ORIGINAL ARTICLE

Malignant Melanoma of Heel, Middle Foot Sole, Plantar Forefoot and Immediate Reconstruction with Various Pedicle Locoregional flaps: Clinical Experience with 23 Cases

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ABSTRACT

Objective: To present our experience of cases of malignant melanoma of various regions of sole of foot and Immediate Reconstruction with various pedicle locoregional flaps

Study Design: Descriptive case series

Place and Duration of study: Study was conducted at Shifa International Hospital, Islamabad from August, 2009 to December, 2018.

Patients and Methods: Total of 23 patients underwent biopsy proven melanoma excision from sole of foot. The defect location was on heel in 17 patients, the middle plantar foot in 4 and forefoot in 2 patients. Excision margins were taken according to Breslow thickness. All the patients included in surgery had immediate reconstruction using pedicle locoregional flaps. Synchronous inguinal lymph node dissection was done in 15 cases and delayed lymph node dissection was done in 4 cases.

Results: Total of 14 sensate medial plantar artery flaps for defects of heel and mid-foot were performed, 6 single stage neurocuataneous sural flaps were done for defects of heel, and in one case a combination of sural and medial plantar artery flap was used. The medial plantar and fillet flaps healed well and the colour matches were excellent. None of the patients complained about the donor-site scar. All patients were satisfied with the functional results and cosmetic appearance. Positive margin was seen in one of the heel melanoma on definitive histopathology, re-resection with advancement of sural flap was done

Conclusion: Immediate reconstruction of various defects after acral lentiginous melanoma extirpation can be attempted with acceptable oncological safety. Majority of the defects can be reconstructed with loco regional flaps without relying on complex reconstruction procedures involving microsurgery with the added benefit of like with like reconstruction.

Introduction

Malignant melanoma accounts for a small percentage of the overall skin cancers diagnosed each year (3 percent) but is responsible for an alarming number of the deaths (65 percent) amongst white population.[1] Wide local excision is considered the mainstay of treatment for cutaneous melanoma and is dictated by the tumor thickness.[2,3] Melanoma exhibits great ethnic variability in terms of incidence, histopathology, areas of body involved and

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prognosis. Though it is the third most common skin cancer in Africans and Asians but incidence is significantly lower than Caucasians. Moreover, Asians and Africans develop melanoma at atypical, sun protected sites including acral, sub-ungual and mucosal skin. [4]

The foot represents the most common site for melanoma in people of African and Asian descent and most common histologic subtype of melanoma encountered is Acral Lentiginous Melanoma.[5] It was so named because of its predilection for acral (nonhair bearing) areas of the body, particularly the palms, soles, and the subungal areas, and its distinct radial or "lentiginous" growth phase. [7,8]

Defects in weight bearing regions of foot sole after melanoma extirpation can represent a substantial restriction in quality of life and pose a challenge for reconstructive plastic surgery. Therefore, choosing from reconstruction options for the weight-bearing plantar foot surface is crucial. Because of the limited availability and mobility of the adjacent skin, defects involving the plantar foot area may require complex reconstructive procedures. One of the most important factors for skin resurfacing of the weight-bearing area of the foot sole is the provision of an adequate type of skin with similar properties of thickness and sensitivity. [9]

Many techniques—such as skin graft, local flaps, local pedicle flaps, and free flaps—have been already described for the reconstruction of these regions.[10-17] However, the reconstructive options to improve outcomes are still under discussion and there is not a supreme procedure, which is considered as a gold standard; there are only few flaps that can withstand the daily stresses and loads posed by a person's body weight. Ideally, defects involving this area are optimally repaired using thin and pliable flaps, based on basic plastic surgery principles to replace "like with like," with minimal donor-site morbidity.[18]

In this article, we describe our experience using locoregional flaps including the sensate medial plantar artery flap, sural flap and sensate fillet flap for immediate reconstructionof various defects of the sole of foot after acral lentiginous melanoma excision in a series of 23 cases.

Patients and Methods

23 patients underwent biopsy proven melanoma excision from sole of foot from August, 2009 to December, 2018. There were 9 male patients and 14 female patients. The average age of the patients was 57 years (range, 30 to 74 years). The defect location was on the heel in 17 patients, the middle plantar foot in 4 and the forefoot in 2 patients. All patients were staged according to AJCC staging system, 7th Edition (Table 1). Tumor margins were taken according to Breslow thickness(T), and margins were subjected to frozen section. In all cases, owing to the weight bearing sites, skin grafting could not be done. All the patients included selected for surgery had immediate reconstruction using pedicle
loco-regional flaps. Simultaneous inguinal lymph node dissection was done in 15 cases and delayed lymph node dissection was done in 4 cases.

