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Reconstruction of the maxilla following hemimaxillectomy defects with scapular tip grafts and dental implants

Christian Mertens*, Christian Freudlsperger, Jens Bodem, Michael Engel, Jürgen Hoffmann, Kolja Freier

Department of Oral- and Cranio-Maxillofacial Surgery, Heidelberg University Hospital, Heidelberg, Germany

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ABSTRACT

Background: Treatment of post-resective defects of the maxilla can be challenging and usually requires dental obturation or microvascular reconstruction. As compared to soft-tissue microvascular grafts, bone reconstruction can additionally allow for facial support and retention of dental implants. The aim of this study was to evaluate scapular tip grafts with respect to their applicability for maxillary reconstruction and their potential to retain dental implants for later dental rehabilitation.

Materials and methods: In this retrospective study, 14 patients with hemimaxillectomy defects were reconstructed with free scapular tip grafts, oriented horizontally, to rebuild the palate and alveolar ridge. After bone healing, three-dimensional virtual implant planning was performed, and a radiographic guide was fabricated to enable implant placement in the optimal anatomic and prosthetic position. All patients' mastication and speech were evaluated, along with the extent of defect closure, suitability of the graft sites for implant placement, and soft-tissue stability. Pre- and postsurgical radiographs were also evaluated.

Results: A good postoperative outcome was achieved in all patients, with complete closure of maxillary defects that were class II, according to the system of Brown and Shaw. Additional bone augmentation was necessary in two patients in order to increase vertical bone height. Patients were subsequently treated with 50 dental implants to retain dental prostheses. In all cases, additional soft-tissue surgery was necessary to achieve a long-term stable periimplant situation. No implants were lost during the mean observation period of 34 months.

Conclusions: Due to its specific form, the scapular tip graft is well suited to reconstruct the palate and maxillary alveolar ridge and to enable subsequent implant-retained rehabilitation. Due to the limited bone volume, an accurate three-dimensional graft orientation is essential. Furthermore, most cases require additional soft-tissue surgery to achieve a long-term stable periimplant situation.

1. Introduction

Post-resective bone defects of the maxilla, especially after surgical resection of malignant tumors, are typically associated with severe functional impairment and problems with deglutition, mastication, and missing midfacial support. Depending upon the defect size and location, different therapeutic options are feasible. Smaller defects typically can be treated by means of dental obturation, while larger defects require surgical reconstruction. For larger defects, the use of microvascular grafts is obligatory, especially in patients with adjuvant or neoadjuvant radiotherapy.

Defects of the maxilla and midface can be classified by different systems (Aramany, 2001; Brown and Shaw, 2010; Cordeiro and Santamaria, 2000; Okay et al., 2001). Recent literature often uses the classification system of Brown and Shaw. According to them, class I defects are mainly treated with either dental obturators or fasciocutaneous radial forearm flaps.

Class II defects can be treated similarly with dental obturators or with microvascular reconstructions. For defect sites not requiring

* Corresponding author. Department of Oral- and Cranio-Maxillofacial Surgery, Heidelberg University Hospital, Im Neuenheimer Feld 400, 69120 Heidelberg, Germany. Fax: +49 6221 56 4222.
E-mail address: christian.mertens@med.uni-heidelberg.de (C. Mertens).

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bone reconstruction, the fasciocutaneous radial forearm flap or the anterolateral thigh are described as successful options. However, these flaps do not provide sufficient support for dental reconstructions. Osteocutaneous free flaps provide good results, with the fibula, iliac crest flap with the deep circumflex iliac artery and internal oblique muscle (DCIA), and scapular grafts described in this context.

Class III defects, which additionally lack orbital support, require reconstruction of the orbital rim, generally by the integration of titanium mesh. Various microvascular donor sites have been described in the literature, such as the fibula, iliac crest, or scapular grafts with skin islands. No single graft type can exclusively provide for reconstruction of this defect type.

For restoration of class II and III maxillectomy defects, the scapular graft is a microvascular flap with relatively low morbidity (Clark et al., 2008; Coleman et al., 2000). Microvascular scapular grafts can be divided into two groups: lateral scapular grafts that incorporate the circumflex scapular artery, and scapular tip grafts that include the longer angular arch vessels of the thoracodorsal artery. Due to its bone morphology, the scapular tip osseomyogenous free flap has the advantage of providing midfacial support. It also can be used to reconstruct the palate and the alveolar ridge. In a recent study, computed tomography (CT) scans of the head, neck, and chests of 10 patients were analyzed, focusing on the morphology of the scapular tip and its ability to reconstruct simulated resection patterns such as total palate resection, subtotal palate resection, and hemipalate resection. The study found a close similarity between the shapes of the palate and the scapular tip (Burke et al., 2006). The use of scapular tip grafts also has been well documented in various clinical studies (Chepeha et al., 2010; Clark et al., 2008; Kakibuchi et al., 2002). However, little data has been reported regarding subsequent systematic implant treatment (Hibi and Ueda, 2012; Vinzenz et al., 2008). Some have argued that due to its limited bone quantity and quality, this type of graft does not provide sufficient bone to support implant placement.

