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CASE REPORT

The medial sural artery perforator flap and its application in electrical injury to the hand☆

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Summary We describe the use of a free medial sural artery perforator flap to reconstruct a complex composite defect to the dorsum of the right index finger following a low voltage electrical injury. The resulting defect was a 3.5 × 5 cm full thickness wound, with segmental tendon loss and loss of underlying periosteum.

Due to both size and local vascular injury related to the mechanism, free tissue transfer was felt to be the most reliable option to resurface the composite defect in a single stage. The medial sural artery perforator flap, for reasons outlined below, was felt to be the best option:

1. Thin profile.
2. Vascularised fascia can be taken as a tongue, adjacent to the skin paddle: a gliding surface to prevent the tendon graft sticking to exposed bone.
3. Long pedicle: micro-anastomosis away from zone of injury.
4. Little donor site morbidity: can be closed directly (if <6 cm wide) and does not require sacrifice of any major blood vessel.
5. Can be harvested with nerve and tendon from the same wound.
6. Can include as little or as much tissue required and compared to other fasciocutaneous flaps matches the texture and thickness of the hand most closely.

We describe the reconstruction of the composite defect on day 42 post-injury, following one prior debridement.

This case highlights the versatility and suitability of the medial sural artery flap in the reconstruction of complex hand burns with resulting composite defects.

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Introduction

We describe the use of a free medial sural artery perforator flap to reconstruct both full thickness skin defect and segmental tendon loss following an electrical injury to the dorsum of the right index finger.

This 28-year old right hand dominant male gas engineer presented to our Burns Unit having sustained a low voltage mains injury (<1000 V) to the dorsum of his right index finger while at work. He had no significant past medical history. He was cutting through a metal pipe wearing no personal protective equipment, when he accidentally cut an accompanying cable, sustaining the electrical injury — a full thickness defect approximately 3.5 × 5 cm, with segmental loss of the extensor mechanism over the proximal phalanx and loss of periosteum, leaving bone exposed (Figure 1).

Reconstructive options

Reconstruction in the context of electrical injury

Electrical injury can result in local vascular injury, such as damage to both the media and endothelium, thrombosis and segmental narrowing.[1,2] This ruled out local reconstructive options, such as Quaba, Merle or adipofascial turnover flaps, while the size of the defect stood against either a Quaba or a reverse cross finger flap being used. Free tissue transfer, although more technically demanding, was felt to be a more reliable option to resurface the composite defect in a single stage.

Kuo described the safe use of free tissue transfer in reconstruction following electrical injury in a rabbit model, as long as the anastomosis was performed more than 3 cm outside the zone of injury, together with the findings of normal elasticity, bleeding and intact endothelium.[3] Furthermore Shen et al. claim the most reliable indicator of vessel viability in this scenario to be peri-operative inspection under the microscope.[4]

Figure 1 Right index finger defect following electrical injury, with one prior debridement: a full thickness defect approximately 3 × 5 cm, with segmental loss of the extensor mechanism over the proximal phalanx and loss of periosteum.

Medial sural artery perforator flap: advantages

The medial sural artery flap was formally described by Cavadas in 2001, based on musculocutaneous perforators from the medial sural artery.[5] Although originally used in the management of lower limb trauma, more recent studies have demonstrated its successful use in soft tissue reconstruction of the hand.[6,7]

Advantages of the medial sural artery perforator flap include:

1. Thin profile, regardless of body habitus.[7–9]
2. Vascularised fascia, acting as a gliding surface and sheath for tendons.[6]
3. Long pedicle, enabling micro-anastamosis away from zone of injury.[5–8,10]
4. Little donor site morbidity, as can be closed directly if width <6 cm,[6,7,9] with no major blood vessels being sacrificed.
5. Can be harvested with saphenous/sural nerve and plantaris tendon from the same wound, for reconstruction of composite hand defects.[6]
6. Can include as little or as much tissue required and when compared to other fasciocutaneous flaps, such as the anterolateral thigh flap, matches the texture and thickness of the hand most closely.[5]

Medial sural artery perforator flap: anatomy

Examination of the literature reveals findings of fairly consistent anatomy. Perforators from the medial sural artery are identified along its axis, a line drawn from the midpoint of the popliteal crease to the midpoint of the medial malleolus.[6,10]

The mean number of perforators is two, ranging between one and four.[5,8] Cavadas originally described the two perforators as arising a mean 11.8 (8.5–15) and 17 (15–19) cm from the midpoint of the popliteal crease respectively.[5] An anatomical study of 40 lower limbs in 2006 identified the two perforators at 9.68 ± 1.08 cm and 15.04 ± 1.79 cm.[10]

Perforators are noted to be 0.9 ± 0.2 mm in diameter, each supplying 55 ± 20 cm^2 of skin territory.[10] These are often accompanied by two venae comitantes, which may connect to a single vein that drains into the popliteal vein.[10] The length of pedicle has been found to range between 5 and 17 cm.[5–8,10]

Flap dimensions of up to 17 cm long and 8 cm wide are reported,[6] with a usual thickness of 5 mm, ranging between 4 and 8 mm.[8] The donor site can be closed directly when less than 6 cm wide.[6,7]

Other reconstructive options

Other potential options for free tissue transfer included the groin flap, which was thought to be too bulky; the superficial circumflex iliac artery perforator flap, which could not be harvested with vascularised fascia; the radial forearm flap, which would both sacrifice the radial artery and leave a poor donor site.