Available online at www.sciencedirect.com

SciVerse ScienceDirect

British Journal of Oral and Maxillofacial Surgery 54 (2016) 181–186

BRITISH Journal of Oral and Maxillofacial Surgery

www.bjoms.com

Prospective biomechanical evaluation of donor site morbidity after radial forearm free flap

Björn Riecke [a,*,1], Carsten Kohlmeier [a,1], Alexandre T. Assaf [a], Johannes Wikner [a], Anna Drabik [b], Philip Catalá-Lehnen [c], Max Heiland [a], Carsten Rendenbach [a]

[a] *Department of Oral & Maxillofacial Surgery, University Medical Center Hamburg Eppendorf, Martinistr. 52, 20246 Hamburg, Germany*
[b] *Department of Medical Biometry and Epidemiology, University Medical Center Hamburg Eppendorf, Martinistr. 52, 20246 Hamburg, Germany*
[c] *Institute of Osteology and Biomechanics, University Medical Center Hamburg Eppendorf, Martinistr. 52, 20246 Hamburg, Germany*

Accepted 20 November 2015
Available online 18 December 2015

Abstract

Although the radial forearm free flap (RFF) is a commonly-used microvascular flap for orofacial reconstruction, we are aware of few prospective biomechanical studies of the donor site. We have therefore evaluated the donor site morbidity biomechanically of 30 consecutive RFF for orofacial reconstruction preoperatively and three months postoperatively. This included the Mayo wrist score, the Disabilities of the Arm, Shoulder and Hand (DASH) score, grip strength, followed by tip pinch, key pinch, palmar pinch, and range of movement of the wrist. Primary defects were all closed with local full-thickness skin grafts from the donor site forearm, thereby circumventing the need for a second defect. Postoperative functional results showed that there was a reduction in hand strength measured by (grip strength: -24.1%, in tip pinch: -23.3%, in key pinch: -16.5, and in palmar pinch: -19.3%); and wrist movement measured by extension (active=14.3% / passive= -11.5%) and flexion = -14.8% / -8.9%), and radial (-9.8% / -9.8%) and ulnar (-11.0% / -9.3%) abduction. The Mayo wrist score was reduced by 9.4 points (-12.9%) and the DASH score increased by 16.1 points (+35.5%) compared with the same forearm preoperatively. The local skin graft resulted in a robust wound cover with a good functional result. Our results show that the reduction in hand strength and wrist movement after harvest of a RFF is objectively evaluable, and did not reflect the subjectively noticed extent and restrictions in activities of daily living. Use of a local skin graft avoids a second donor site and the disadvantages of a split-thickness skin graft.

Keywords: Donor site morbidity; Radial forearm free flap; Biomechanics; Harvesting defect; Skin graft

Introduction

Since its introduction in 1981,[1] the radial forearm free flap (RFF) has become the one most commonly-used in reconstructions of the head and neck.[2,3] It is a thin, pliable, and mostly hairless fasciocutaneous flap with high calibre vessels and a long vascular pedicle, it has high success rates, it can be harvested quickly, and it can be raised at the same time as the tumour in the head and neck region is being resected.[4] However, it does have some disadvantages. The donor site is in an exposed region, it has been associated with frequent complications, predominantly as a result of the poor transplant bed for a split-thickness skin graft, and it carries the risks of wound healing problems because tendons are constantly moving.[5–9] Additional complications such as the formation of oedema, weakening of the hand, and reduced range of movement of the wrist, dysaesthesia in the distribution area of the superficial branches of the radial nerve and cold intolerance have been reported,[10] and a split-thickness skin graft also requires a further donor site, which makes it

* Corresponding author at: Department of Oral and Maxillofacial Surgery, University Medical Center Hamburg Eppendorf, Martinistr. 52, 20246 Hamburg, Germany. Tel.: +49-40-7410-53259; fax: +49-40-7410-55467.
E-mail address: briecke@uke.uni-hamburg.de (B. Riecke).
[1] Both authors contributed equally to the work.

http://dx.doi.org/10.1016/j.bjoms.2015.11.021

prone to prolonged wound healing. To circumvent this different methods of primary closure have been suggested: the V-Y transposition of an ulnar forearm fasciocutaneous flap,[11] a transposition flap,[5] the prefabrication of the forearm fascia,[12] and the use of tissue expanders.[13]

Autogenous full-thickness skin grafts have been reported to achieve similar or better aesthetic results for indirect closure of the defect.[14,15] They can be harvested locally[16] or from remote regions such as inner upper arm,[17] abdominal wall,[18] or groin.[19] In microvascular reconstruction in the head and neck a long pedicle together with a thin flap are often needed, which commonly leads to removal of a RFF at the distal forearm. The resultant donor site defect close to the wrist and hand makes special demands on the wound closure because of the presence of superficial flexor tendons and the restricted amount and movement of the local tissue. When a surgeon is deciding which free flap to use for reconstruction of soft tissue defects, donor side morbidity is an important factor.[20]

Although the RFF is commonly used for orofacial reconstruction, we know of few prospective and biomechanical studies of its donor site morbidity.[21] We have therefore made a prospective biomechanical and aesthetic study of donor site morbidity associated with the RFF.

