Iliac Crest Flap for Mandibular Reconstruction After Advanced Stage Mandibular Ameloblastoma Resection

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Abstract: Ablative surgeries for neoplastic processes of the oral cavity, traumas, infections/inflammations, osteoradionecrosis, and congenital deformities are the most common causes of large mandibular defects. Ameloblastoma is a locally aggressive tumor that, if not treated, can gain an enormous size and cause severe facial disfigurement and functional impairment. Although the smaller lesions of ameloblastoma in the mandible are treated by conservative approaches such as marsupialization, enucleation, and curettage combined with liquid nitrogen spray cryosurgery, larger lesions require radical surgical ablation procedures resulting in large tissue defects. A large mandibular defect has deleterious effects on a person's life, with a significant loss in the quality of life unless it is reconstructed successfully. The aim of present case series report is to show the results of the multidisciplinary treatment of patients with advanced stage ameloblastoma, including tumor resection, simultaneous reconstruction with iliac crest flap, followed by placement of endosseous dental implants, and finally the prosthodontic rehabilitation.

Key Words: ameloblastoma, deep circumflex iliac artery osseous flap, iliac bone flap, mandibular reconstruction

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The most common causes of large mandibular defects are the ablative surgeries for neoplastic processes of the oral cavity and oropharynx. The other causes include trauma, infection/inflammation, osteoradionecrosis, and congenital deformities.[1–3]

Ameloblastoma accounts for 1% of all cysts and tumors of the oral cavity and 11% of all odontogenic tumors.[4] It is a locally aggressive tumor that, if not treated, can gain an enormous size and cause severe facial disfigurement and functional impairment. It has a tendency for aggressive invasion of the mandible and has a high recurrence rate with equal frequency of occurrence in both the sexes.[5]

The smaller lesions of ameloblastoma in the mandible are treated by conservative approaches such as marsupialization, enucleation, and curettage combined with liquid nitrogen spray cryosurgery. On the other hand, the larger lesions require radical surgical ablation procedures resulting in large tissue defects.[6]

The aim of the present case series report is to show the results of the multidisciplinary treatment of advanced stage ameloblastoma patients, including tumor resection, simultaneous reconstruction with iliac crest flap, followed by placement of endosseous dental implants, and finally the prosthodontic rehabilitation.

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PATIENTS AND METHODS

A total of 10 advanced-stage mandibular ameloblastoma patients were treated by the same surgeon between 2004 and 2009. There were 6 men and 4 women in this series whose ages ranged between 17 and 63 years (mean: 29, 25 ± 16.22 years). In all, 8 patients (80%) underwent hemimandibulectomy including the condyle, and 2 patients (20%) underwent segmental mandibular resection after histologic confirmation of the diagnosis as ameloblastoma. Sizes of the mandibular defects ranged between 6 to 13 cm. Iliac crest flap was used for mandibular reconstruction in all the patients in this series, followed by placement of endosseous implants and finally prosthodontic rehabilitation of the patient. Tumor resections, reconstructions, and the dental rehabilitations were performed by the same doctors.

Case 1

A 63-year-old male patient presented to our department with facial asymmetry and a mass in the right side of the mandible. Panoramic radiologic examination demonstrated a great radiolucent region at the right side of the mandibular area including the body, angle, ramus, and condyle (Fig. 1).

A right-sided hemimandibulectomy was performed including the condyle after confirmation of the diagnosis with needle biopsy. Next, mandibular reconstruction was performed by using ipsilateral iliac crest flap. The flap was 13 cm in length, 5 cm in width, and 1 cm in thickness. Right facial artery and vein were used as recipient vessels. The iliac crest flap was fixated to the symphyseal region of the mandible on the medial side by using 2 plates and 10 screws. The lateral side of the bone flap was sutured to the posterior part of the zygomatic arch with 2-0 nylon sutures. The oral mucosa and the skin incision were primarily closed. Postoperative course was uncomplicated (Figs. 2, 3).

