Original Article
Pak Armed Forces Med J 2020; 70 (1): 48-52

DONOR SITE MORBIDITY OF RADIAL FOREARM FREE FLAP; A CASE SERIES

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ABSTRACT

Objective: To evaluate the donor site morbidity associated with the radial forearm free flap surgery.
Study Design: Case series study.
Place and Duration of Study: Departments of Plastic and Reconstructive Surgery, Combined Military Hospital Rawalpindi and Bahawalpur, from Jul 2011 to Jul 2017.
Methodology: One hundred and nineteen patients, who underwent radial forearm free flap surgery, were included in the study. Patients were followed up at first and second week and then at six months. Patients were examined for wound infection, radial nerve injury, flexor tendon desiccation, cold intolerance, persistent post-op pain, wrist mobility, and pinch and grip strength (using a dynamometer).
Results: There were a total 109 patients out of which 78 (71.6%) were male patients and 31 (28.4%) were female patients. The mean age was 35 ±12 years (range: 16 to 64) years. Three (2.8%) patients had early wound infection. Two (1.8%) patients had injury to sensory branch of the radial nerve and two (1.8%) had desiccation of flexor tendons near wrist. On six-month's follow-up, five (4.6%) patients developed cold intolerance while six (5.5%) patients had persistent post-operative pain. Four (3.7%) patients developed reduced wrist mobility and same percentage of patients (3.7%) had reduced pinch and grip strength.
Conclusion: The donor site in radial forearm free flap surgery carries donor site morbidity that can be minimized by careful and meticulous surgical techniques.

Keywords: Donor site morbidity, Outcome, Radial forearm free flap, Surgery.

INTRODUCTION

The radial forearm free flap (RFFF) is a useful and versatile fasciocutaneous flap designed on the radial artery. The flap includes the volar forearm skin, the underlying antebrachial fascia, and the intermuscular fascia, which contains the radial artery and its cutaneous branches. It can be innervated by the medial and lateral antebrachial cutaneous nerves. Its' thinness, pliability, pedicle length, and vessel size are particularly suited for oropharyngeal and oral cavity reconstruction[1].

RFFF was first described by Yang *et al* in 1981[2]. Soon after its introduction in the reconstructive surgery armamentarium, it has become a workhorse flap in many reconstruction surgeries. In spite of many advantages, the RFFF surgery has significant donor site morbidity because of which there have always been concerns about the donor site morbidity associated with its use. Hand and wrist function are the most important issues in the assessment of morbidity for the RFFF surgery. Common early complications include wound breakdown and skin graft loss resulting in delayed wound healing and tendon exposure[3,4]. The long-term complications mentioned in the previous studies are reduced wrist mobility,[5,6] wrist and/or hand weakness,[2,7] sensory deficits,[5,6,8] persisting pain,[2,3] decreased hand dexterity,[2] and cosmetic deformity[2,3,5] in objective and subjective assessments. A lot of efforts have been made to minimize donor site morbidity but none has been completely successful and cost free. So far, there have been very few studies in Pakistan to observe the complications pertinent to the donor site in RFFF surgery. This study was aimed at determining the short and long-term morbidity associated with

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Received: 24 Jul 2019; revised received: 11 Aug 2019; accepted: 16 Aug 2019

the donor site for RFFF surgery at our tertiary care setups. This would help in determining the local burden of such complications and devise strategies based on our experience, to prevent these complications.

METHODOLOGY

It was a case series study conducted at the Plastic and Reconstructive Surgery Departments of Combined Military Hospital Rawalpindi and Bahawalpur from July 2011 to July 2017 after approval from the hospital research ethical committees. All patients reporting to the departments for various surgical problems, which were planned for coverage of defect with RFFF were included through consecutive sampling. Prior to enrollment for this study, these patients were counseled in detail about the procedure, hospital stay, and possible adverse outcomes. Patients were enrolled after getting written informed consent. Patients with wrist arthritis, diabetic neuropathy, and a history of smoking during the past six months were excluded.

A detailed history was taken from the patients. History of hand dominance, occupation, pre-existing pain, previous trauma, or diabetes mellitus was obtained and recorded in especially designed proformas. A detailed and focused local and systemic examination was carried out. Both motor and sensory examinations were done in both hands. Following neurological examination, Allen's test was done on both forearms in all patients. During patient selection, ten patients were excluded from the study. One patient had diabetic neuropathy and two patients had severe hand and wrist arthritis. Seven patients were excluded as they smoked cigarettes during the past six months.

