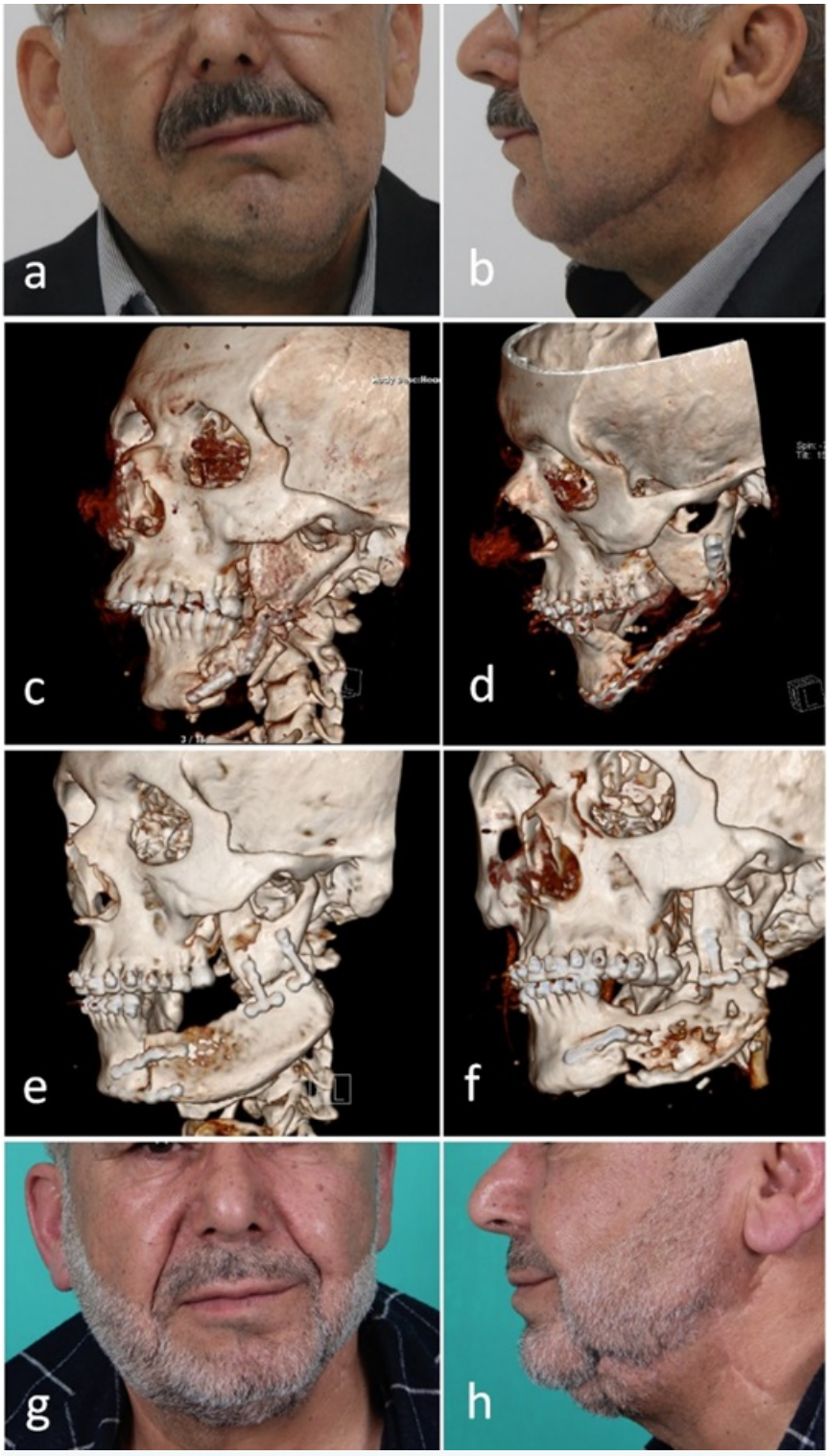

Figure 4. The patient's view who had mandibular defect due to osteomyelitis (a, b).3D CT imaging taken during the first application (c). Mandible was positioned to normocclusion and fixated with the reconstruction plate (d). Three months later, the bone defect was reconstructed with the iliac bone flap. A circulatory problem was seen in the flap and all soft tissue of the flap was removed and bone tissue was left as a graft on the postoperative fifth day. 3D CT image 1 month later (e). After three years, bone tissue was preserved and non-union was never seen (f). Patient's images three years later. Fistula or other bone-related problem was not seen (g, h).

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