Reconstruction of the Mandible by Fibula Free Flap

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The mandible is a major component of the human facial appearance, providing the profile and framing the lower one-third of the face. It serves as a platform for dentition, a crucible origin for the tongue muscles, and a mobile frame for insertion of mastication muscles. The mandible is an integral factor in mastication, deglutition, oral competence, phonation, and facial esthetics.

When the mandible is resected – following surgery for tumor, osteoradionecrosis, osteomyelitis or trauma – the surgeon must choose a reconstructive technique that will allow the maintenance of good oral function, provide an acceptable cosmetic contour, and permit the patient to return to a reasonable quality of life. The concept of maintaining quality of life has become particularly important in the overall care and treatment of cancer patients. Thus, even patients with a very limited life expectancy are routinely reconstructed if it is expected that their quality of remaining life would be significantly enhanced. The high success rate of head and neck microsurgical reconstructive procedures has allowed for significant improvement in both functional and esthetic results and has completely changed the approach to mandibular reconstruction.

Today, mandibular construction is most commonly accomplished by using free vascularized bone transfer. Only patients who are medically unfit to tolerate a long operation or have a grave prognosis are excluded as candidates for resection and immediate vascularized bone reconstruction. The advantages of free vascularized osteocutaneous flaps have been well documented in the surgical literature [1–4]. Healing by callus replaces the creeping substitution of conventional bone grafts [5], while the vascularity of the attached soft tissue promotes primary healing and reduces the risk of fistula formation. In a hostile bed due to prior irradiation, scarring or chronic infection, these flaps have the vascular independence to survive and even augment the vascularity of the bed into which they are transferred. Due to their autonomy, large segments of bone can be transferred with similar success to that of smaller segments [6]. Furthermore, free osteocutaneous transfer is achieved in a single stage, permitting the patient to resume regular social activities in the shortest possible time. The immediate restoration of appearance and function and the absence of long-term sequelae are particularly important in the older patient whose life span is limited because of age, general health, or the disease itself. In younger patients, the reliability and durability of vascularized bone grafts and their ability to accept osseo-integrated implants for full dental rehabilitation make them a desirable choice, even within a hostile bed [7].

A variety of free flaps has been used for mandible reconstruction. Current choices include rib, metatarsal bone, scapula, radius, ilium and fibula [1–13]. The rib and metatarsus, among the first to be used for mandible reconstruction, were abandoned. The iliac bone, radius, scapula and fibula remain popular. Although most publications have attempted to define the advantages and disadvantages of these donor sites, there are very few studies that objectively compared one with the other [14–16]. The choice of flap depends on factors such as the bone and soft tissue requirements and the site of the defect. Donor site availability, morbidity, ease of flap dissection and the status of the recipient vessels in the neck, as well as the patient's overall medical condition may also influence the final decision.

With the advent of microvascular surgery, mandibular reconstruction has reached such a high level of sophistication that there is a debate not only about which type of living bone transplant gives the best functional and esthetic result, but also about which bone flap provides the most appropriate bed for prosthetic osseo-integrated implants.

Every donor site has its limitations. Use of the scapula often results in shoulder stiffness and decreased range of motion. Furthermore, there are positioning problems that can preclude a two-team simultaneous approach and add significantly to the operating time. Use of the radius is associated with a risk of fracture. Furthermore, bone length and width is limited [12,16]. The ilium is commonly associated with delayed ambulation because of pain. Moreover, in a composite oromandibular defect, the iliac crest is limited due to the inherent bulkiness of the soft tissue component [15,16].

In general, the iliac crest patients are difficult to mobilize after surgery, which causes a significantly greater number of systemic complications, including peri-operative deaths [16]. The fibula, on the other hand, is associated with the least donor site morbidity compared with other sites used for mandibular reconstruction, and there is less pain than in the iliac crest patients. The vascularized fibula has more recently become a universally preferred donor tissue [17]. Proven advantages include a long bone segment, adequate strong bicortical bone to support osseo-integrated implants, a segmental blood supply that allows complete freedom in osteotomy site selection and number, a large skin island of intermediate thickness that can be designed, and muscle, which can be included for replacing soft tissue bulk. Further advantages include large vessels of sufficient length to preclude the need for vein grafts and an ideal location that facilitates a two-team

approach during ablation and reconstruction [17–22]. In adults, a straight 20–26 cm fibular segment can be harvested, providing great versatility for reconstruction of extensive mandibular defects. The fibula tolerates osteotomies at 2 cm intervals to enable accurate reconstruction [17]. The skin island quality of the fibula donor site is intermediate in thickness, and therefore ranks behind that of the radial forearm free flap. In addition, the skin paddle has been considered unreliable [17]. The fibula is an excellent first choice for virtually all anterior mandibular reconstructions. This portion of the mandible can be accurately reproduced with good contour and inter-arch alignment using this donor tissue. In addition, the configuration of the skin paddle available with the fibula enables it to effectively resolve the specific soft tissue problems posed by anterior defects. However, the speech results, as well as intrinsic opening, are poor in cases with a large anterior mucosal lining defect, which requires a large skin paddle. The fibula is also ideally suited to the reconstruction of most lateral defects. The functional outcome in a patient with lateral bone-only defects or those requiring small and large lateral mucosal lining most often is excellent or good. However, patients with extensive oropharyngeal defects that require a large skin paddle have poor oral deglutination and oral continence results.

Cosmetic results, as measured by the rated appearance of the patient by the patient and physician, are excellent or acceptable in the majority of cases. Patients with bone-only defects or those requiring lateral mucosal lining most often have the best results.

In the present era, in which we are obligated to provide a better quality of life to complex and even terminal patients, we are blessed with sophisticated reconstructive options to reach that goal. A frontier field of plastic surgery today is reconstructive microsurgery, which offers us the ability to transfer different kinds of tissues from one body location where it is needed less, to another where it is needed more. One of the challenging aspects of that innovative field is reconstruction of the mandible. It is well accepted today that the fibula is an ideal donor site for mandibular reconstruction because of its length, high density of cortical bone, blood supply anatomy, adjacent soft tissue availability, and convenient location. Furthermore, the skin paddle is reliable and donor site morbidity is low. Rigid fixation with mandibular reconstruction plates allows the rapid resumption of oral function and ensures proper occlusion while serving as a template. On the other hand, the incidence of complications such as plate exposure is low. The functional and esthetic results of mandible reconstruction with the fibula are mostly excellent or acceptable.

In this issue of *IMAJ*, Dr. Ad-El and his group from Hadassah Hospital [23] report their experience with 11 patients undergoing reconstruction of the mandible with a free fibula flap. These researchers elegantly demonstrate the increasing use of advanced microsurgery techniques in Israel. This report is important for making Israeli medical professionals aware that microsurgery is being practiced in this country in different medical centers, for head and neck surgery as well as for other complex problems, for example in the field of trauma, orthopedic and breast oncology, neurosurgery and more.

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