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## Review

# Is there an ideal way to close the donor site of radial forearm free flaps?

A.M. Pabst<sup>a,\*</sup>, R. Werkmeister<sup>a</sup>, J. Steegmann<sup>b</sup>, F. Hölzle<sup>b</sup>, A. Bartella<sup>b</sup><sup>a</sup> Department of Oral- and Maxillofacial Surgery, Federal Armed Forces Hospital, Rübenacherstr. 170, 56072 Koblenz, Germany<sup>b</sup> Department of Oral- and Maxillofacial Surgery, University Clinic RWTH Aachen, Powellsstr. 30, 52074 Aachen, Germany

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## Abstract

Radial forearm free flaps (RFFF) are the “workhorse” of reconstructive head and neck surgery, but have considerable morbidity at the donor site. The aim of this study was to review current publications about the incidence and type of morbidity and the different techniques used for closure of the site. We screened the MEDLINE database to find relevant papers using the terms “RFFF head and neck” and “RFFF donor site”. Abstracts were filtered, and the full texts studied carefully. We found 1056 publications during the period 1982–2017 of which 389 were studied in full, and 39 studies were finally included in the review. We found four main methods of closure of the donor site: full-thickness skin grafts (FTSG); split-thickness skin grafts (STSG); modified techniques for raising the flap and closure of the wound by local flaps; and others (such as allografts, expanders, and vacuum bandages). For STSG and FTSG the preparation of the donor site seems to be a relevant factor. Special attention should be paid to the coverage of the flexor tendons. FTSG give better aesthetic results than STSG. Closure by local flaps may achieve primary closure of the donor site without a third surgical site, but the techniques are limited by the amount of tissue required at the site of the defect. The most common side effects are disorders of wound healing such as exposed tendons. To avoid exposure of the tendons, flexor tendons should be covered with muscle bellies when STSG are used. It is still not clear whether many other reported side effects (such as impairment of sensitivity) are induced by raising the flap or closing the donor site. There is an argument for closure of individual donor sites independently, but there is no one method of closure for all donor sites, because each has its specific disadvantages and complications. © 2018 The British Association of Oral and Maxillofacial Surgeons. Published by Elsevier Ltd. All rights reserved.

**Keywords:** radial free forearm flap; RFFF; donor site morbidity; microsurgery; reconstructive surgery; skin graft

## Introduction

Radial forearm free flaps (RFFF), also called “Chinese” flaps, were first reported in a large series by Yang et al in 1981 and are still one of the most common and widely-used free flaps in oral and maxillofacial surgery.<sup>1</sup> They can be used to cover and reconstruct intraoral and extraoral, three-dimensional, soft-tissue defects in the head and neck. They can also be used for phalloplasty in female-to-male transgender surgery,

and for several other indications in plastic and reconstructive surgery.<sup>2</sup>

Advantages of the flap are reliable anatomy and so a relatively easy operation, a long vascular pedicle with a high arterial calibre, and a thin flap. This is particularly useful for intraoral defects that require low volume. Their main drawback is the donor site, which often requires a third operating field for autogenous wound closure, but disturbances of post-operative wound healing, exposure of underlying tendons, impaired sensitivity, and problems with wrist extension have been reported.<sup>3</sup>

Anatomically, the flap is created by a composite paddle of the volar forearm including skin and underlying subcuta-

\* Corresponding author. Tel.: +49 261 281 2718; Fax: +49 261 281 2702.  
E-mail address: [andipabst@me.com](mailto:andipabst@me.com) (A.M. Pabst).

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neous fat, with or without the underlying antebrachial fascia. The pedicle of the flap is created by the radial artery in the lateral intermuscular septum and the accompanying veins. The length of the pedicle is limited to the length of the radial artery until its transition to the brachial artery, and can vary individually.<sup>4–6</sup> Different modifications have been reported in addition to the standard procedure. The flap can also be raised as an ulnar forearm free flap, where the pedicle is created on the ulnar artery. Maan et al have also reported the reverse RFFF, in which the skin island is raised near the elbow and the vascular pedicle is created by the distal end of the radial artery starting from the wrist.<sup>7</sup> Variations of the flap include osteocutaneous flaps, implementation of the palmaris longus tendon, or the raising of two separate skin islands for composite reconstructions.<sup>8–10</sup> Each of these variations of the RFFF lead to distinct problems at the donor site and demand individual approaches to the closure.

