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Medial Sural Artery Perforator Flap in Resurfacing Superficial Dorsal Defect of the Foot

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1. Introduction

Reconstruction of the soft tissue defects of the dorsum of the foot is difficult. The Dorsum of the foot has unique anatomy of thin skin, less subcutaneous tissue, and superficial tendons. It requires a thin flap to cover (Fitzgerald O'Connor et al., 2020).

Many options for coverage were described, but there is no ideal method for reconstruction. Distorting the aesthetic appearance and bulky flaps are major problems (Lorenzetti et al., 2010). Free tissue transfer is a perfect solution for coverage. Soft tissue defects of the dorsum of the foot need thin, pliable flaps, early mobilization, less donor morbidity, and normal footwear fitting. Cavadas described the use of a medial sural artery perforator flap (MSAP) for lower limb defects. A series of 30 MSAP flaps was conducted to assess the use of this flap to reconstruct soft tissue defects of the dorsum of the foot.

2. Materials and Methods

The study was approved by the medical research ethics committee of the Sohag Faculty of Medicine. Written informed consent was obtained from each participant patient or his /her legal guardians.

Abstract

We assessed the suitability and relevance of the medial sural artery perforator flap in covering shallow defects of the dorsum of the foot. The study was conducted on 30 patients with post-traumatic soft tissue defects of the dorsum of the foot between August 2018 and August 2020. All defects were covered with medial sural artery perforator flap. Complete flap survival was achieved in 27 cases with one flap totally lost and two flaps had distal necrosis. 26 patients were satisfied with the result need no debulking. The flap had a good aesthetic appearance in most cases. MSAP flap is a good option in covering dorsal foot defect. It has many advantages: it is thin, pliable, fitted to normal footwear, less hairy and there is no need for secondary procedures in most cases.

Keywords

Reconstruction, free flaps, medial sural artery perforator flap, dorsal foot

The study was done on 30 patients with dorsum foot soft tissue traumatic defects attended to the microsurgery unit in Assuit University Hospital and emergency unit of the plastic surgery department in Sohag University Hospital in the period between August 2018 and August 2020. Detailed information about the procedure was given to the patients or their relatives before surgery. Pre-operatively, full history was taken regarding the age and sex of each patient, type of trauma, size of the defect, time since the injury to reconstruction. Careful examination was performed to evaluate the defect and presence of exposed bones or tendons and to detect any co-morbid conditions. Pre-operative routine investigation and necessary imaging were done including plain X-ray, Doppler examination, and C. T angiography in selected cases. Initial debridement (single or multiple stages) of the defect was done in cases with crushing injuries and with delayed presentation. All cases were covered with a medial sural artery perforator flap. Size, number of perforators, pedicle length, type of anastomosis, closure of donor site, satisfaction, and complications were reported.

Operative technique: All flaps raised from contralateral side to shorten operative time and ability of two teams. The patient was lying supine with the hip flexed and externally rotated and knee slightly flexed. A line was drawn from the midpoint of the popliteal crease to the medial malleolus. The perforator was traced along this line with Doppler (8mgh) and marked. The anterior exploratory incision was used. The perforator was dissected by splitting the gastrocnemius muscle. Dissection continued according to the desired pedicle length and clipping branches arising from the main pedicle.

When the dissection ended the lateral side of the flap was incised. The flap is ready for anastomosis at the recipient site.

3. Results

Between August 2018 to August 2020, 30 patients with dorsal foot defects underwent coverage with MSAP flap.

Age: age was ranged from 3 to 42 years.

Sex predilection: 22 males and 8 females.

Defect: Size: mean size is 102.6 ± 42.6 cm².

Type of injury: soft tissue traumatic defect.

Site: dorsum of the foot. Right or left?

Time passed since the injury to reconstruction: ranged from 2 days to 1 month.

Pedicle length: pedicle length ranged from 8 to 14 cm.

Ischemia time: from 1 to 2 hours.

Anastomosis: End to end anastomosis was done, 28 cases anastomosed with anterior tibial artery and 2 cases with posterior tibial artery. The venous anastomosis was done with venae comitantes.

Operative time: time ranged from 3.5 to 5.5 hours.

Flap complications: Partial flap loss occurred in two cases in day two postoperative managed with dressing and skin graft. Infection occurred in 2 cases in the first postoperative week treated with dressing and parenteral antibiotics.

Secondary procedures: No cases needed secondary debulking procedures.

Donor site closure: Fifteen cases closed with split-thickness skin graft; 15 cases closed primary.

Hospital stays ranged: from a week to 2 weeks.

Follow-up time: ranged from 6 months to 1 year postoperative.

Patient satisfaction: one patient poor, three fair, 26 good.

Flap survival: 27 flaps were completely survived; two flaps had partial necrosis and one flap was completely ischemic (30 cases).

3.1. Case reports

Case 1. Female patient 6 years old with soft tissue defect of left foot dorsum covered with MSAP flap follow up after 1 year. Flap size was 14 *10 cm anastomosed to anterior tibial vessels pedicle length 10 cm with one perforator (Figure 1).



Figure 1. A. preoperative view of defect, B. MSAP flap inset, C. postoperative view after flap anastomosis and, D. donor site closure postoperative view after 1 year.

Case 2. Male patient 13 years old with soft tissue defect of right foot dorsum covered with MSAP flap 14*8 cm with pedicle length with one perforator anastomosed to anterior tibial vessels. Follow up after 2 months (Figure 2).



Figure 2. A. preoperative view of defect, B. flap planning, donor site closure, C. intraoperative view after flap anastomosis, and D. postoperative view after 3 months.

