Reverse first dorsal metatarsal artery flap for reconstruction of a soft tissue defect of the big toe. A case report

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Case Report

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ABSTRACT: Introduction: The distal foot is the main weightbearing part of the foot, and soft tissue reconstruction of this area, especially the toes, is a difficult problem in reconstructive surgery. The ideal flap should have a dependable vascular supply, provide an acceptable functional and aesthetic result, and cause minimal donor site morbidity

Clinical case: We present the case of a patient of 61 years old, he suffered an electrical burn with a high-voltage cable when he was working with a blacksmith. Entry site on both hands with exit site on the 1st toe of the right foot. Due to sequelae of a burn in the first toe of the right foot, programming for performing a reverse flap of the first dorsal metatarsal artery, which was performed without complications.

Conclusion: The advantages of the reverse FDMA flap include: 1) creation of a thin and pliable flap providing good contour that avoids debulking procedures or special footwear; 2) decreased operative, hospitalization, and recovery times; 3) minimal donor site morbidity; 4) reliability; and 5) single-stage procedure.

KEYWORDS: First dorsal metatarsal artery flap, great toe

Introduction

Electrical injuries represent 4% of patients admitted to burn centers and are more common in males[8]. The distal foot is the main weightbearing part of the foot, and soft tissue reconstruction of this area, especially the toes, is a difficult problem in reconstructive surgery[9].

Historically, options such as toe amputations, fillet flaps, cross leg flaps, reverse anterior artery flaps, and free autogenous and allogenic tissue transfers have been used. But despite their successes, each of these are associated with significant difficulties[4,7].

The first dorsal metatarsal artery flap has been useful in the reconstruction of the defects on the dorsomedial side of the distal foot[9]. The advantages of the reverse FDMA flap include: 1) creation of a thin and pliable flap providing good contour that avoids debulking procedures or special footwear; 2) decreased operative, hospitalization, and recovery times; 3) minimal donor site morbidity; 4) reliability; and 5) single-stage procedure[6].

Case report

This is a 61-year-old male patient, he does not have chronic degenerative diseases, he denies allergies. Positive smoking (10 daily cigarettes).

He began his current illness on July 19, 2020 when he suffered an electrical burn with a high-voltage cable when he was working with a blacksmith. Entry site on both hands with exit site on the 1st toe of the right foot.

With initial management based on cures and with RTD dressing. As well as avoiding smoking, pentoxifylline and vitamin C. With poor evolution despite 30 days of management, with the presence of necrotic areas and bone exposure of the first toe of the right foot, for which advanced measures for reconstruction were decided. Hospital admission was decided due to sequelae of a burn in the first toe of the right foot, programming for performing a reverse flap of the first dorsal metatarsal artery, which was performed without complications.

Discussion

Electrical burns and their related mortality are increasing due to the use of electricity in all areas of life and with the development of technology. Electrical injuries represent 4% of patients admitted to burn centers and are more common in males. The entry and exit sites of injuries caused by this mechanism should be carefully evaluated to determine which extremities should be closely monitored for the risk of developing

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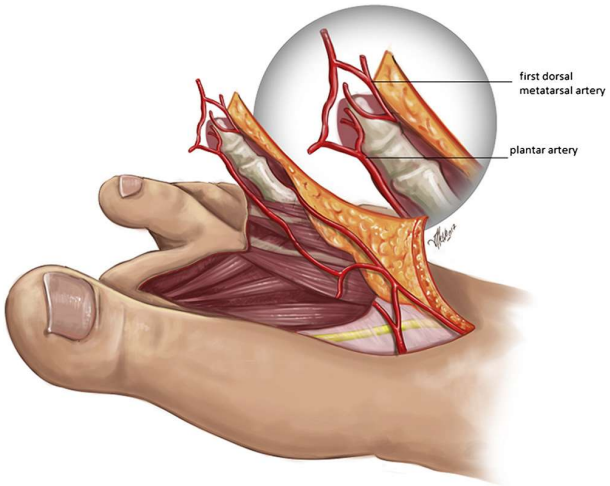

Figure 1. Illustration of the first dorsal metatarsal arterial course and communication with the plantar artery

compartment syndrome and irreversible skin lesions. Surgical management of electrical burns is characterized by early debridement. Skin grafts or pedicled myocutaneous flaps are used to repair tissue defects. Amputations should be avoided until damaged tissue has been completely demarcated[8].

The distal foot is the main weightbearing part of the foot, and soft tissue reconstruction of this area, especially the toes, is a difficult problem in reconstructive surgery. The ideal flap should have a dependable vascular supply, provide an acceptable functional and aesthetic result, and cause minimal donor site morbidity. In addition, soft tissue reconstruction of the distal foot should provide a good contour with thin and pliable tissue to allow for the wearing of a shoe[1]. The great toe is subjected to 60% of the load applied to the entire set of toes while walking. The loss or shortening of the great toes has a significant impact on walking ability, which in turn leads to deformities in the other toes and ulcers[9].

Historically, options such as toe amputations, fillet flaps, cross leg flaps, reverse anterior artery flaps, and free autogenous and allogenic tissue transfers have been used. But despite their successes, each of these are associated with significant difficulties. For example, the use of the fillet flap precludes toe salvage. The cross leg flap requires two operative stages, causing discomfort and stiffness to immobile joints. The reverse anterior tibial flap provides excess tissue bulk for small defects of the great toe, and free tissue transfers are time consuming and may be associated with higher failure and reoperative rates in patients with comorbities such as diabetes or aging. The reverse first dorsal metatarsal artery (FDMA) fasciocutaneous flap offered greater reach than the dorsalis pedis flap.The adipofascial version of this flap can yield a larger-sized flap and largely avoid the donor site complications associated with the dorsalis pedis flap, but this flap may need skin grafted at the recipient site[4,7].

