European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 9, Issue 7, 2022

ORIGINAL RESEARCH

Foot and Heel reconstruction using Reverse Sural Fascio cutaneous flaps after Melanoma Resection

[1]Dr. Sandeep Gupta, [2]Dr. Surendra Beniwal, [3]Dr. Rajesh Sinwar, [4]Dr. Pankaj Tantia, [5]Dr Shweta Mohata

[1]Associate Professor, Surgical Oncology, SP Medical College Bikaner, Rajasthan, India
[2]Professor, [4]Assistant Professor, Medical Oncology, SP Medical College Bikaner, Rajasthan, India
[3,5]Assistant Professor, Radiation Oncology, SP Medical College Bikaner, Rajasthan, India

Correspondence:
Dr. Sandeep Gupta
Associate Professor, Surgical Oncology, SP Medical College Bikaner, Rajasthan, India

ABSTRACT

Melanoma is the most common malignant neoplasm of the foot and ankle and are associated with a poor prognosis. The aim of the current study was to evaluate the functional and oncological outcomes of salvage surgery using Fascio- cutaneous flaps for soft tissue reconstruction of the foot following the resection of a melanoma. A retrospective review was conducted to evaluate patients who presented with foot melanoma and underwent salvage surgery and defect reconstruction using Fascio-cutaneous flap between January 2015 and December 2021at Acharya Tulsi Regional cancer Treatment & Research institute, Bikaner. The postoperative morbidity, surgical complications, functional outcomes and oncological outcomes were evaluated. 10 patients were enrolled. The median follow-up time of the patients was 52 months (range, 8-84 months). A reverse sural fasciocutaneous island flap was used in all patients to perform the foot reconstruction. All 10 cutaneous flaps survived and provided satisfactory coverage. Only one cutaneous flap showed partial necrosis and required treatment comprising of debridement and regular changes to the wound dressing. The overall survival rate of patients was 69.0% and good oncological outcomes. Salvage surgery with Fasciocutaneous flap reconstruction was found to be a reliable option for patients presenting with malignant melanoma of the foot.

Keywords: reverse sural flap, foot melanoma, heel reconstruction, sural flap, fasciocutaneous flap

INTRODUCTION

Melanoma is a malignant tumor that is derived from melanin-producing melanocytes. Although melanoma is a rare disease, accounting for only 4% of all skin cancers, it is responsible for 80% of skin cancer-related mortalities worldwide (1). Between 3 and 15% of all cutaneous melanomas affect the foot and ankle region and are associated with a poor prognosis (2).

The treatment of malignant melanoma varies depending on the tumor characteristics (for example, the stage or site). Below-knee amputation previously adopted for the treatment of malignant tumors of the foot and ankle, which effectively reduces the recurrence rate, however, results in an increasing financial and psychological burden for the patients (3). With the progress of microsurgical reconstruction, limb salvage surgery using soft tissue reconstruction has recently emerged as a potential alternative for resectable malignant tumors

of the extremities. The surgical excision of melanoma, with adequate margins, is the fundamental treatment that leads to recovery in the majority of cases (4). However, large, complex soft tissue defects often remain following tumor excision, which are difficult to reconstruct due to the exposure of the bones, joints and tendons. Conversely, foot melanoma remains a challenge to surgeons who are required to consider the oncologic resection whilst preserving limb function (including, walking, moving and other weight-bearing activities). Therefore, the availability of a safe, easy and reliable reconstructive option is required to repair the foot in the region of the melanoma. A variety of techniques, including skin grafting and local- or free-tissue transfer, have been used for the soft tissue reconstruction of the foot and ankle (5,6). However, each has their own disadvantages and may not be suitable for all patients. Various reconstructive flaps have been used for repairing soft tissue defects in the foot and ankle, including lateral supramalleolar, medial plantar, reverse sural fasciocutaneous island, medial leg and lateral leg flaps. All of these types of cutaneous flap yield satisfactory results (7–9).

The reverse sural artery fasciocutaneous island flap was originally described by Masquelet *et al* (10) in 1992 and is a distally-based flap, which is generally accompanied by the sural nerve and vascularized by the median superficial sural artery. It has been shown to be ideal for coverage of the heel and the region of the lateral malleolus of the foot, particularly for large soft tissue defects.

Although cutaneous flaps have successfully been used in the soft tissue reconstruction of the foot as a result of trauma, infection and ischemia (7), few studies have considered the results of cutaneous flap reconstruction in patients presenting with a foot melanoma. Therefore, the aim of the present study was to assess the effectiveness of reverse sural fascio- cutaneous flap for reconstructing soft tissue defects following melanoma resection.