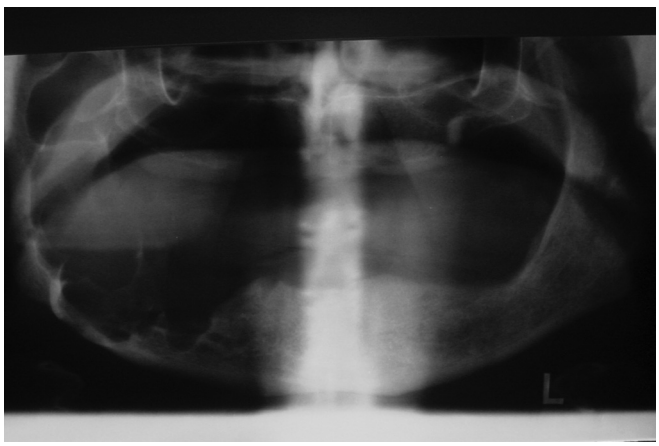

FIGURE 1. The preoperative panoramic radiography; A unilateral radiolucent lesion was diagnosed at the right side of the mandible, including the body, angle, and the condyle.

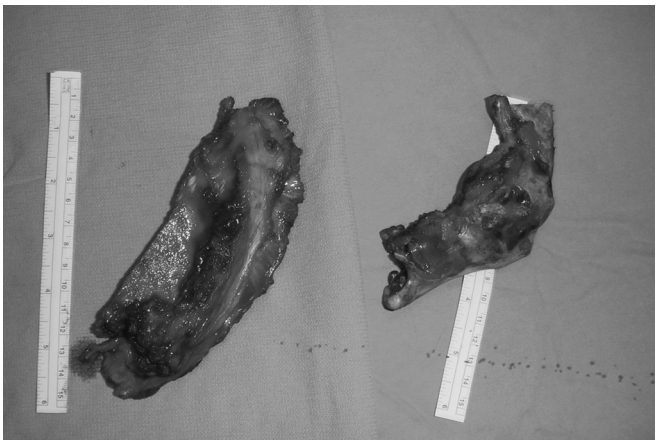

FIGURE 2. Hemimandibulectomy specimen (right) with the harvested iliac osseous flap (left) ex vivo.

FIGURE 3. Medial side of the flap fixated to the symphyseal region of the mandible by using 2 plates and 10 screws, and the lateral side of the flap sutured to the posterior part of the right zygomatic arch with 2-0 nylon sutures.

Dental rehabilitation plan was conducted 3 months after the reconstructive surgery. Following his clinical and radiologic evaluations, a total of 5 endosseous 1-stage surgery implants with a diameter of 4.8 mm and a length of 14 mm (Tapered Swiss Plus, Zimmer Inc., Dental, Carlsbad, CA)—1 into the reconstructed area and 4 into the intact side of the mandible—were placed according to the manufacturer's instructions. The final prosthetic rehabilitation was performed 6 months after the implant surgery. Neither soft-tissue related, nor hard tissue or implant related problems were observed 3 years after the insertion of the final prosthesis with near perfect facial symmetry and jaw movement (Figs. 4, 5).

Case 2

A 20-year-old male patient admitted to our hospital with a mass in the left side of the mandibular region. The panoramic x-ray demonstrated that the radiolucent lesion at this site starting from left parasymphyseal region to the left subcondylar region. The diagnosis of ameloblastoma was confirmed with biopsy and the patient underwent left hemimandibulectomy including the left condyle, followed by reconstruction by the iliac crest flap. The flap was 11 cm in length, 3 cm in width, and 0.7 cm in thickness. The recipient vessels were the left facial artery and vein. The lateral part of the flap was fixated to the zygomatic arch with 2-0 nylon suture and the medial part was fixated with 2 plates and 9 screws to the rest of the mandible. The postoperative course was uneventful (Figs. 6, 7).

A total of 4 endosseous 1-stage dental implants and 1-stage surgery implants with a diameter of 4.8 mm and a length of 14 mm (Tapered Swiss Plus, Zimmer Inc., Dental, Carlsbad, CA) were placed into the reconstructed mandible 3 months after the reconstruction of the mandible according to the manufacturer's instructions. The final prosthetic rehabilitation was successfully performed 6 months after the implant placement. The patient regained facial symmetry and as well as jaw movement was quite well without any problem 2 years after the insertion of the final prosthesis (Figs. 8, 9).