The first dorsal metatarsal artery flap has been useful in the reconstruction of the defects on the dorsomedial side of the distal foot. The initial report of the FDMA flap was published by McCraw and Furlow in 1975[9].The blood supply of this flap comes from the distal communicating artery and the cutaneous branches arising from the FDMA. After originating from the DPA, FDMA courses through the first intermetatarsal space in the subcutaneous level proximally and within the first dorsal interosseous muscle distally. It passes dorsal to the transverse metatarsal ligament to join the first plantar metatarsal artery via the distal communicating artery[10].

Vasculature of the flap

The reverse first dorsal metatarsal artery (FDMA) flap has a longer vascular pedicle and can be used for distal foot wounds. The dorsalis pedis artery, which is an extension of the anterior tibial artery, supplies the flap. The reversed first dorsal metatarsal artery flap has a dependable arterial supply because the first dorsal metatarsal artery gives off numerous cutaneous branches to provide enough arterial supply to the intermetatarsal skin and it communicates with

Figure 2. A) Bone exposure of the first toe of the right foot and flap markings. B) Raised first dorsal metatarsal artery flap.

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Figure 3. Complete survival of flap A) Closure of the defect B) Result at 3 months.

the plantar arterial network via the distal communicating branches. Some variations exist of first dorsal metatarsal arterial branches that do not anastomose with the plantar arterial network, which is important for the viability of the distally based FDMA flap and to avoid venous failure. Therefore, the dorsalis pedis artery should not be divided and ligated before verifying a sufficient arterial supply by clamping the proximal pedicle[1,5].

Anatomy FDMA

The anatomy of the course or even existence of the FDMA can be confusing. Hou et al recently offered some simplified insights. They suggested an ‘‘abc’’ system which is an acronym for ‘‘arises’’ (origin), ‘‘branches,’’ and ‘‘course’’ of this vessel, respectively. In 86% of feet, its ‘‘origin’’ is the dorsalis pedis artery or its branch, the deep plantar artery. This is typically within a centimeter distal to the tarsal-first metatarsal joint and 5.5 mm plantarwards from the dorsal surface of the second metatarsal bone. In about 4% of cases, the artery is either absent or too small to be of any practical consequence. The remaining FDMA arise from the plantar circulation. The ‘‘course’’ of the FDMA has 3 distinguishing variations. Most commonly (84%), the artery after its dorsalis pedis based origin passes under the muscular arch formed by the tibial head of the first dorsal interosseous muscle to run adjacent to the first metatarsal bone. Typically, at the distal third of the space between the first and second metatarsal bones, it again assumes a superficial location. Along this course, numerous cutaneous perforators emanate from the FDMA, with the most distal such perforator consistently located between the heads of the first and second metatarsals. In all cases when present, the FDMA always eventually passes dorsal to the transverse metatarsal ligament before ending in its terminal branches. What is next of importance is the branching pattern found in the first web space. The FDMA does not always bifurcate into dorsal digital branches, sometimes giving off a branch only to the great toe or sometimes only to the second toe. However, 85% of the time here, there is a ‘‘perforator’’ or distal communicating branch with the first plantar metatarsal artery, which will be the basis of the circulation to the FDMA perforator propeller flap[3,5].

Surgical techniques

Basically, the skin island is designed on the first intermetatarsal area. A pre-operative Doppler examination evaluates the blood flow of dorsalis pedis artery, the plantar artery and the FDMA, and their direction. The FDMA flap is designed so that the dorsalis pedis artery and FDMA are at the middle of the flap. A pneumatic tourniquet is applied and the dissection begins at the distal edge and then proceeds toward the perforator found just distal to the transverse metatarsal ligament to confirm its location. The flap can be extended to the territoty of the dorsalis pedis with the safe limit to the lower bordes of extensor retinaculum. The proximal edge is then elevated to expose the dorsalis pedis vessels. This dissection is continued distally in the usual subfascial plane to identify the origin and course of the FDMA. The proximal communicating branch with the plantar arterial network located just distal to the tarsometatarsal joint should be ligated and divided to allow flap rotation. Care is taken to preserve any perforators observed to course to the overlying integument. Flap elevation ceases when the distal communicating branch perforator is again encountered. Fibrous constraints about the distal communicating branch perforator must be released to allow unhindered clockwise or counterclockwise

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rotation of the flap into the defect. While in situ, the tourniquet is deflated to assess flap perfusion. After confirming adequeate arterial inflow and venous return by clamping the proximal pedicle for 15 minutes. If adequate perfusion is observed, flap rotation is completed and the flap is inset into the defect[2,5,6].

The success rate of a distally based FDMA flap is inaccurate owing to the small number of cases reported in the literature. There have been no reports on complete necrosis, and the complication rate varies from 0% to 28.5%[9]

Conclusions

Management options for defects of the distal foot, especially first ray defects, are limited because of the poor skin laxity and restricted number of local and random flap options. In many cases, coverage with a skin graft is not suitable because of exposure of the bone and tendons without periosteum and paratenon. Any reconstructive method chosen should result in a good contour and allow the patient to wear daily shoes with ease. The reverse first dorsal metatarsal artery fasciocutaneous flap offered greater reach than the dorsalis pedis, it can yield a larger-sized flap and largely avoid the donor site complications associated with the dorsalis pedis flap, but this flap may need skin grafted at the recipient site. The advantages of the reverse FDMA flap include: 1) creation of a thin and pliable flap providing good contour that avoids debulking procedures or special footwear; 2) decreased operative, hospitalization, and recovery times; 3) minimal donor site morbidity; 4) reliability; and 5) single-stage procedure

Conflicts of interests

The authors declare no conflict of interest.

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