All patients were followed up at first and second week (early morbidity), and then at six months (late morbidity) from operation. They were examined for wound infection, radial nerve injury, flexor tendon desiccation, cold intolerance, persistent post-op pain, wrist mobility, and pinch and grip strength. The pinch and grip strengths were evaluated using a hydraulic hand dynamometer and pinch gauge (Jamar; J A Preston Corporation). Cutaneous sensations over the radial nerve distribution were measured using the Semmes-Weinstein monofilament technique (Touch-Test; North Coast Medical, Inc).

All RFFFs were harvested in a standard fashion by using a sub-fascial dissection technique preserving the epitenon. Tourniquet was used in all patients to obtain bloodless field. Preoperative marking for vessels and skin paddle were carried out in all patients by reverse planning keeping in view the recipient wound size (fig-1A). Radial nerve sensory branches were identified and preserved. Vascular anastomosis was carried out by 8.0 Ethicon sutures by end to end or end to side techniques (fig-1B). The donor site was closed by a split-thickness skin graft (STSG) (fig-1C). The STSGs were harvested from the thigh using a Zimmer Electric dermatome at a thickness of 0.13 to 0.16 mm. The harvested STSGs were fixed by skin staplers followed by multilayered dressing.

The statistical analysis was done using Statistical package for social sciences version 20.0 Continuous variables were expressed as means and standard deviations, whereas frequencies and percentages were shown for categorical variables.

RESULTS

Out of a total 109 patients, 78 (71.6%) were male patients and 31 (28.4%) were female patients. The mean age was 35 ± 12 years (range: 16 to 64) years. Three (2.75%) patients had early wound infection that settled with conservative measures. Two (1.83%) patients had injury to sensory branch of the radial nerve. Two (1.83%) patients had desiccation of flexor tendons near wrist that settled with conservative measures. One-hundred and two (93.6%) patients had no short-term complications (figure-1(A-C)).

The long-term follow-up at 6 months revealed that five (4.6%) patients developed cold intolerance while six (5.5%) patients had persistent post-operative pain. Four (3.7%) patients developed reduced wrist mobility and same percentage of patients (3.7%) had reduced pinch and grip

strength. Ninety (82.6%) patients had no long term post-operative complications.

DISCUSSION

RFFF is a wonderful addition to the armamentarium of a reconstructive surgeon. It is commonly used in head and neck reconstructions following defects of cancerous and non-cancerous

Figure: (A) Pre-operative marking for vessels and skin paddle, (B) Vascular anastomosis carried out by 8.0 Ethicon sutures, (C) Closure of donor site by a split-thickness skin graft.

etiologies. Patients with soft tissue defects of lower third of leg, ankle, heel, and foot are often reviewed by plastic surgeons for reconstruction using RFFF. Apart from the above-mentioned indications, RFFF is also used for phalloplasty that has proved to be a reliable therapeutic tool in these patients[9].

Surgical infection is a known complication of all surgical interventions and all available measures should be taken to minimize it. It can significantly increase the cost and hospital stay of the patients. In our study, it occurred only in 2.8% of the participants. Knott *et al* found a similar frequency of 2.6% in patients undergoing RFFF surgery in the Cleveland Clinic Head and Neck Institute in Cleveland, Ohio, USA[10]. The Department of Plastic and Reconstructive Surgery of Korea University College of Medicine, Seoul, Korea revealed an infection rate of 4% in one of their studies[11]. A study from Plastic, Reconstructive and Burns Unit, Tanta Faculty of Medicine, Tanta, Egypt, revealed an infection rate of 10% at the RFFF donor site[12]. Researchers from the Department of Maxillofacial Surgery, University Hospital of Luebeck, Luebeck, Germany noted the infection rate to be around 8%[13]. The surgical site infection not only impairs activities of daily living but can also affect adversely the appearance of the scar. The visible scar remains a source of concern for many patients later in life.

Amid early complications, the desiccation of flexor tendons at the donor site is worth mentioning. Among flexor tendons, the tendon of flexor carpi radialis is the most commonly involved tendon. Desiccation of flexor tendons may occur if the epitenon is not preserved during dissection. Although this complication is rare but carries a significant morbidity. In our study, this complication occurred in 1.8%. Our data confirmed Emerick *et al*[14] who identified only one patient out of a sample of 54 (1.8%) who had a partial graft loss at the donor site with delay in wound healing. An earlier study by Yun *et al*[11] revealed partial loss of graft in 16% and total loss in 0.5%. Mahmoud reported partial graft loss at the donor site in one out of ten patients (10%)[12]. Fourteen percent had a partial or complete loss of skin graft in the study carried out by Hekner *et al*[15] Graft loss has been reported as high as 30% in the literature as described by Harris

and Bewley[16]. The techniques for reducing graft dehiscence are precise dissection, making small wounds, early mobilization, and painstaking wound care[17].

