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# Transformation of a vascularised iliac crest or scapula bone to a pedicled osteomuscular transplant for reconstruction of distant defects in the head and neck region: A new method of transforming two island flaps to one longer island flap

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ABSTRACT

*Objective:* Bone defects in the maxillofacial region after ablative surgery require reconstructive surgery, usually using microvascular free flaps. This paper presents a new method of reconstructing extensive defects in patients not suitable for microvascular surgery using prefabrication of a vascularised osteomuscular flap from the scapula or iliac crest bone.

*Methods:* Three patients who were treated with this new technique are presented. Two patients (one mandibular defect and one defect in the maxillary region) received prefabricated osteomuscular flaps from the iliac crest bone using the latissimus dorsi muscle as a pedicle. One patient also presenting a mandibular defect after tumour surgery received a scapula transplant for reconstruction of the defect using the pectoralis major muscle as pedicle.

*Results:* In all three cases vital bone could be transplanted. The pedicle was strainless in all three cases. Minor bone loss could be seen initially only in one case. The results are stable now and one patient received dental implants for later prosthetic treatment.

*Conclusion:* The presented two-step surgery provides an excellent method for reconstruction of bony defects in the maxillofacial region in patients where microvascular surgery is not possible due to reduced state of health or lack of recipient vessels.



## 1. Introduction

Nowadays, the treatment of malignant tumours of the head and neck region mostly consists of a combination of surgery and radiochemotherapy. In advanced tumours the sequelae of this treatment can be large bony defects in the maxillofacial region either due to ablative surgery directly or after severe cases of osteoradionecrosis. Moreover, malformations or severe atrophy of the mandible or maxilla as well as defects after trauma also present common indications for microvascular reconstructive surgery. This technique has enabled the immediate primary or secondary reconstruction of large defects of the head and neck region in nearly all cases in the last decades.

For a long time pedicled bone flaps were used before microvascular bone and soft tissue free flaps became a more versatile alternative. Mainly the trapezius pedicled scapula was used (Demergasso and Piazza, 1979; Guillamondegui and Larson, 1981). The clavicule, pedicled on the sternocleidomastoid muscle (Reid and Taylor, 1984) or the rib pedicled at the pectoralis major muscle are of historical interest as well as the temporal bone pedicled at the temporal muscle (Antonyshyn et al., 1986).

A major breakthrough was the classification of skin flaps by McGregor and Morgan (1973) who divided skin flaps in “random pattern flaps” and “axial pattern flaps”. The crucial criterion was the anatomy of vascularisation for their classification. Daniel and Williams (1973) proposed another classification: cutaneous flaps, arterial flaps and island flaps. The anatomy of “island flaps” became the basis for microvascular free flaps. Harii et al. (1974) succeeded in revascularising free flaps by performing microvascular anastomosis. This new technique reduced multistage operations to a single-step procedure. During the last two decades the free vascularised iliac crest bone (Sanders and Mayou, 1979; Taylor et al., 1975; Taylor et al., 1979), the free fibula flap (Taylor et al., 1975; Gilbert, 1979) and the scapula bone (Swartz et al., 1986) have been established for the reconstruction of the maxillofacial region.

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However, microvascular surgery can be time consuming and strenuous especially for patients not suitable for longer interventions from an anaesthetic point of view. Moreover, after lymph node dissection + radiation the risk for reconstructive procedures and loss of free flaps increases significantly (Bianchi et al., 2010a,b). Before the introduction of microvascular surgery a standard procedure in head and neck reconstruction was covering the defect using pedicled flaps such as the pectoralis major myocutaneous pedicled flap (PMMF). The PMMF has proved to be reliable in a variety of reconstructive procedures. However, in cases of previous radiotherapy the rate of postoperative complications is up to 79% (v. Biberstein and Spiro, 1994). In cases of "salvage procedures" (reconstruction after fistula, flap failure, osteoradionecrosis and internal jugular vein rupture) up to 35% are affected by problems such as dehiscence, partial or total flap failure (Liu et al., 2001). Ethier et al. (2009) also report a failure of 50% of PMMF in cases of reconstructive salvage. The major disadvantage however is that the absence of bone, especially in the mandibular region, allows only limited oral rehabilitation. Osseointegrated dental implants have dramatically improved the therapeutic possibilities, especially so for maladaptive patients and two- or even a one-implant overdenture is increasingly regarded as a minimum standard of care nowadays (Carlsson and Omar, 2010). Nonetheless, these patients should be reconstructed even if they are not suitable for a second microvascular flap.

To meet the necessary prerequisites it is mandatory to keep operation time as low as possible, especially in older patients. Until now this problem has mainly been unsolved, especially in cases of bony reconstruction.