Case 3. Male patient 7 years old with soft tissue defect of the right dorsal foot covered with MSAP flap 12 *6 cm one perforator pedicle length 10 cm anastomosed to anterior tibial vessels. Follow up after 3 months (Figure 3).



Figure 3. A. Preoperative view of defect, B. flap planning, donor site closure, C. postoperative view after flap anastomosis and, D. postoperative view after 3 months.

Case 4. Female patients 8years old with soft tissue defect of the right foot dorsum covered with MSAP flap 12 *5 cm with 3 perforators pedicle length 8 cm anastomosed to anterior tibial vessels. Follow up after 2 months (Figure 4).



Figure 4. A. preoperative view of defect, B. flap planning, donor site closure, C. postoperative view after flap anastomosis, and D. postoperative view after 2 months.

3. Discussion

The dorsum of the foot is important from the aesthetic point as it has very thin skin. Medial sural artery perforator flap presented as modification of gastrocnemius muscle flap. Raising only the skin portion with a perforator sparing the muscle which greatly reduces the bulk of the flap and donor site morbidity (Feldman, Cohen BE, 1987). Perforator flaps greatly helped surgeons in using fasciocutaneous or cutaneous flaps for resurfacing shallow defects and better aesthetic outcomes. (Balan, 2018) Flap survival in this series was reasonable, in the study in 2013 reported two cases with partial flap loss out of nine cases and healed secondarily with dressing (Wang, et al., 2013). Chen et al. (2005) reported one case of partial flap necrosis out of thirteen cases in thereconstruction of tendon Achilles managed with a skin graft in a series of 11 cases, Kim et al. (2009) reported distal flap end necrosis in the diabetic wound in the forefoot and midfoot areas. Hallock et al. (2014) reported total flap loss due to venous congestion managed with another free flap. (Hallock, 2014). As regard flap size MSAP flap is used for small to size medium-sized defects. Flap width around 6 cm or any size which can be closed by pinch test (Deek et al., 2020). In our series flap size ranged from 5*8cm to 18*11 cm. flap width in most cases was more than 6 cm so half of the cases needed skin graft closure.

As regard pedicle length of the flap, it considered long enough to anastomose away from trauma zone. Range 12 to 15 cm in a study of 200 cases in 2020 (Deek et al., 2020). In our series of 30 cases pedicle length range from 8 to 14 cm tailored according to the size of the defect and zone of trauma. No problems encountered as regard pedicle length in anastomosis. As regard number of perforators, perforators emerged from medial gastrocnemius muscle to the skin 1 to 4 perforators with mean of 2.2 (Cavadas et al., 2001). In this series most of cases we used one or two perforators tailored to be in the upper segment or the center of the flap. As regard closure of the donor site, as mentioned above flap width range 6cm. In our series of about 15 cases medium sized defect needed flap width more than 6cm. Split thickness skin graft used in 15 cases and direct wound closure in the other 15 cases. Complications in our series was very low; one flap total loss and two flaps with distal end necrosis and two cases with infection. No cases needed a second flap and split thickness skin graft used in two cases. Antibiotics and regular dressing used for infection treatment. No dehiscence occurred with early mobilization of the patient. Satisfaction scale of three grades poor, fair and good checked by the patients. 26 were good and three were fair and only one was poor that greatly support MASP flap. From the aesthetic point MSAP flap is tolerated by the patients as it thin flap matched with the dorsal foot characteristics. As MSAP flap is thin normal footwear fitting by the patients and no need for debulking as in other bulky flaps for example anterolateral thigh flap. Patient counselling about donor site scars discussed preoperatively with patients, they accepted and well tolerated. In literature, advantages of MSAP flap; thin flap even in obese patient, less hairy region in comparison with anterolateral region as an example, good caliber vessels, long pedicle, consistent perforator site, minimal damage to the gastrocnemius muscle and less donor site morbidity (Xie & Chai, 2012). In this series was greatly matched these advantages. Thickness of the flap was perfect and patient satisfaction proved that. Also, literature mentioned the disadvantages as it needed a high microsurgical skill, variation of perforator location and unsightly scar of donor site especially in females and children (Xie & Chai, 2012). As regard tedious flap dissection, it can be overcome with good training. Preoperative we can take a good idea about perforator location. Patient counselling greatly affect the psychic element of the patient toward the ugly scar when occurred. At last, from this series MSAP flap could be considered a reliable option for soft tissue defect of dorsal foot coverage.

5. Conclusions

In conclusion, MSAP flap is the reliable option for resurfacing dorsal foot defects as it is thin, pliable, and has normal footwear fitting.

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الملخص العربي

استخدام السديلة الربلية الانثوية من الساق لتغطية الأجزاء المكشوفة من الأنسجة الرخوة المفقودة بالقدم

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تناولت هذه الدراسة استخدام السديلة الربلية الانثوية من الساق لتغطية الأجزاء المكشوفة من الأنسجة الرخوة بالقدم ما بعد الإصابات. اشتملت هذه الدراسة على عدد ثلاثون حالة تم استخدام السديلة الربلية الحرة بها. تراوح المعدل العمري لهذه الدراسة للحالات المشاركة بها من ثلاثة سنوات الي اثنين وأربعين سنة. وتميزت هذه الدراسة بمستوي مضاعفات منخفض جدا ما بعد الجراحة حيث انه تعرضت حالتين لفقد جزئي للأنسجة وحالتين أيضا لعدوي وتم التعامل معهم بعمل غيارات واخذ العلاج المناسب. وتبين هذه الدراسة مميزات هذه السديلة وأنها تصلح أن تكون بديل واختيار مناسب لإعادة تكميل الأجزاء الرخوة المفقودة من القدم ما بعد الإصابات.