28 Reconstruction of Defects of the Mandibular Angle

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Unrepaired defects of the mandible, including the angle, ascending ramus, and posterior body, leave a significant deformity, both functional and aesthetic. The muscles of mastication pull the remaining mandible into a lingual relationship with the maxillary teeth, rendering the remaining teeth functionless. The soft tissues of the tongue and larynx lose their support, resulting in difficulty with oral competence and intelligible speech (Fig. 28.1).

The goals of mandibular reconstruction are to provide a reliable restoration of hard and soft tissue, enhancing both cosmesis and function. Due to its exceptional utility for restoration of the mandible, the three-dimensional reconstruction plate has become the cornerstone of the operative reconstructive strategy for these defects (Fig. 28.2). The plate functions as a template of the mandible. It also helps to maintain the orientation and position of the remaining native mandibular segments. Consequently, proper occlusal relationships are preserved. In addition, the plate provides an excellent mechanism for the fixation of vascularized bone grafts.

Vascularized bone transferred by microvascular techniques has become the gold standard for reconstruction of the mandible. Initially, many centers were reluctant to use microvascular transfer, fearing the procedure to be unreliable due to the complex nature of the surgery. Ironically, this "complicated" technique is actually the most dependable method of mandibular reconstruction currently available. Success rates of approximately 95% for microvascular head and neck reconstructions are routinely reported in the literature [1–3].

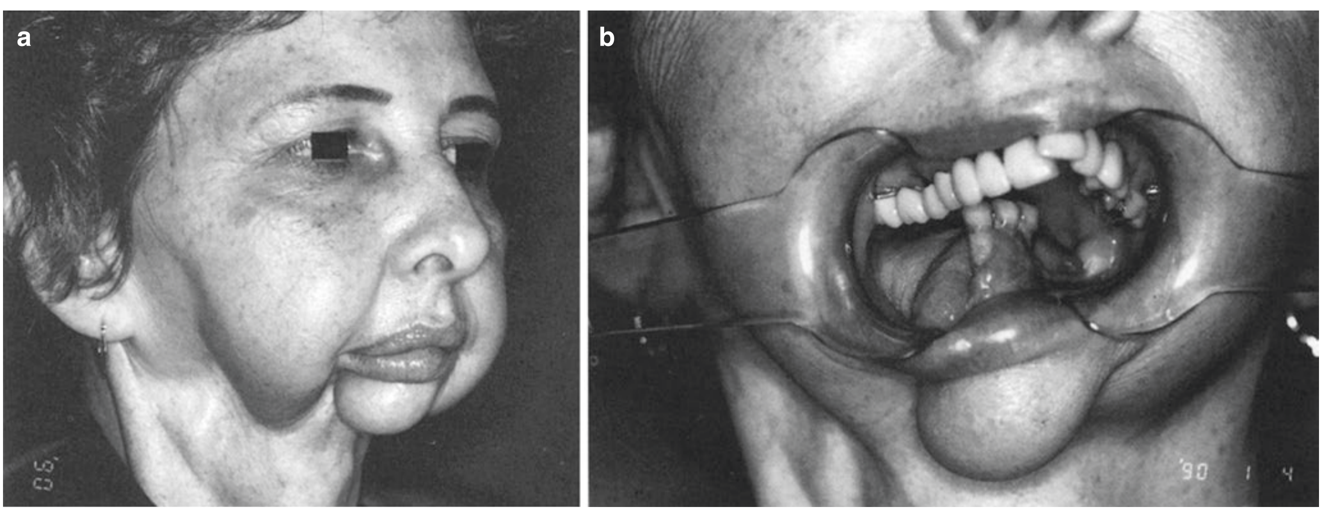

Fig. 28.1 Residual deformity after posterolateral mandibular resection with primary closure. (**a**) Oblique view. (**b**) Intraoral view. Note the tethering of the tongue and the deviation of the mandible