Table 1: AJCC 7th Edition TNM Staging for Malignant Melanoma[19]

Tumor	**Thickness (mm)**	**Ulceration status**
Tis	NA	NA
T1	≤1.00	a) Without ulceration and mitosis <1/mm2 b) With ulceration or mitosis >1/mm2
T2	1.01-2.00	a) with ulceration b)without ulceration
T3	2.01-4.00	a) with ulceration b)without ulceration
T4	>4.00	a) with ulceration b)without ulceration
Node	**No of Metastatic Nodes**	**Nodal Metastatic Burden**
N0	0	a) Micrometastasis b) Macrometastasis
N1	1	a) Micrometastasis b) Macrometastasis
N2	2-3	a) Micrometastasis b) Macrometastasis c) In transit metastases/satellite without metastatic nodes
N3	4+metastatic nodes or matted nodes, or in transit /satellite with metastatic nodes	
Metastasis	**Site**	**Serum LDH**
M0	No distant metastases	NA
M1a	Distant skin, subcutaneous or nodal metastases	Normal
M1b	Lung metastases	Normal
M1c	All other visceral metastases Any distant metastasis	Normal Elevated

Table 2: Summary of Characteristics of Patients, Tumor and type of Defects and Flaps

Patients	Age yrs	Sex	Tumor Class	Excision Margins (cm)	Defect Location	Defect Size (cm)	Type of flap (All pedicled)	Inguinal Lymph node dissection	Follow Up Months	Complication
1	63	M	T3	1.8	heel	3x3	MPAF	synchronous	8	None
2	47	F	T2	1.6	heel	2.5x3.5	MPAF	delayed	6	None
3	74	F	T4	1.8	midfoot	2.5 x 3.0	MPAF	synchronous	12	None
4	56	M	T4	1.8	heel	6.5x5	MPAF	synchronous	9	Donor site partial graft loss
5	55	F	T3	1.8	midfoot	3x4	MPAF	synchronous	9	none
6	65	F	T2	1.6	heel	5x4	SF	delayed	9	Flap congestion, wound dehiscence
7	30	M	T1	1.0	heel	3x3	MPAF	synchronous	12	none
8	48	F	Tis	0.6	heel	2.5x2.5	MPAF	None	4	none
9	50	F	T3	1.8	heel	3x3	MPAF	synchronous	16	none
10	44	M	T4	1.8	heel	6x6	SF	synchronous	6	Flap congestion
11	70	M	T3	1.8	forefoot	3x3	FF(2^{nd} toe)	synchronous	6	none
12	66	F	T3	1.8	heel	5x5	SF	synchronous	4	none
13	39	F	T2	1.6	heel	2x3	MPAF	delayed	9	None
14	72	M	T1	1.0	heel	4x4	MPAF	None	8	none

15	67	F	T2	1.6	heel	3x4	SF	synchronous	9	none
16	53	F	T4	1.8	forefoot	2x2	FF(3rd toe)	synchronous	12	none
17	71	M	T4	1.8	heel	2x2	MPAF	synchronous	8	none
18	66	F	T3	1.8	midfoot	3x2	MPAF	synchronous	8	none
19	57	F	T2	1.6	heel	7x8	SF	delayed	6	none
20	61	M	T4	1.8	heel	10x7	MPAF +SF	synchronous	5	Wound dehiscence
21	44	F	T3	1.8	heel	4x3	MPAF	synchronous	8	none
22	49	F	T2	1.6	midfoot	3x3	MAPF	synchronous	4	none
23	64	M	T3	1.8	heel	4x3	SF	synchronous	6	none

M: male, F: female, MPAF: medial plantar artery flap, SF: sural flap, FF: fillet flap

Results

All flaps were pedicled. Total of 14 sensate medial plantar artery flaps for defects of heel and mid-foot were performed, 6 single stage neurocuataneous sural flaps were done for defects of heel, and in one case a combination of sural and medial plantar artery flap was used for 10x7cm defect on heel of foot. In all cases donor site was given coverage with split thickness skin graft secured with tie over dressings. Two cases of tumor extirpation defects on plantar forefoot were dealt with sensate fillet flaps from 2nd and 3rdtoe. All of the flaps survived with success rate of 100%. Early flap congestion was seen in two sural flap cases, both of which were managed by elevation, suture opening and heparin leeches. One of the flaps which was congested was associated with wound dehiscence afterwards.