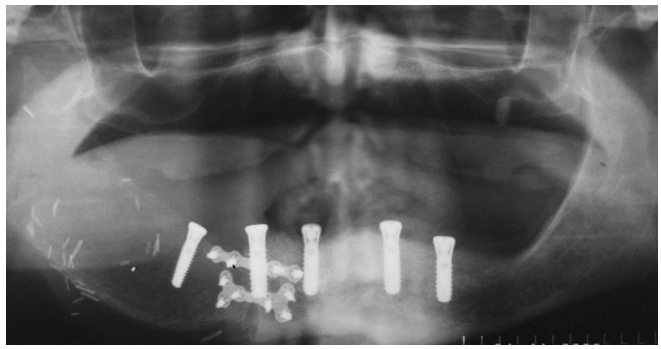

FIGURE 4. The postoperative panoramic radiography; tapered endosseous implants were inserted into the mandible, including a total of 5 implants.

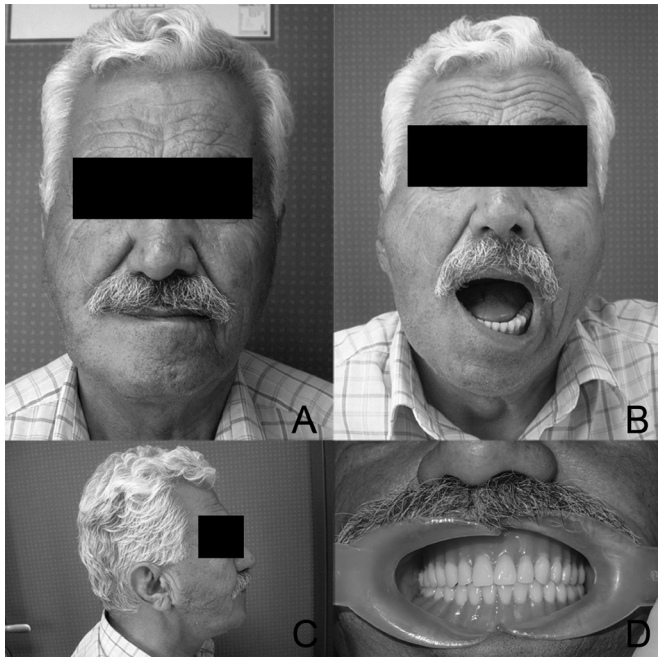

FIGURE 5. Late postoperative frontal (A, B), right side lateral (C) views, and the dental restoration (D).

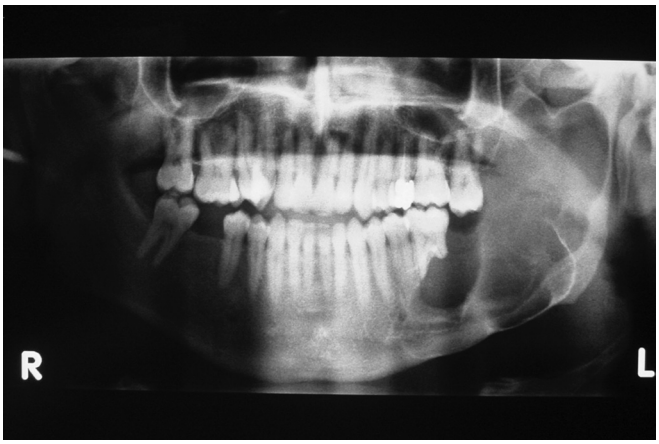

FIGURE 6. The preoperative panoramic radiography demonstrating the radiolucent lesion starting from left parasymphyseal region to the left subcondylar region.

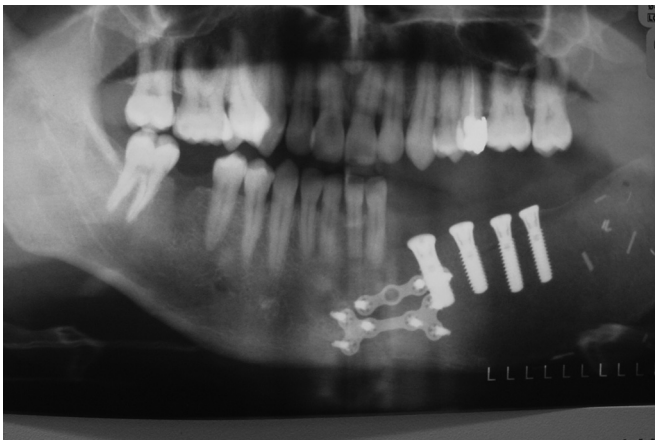

FIGURE 8. The postoperative panoramic radiography; a total of 4 endosseous tapered implants were placed into the reconstructed mandible.

FIGURE 7. Hemimandibulectomy specimen (lower) with the harvested iliac osseous flap (upper) ex vivo.