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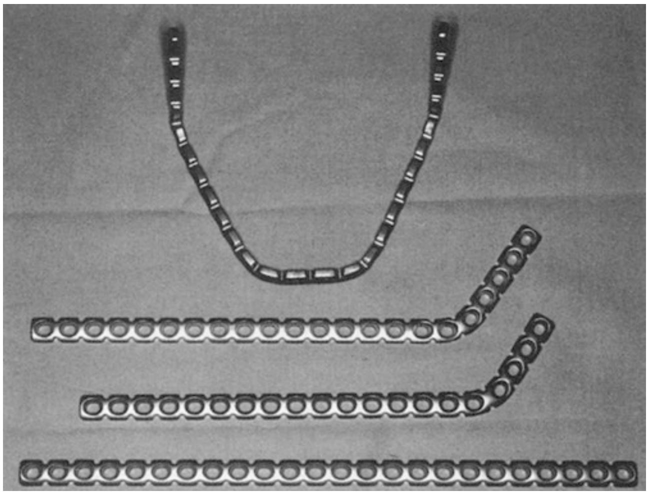

Fig. 28.2 Reconstruction plates come in a variety of sizes of configurations. They serve as a template for the native mandible and as a fixation device for the vascularized bone flap

There are, however, circumstances in which it may not be imperative to restore bone. This may stem from either the location or extent of the mandibular defect or from variables related to the patient's overall health or prognosis. Reconstruction plates may be used alone or in combination with soft tissue flaps to provide restoration of the mandible. These alternative techniques allow immediate function with minimal donor deformity in patients whose physical status mitigates against a lengthy surgical procedure. Reconstruction of the mandible solely with a reconstruction plate should likely be limited to lateral or posterior defects due to the excessively high rate of plate exposure when plates are used without vascularized bone on anterior repairs. Reconstruction of 31 patients comparing plate fixation alone to immediate vascularized bone graft repair demonstrated that while plate reconstruction had an overall success in 15 of 20 patients (75%), the failure rate for anterior plates was 76%. This contrasts with a 100% success rate for the vascularized bone grafts, 6 of 11 of which were for anterior defects [4].

Types of Flaps in Common Use

Historically, a number of different vascularized bone flaps have been used for mandibular reconstruction, ranging from rib [5, 6] to second metatarsal [7]. The most commonly used osteocutaneous flaps include the radial forearm, incorporating a portion of the radius, scapula, iliac crest, and fibula. All these flaps can provide a skin paddle, which may be needed for intraoral lining or external skin coverage. The particular flap used is dependent upon the specific needs of the reconstruction.

The radial forearm flap based on the radial artery and the cephalic vein provides a dependable pedicle and a thin, potentially sensate soft tissue. However, pathologic fractures of the radius and a significant functional and aesthetic donor-site deformity can occur [8–10]. The scapular flap has a long pedicle from the circumflex scapular artery, which supplies a large amount of dependable skin for harvest. The skin paddle may be oriented independently of the bone stock, giving added versatility [11]. However, the available bone may be thin and somewhat limited, especially in female patients [12, 13]. Most significantly, the lateral positioning of the patient necessary for flap harvest precludes simultaneous dissection with the ablative team, greatly increasing the operative time. We have most commonly employed the fibular flap, which is based on the peroneal vessels. The fibula flap provides excellent bone stock, minimal donor-site deformity, and when a small cuff of muscle is included in the dissection, it is a reliable skin paddle as well [14, 15]. The iliac crest is a large bone with a bulky skin/soft tissue paddle. The donor site is often painful, but this flap has shown excellent results for bony restoration in patients with osteoradionecrosis [16–18].

Preoperative Evaluation

A thorough evaluation of the patient in preparation for the reconstructive surgery is essential in obtaining reliable results. Issues that require assessment include:

1. The size and location of the defect
2. The composition of the defect
3. Status of recipient vessels
4. Overall health and nutritional status of patient
5. History of smoking

Fibular Free Flap

The fibular flap is our flap of choice for mandibular reconstruction. The operative procedure we employ will be described in detail. The advantages of the fibular flap include:

1. The harvest is straightforward and may proceed simultaneously with the ablative part of the operation.
2. The bone stock is of high quality and excellent length.
3. The segmental periosteal blood supply allows for multiple osteotomies.
4. The skin paddle is reliable if the perforators are protected by including a cuff of soleus muscle in the dissection.
5. Donor-site morbidity is low.

