Middle third defects of the face following total or partial oncologic maxillectomy involve very important facial structures, both for esthetic and for functional reasons. Among the outcomes, large oroantral or oromaxillary fistulas due to destruction of big bone segments and soft tissues have long been the consequences of such extensive surgical ablations. In the last few years, immediate reconstruction of maxillary bones and soft tissues has proved to be a reliable morphofunctional reconstruction technique following surgery for large oncological defects or the late effects of radiation therapy. Among other free flaps such as composite fibula, composite scapula, or composite radial, the use of vascularized iliac crest with the internal oblique flap has become our flap choice for morphofunctional maxillary reconstruction for bone segments within 6–15 cm of length, and when there is no need for overlying facial skin or oral sphincter reconstruction. The advantages of this composite bone flap are its available large and resizable bone stock; the quality of the bone for transfer (optimal height, depth, and contour to maintain a good facial profile); and the possibility to properly reconstruct the oral lining, orbital content; and maxillary soft tissues with a portion of the internal oblique muscle flap raised with the same pedicle. In addition, this flap’s soft tissue will epithelialize during the healing stages. © 2007 Wiley-Liss, Inc. Microsurgery 27:000–000, 2007.

The middle third defects of the face following total or partial oncologic maxillectomy include very important facial structures, both for esthetic and for functional reasons. Among the outcomes, large oroantral or oromaxillary fistulas due to destruction of bone segments and soft tissues have long been the consequences of such extensive surgical ablations. In the last few years, immediate reconstruction of maxillary bones and soft tissues has been performed following large oncological defects or late effects of radiation therapy (RT), and has proved to be a reliable morphofunctional reconstruction technique.

When the treatment plan arranged by the clinical team and the patient is to proceed with immediate maxillary reconstruction, there are many opportunities available using free tissue transfer techniques. All these techniques have to provide not only for bone reconstruction but also for the adequate rebuilding of the internal oral cavity. If the length of bone to be reconstructed is between 6 and 15 cm and the treatment plan requires internal soft tissue reconstruction even up to the orbital content (but with no need for overlying facial skin or oral sphincter reconstruction), the use of vascularized iliac crest with internal oblique muscle flap has to be considered the flap of choice among other possible free flaps.

The vascularized iliac crest with internal oblique muscle flap DICA was popularized by Urken et al., when they reported few failures and low donor site morbidity in their 1998 series.1,2 The use of the internal oblique muscle had been considered inferior in outcome when compared with the composite fibula flap described by Hidalgo and Pusic,3 a flap which is still in use because of its pedicle length, considered longer than other composite flaps.

The vascularized iliac crest with internal oblique muscle flap is a unique flap. It offers advantages in terms of quality and quantity of bone for contouring of the orbital floor, and of soft tissue for reconstruction of the mouth or the orbital content. When used to line the oral cavity, the internal oblique muscle becomes epithelialized and therefore provides an excellent mucosal environment. This muscle also fills the orbital content with a good muscular bulk, reducing the risk of fistulas to the nasal or oral cavity. The quality of bone is a satisfactory internal lining, providing good support for the eye or for an implant-retention prosthesis.

The aim of this study is to report our experience with the vascularized iliac crest with internal oblique muscle flap for upper maxillary reconstruction.

**PATIENTS AND METHODS**

The clinical notes of 50 consecutive patients admitted from June 2001 to October 2006 for malignant neoplasm of the upper maxillary region were analyzed. The diagnosis, “Tumor Node Metastasis (TNM) Classification,” and type of defect were recorded for each patient. Of these patients, 24 were not included in the study because they had a maxillectomy that was not reconstructed, or had a reconstruction using a pedicled flap (i.e., temporalis flap) or another free flap (i.e., latissimus dorsi or rectus abdominis). The remaining 26 patients were then included in our study on upper maxillary reconstruction.
Among all the classification attempts for maxillary reconstruction that consider the entity of the remnant defect (such as the one proposed by Cordeiro in Fig. 1), our choice was made by assessing the type of defect and function using the classification proposed by Brown from the Liverpool Group (Fig. 2).

The flap harvesting surgical technique used was basically that described by Urken et al. in 1998, using the superolateral approach, and the modification of this technique described by Vaughan et al., with the inferomedial approach depending on the quantity of internal oblique muscle needed.

Among treated cases, the flaps were raised ipsilaterally to the defect site in 45% of the procedures, and contralaterally in 55%, as in upper maxillary reconstruction there is no significance based on the harvesting side. In all of the cases there had been no necessity of including the anterior superior iliac spine (ASIS) in the flap. We performed bone osteotomies to reshape the bone harvested only when necessary.

The amount of internal oblique muscle harvested varied among the patients treated and the extension of the maxillectomy defect was between 45 and 120 sq cm, being of minor extent in class 2A maxillectomies and larger in 4C maxillectomies. The muscle was always well vascularized on the ascending branch of the DICA/V.