FIGURE 9. Late postoperative frontal (A, B), left side lateral (C) views, and the dental restoration (D).

Case 3

An 18-year-old female patient presented with facial asymmetry and a mass in the right side of the mandible. A big translucent lesion was evident on the panoramic x-ray including the right side condyle, ramus, angle, and a portion of the body of the mandible. Hemimandibulectomy was performed in this side including the condyle after confirmation of the diagnosis with incisional biopsy. The iliac crest flap was used for mandibular reconstruction, and the bone flap was 10 cm in length, 3 cm in width, and 0.6 cm in thickness. Left side superior thyroidal artery and vein were used as recipient vessels because of the low caliber of the facial artery and vein in this patient. The postoperative course was uncomplicated (Figs. 10, 11).

A total of 3 endosseous 1-stage dental implants and 1-stage surgery implants with a diameter of 4.8 mm and the lengths of 14 mm (2 implants) and 10 mm (1 implant) (Tapered Swiss Plus, Zimmer Inc., Dental, Carlsbad, CA) were placed into the reconstructed mandible, according to the manufacturer's instructions, 6 months after the reconstruction of the mandible and the prosthetic rehabilitation was performed 6 months after the implant placement. The facial symmetry, mandibular function, and the contour were near perfect 1 year after the prosthetic rehabilitation (Figs. 12, 13).

DISCUSSION

The mandible is considered to be one of the most important parts of the head and neck region. Apart from the function of the dentition, it is also very important for the aesthetics of the face.[7] The face plays a central role in our daily interactions through its expression of feelings, beauty, and identity; therefore, it is essential in social interaction. As a result, a large mandibular defect stemming from a

FIGURE 10. The preoperative panoramic radiography demonstrating the radiolucent lesion extending from right parasymphyseal region to the left subcondylar region.

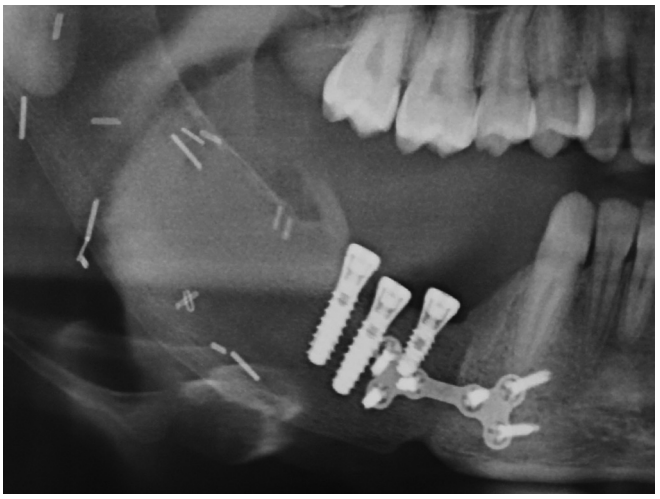

FIGURE 12. The postoperative panoramic radiography; A total of 3 endosseous tapered implants were placed into the reconstructed mandible.

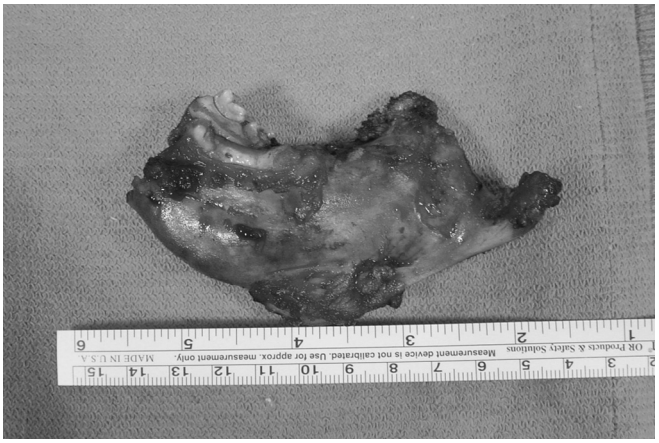

FIGURE 11. Hemimandibulectomy specimen ex vivo.