Various techniques have been reported for closure of the donor site, the most popular being covering with a split-thickness (STSG) or full-thickness (FTSG) skin graft, and primary closure.<sup>11,12</sup>

Despite the clinical importance of adequate closure of the donor site for both patients and practitioners, we know of no systematic review of relevant publications, so the question about an ideal technique for closure and subsequent low morbidity at the donor site has still not been answered properly. In addition we could find no information about whether the reported donor site morbidity is associated with raising of the flap or with closure of the donor site. Such information would be helpful in the selection of the ideal technique of closure in individual cases. The aim of this study was to assess, review, and summarise available publications on this topic.

## Methods

The database of MEDLINE/PubMed was used to identify original papers and case reports about closure of the RFFF donor site. Inclusion criteria were a study group of five or more patients, publication in the English or German languages, and publication dates from 1982–October 2017. All papers were screened independently for eligibility by two authors (AP and AKB). If they disagreed about a paper, a third author's opinion (JS) was taken in consideration. Exclusion criteria were: animal and cadaver studies and case reports of fewer than five patients. Donor sites of osseous RFFF were also excluded.

The headings used were: “radial free forearm flap head and neck” (n = 622) and “radial free forearm flap donor site” (n = 434). After the removal of duplicates and the application of our exclusion criteria, 389 studies had their full texts screened, and 39 were found to be suitable for inclusion (Fig. 1).

The papers identified were divided into four groups depending on the technique of wound closure: split-thickness

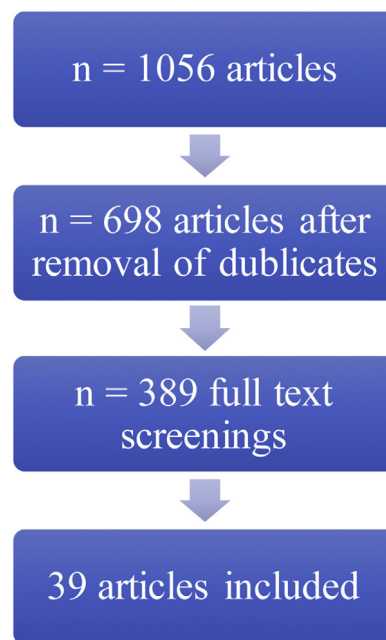


Fig. 1. Work flow for the selection of papers. Thirty-nine papers were finally found to be suitable for the study, eight of which gave general advice and 31 of which were allocated to the four techniques for closure of the donor site.

skin grafts (STSG, n = 11); full-thickness skin grafts (FTSG, n = 9); modified raising of the flap, including local flaps for primary closure (n = 5); and others (n = 6). Eight of the studies gave general advice (n = 8).

Because of a lack of homogeneous acquisition of data, and no clear definition of successful closure of the donor site, we made no descriptive analysis.

## Results

Although the RFFF is a common and widely-used free flap for reconstructions in the head and neck, its donor site morbidity is challenging.<sup>13,14</sup> The right preparation of the wound seems to be crucial for low morbidity, regardless of the closure technique. If a suprafascial flap is raised, it may reduce donor site morbidity.<sup>15–17</sup> The exposed tendons of the flexor muscles should be covered by paratendinous tissue – for example, by suturing flexor carpi muscle, or brachioradial muscle, or both, over them.<sup>17,18</sup> Absorbable suture material should be used so as not to compromise the long-term outcome. Another consideration might be to reduce the area of the donor site by up to 44% with a pursestring suture.<sup>19</sup> Short-term splinting of the forearm to decrease the mobility of the wrist may also lead to improved wound healing, particularly in patients with STSG or FTSG.<sup>20</sup>

### Split-thickness skin grafts (STSG)

The usual way to close the donor site after raising a RFFF is with a STSG,<sup>3,18,21,22</sup> but a serious drawback of the technique

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