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The free instep flap for palmar and digital resurfacing

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Summary The palmar and digital volar skin is unique because of its glabrous nature, texture and light colour in all races. Any defect on the palmar surface not suitable for a homodigital or thenar flap remains a challenge for reconstructive surgeons. Various skin flaps have been described in the literature for palmar resurfacing. They all provide wound cover and may even match the contour satisfactorily, however, the colour and texture mismatch compromises the aesthetics of reconstruction.

In our experience, the free instep flap is a more appropriate choice for palmar and volar digital resurfacing. It provides glabrous, potentially sensate, hairless skin with a better colour and texture match compared to conventional pedicled or free flaps in all cases.

This paper describes our refined flap raising technique, the possibility of a neurotisation and discusses the role of the free instep flap for idealised digital and palmar resurfacing. It can provide a truly cosmetic microsurgical reconstructive option.

Introduction

Homodigital flaps offer the best form of reconstruction by replacing like for like, however defects on the palmar surface of the hand and where this reconstructive option is not available remains a challenge for reconstructive surgeons because of the unique glabrous nature and light colour of this skin. While various super thin skin flaps have been described for palmar resurfacing, colour and texture mismatch often compromises the aesthetics of these reconstructions. The instep area of the foot provides adequate skin to cover larger palmar or single digit defects or segmental defects on multiple digits. The skin is similar to palmar skin in texture and uniformly light coloured in all races. The instep skin can be harvested as a free flap on the

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medial plantar vessels, with the medial plantar nerve being split longitudinally to provide a sensate flap. The free instep flap is a medial plantar artery flap with a skin paddle entirely within the instep space of the foot.[1] It differs from the medialis pedis flap which is based on the skin perforators of the deep branch of the medial plantar artery.[2] The medialis pedis flap can give a partial non glabous skin paddle outside of the boundaries of the instep space of the foot.[3] Given the robust experience in flap success we must start to move always from large robust flaps maintaining the high success rates but focussing more on the functional, aesthetic and donor site morbidity. Utilising this principle we aim to develop better cosmetic microsurgical reconstructive options.

This paper reports our indications for using the free instep flap, including a modified flap harvesting technique alongside the protocol for postoperative case to minimise donor site complications.

Patients and methods

Over the period 2008—2011 we have performed five free instep flaps for resurfacing volar hand wounds. The age range was 19—59 years old. Four patients were male and one female. Four patients were right hand dominant and one left-handed. All patients who presented with volar skin loss that was suitable for reconstruction were offered surgery. The long flexors were intact and some degree of nerve injury noted in all cases (Table 1).

Operative technique

Preoperative markings

The most proximal and distal points on the non-weight bearing instep area are marked with patient standing. The patient is then asked to lie supine on a bed with the hip flexed, abducted and externally rotated, the knee flexed and the ankle in a semi flexed position. This simulates the position on the operating table during harvest of the flap.

The course of the medial plantar artery is marked on the instep area with the help of a hand held Doppler (Huntleigh Healthcare Limited, Cardiff, United Kingdom). The axis of the flap lies between the sustentaculum of the talus and the mid point of the heads of the first and second metatarsals. The perforator from the medial plantar artery usually arises one third of the way between the sustentaculum and the metatarsophalangeal joints. The flap is then marked, keeping the neurovascular pedicle in its centre and restricting the flap to the non-weight bearing area as marked (Figure 4).

Preparation of the recipient area

The palmar or digital wounds are debrided and the size of the defect measured. The radial artery has been used for palmar defects due to its superficial position. The digital arteries have been used for finger defects. These vessels are exposed and prepared for the arterial anastomosis under loupe magnification. Similarly, the vena commitantes running with the radial artery and the subcutaneous veins on the dorsum of the digit are prepared. The digital nerve stump may also be prepared for coaptation with a branch of medial plantar nerve. The required length and orientation of the pedicle is then assessed.

Flap dissection on the foot

The dissection begins by making an exploratory incision at the distal edge of flap marking. The incision is deepened through the plantar fascia to identify the vessels lying deep to it. The medial plantar vessels normally lie between the first and second metatarsals of the foot. Once identified, the pedicle is ligated distally. The nerve is divided at the same level. The incision is then extended laterally and flap elevation continues laterally in the suprafascial plane. The majority of the plantar fascia is left in situ to avoid exposure of the lateral plantar nerves and vessels and foot stability. The fascia also provides a smooth surface that may facilitate a more stable and aesthetic graft take. At a point 5 mm—8 mm lateral to the vessels, the plantar fascia is necessarily divided and then the plane of dissection is deep to the neurovascular bundle. This is followed by a medial incision, which starts in the suprafascial plane. The plantar fascia is thin over the medial side of flap. As the pedicle is approached, the plantar fascia is again divided 5 mm to 8 mm medial to the neurovascular bundle joining the plane deeper towards the pedicle. The whole flap is then lifted along with a 8—10 mm wide strip of fascia just enough to support the neurovascular pedicle which runs

Table 1 Description of patient injuries treated.

Patient	Age	Gender	Dominance	Job	Injury	Defect site
1	19	Male	Right	Manual	Palmar skin loss secondary to 3 cm drill. Segmental loss of common digital nerve to 3rd web, median nerve injury.	Central palm
2	54	Male	Left	Clerical	Circular saw injury to radial aspect of left index finger, loss of radial neurovascular bundle.	Volar index finger distal to PIPJ
3	59	Female	Right	Chef	Infected left index finger following knife injury at work. Two debridements prior to flap cover.	Volar index finger distal to PIPJ
4	44	Male	Right	Manual	Infected left index finger sustained when digging out a lake. Volar skin necrosis and segmental loss of both neurovascular bundles at level of middle phalanx.	Volar index finger distal to PIPJ
5	49	Male	Right	Manual	Avulsion injury to left index finger. Loss of volar surface. Overlying proximal and middle phalanges, pulp intact. Segmental loss of ulnar digital artery and nerve contused.	Volar index finger proximal to DIPJ to MCPJ crease