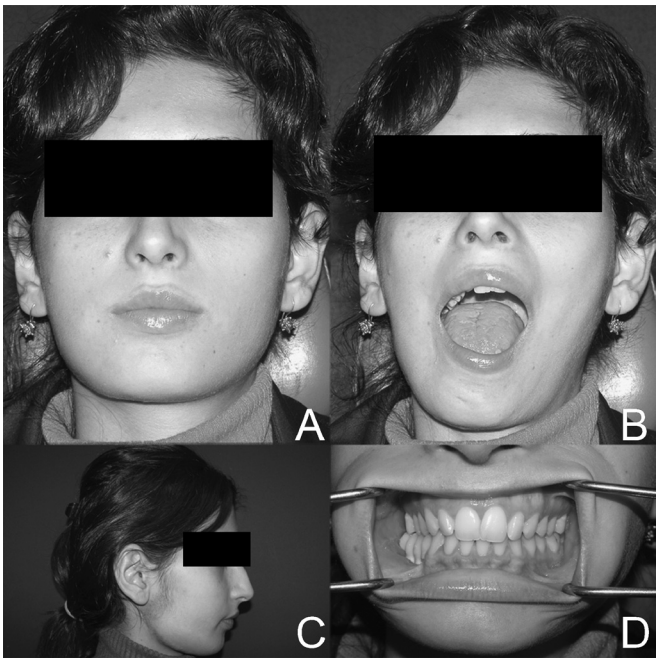

FIGURE 13. Late postoperative frontal (A, B), right side lateral (C) views, and the dental restoration (D).

trauma or resection of a tumor has deleterious effects on a person's life with a significant loss in the quality of life unless it is reconstructed successfully.[8]

Bone plates and screws are among the commonly used alloplastic materials for mandibular reconstruction, but delayed complications such as hardware extrusion or fracture are frequently observed with these materials.[1–3]

Historically nonvascularized, free bone grafts have been used, but compared with alloplastic bone substitutes and nonvascularized bone grafts, vascularized bone grafts provide much superior results when the amount and the durability of supplied bone are considered. Consequently, over the past 25 years vascularized bone transfer has become the gold standard for mandibular reconstruction.[6,7,9]

Fibula, ilium, scapula, and radius are the 4 most commonly used osteocutaneous flaps for mandibular reconstruction. The detailed features of these flaps have been well characterized in the literature.[10–14]

Radial forearm osteocutaneous free flap is a less popular choice for mandibular reconstruction because of high donor site morbidity and limited bone stock, which is not favorable for osseointegrated dental implants. The bone thickness that can be harvested is too small to endure stress in the mandible. A high rate of fracture in the radius after harvesting limits its clinical practice, although preventive modifications such as "keel-shaped modification"[15] or prophylactic plating of the radius[16] can be performed to prevent these fractures in the donor site.[17]

The scapular osteocutaneous free flap is usually preferred in selected cases for through-and-through defects involving facial skin, bone, and mucosa. The 3-dimensional maneuverability of the skin island relative to the bone segment because of the separate vascular pedicles is an advantage of this flap. The need for repositioning during

FIGURE 14. The inconspicuous donor site scar that can be easily hidden by the underwear 6 months after the reconstruction.

the operation and the inconvenience for the 2-team approach are the main disadvantages of this flap that makes it preferable in only selected cases.[18,19]

Among these flaps, fibula and iliac crest are the most commonly used free flaps for mandibular reconstruction. Providing sufficient bone segment for any length of mandibular defect, flap dissection under tourniquet with minimal blood loss, possibility of multiple osteotomies because of both endosteal and segmental blood supply, and a long pedicle up to 8 cm in length are the main advantages of the fibula flap. On the other hand, straightness of the bone necessitating osteotomies for curvature and inappropriate height of the bone when compared with a dentate mandible, which can be a problem when dental implants are planned for occlusal rehabilitation, are the main disadvantages of this flap.[20] The use of a "double barrel" flap[21] and vertical distraction of fibular flap[22] have been described in the literature to overcome this problem. The skin flap of the fibula is thin and pliable that is suitable for use as oral lining; however, unreliability of the attached skin has limited the potential for reconstruction of composite mandibular defects, as reported by Hidalgo.[12] Besides, the potential of leaving dead space exists when the free fibula flap is used as a single composite flap, and this can lead to infection and fistula formation.[23] Although the donor site morbidity is accepted as relatively mild from the standpoint of functionality, it is a serious aesthetic problem, particularly for female patients. Moreover, preexisting peripheral vascular disease precludes the use of this flap.[24]

