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Original Research

Surgical Management of Plantar Melanoma: A Retrospective Study in One Center

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ABSTRACT

Cutaneous melanoma is a highly malignant skin tumor, and in China, the planta pedis is a commonly involved site. The sites of plantar melanomas are a challenge to reconstruct after wide excision. Our experience with surgical management of melanomas was based on the 4 different anatomic subunits of the planta pedis. From January 1, 2002 to December 31, 2016, 35 patients who had had plantar melanoma had undergone surgical treatment in our clinic. The tumor locations were as follows: the toe in 6, the ball of the foot in 5, the arch in 15, and the heel in 9. Surgical management involved extended resection of the tumor, repair of defects with skin grafts or flaps, and inguinal lymphadenectomy. The skin flaps included a residual toe flap, an anterograde or retrograde medial plantar flap, and a retrograde sural neurocutaneous vascular flap. Of the 35 cases of flaps and skin grafts, 33 (94.29%) survived, and the wounds had healed by first intention. After a follow-up period of 6 months to 7 years, 24 patients (68.57%) were free of local and systemic disease and 30 patients (85.71%) were ambulatory using shoes, and all the flaps and skin grafts showed a good appearance. The personalized surgical treatments we used for melanoma in the planta pedis resulted in overall satisfactory outcomes and adequate disease clearance, and allowed the patients to resume normal lives. The function of the foot was maintained or restored to the greatest possible degree, and the patients' quality of life improved postoperatively.

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Cutaneous melanoma is a common malignant skin tumor, and its incidence has increased considerably during the past 30 years in most countries (1,2). In China, acral melanoma is the most common subtype of melanoma, commonly occurring on the planta pedis (2,3). Extended surgical resection is the primary treatment of cutaneous melanomas, and optimal surgical margins are determined by the thickness and diameter of the primary lesion (4,5). According to the guidelines from the National Comprehensive Cancer Network, adequate surgical margins should be ≥ 1 to 2 cm from the edge of the tumor (5). Excision typically results in a large soft tissue defect with exposed metatarsal fascia or exposed bones that requires closure. However, the

plantar foot lacks skin laxity and is not amenable to primary closure. Therefore, the plastic surgeon must reconstruct the soft tissue defects after primary tumor resection.

Possible approaches to reconstruct the plantar foot include skin grafts or skin flap transplantation, such as free flaps, local flaps, and muscle flaps. However, each technique has its own limitations. Free flap operations are complex and time consuming and must be performed by microsurgical professionals. Also, the patient must be in good condition. The compact structure of the soft tissue of the plantar foot leads to difficulty in designing local flaps. Additionally, skin flaps are not able to meet the subsequent functional requirements of the foot. Therefore, to maintain adequate function and appearance, defects resulting from wide local excision must be repaired according to the location of the melanoma. Based on our previous experience, we divided the planta pedis into the following 4 anatomic regions according to the different functions: the toe, ball, arch, and heel (Fig. 1). We reviewed the medical records of 35 patients who had had melanoma in the planta pedis and had undergone surgical treatment in our clinic. We believe that sharing our experience will be helpful for future clinical practice.

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Fig. 1. Regions of the planta pedis and strategies for surgical management of the melanomas. Region I (toes): when the tumor was located on the toe, proximal toe, or the toe web, extended resection of the tumor and amputation of the toe was performed, and a residual toe flap was used to repair the wound. Region II (ball of the foot): when the tumor was located on the ball of the foot, extended resection of the tumor was performed, and a retrograde medial plantar flap was used to repair the wound. Skin grafts can be added, if necessary. Region III (arch): when the tumor was located at the arch, extended resection of the tumor was performed, and skin grafts were used to repair the wound. Region IV (heel): when the tumor was located on the heel, extended resection of the tumor was performed, and a medial plantar flap or retrograde sural neurocutaneous vascular flap was used to repair the wound.

Patients and Methods

From January 1, 2002 to December 31, 2016, 35 patients (24 [68.6%] males and 11 [31.4%] females), aged 18 to 78 years, were enrolled in the present study. The diagnosis was melanoma in the planta pedis in all patients, who underwent surgical management in our clinic. Melanoma in the planta pedis typically appears as an unusual skin pigmentation or a progressively enlarging neoplasm. Some are also accompanied by recurrent ulcers and infection (2). After a biopsy of the lesion and confirmation of the diagnosis of melanoma, the patients underwent the necessary preoperative laboratory examinations, including routine blood tests, coagulation studies, and a comprehensive metabolic panel. Color Doppler, computed tomography (CT), or positron emission tomography-CT images were obtained to exclude the presence of distant metastasis. The patients underwent surgical management as soon as possible, which included extended resection of the tumor, repair of the wound, and inguinal lymphadenectomy.