Patients and Methods

Between September 2011 and December 2012, we prospectively evaluated 30 consecutive RFF, all of which were transplanted for reconstruction after resection of tumours in the orofacial region. Examinations were made before and three months after the operation.

All patients gave written informed consent to the study which was approved by the local ethics committee (Nr. PV 3768). The RFF had been raised from the non-dominant side in all cases. We used the Allen test preoperatively to avoid impairment of blood supply to the hand after division of the radial artery.

Surgical technique

All flaps were harvested as fasciocutaneous flaps at least 3 cm proximal to the skinfold of the wrist without a tourniquet. The RFF were harvested at the same time as the tumour was being resected. For aesthetic reasons no flap was extended to the dorsal aspect of the arm. The paratenon that envelops the tendons was meticulously left untouched to achieve an accurate wound bed. The surrounding muscle bellies were neither mobilised nor oversewn. The superficial branch of the radial nerve was carefully preserved during further dissection to prevent dysaesthesia of the hand. No radial artery required reconstruction. Donor site defects were uniformly closed with two, spindle-shaped, local, full-thickness skin grafts taken through a sinusoidal access incision. This avoided the disadvantages of a split-thickness skin graft and a second donor site defect (Figs 1(A) and (B)). No fenestrating incisions or cross-sutures were made to reduce the size of the wound. To prevent formation of haematoma the wound was covered with a tieover dressing for 10 days (Fig. 1(C)). A passive silicone capillary drain was placed subfascially before closure. No subatmospheric pressure dressing or immobilising cast was needed. Physiotherapy was started on the fourth day after operation.

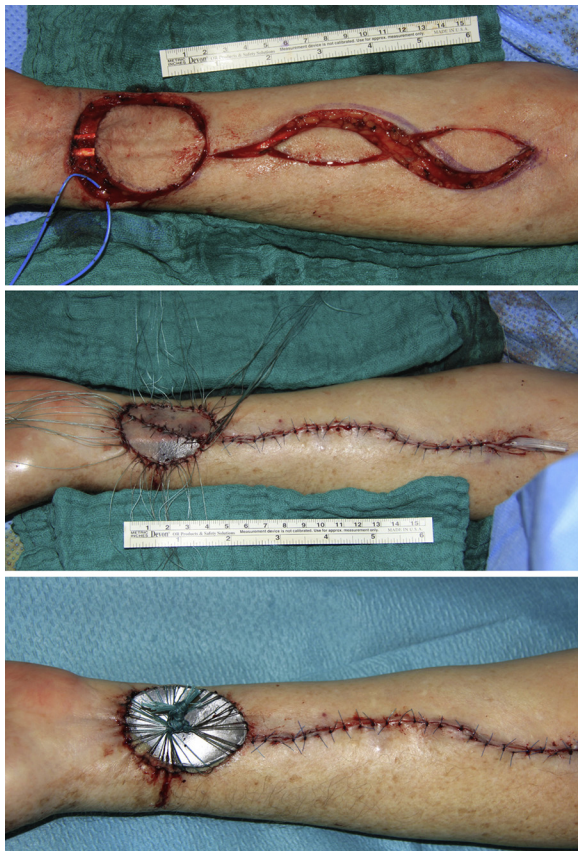

Fig. 1. Coverage of the forearm donor site with a local full-thickness skin graft: (A) design of two adequate spindle-shaped grafts after sinusoidal access incision - the loop indicates the superficial branch of the radial nerve; (B) coverage of the donor site with the local skin graft; and (C) after application of the tieover dressing.

Biomechanical evaluation

Detailed biomechanical evaluation was made using a standard Mayo wrist score and DASH score, and the range of movement was recorded with a goniometer and using a protractor for active and passive movement. It included extension and flexion, radial and ulnar abduction, supination, and pronation. All patients had both arms examined. Grip strength was measured with a hand dynamometer (B&L® Engineering) and for tip pinch, key pinch, and palmar pinch we used the B&L® pinch gauge.

The arm and hand was placed in a standard position for all measurements of hand strength. Each patient was seated with the shoulder adducted, elbow flexed in 90°, and the