Injury to sensory branch of the radial nerve is another early complication at the donor site that is quite common. Dysesthesia of the dermal region representing sensory territory of cutaneous branch of the radial nerve has been reported as high as 76%[10]. The injury can lead to formation of a painful neuroma, which is a recalcitrant malady. This can be avoided by good surgical technique. Fortunately, neuroma formation is not a common happening. Injury to cutaneous branch of the radial nerve was observed in 1.8% (2 cases) in our study. Cheema and Talaat[17] in another study, as well as, Ali and Zulfiqar[18] reported not a single case of neuroma or an area of numbness in a Pakistani case series of sixteen cases each. Hegazi[19] did not observe any painful neuroma nor symptoms of cold intolerance in any of the patients in a Saudi case series.

Upon follow-up, at six months, some patients had persistent problems at the donor site. Three patients (2.8%) had persistent pain in the wrist. They were managed conservatively, while two patients (1.8%) had cold intolerance. Both complications produce adverse effects on the quality of life. Bardsley *et al*[20] published a series on RFFF donor site morbidity and found similar results.

Decreased wrist mobility and grip strength occurred in only two patients (1.83%) in our study, which gradually improved with physiotherapy. These figures are compatible with other studies. In a series of 50 patients undergoing RFFF harvest, grip power and wrist flexion were significantly decreased after surgery compared with pre-operative values[21]. Yun *et al*[11] reported 3 (2%) patients with decreased grip power. Timmons *et al*[4] described high prevalence of reduced hand and wrist strength (40%) and increased persisting wrist stiffness (27%). Richardson *et al*[3] found significantly reduced wrist extension and pinch and grip strength compared with pre-operative values in a subgroup of patients with fasciocutaneous flaps. In a case-control prospective series of 11 patients, Brown *et al*[5] found measurable reduction in wrist flexion and pinch strength associated with RFFF harvest. Toschka *et al*[6] found more pronounced postoperative limitation of wrist movements in patients who underwent RFFF harvest on their non-dominant limb.

Though most of these studies have ratified the findings of loss of muscle power and grip strength, some studies have added controversy by reporting no significant difference in pre- and post-operative strength measurements in the muscles of the donor arm. Writthmann and colleagues[22] did not observe any limitation in grip strength or wrist movement at the donor site following RFFF harvest. The study by de Witt *et al*[7] revealed no difference between the donor and the non-donor arm regarding movement, grip, and temperature except the pinch grip values post-operatively. Sardesai *et al*[8] found no significant functional decrease in quantitative measurements (mobility and strength) following RFFF tissue transfer. Sieg and colleagues[13] observed no significant grip strength decrease in the donor limbs. Orlik *et al*[23] found no significant difference in all aspects of grip strength on the donor side compared to the non-donor side following operation.

Considering the concerns about the donor site morbidity, a number of techniques were explored by various authors at different centers. Some authors have advocated that this flap should be raised suprafascial to reduce donor site morbidity. Although this technique is excellent in achieving this goal but it decreases the chances of survival of flap. Other method to reduce the donor site morbidity is pre-lamination. Pre-lamination is an old concept where the flap is first expanded, raised and various layers like skin graft are added. This technique helps closing the donor site primarily. This is not achieved without cost. It needs extra time, multiple visits, and added cost[24].

Every effort should be made to identify and protect the superficial branch of radial nerve in distal forearm; otherwise paresthesias on dorsum of hand including first web could occur. In all circumstances, the paratenon over the flexor tendons in distal forearm should be preserved through meticulous dissection for better uptake of partial thickness skin graft. Last but not the least, the flap extension over the dorsal side of forearm should be avoided for better aesthetic results[25].

The RFFF is a safe and reliable method for reconstructing most defects of the oral cavity. It is characterized by outstanding modeling ability, thinness, technically simple flap harvesting, and a long, wide-caliber vascular pedicle. This type of flap can be harvested concurrently with surgery in the oral and maxillofacial area with ease, and is the most commonly used type of free flap used in this area. A success rate over 95%[2] is not uncommon at experienced centers, but there is still a small risk of flap compromise necessitating urgent re-exploration.

CONCLUSION

The RFFF is a versatile flap for lots of reconstructions. However, it carries significant donor site morbidity which can be minimized by careful and meticulous surgical technique.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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