The aim of the present study was thus to evaluate the effectiveness of scapular tip flaps for the reconstruction of maxillary and midfacial defects, and to assess their efficacy at retaining dental implants to support subsequent prosthetic reconstructions.

2. Materials and methods

2.1. Patients

The study protocol was reviewed and approved by the ethics committee for clinical studies of the Medical Faculty of the University of Heidelberg. All patients in this retrospective cohort study were treated in the Department of Oral and Maxillofacial Surgery of the University Hospital, Heidelberg, Germany. Records of all those who received reanastomized microvascular scapular transplants between January 2011 and January 2015 were checked for eligibility. Of the 42 patients treated, 22 had received scapular transplants in the mandible and so were excluded. Four transplants failed to heal and had to be explanted. Two patients who received maxillary scapular transplants did not subsequently receive dental implants, and for that reason were excluded from evaluation as well. Thus 14 patients with post-resective defects of the maxilla who underwent reconstruction with free microvascular reanastomized scapular tip grafts and who received subsequent implants were able to be included in the present study (Table 1).

Six patients were male and eight were female; the mean age was 54.86 years (standard deviation [SD] 16.81 years, range 27–81 years). Each resection of the primary tumor was performed within free surgical margins. Nine patients received additional radiotherapy prior to reconstruction. Eleven patients underwent delayed reconstructions after expressing dissatisfaction with their dental obturators for reasons including compromised speech and/or swallowing, poor denture retention, leakage, and/or oronasal regurgitation. Three patients underwent reconstruction primarily. Depending upon the size of the defect, patients were treated according to the scheme of Brown and Shaw. All patients' general medical conditions were adequate to allow microvascular surgery.

2.2. Surgical reconstructive procedure

After intraoral preparation of the recipient site, free surgical margins were ensured before beginning the reconstructive surgery. No extraoral approach (Weber Fergusson) was necessary. Prior to intraoral adaptation, the harvested bone graft was shaped extraorally on a three-dimensional printed model of the recipient site, and the tip of the scapular graft was oriented anteriorly. Fixation

Table 1
Patient characteristics.

Case	Age (y)	Sex	Etiology	Defect class	Reconstruction	In-patient period	Revisional surgery	Tracheotomy	Radiotherapy	Postoperative complications	Recipient artery	Recipient vein
1	37	F	MEC	II b	sec.	11	No	No	No	No	A. facialis	V. jugularis ext
2	40	M	Angiosarcoma	III b	sec.	11	No	No	Adj. radiochemotherapy	No	A. facialis	V. facialis
3	71	M	ACC	II b	sec.	12	No	Yes	Adjuvant	No	A. lingualis	V. jugularis int
4	73	F	Ameloblastoma	II b	sec.	12	No	No	No	Seroma	A. facialis	V. facialis
5	81	F	BCC	II c	sec.	14	No	No	Adjuvant	No	A. thyreoidea	V. jugularis ext
6	27	F	Fibromyxoma	III b	sec.	11	No	No	No	No	A. facialis	V. jugularis ext
7	70	F	OSCC	II d	sec.	18	No	Yes	Adjuvant	Seroma	A. facialis	V. facialis
8	59	F	OSCC	II d	sec.	12	No	No	Neoadjuvant	No	A. thyreoidea	V. jugularis int
9	43	M	ACC	II b	prim	17	No	No	Adjuvant	Intraoral dehiscence	A. facialis	V. facialis
10	71	F	OSCC	II b	sec.	19	Yes	Yes	Adjuvant	Intraoral dehiscence	A. facialis	V. facialis
11	61	F	ACC	II b	sec.	11	No	No	Adjuvant	No	A. thyreoidea	V. facialis
12	29	M	Ossifying fibroma	II b	prim	8	No	No	No	No	A. facialis	V. facialis
13	51	M	ACC	II b	prim	21	No	No	Adjuvant	Seroma	A. facialis	V. facialis
14	55	M	Adenocarcinoma	II b	sec.	8	No	No	No	No	A. thyreoidea	V. jugularis ext

ACC = adenoid cystic carcinoma; OSCC = oral squamous cell carcinoma; MEC = mucoepidermoid carcinoma; BCC = basal cell carcinoma; Defect class according to classification Brown & Shaw; prim = primary reconstruction; sec. = secondary reconstruction.