Positive margin was seen in one of the heel melanoma (4%) on definitive histopathology, re-resection was done with advancement of sural flap was done. Partial graft loss was seen in donor area of medial plantar artery which was dealt conservatively on dressings. Wound break down was seen in two cases of heel reconstruction with sural flap and combination of sural and medial plantar artery flap which was managed conservatively with silver impregnated

alginate dressings and NPWT, respectively. The follow-up time ranged from 4 to 16 months (mean, 9 months). The medial plantar and fillet flaps healed well and the color matches were excellent. None of the patients complained about the donor-site scar. All patients were satisfied with the functional results and cosmetic appearance. All the patients with medial plantar artery perforator flap started wearing regular footwear, patients with fillet flaps showed preference for close footwear after surgery. 02 patients with sural flap have to wear silicone insole as well as one size above their pre-surgical shoe size. Details are listed in Table 2.

Case Series

Case 1: Coverage of Heel Defect: A 56-year-old man sustained a weight-bearing malignant melanoma on the right heel. After a wide excision, a tumor-free defect measuring 6. 5 × 5 cm was noted. A pedicled medial plantar artery perforator flap was harvested from the ipsilateral instep area based on one perforator. Then, the flap was transferred to reconstruct the defect. The donor site was covered with split-thickness skin graft from the contralateral thigh. The flap survived completely and the donor site healed uneventfully. The follow-up time was 9 months (Fig.1). The patient had full functional recovery with an acceptable cosmetic result.

Figure 1: Coverage of malignant melanoma defect with medial planter flap.

Case 2: Coverage of MidfootDefect:A 66-year-old woman had biopsy proven acrallentiginousmalignant melanoma on the rightmid footh. After a wide excision, a tumor-free defect measuring 6. 5 × 5 cm was noted. A pedicled medial plantar artery flap was harvested from the ipsilateral instep. Then, the flap was transferred to reconstruct the defect. The donor site was covered with split-thickness skin graft from the contralateral thigh. The flap survived completely and the donor site healed uneventfully. The follow-up time was 12 months(Fig.2). The patient had full functional recovery with an acceptable cosmetic result.

Figure 2: Coverage of Midfoot melanoma –defect with medial planter artery flap

Case 3: Coverage of Heel Defect: A 44-year-old man sustained a weight-bearing malignant melanoma on the right heel. After a wide excision, a tumor-free defect measuring 6 × 6 cm was noted. A pedicled neurocutaneous sural flap based on perforators was harvested. Then, the flap was transferred to reconstruct the defect. The donor site was covered with split-thickness skin graft from the contralateral thigh. The flap survived completely and the donor site healed uneventfully. The follow-up time was 9 months (Fig.3). The patient had full functional recovery with an acceptable cosmetic result.

Figure 3: Coverage of Heel Defect with neurocutaneous sural artery flap.

Case 4: Coverage of Plantar Forefoot Defect: A 70-year-old man had biopsy proven acral lentiginous melanoma on left plantar forefoot near base of 2nd toe. After a wide excision, a tumor-free defect measuring 3 x3 cm was noted. Fillet of 2nd toe was raised (patient was consented about loss of 2nd toe before the procedure). Then, the flap was transferred to reconstruct the defect. The flap survived completely and the donor site healed uneventfully. (Fig.4).Patient had full functional recovery.

Figure 4: Coverage of forefoot acral letigminame melanoma with a 2nd fillet flap

Discussion

Acral-lentiginous melanoma is the least common melanoma in Caucasians but is responsible for 30 to 60 percent of melanoma in dark-skinned individuals. It commonly occurs on the palms, soles of the feet, and beneath the nail beds. It is aggressive, usually presents late and frequently metastasize.[20] The Jamaican musician Bob Marley died as a result of an acral lentiginous melanoma.

All lesions suspicious of melanoma should be submitted to an excisional biopsy. The biopsy should be performed with 1- to 3-mm margins of skin, removing the subcutaneous fat but leaving fascia. Even with a very suspicious lesion, wide curative excision should not be performed before a tissue diagnosis. Shave or punch biopsies should not be performed. These incisional techniques should be used only in cases where the diagnosis is uncertain and the lesion is so large that a significant cosmetic defect would result if the lesion turns out to be benign.Two studies(2005 and 2010) have compared the recurrence rates and survival statistics in excisional and incisional biopsies.[21,22]These studies failed to find any difference in prognosis, recurrence, or disease free or overall survival.