If skin is not required for the reconstruction, the fibula is harvested from the ipsilateral leg. The contralateral leg is used if both skin and bone are needed. A posterior mandibular reconstruction requires creation of a ramus. Use of the proximal fibula mandates pedicle location at the neoangle, which is essential for flap inset and vessel anastomosis. Conversely, the distal fibula is used when a proximal reconstruction is performed, as the vessels are ideally positioned.

Operative Procedure

Occlusion should be set prior to resection, using intermaxillary fixation via arch bars. Both teams begin the operation concurrently. The ablative team is positioned at the patient's head, while the reconstructive team is harvesting the flap from the leg. The ablative surgeon notifies the reconstruction team once the mandible is exposed and ready for resection. The proposed sites for the bone cuts are marked with an oscillating saw penetrating only the outer cortex. Prior to the removal of any bone, the reconstruction plate is bent to precisely match the native mandible. The plate is then fixed into place with screws. The appropriateness of the shape and orientation of the plate is checked. This will allow precise placement of the graft in reference to the existing mandible. The plate is subsequently removed, set aside, and the resection completed.

Fibular Dissection

The patient is positioned supine on the table with a roll under the hip of the donor leg (Fig. 28.3a, b). A tourniquet is used to facilitate the dissection.

The course of the fibula is noted. The fibular head is palpated at the knee and marked. The peroneal nerve is palpated and marked in its location just below the fibular head. A skin paddle of the appropriate size is sketched out and centered along the posterior border of the lateral leg. Marks are placed at a distance of 10, 15, 20, and 25 cm from the fibular head. The majority of significant perforators emerge at 10–20 cm below the fibular head; thus it is preferable to locate the skin paddle within this location (Fig. 28.3c). As the anterior incision is made through the deep fascia, care should be taken to avoid injury to the superficial branch of the peroneal nerve. The dissection continues posteriorly to the posterolateral intermuscular septum, exposing the peroneal muscles (Fig. 28.3d). The anterior surface of the septum is then followed down the fibula, and the peroneal muscles are elevated from the lateral and anterior surfaces of the bone. The anterolateral intermuscular septum is divided close to the fibula to preserve the integrity of the anterior tibial neurovascular bundle. The interosseous membrane is then divided as well.

The posterior skin incision is then made through the deep muscle fascia, and the skin paddle is elevated to the edge of the soleus muscle. A 1-cm cuff of soleus muscle is taken from the lateral edge. The fibular cuts are made with an oscillating saw. The proximal cut in the fibula is made first and positioned as superiorly as possible without endangering the peroneal nerve. To ensure stability of the knee, the proximal 10 cm of fibula are preserved. However, the majority of the proximal fibula is resected, even if it is not used, to facilitate dissection of the pedicle. Once both cuts are made, the fibula is retracted laterally. The peroneal vessels are located and followed distally where they are ligated and divided. The flap dissection continues in a medial to lateral direction to avoid injury to the perforating vessels of the skin.

After elevation of the flap is complete, the tourniquet is released, the flap perfused, and hemostasis controlled at the donor site (Fig. 28.3e).

The previously shaped reconstruction plate is then brought to the leg. Measurements from the mandibular defect are used to determine bone length and location of the osteotomy. To minimize ischemic time, the fibular osteotomies are made in situ while the graft is still being perfused. With the reconstructive plate used as a template, a single closing wedge osteotomy is made to create a neoangle. The bone fragments are then stabilized to the plate with monocortical screw fixation to avoid injury to the underlying vascular pedicle.

Insetting the Flap

The recipient vessels are prepared prior to division of the pedicle and flap transfer. Once the status of the neck vessels is assured, the peroneal vessels are divided, and the flap is transferred to the oral defect. Since fixation of the graft often makes subsequent intraoral repair very difficult, the skin paddle is inset first (Fig. 28.3f). The fibula is tailored to fit the defect, placed in anatomic position, and secured to the native mandible by screws placed in the previously drilled holes.