In the oral cavity, the muscle becomes fibromucotized and offered a good layer for implant placement. No trismus was observed in any of our patients. In class 2–3B maxillectomies, the bone portion of the flap had been positioned horizontally (Figs. 3–6) or vertically (Figs. 7–9), with prevalence in the latter display. In class 3 maxillectomies, an important point is that the orbit must be well supported. A vertical set-up of the flap can accomplish this role. In this position, the iliac crest bone can be remodeled to better reconstruct the floor of the orbit (Figs. 10 and 11). In class 4 defects, if there were eyelid or skin involvement, multiple flaps were raised, namely composite DCIA and radial forearm flap (RFFF) (Fig. 12–15) or DICA and latissimus dorsi FF, depending on the area of skin needed or on the need of a bulky flap.

Particular care was used for the donor site closure: a nonresorbable mesh in 2 layers was used in all patients. No abdominal wall weakness developed in any patient (Figs. 16 and 17).

Neck dissections were carried out in 6 of the 26 patients, while 6 patients had secondary reconstruction with this particular flap. A detailed assessment of the surgical complications was carried out.

RESULTS

Twenty-six consecutive patients had a maxillectomy reconstructed with a vascularized iliac crest with internal oblique flap. There were 14 males and 12 females, with a mean age of 56 years (range 23–72). According to the classification proposed by JS Brown 8% of our patients were class 1 maxillectomies, 30% class 2, 40% class 3 and 22% class 4, mainly b and c. Five patients were operated on for secondary recurrence. All others were treated for disease that required large ablation and
for which an immediate morphofunctional reconstruction had been chosen.

The pedicle was consistently brought to the neck, either by means of a subcutaneous tunnel in the cheek from the maxillary region to the mandible border to use the facial vessels in that area; or medially to the mandible ramus to the neck. One flap was lost 2 months after RT because of major infection that led to the flap pedicle closure. This particular patient had had high dose radiotherapy postoperatively; however, there was no evidence that this failure was caused directly by RT. No vein graft had been necessary in any of our series.

DISCUSSION

The use of vascularized iliac crest with internal oblique flap has become a flap of choice for upper maxill-
lary reconstruction in defects class 2–4, when the bony defect is between 6 and 16 cm and the treatment plan requires internal soft tissue reconstruction without need for overlying facial skin or oral sphincter reconstruction.
The most important finding from our series is the functional facial rehabilitation that all the patients have achieved. All of the patients had a satisfactory result, both intraorally and esthetically. Some of them have started on an implant-retained prosthesis protocol, though some of them had satisfactory results without a prosthesis. Some patients had a successful oral and facial rehabilitation.

This particular composite flap provides a better base for oral and dental rehabilitation and for esthetic and functional purposes than the one offered by other kinds of reconstruction. Fibular flaps provide adequate length of bone, even for segments longer than 15 cm. However, fibula flaps fail to provide adequate height of bone to support the soft tissues of the cheek without using supplementary techniques such as double-barrelled fibula flap or distraction osteogenesis, which adds more risk and complexity to the reconstructive procedure. Moreover, in the majority of maxillectomies, there is no need for a skin island that can fail to fit well in the oral mucosa and does not offer the same quality of lining and interface for an implant-retained prosthetic rehabilitation.

This is also the problem with the composite scapular flap, which has the advantage of a better bone quality than the composite fibula flap and offers the possibilities to raise multiple flaps on a single pedicle. For this reason, the composite fibula flap has been considered by many authors to be the flap of choice, especially for craniofacial resections. The composite RFFF is not adequate for the quality and quantity of bone it can supply and, in
our opinion, must be considered as a second choice flap for maxillary reconstruction or as a second flap in case of defects that include skin. The vascularized iliac crest with internal oblique muscle flap provides the best bone source for functional maxillary reconstruction in terms of quality, quantity, and esthetic contouring of the face. This flap has the added advantage of providing a unique oral mucosal lining ideal for the implant soft tissue interface. The real question is whether to reconstruct the maxillary area primarily or to wait in order to better evaluate the resected area for secondary tumors. There is no established evidence in the literature showing that patients who have delayed reconstructions have better survival rates than those who have primary reconstructions. All of these patients need close follow-up, consisting of clinical examination, CT, MRI, or TC-PET scans. These techniques are successful in detecting recurrences or secondary neoplasms in the reconstructed area.

The aim of this particular reconstruction technique is for a morphofunctional primary reconstruction, even in cases of large resection, including the temporal area. Primary use of vascularized iliac crest with internal oblique muscle flap obtained a good esthetic contour that made it possible to fully rehabilitate the patients and improves their quality of life than that accomplished by using only an obturator or soft tissue flap.

REFERENCES