A complete history and physical examination should be performed with attention to the locoregional area and draining lymph nodes. Imaging (computed tomography, magnetic resonance imaging, or positron emission tomographic scanning) should be performed only if indicated by specific signs or symptoms identified during the examination. Sentinel node biopsy represents the most important step in the workup for regional metastasis. If clinically enlarged nodes are identified, a fine needle biopsy or open biopsy is recommended. Baseline imaging may be obtained in patients with clinical regional or distal metastasis.

Immediate reconstruction of post melanoma extirpation defects can be done with acceptable oncological safety. In our series only one patient had positive margin (4%).

Surgical reconstruction of soft-tissue defects in the foot sole regions poses one of the greatest challenges for plastic surgery. The location of the defect hampers the patient's quality of life enormously, and the peculiar anatomical structure of the plantar foot can make repair of even a small defect a difficult task. In particular, because of the very robust and thick characteristics of the skin of this area, it can easily withstand the stresses and loads to which it is exposed on a daily basis. Many soft-tissue reconstructions of these areas have been described using traditional local and free flaps with the common aim to use a type of skin having properties similar to those of the original skin for appropriate coverage and function. Since the description of the freestyle perforator flap and the perforasome theory pioneered by Wei and Mardini, the use of local perforator flaps has grown in popularity.[23] Thus, local perforator flaps based on the plantar medial artery have been successfully used for plantar foot reconstruction, although the size of the defects represents the main limitation.As it has been already reported in the literature, the perforator nourishing the medial plantar artery perforator flap is constant and can be found between the adductor hallucis muscle and the flexor digitorum brevis muscle in proximity to

The navicular bone.[24]In on our series however, we did not island the medial plantar artery flap on perforators and used a pedicle flap in all cases providing reliable like with like kind of reconstruction for most of the heel and mid-foot defects. Nevertheless, the small size of the flap is an unavoidable limitation of this flap.

Defects in forefoot pose special challenge, owing limited local reconstruction options. The first choice is medial plantar artery perforator flap based on distal perforator but it is very small in most of the cases and difficult to perform. In our experience, in highly selected cases and proper counseling and consenting second and third toe fillet flap is still a viable option as it not only provided sensate good quality skin but also an acceptable donor site. The limitation of the pedicled medial plantar artery flap is that it is not suitable for the repair of a large defect involving more than two-thirds of the plantar foot; our largest flap was 4.5 × 7 cm, which actually represents the whole instep area. Secondly, pedicle medial plantar artery flap cannot usually reach the forefoot defects especially between the 3rd and 4th metatarsal, where either a free flap or other reconstruction options are required. Thirdly, if the heel defect extends to the non-weight bearing part of the heel, pedicle medial plantar artery flap becomes insufficient. However, it is usually large enough for middle and small defects coverage. In contrast, the medial plantar artery flap has several advantages: (1) optimal flap thickness and quality for plantar foot reconstruction, (2) good color and texture match, (3) minimal donor-site morbidity, (4) lack of functional loss, (5) wide arc of rotation, (6) consistent and reliable vascular anatomy.

The reverse sural flap is a proven method for providing coverage for defects of the lower one-third of the leg, ankle, and foot.[25,26] Limitations regarding plantar defect coverage using the reverse sural flap relate to its reach, tethered by its perforator. Flaps as large as 338 cm^2 can be obtained by extending the flap proximally to just distal of the popliteal crease,[27] and transversely to the mid-lateral line on either side of the lower leg.[28] Approximately one-third of studies mention recovery of at least deep or protective sensation in non-necrotized flaps. The sural artery flap is prone to edema and venous congestion. In our clinical experience it was seen that complications like wound dehiscence and congestion are high in sural flap reconstruction than medial plantar artery flap. Return to usual life is delayed in sural flap reconstruction for heel defects as compared to medial plantar artery flap.

Conclusion

In summary, immediate reconstruction of various defects after acral lentiginous melanoma extirpation can be attempted with acceptable oncological safety. Majority of the defects can be reconstructed with loco-regional flaps without relying on complex reconstruction procedures involving microsurgery with the added benefit of like with like reconstruction. Our case series shows that the medial plantar artery flap is an ideal and optimal method for covering small to medium size defects of the heel and middle foot sole with a minimal donor site morbidity. Sural flap is a viable option for defects of heel lying not amenable to medial plantar artery flap reconstruction.

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