The iliac crest is the other most commonly used donor site for mandibular reconstruction. Initially, the superficial circumflex iliac vessels were used as the vascular pedicle for combining a groin skin flap with iliac bone; however, Taylor et al was the first to report that the deep circumflex artery and vein play the major role in supplying the iliac bone in this flap.[25] The iliac crest displays an intrinsic curve that is used to advantage in mandibular reconstruction, because it is already precontoured for ipsilateral reconstruction. In this way, hemimandibular defects are easily reconstructed by incorporating the anterior edge of the ilium.[26] No other site in the body can supply similar abundance of vertical and horizontal height of bone available for mandibular contour and osseointegration. The inconspicuous donor site scar is superior when compared with other choices (Fig. 14). Conversely, the soft-tissue attachment is often excessively bulky.[18] To overcome this problem, Safak et al have described a new design of the iliac crest microsurgical free flap without including the obligatory muscle cuff. In this design, the skin island was elevated on a dominant cutaneous branch from the deep circumflex iliac artery. Harvesting the skin as an axial pattern flap greatly increased its independence from the bone, which improved maneuverability.[27] Higher blood loss compared with fibula is the major disadvantage of this flap. The length of the bone that can be harvested is more limited when compared with fibula, which is another deficiency of this bone flap. Although its dissection is considered to be difficult, in our opinion this can be overcome after gaining experience.

In this series, we did not choose radius and the ribs as vascularized bone grafts because of their limited bone supply. The mandibular defects created after resection of the tumors were not through-and-through defects, and that is why there was no reason to use scapula. Fibula and the ilium were the 2 main reconstructive options that we considered. The intrinsic curvature of the ilium was suitable for the hemimandibular defects that were created after resection of the ameloblastomas in this series. Besides, as we have mentioned earlier, dental rehabilitation with endosseous implants was easier after reconstruction with iliac crest flap because of the inappropriate height when the fibula was used.

The medial coaptation of the iliac crest flap and the mandible was performed by using 1 or sometimes 2 miniplates (Synthes miniplates, Synthes GmbH, Solothurn, Switzerland) and we never faced any nonunion and loosening of the hardware in this series. This type of osteosynthesis is based on the experiences of our senior author (T.S.) who performed over 100 mandibular reconstructions by using iliac crest flap since 1987.[23] Based on his experiences, if there is no problem in the vascularization of the iliac crest flap and the fixation was performed properly with good bone contact, we usually do not experience any problems with nonunion. We believe that this is because of the great vascularization of the iliac crest flap, which enables good bone union.

We did not experience any significant donor site complications in any of our cases except a temporary gait disturbance that was spontaneously resolved in 1 month. All of the cases in this series were of advanced stage ameloblastoma, and although the mandibular incisions were performed at least 1 cm inferior to the margin of the mandible, we could not save the periosteum in these cases because of tumor invasion, which resulted in marginal mandibular nerve injury, in order to prevent tumor recurrence.

Although the mandibular condyle was resected in most of the cases (8 of 10 cases), all the patients could chew food on the reconstructed side without pain after the dental rehabilitation was complete. The range and average excursion of the jaw opening anteriorly were quite sufficient in all of the cases.

We did not prefer the use of reconstruction plates, if we did not perform osteotomy to increase curvature of the iliac bone. Usually, the curvature of the iliac crest is proper for reconstruction of hemimandibular defects. But on the other hand, the use of reconstruction plates is essential when this type of reconstruction is performed with fibula bone grafts that need 1 or sometimes 2 osteotomies for the curvature.

There are many reports in the literature about the technique for accurate placement of implants with vascularized bone transfers. Moreover, many reports compared the long-term results of the different techniques of mandibular reconstruction with endosteal implant placement.[28–32] The novelty of this case report is the combination of the step-by-step details of the surgical procedure and the dental rehabilitation in the same case report. From these points of view, our case report is of benefit to inexperienced reconstructive surgeons in providing a means for creation of the whole treatment plan of hemimandibular reconstruction followed by dental rehabilitation.

CONCLUSION

Vascularized free iliac crest flap is a safe and reliable method to achieve a functional and aesthetic mandibular reconstruction, particularly in lateral defects of the mandible. However, dental implant placement followed by the fabrication of an appropriate prosthesis provides

significantly improved outcomes for the patients when compared with wearing dentures. Thus, it may be suggested that preserving the patient's quality of life by using a multidisciplinary reconstructive treatment protocol has a significant value.

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