PATIENTS AND METHODS

PATIENTS AND GROUPS

A series of patients exhibiting melanoma involving the foot , fromAcharya Tulsi Regional cancer Treatment & Research institute, Bikanerduring the seven-year period from January 2015 to December 2021, were retrospectively reviewed. A total of 10 patients (males, n=7; females, n=3s) were enrolled in the present study and the mean age was 52.5 years (range, 39–66 years). The inclusion criteria were as follows: i) The patient diagnoses were validated by postoperative biopsy; and ii) the patient's skin lesion was confined to the foot and ankle. All patients, underwent Limb salvage surgery with soft tissue reconstruction. All the patients were followed up for an 8–84 months (median, 52 months) postoperatively. Patients provided written informed consent.

Cutaneous flaps were designed based on the incision size and anatomical characteristics of the affected area. A reverse sural artery fascio-cutaneous flap was selected to repair the soft tissue defects of the sole and heel of thefoot resulting from tumor resection.

SURGICAL TECHNIQUE

Melanoma tumors were excised based on their site of origin and anatomical characteristics. In all patients lesions were widely excised using a margin of 2-3 cm in all cases and all excisions extended into or included the deep fascia.The reverse sural flap is a fasciocutaneous flap that is raised along the course of the sural nerve [Figure 1]. Its blood supply depends on a constant sural artery that accompanies the nerve along its very proximal course. Distally, it depends on perforators coming from the peroneal artery. The flap is designed in the proximal posterior region of the leg, and the pivot point for this flap should be 5 cm posterior and superior to the lateral malleolus. We mark the site of perforators preoperatively using routine

Doppler ultrasound .we put split-thickness skin graft (SSG) to cover the pedicle. The donor site was closed using SSG based on the size of the defect.

POSTOPERATIVE CARE AND FOLLOW-UP

Following surgery, all patients were admitted to a specialized intensive care unit for monitoring. Surgical complications, cutaneous flap survival, tumor recurrence and metastasis, recovery of foot function, sensory recovery, and patients' complaints were observed during the hospital stay and the follow-up period. All patients received adjuvant treatment as per final histopathological report.

RESULTS

PATIENT COHORT

The demographics of the patients in each group are summarized in Table I. Among 10 patients, males outnumbered females at a ratio of 2:1 (males, n=7; females, n=3), although previous studies revealed that melanoma may be more prominent in females (11). Of the 10 patients diagnosed with melanoma, six were of the left foot and four were of the right foot. In the present study, various sites of the foot were found to be affected, including the sole of the foot (n=7), the heel (n=3). Patients commonly presented with pigmented black mass, with or without ulceration. The mean course of disease in these patients was 80 days. According to the European Organization for Research and Treatment of Cancer criteria (12), at diagnosis, there were 5 stage-I patients, 3 stage-II patients and two stage-III patients. Three patients underwent ipsilateralIlioinguinal lymph node dissection.

Table I: Demographics of the patients

							Post Surgery		
Patient No.	**Gender**	**Age (years)**	**Affected Foot**	**Location Plantar Sole**	**Tumor Stage**	**Surgical method**	**Follow up Months**	**Recurrence/ Metastasis**	**Patient Status DOD**
1	Female	66	Left	Plantar Sole	III	TR+RSF CF	70	Yes(Lun)	DOD
2	Male	39	Right	Plantar Sole	II	TR+RSF	62	No	NED
3	Female	63	Left	Plantar Sole	I	TR+RSF	57	No	NED
4	Male	55	Right	Heel	I	TR+RSF	42	No	NED
5	Male	50	Left	Plantar Sole	II	TR+RSF	36	Yes(Local)	DOD
6	Male	55	Right	Plantar Sole	I	TR+RSF	25	No	NED
7	Female	60	Left	Heel	III	TR+RSF	18	No	NED
8	Male	55	Left	Plantar Sole	II	TR+RSF	13	Yes(Ing.)	DOD
9	Male	50	Right	Heel	I	TR+RSF	8	No	NED
10	Male	55	Left	Plantar Sole	I	TR+RSF	6	No	NED

TR, Tumor Resection; RSF, Reverse Sural Flap; DOD, Died From Disease; NED, Alive with no evilence of disease; AWD, alive with disease; ING, Inguinal

POSTOPERATIVE COURSE OF THE PATIENTS

The size of the soft tissue defects following excision of the melanoma ranged from 4×4 cm to 6×8 cm. The reverse sural fasciocutaneous island flap was used in all patients for foot reconstruction. The length of the cutaneous flaps varied from 6 to 25 cm (mean, 12.2 cm) and

the width varied from 4 to 10 cm (mean, 6.6 cm). The patients were administered with routine treatment, which included elevation of the affected leg, anticoagulant agents, and antibiotics following surgery. During the postoperative follow-up, all cutaneous flaps survived the transfer and provided stable defect coverage, good contour, and nine out of 10 patients were able to ambulate with full weight bearing and no pain. After the reverse sural island flap, certain patients complained about a loss of sensation on the lateral aspect of the foot due to the routine sacrifice of the sural nerve during surgery, which has been reported in a previous study (13).