The purpose of this study is to present a new two-step surgical procedure which enables a non-microsurgical, but vascularised bone or skin, muscle transplantation in an as short a way as possible.

## 2. Material and methods

The technique described combines two island flaps in one step by superimposing the two flaps (Fig. 1). The two overlapping island flaps become connected by new vascularisation while the anatomical blood supply is still intact during that period. This process is based on angiogenesis, which is the extension of existing vessels into new areas (Akhavani et al., 2008). After having attained a good capillary connection between the two flaps, one pedicle can be cut without loss of that flap. The whole circulation now runs over one island flap to the second over its original blood vessels via the capillary connection between the two island flaps. This produces a lengthening of the new unit and the still intact island flap now serves as the lengthened pedicle of the newly integrated tissue (bone, etc.) designated for transplantation into the maxillofacial region.

Two different techniques are possible: The pectoralis major muscle is used to overlap the vascularised scapula flap. Three months later the pedicle of the scapula flap is cut and the scapula is integrated, now vascularised by the pectoralis major muscle. This newly pedicled flap can then be rotated into the defect. The second possibility is the combination of a latissimus dorsi musculous flap with the vascularised iliac crest bone. Of course skin can also be included in both flaps.

## 3. Patient histories

Three patients have now been operated on with this new technique. In two patients the primary reconstruction with a free microvascular flap had failed. The third patient was not suitable for long general anaesthesia. In all three cases a radical ipsilateral neck dissection had been performed, followed by surgical tumour ablation and curative radiotherapy.

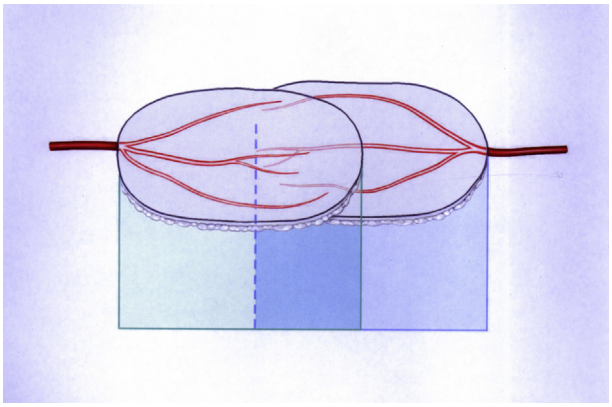

**Fig. 1.** Principle of superimposing two flaps as premise for the presented technique.

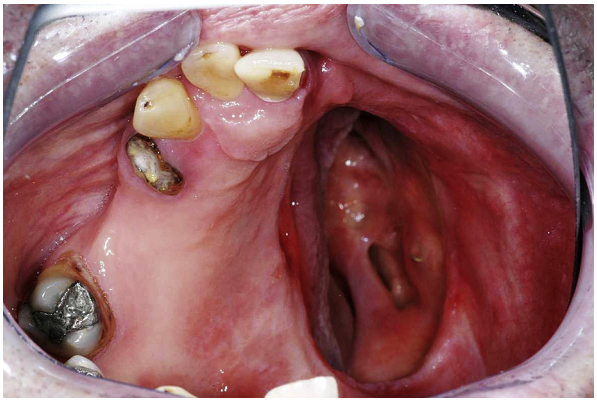

**Fig. 2.** Defect of the upper jaw after tumour ablation and loss of a free flap.

### 3.1. Case 1: maxillary defect

A 63-year-old male patient with a SCC carcinoma of the maxilla (T4N0M0) had been operated on in 2003. Initially a scapula free bone flap had been used to cover the defect following hemimaxillectomy and radical ipsilateral neck dissection. The microvascular free scapula flap had been lost, presumably due to thrombosis of the recipient vein. After analysing the case the use of another free flap was rejected due to several other general reasons. However, to reconstruct the hemimaxillectomy defect (Fig. 2) and to improve masticatory function a vascularised bone and muscle flap was needed. In a preliminary step a vascularised iliac crest bone, pedicled at the dorsal branches of the DCIA, was connected with the most distal part of the latissimus dorsi muscle in November 2005 (Figs. 3 and 4). The muscle was wrapped around the osteotomized iliac crest bone and kept in place with sutures (Figs. 5 and 6,). After an extended interval of 9 months caused by psychological problems of the patient the prefabricated transplant was harvested at the 10th of August 2006 (Fig. 7). The latissimus dorsi muscle was dissected until up to the subscapular artery and vein. After cutting the nutrient vessels of the iliac crest (DCIA) the prefabricated bone showed profuse bleeding guaranteed by the circulation over the latissimus dorsi muscle. The maxillary region was easily reached through a subcutaneous tunnel (Fig. 8) and the bone was fixed to the maxilla with miniplates. The donor site was