The graft is then revascularized using microvascular techniques. After checking for a watertight intraoral closure, the neck flaps are replaced, and the skin is closed over drains. The leg incision is closed primarily or with a skin graft as needed. Suction drains are placed in the leg and a posterior splint applied.

Postoperative Care

In the immediate postoperative period, the patient is monitored in an intensive care environment by personnel experienced in the evaluation of free tissue transfers. At a minimum, the flap is checked at hourly intervals. Clinical evaluation is the mainstay of the assessment of flap viability. Mechanical

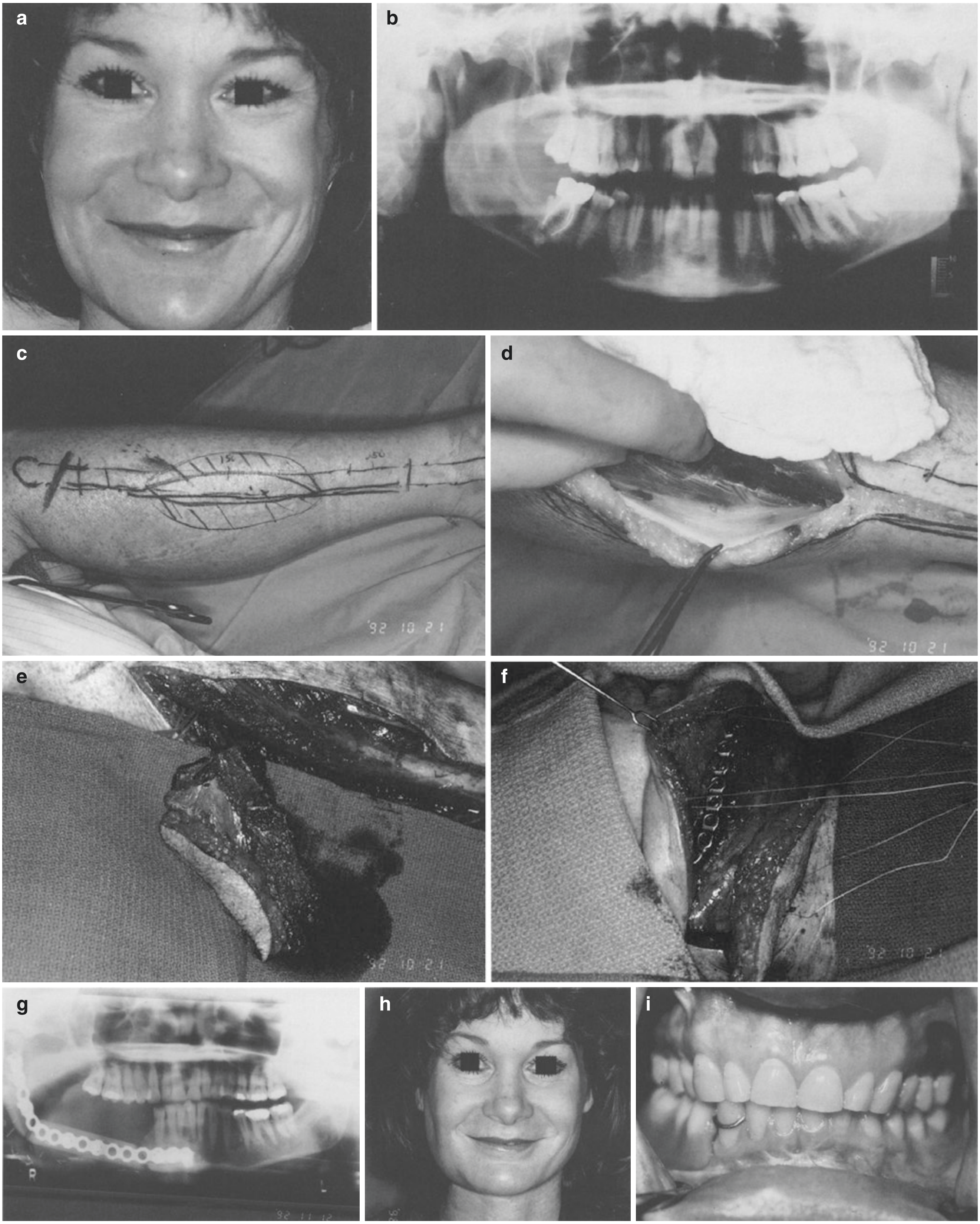

Fig. 28.3 A 41-year-old female patient with adenoid cystic carcinoma involving the mandibular angle. (**a**) Frontal preoperative view of patient. (**b**) Panorex of mandible. Note cystic lesion of angle on the right. (**c**) Drawing of surgical plan on donor leg. Note proximal location of skin paddle. (**d**) Elevation of anterior aspect of skin paddle to the posterolateral intermuscular septum. Note the location of the perforator vessel providing blood supply to the skin paddle. (**e**) Completion of flap elevation. (**f**) Inset of flap onto reconstruction plate. (**g**) Panorex of completed surgery. (**h**) Frontal view of final result. (**i**) Occlusal view of final result

monitoring devices such as Doppler auscultation and laser flow devices may only assist in this endeavor [19]. Any question of flap perfusion must prompt immediate surgical exploration. One may salvage a flap within 2–3 h of occlusion. After 4 h of secondary ischemia, microcirculatory changes occur in a flap that most often preclude salvage [20].

If the flap remains healthy and the patient is stable for 48–72 h, he or she may be transferred to a regular nursing floor. Flap color and perfusion are monitored every 2–3 h until postoperative day 5 or 6.

A feeding tube is placed in all patients requiring any oral or oropharyngeal reconstruction. The patient is not fed by mouth for 1–2 weeks to allow adequate healing of the intraoral suture line, thus avoiding fistula formation. Speech and swallowing services evaluate glottic competence and deglutition prior to the introduction of an oral diet.

The patient's activity increases as tolerated after surgery. The patient may begin light "touch-down" weight bearing on day 5 with the aid of a walker and gradually proceed to unassisted ambulation. Patients should wear a supportive bandage wrap on the donor site for 2 weeks after surgery.