The postoperative complication rate was an important parameter to assess surgical success. The complications associated with salvage surgery using cutaneous flap reconstruction were observed in three patients. Two patients developed a mild infection at the incision site and. The symptoms disappeared rapidly following symptomatic treatment. one of the patients developed partial necrosis at the distal tip of the cutaneous flap, however, managed successfully with debridement and regular dressing.

Fig 1: Melanoma sole foot

Fig 2: After reverse sural flap reconstruction

All the patients were followed up for 8–84 months (median, 52 months). The overall survival rate of patients was 69.0%. In clinical stage I, no patients developed any signs of tumor recurrence or metastasis. The three patients with clinical stage II diseaseand two patients with clinical stage III melanoma develop tumor recurrence, or pulmonary or ilioinguinal lymph node metastasis, after two & three year follow-up.

DISCUSSION

Reconstruction of complex soft-tissue defects of the foot following extensive excision of a tumor remains a challenge due to the limited availability of local soft tissue, in addition to the particular structural and functional characteristics of this area. Recent studies have demonstrated and compared the benefits of cutaneous flaps for the coverage of defects of the foot and ankle (14,15), although primarily following trauma or ischemia. Few studies have investigated the benefits of salvage surgery using cutaneous flap reconstruction for the treatment of foot melanoma. The present study represents a retrospective analysis of a single-canter experience for the use of cutaneous flaps for soft tissue reconstruction as part of the treatment of patients with foot melanoma.

The ideal reconstruction of the foot should provide anatomical contour, durable skin, a protective sensation and, to a certain extent, preserve limb function (standing, walking and weight-bearing activities).

Skin over the sole of the foot, particularly the weight-bearing portion, requires reconstruction with similar tissues to obtain long-term function. The heel is an important, integrated aspect of the foot and is essential for smooth walking and weight-bearing activities. A reverse sural fasciocutaneous island flap is currently used for the reconstruction of large defects of the ankle and heel. Its anatomical structures constitute the pedicle, the superficial and deep fascia's, the sural nerve, the short saphenous vein and the superficial sural artery (16). The advantages of this type of cutaneous flap include a simple dissection procedure, low donor-site morbidity and a decreased surgical time when compared with traditional coverage methods. Rohmiller *et al* (17) reported that 11 procedures using reverse sural neurocutaneous flaps have been performed for hind-foot and ankle defects (mean size, 53 cm^2) and all cutaneous flaps achieved stable coverage. However, certain patients complained of a loss of sensation on the lateral aspect of the foot due to the routine sacrifice of the sural nerve during surgery. Dai *et al* (18) compared the clinical outcome and complications following transfer of a fascia pedicle- or a perforator pedicle-based sural fasciocutaneous flap, and the results demonstrated that the latter was a more reliable and safe procedure for the coverage of soft tissue defects in the lower extremities.

In the present study, the reverse sural fasciocutaneous island flap was used in all patients, , following the excision of melanoma lesions in the heel and sole of feet, which achieved good success rates.

In the present study, the cutaneous flaps varied in size according to the dimensions of the lesion resulting from extended resection of the tumor. The lesions ranged from 6×4 cm to 7×9cm in diameter. The design of the cutaneous flaps is an important factor when considering the final cosmetic appearance and reducing complications during the postoperative period. In the current study, the majority of the cutaneous flaps had sufficient blood supply, which provided good anti-infection protection. Only two patients developed a mild infection at the incision site following the salvage surgery, which soon disappeared following the administration of anti-infection treatment. In previous studies, the most frequently described complication of a reverse sural island flap was superficial flap necrosis. Afifi *et al* (19) conducted a retrospective study using 32 consecutive reverse sural flaps for foot and ankle defects. Four patients had minor superficial loss of the cutaneous flap and four patients experienced a delayed recovery. During the follow-up of the present study, one of the

patients demonstrated superficial flap necrosis at the distal tip of the cutaneous flap, and recovered completely within two weeks of debridement and regular changes of the wound dressing.

The goal of melanoma treatment is to increase the survival rate and the quality of life of cancer patients. Walsh *et al* (20) reported that, for patients with a melanoma of the foot/ankle, the overall five-year survival rate was 52%, compared with 84% for patients with a melanoma elsewhere on the lower extremities.

CONCLUSION

Reverse sural artery fasciocutaneous island flap provide effective coverage of soft tissue defects of varying sizes on the foot following the wide excision of a melanoma with positive oncological and functional outcome. It is easy to learn flap.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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