The scope of the extended resection was determined by the location, size, and depth of the primary tumor. Reconstructive surgery was subsequently performed to provide adequate wound coverage, preserve the function of the foot, and optimize the cosmetic

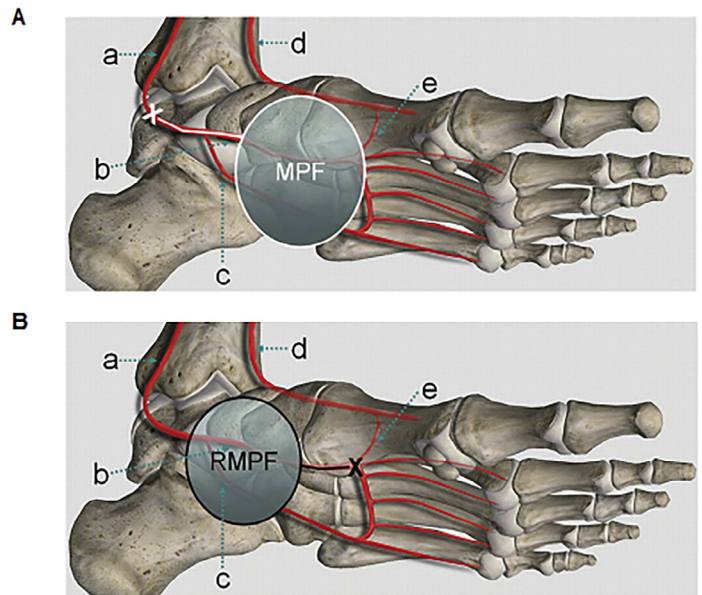


Fig. 2. A diagram of the (A) medial plantar flap (MPF) and (B) retrograde medial plantar flap (RMPF): a, posterior tibial artery; b, medial plantar artery; c, lateral plantar artery; d, dorsal artery of the foot; e, deep branch of the dorsalis pedis artery to the deep plantar arch; and X, rotation point of the flap. Courtesy of Min Wang, MS.

outcome (6). For tumors on the toes or toe webs, the involved toe was amputated, and the wound was repaired using a residual toe flap. For tumors on the ball of the foot, the wound was repaired by a retrograde medial plantar flap and/or skin graft. For melanomas on the arch of the foot, the wound was repaired using a split-thickness skin graft. For melanomas on the heel, a medial plantar flap or a retrograde sural neurocutaneous vascular flap was used to repair the primary wound. Fig. 1 illustrates the strategies for extended tumor resection and wound repair. Fig. 2 illustrates the designs of the anterograde and retrograde medial plantar flaps.

Before surgery, all involved arteries and artery perforators were assessed using a Doppler blood flow meter and marked on the skin. Patients undergoing medial plantar flap repair underwent an ultrasound Doppler or CT angiography (CTA) examination to detect the posterior tibial artery and medial plantar artery. For retrograde medial plantar flaps, the locations of the medial artery, dorsalis pedis artery, and its deep branches were confirmed. CTA examinations were used to identify the vessel arch formed by the dorsalis pedis artery and its deep branches, the medial plantar artery, and the lateral plantar artery, which provide the blood supply to the flap. For the retrograde sural neurocutaneous vascular flaps, Doppler examination was used to confirm the location of the peroneal perforator artery.

All patients routinely underwent inguinal lymphadenectomy with superficial lymph node dissection. An 8- to 10-cm oblique incision was made starting 2 cm medially to the anterior superior iliac spine through the medial one third of the inguinal ligament to the femoral triangle. The inguinal adipose tissue was dissected from superficially to deep and from top to bottom. The great saphenous vein and its superficial branches around the lymphatic fat pad of the femoral triangle were transected and ligated. The medial fascia of the sartorius muscle was exposed, and the adipose tissue surrounding the femoral vessels and femoral triangle were removed completely. To prevent the formation of a seroma or hematoma, a no. 14 drainage tube was placed behind the incision. If enlarged lymph nodes were present in the femoral sheath, the femoral sheath was opened, and complete lymph node dissection was performed.

After surgery, all the patients were placed on strict bed rest, and the affected limbs were elevated to improve blood circulation. Antiinfection treatment and hemostatic therapy were implemented, and drugs were used to improve the microcirculation. The blood circulation to the flaps was monitored by observing the color, temperature, and capillary filling sign. At 9 days after surgery, the dressings were removed to determine whether the skin grafts had survived. The drainage tube was removed when the fluid accumulation was <10 mL/day. The dressings were changed regularly until the wound and incision had healed completely.

Results

Of the 35 patients, 6 (17.14%) had a tumor located on the toes or toe webs. In these patients, the involved toe was amputated, and the wound was repaired by a residual toe flap. In 5 (14.29%) patients, the

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