Complications

The most feared complication of a free tissue transfer is loss of a flap. Thrombosis occurs in a small percentage of patients, primarily during the first 24 h after surgery. Factors such as blood coagulation abnormalities, atherosclerotic vessels, hypotension, and other factors may predispose to thrombosis [21]. However, anastomotic patency rests largely upon the surgical plan and its execution. A well-designed case with meticulous technique, a tension-free anastomosis using large caliber vessels, and minimal ischemia time is the best way to avert this consequence.

Donor-site morbidity from a free fibula is minimal. Complete loss of a skin paddle of a fibular graft is now rare, provided the perforating vessels are preserved by incorporating a small cuff of muscle to protect them. None of our patients have experienced any restriction in their gait or mobility. Partial loss of an iliac crest skin paddle may occur if the bulky flap is compressed too much when it is inset, thereby decreasing flow to the skin. The iliac crest donor site may cause pain, a contour deformity, or abdominal wall herniation [22]. The lateral femoral cutaneous and ilioinguinal nerves must be protected during harvest to avoid anesthesia and pain in the thigh.

Partial loss of a skin graft, hematoma, seroma, and suture line infection have an incidence of approximately 6% [1, 2, 15]. Plate exposure may result whenever there is compromise of the soft tissue cover. This most often occurs in radiated tissues, and as mentioned previously, it is largely a consequence of anterior reconstructions in which vascularized bone is not employed.

Summary

The principles pertinent to mandibular reconstruction in general apply to reconstruction of the defects of the mandibular angle. The critical facet of reconstruction of the posterior mandible is the maintenance of vertical height by accurately restoring the position and orientation of the ramus and angle. The three-dimensional reconstruction plate facilitates reconstruction by acting as a template of the resected mandible, an aid to maintaining proper occlusal relationships, and a fixation device for the vascularized bone. The fibula is our flap of choice due to the ease of dissection, excellent bone quality and length, and the reliable skin paddle it provides for soft tissue replacement.

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