Continuing Medical Education

Squamous Cell Carcinoma of the Foot

This is a case presentation with a discussion of epidemiology, pathophysiology, signs and symptoms, differential diagnosis and treatment.

Objectives

After completion of this article, one should be able to:

1) Learn the etiologies of squamous cell carcinoma.

2) Understand the development of squamous cell carcinoma from a Marjolin's ulcer.

3) Understand the common causes of a Marjolin's ulcer.

4) Learn the stages of squamous cell carcinoma based on differentiation.

5) Understand the different clinical manifestation of squamous cell carcinoma.

6) Understand the imaging modalities available for the assessment and diagnosis of squamous cell carcinoma of the foot and ankle.

7) Learn the different techniques of biopsy available and the need for biopsy of squamous cell carcinoma.

8) Understand the sentinal lymph node for squamous cell carcinoma and the need to biopsy after detection of the tumor.

9) Learn the different treatments available for squamous cell carcinoma and the advantages and disadvantages of each.

10) Understand the different surgical techniques for plantar foot reconstruction after resection of a squamous cell carcinoma.

11) Understand the recurrence of squamous cell carcinoma and the long-term follow-up needed for these patients.

12) Understand that chronic osteomyelitis can develop into squamous cell carcinoma.

13) Understand the common sites and the incidence of metastasis of squamous cell carcinoma.

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*Following this article, an answer sheet and full set of instructions are provided (p. 198).—**Editor***

By Linnie Rabjohn, DPM, Cornelius Donohue, DPM, Richard Montilla, MD, and Frederick Lavan, MD.

Squamous cell carcinoma (SCC) involving the distal lower extremity, specifically the foot and ankle, challenges the ability to ambulate along with the overall health of the individual. Foot and ankle specialists must obtain a greater understanding about transformation of previously injured skin into this form of malignancy, termed Marjolin's ulcer. Currently there is not a defined standard of care relating to the biopsy of suspicious lesions and wounds. While the incidence of SCC occurring on the distal lower extremity is low, the risk of metastases and recurrence is high. A case presentation is followed by a thorough review of literature pertaining to SCC.

Case Presentation

A 65 year old African-American male with no significant medical history was admitted to Graduate

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Hospital from the hospital wound care center with complaint of a painful plantar lesion on his left foot. The patient related that the lesion had been present for thirty-eight years but had increased in size and tenderness over the past eight months. The lesion had been treated as an ulceration with local wound care and oral antibiotics without improvement during that time. He relates a history of surgery in 1966 to have a foreign body removed from his foot.

The patient denied any significant medical or surgical history and related an unknown maternal family history but relayed that his father died of esophageal cancer. He has a pack-daily-for-twenty-years history of smoking along with heavy alcohol use.

Physical examination revealed a lesion on the plantar left foot described as a 5 cm. by 6 cm. circular lesion with blackened borders and centro-medial herniating, pedunculating mass appearing fibro-granular. There was no sign of cellulitis, purulence, or tracking to osseous structures at that time. The dorsalis pedis and posterior tibial pedal pulses were normal and symmetrical, bilaterally.

Admission labs demonstrated no leukocytosis, and all other initial lab values were within normal limits. Radiographs of the left lower extremity were unremarkable and negative for osteomyelitis. Vascular studies revealed ABI of 1.19 and no decrease in segmental pressures or alteration in triphasic waveforms.

Initial Surgery

The first surgery involved a debridement of the area of the left foot with two separate soft tissue biopsies collected. The two biopsies, one central and one from the lesion perimeter, revealed an invasive, well to moderately-differentiated, keratinizing squamous cell carcinoma extending to all borders including the base of the biopsy specimens. The intra-operative soft tissue culture taken of the wound grew pan-sensitive Staphylococcus aureus and Pseudomonas. The patient was treated with a two-week course of appropriate intravenous antibiotic.

Squamous Cell Carcinoma (SCC) is a malignant skin tumor of keratinocytes located in the epidermis or appendages.

Following the initial pathology report, an MRI of the left lower extremity was performed. There was increased signal of the subcutaneous area of the lesion and also tissue deep to the flexors. No bone infection was evident on MRI, and the plantar fascia appeared normal. Six days after the initial surgical procedures, a sentinel lymph node biopsy, wide excision of the lesion and a split-thickness skin graft was performed (Figure 1).

During the wide excision, part of the plantar fascia, as well as the muscle fascia of the first layer of intrinsic musculature, was excised and biopsied. The pathology report from this second surgery showed negative sentinel lymph node results of the left groin and negative involvement of a pigmented nevi also located on the left lower extremity. The flexor digitorum brevis was negative for SCC, and all borders of the excised tissue were clear of SCC. A meshed full-thickness skin graft was applied to the left plantar foot following the excision.

The wound went on to heal uneventfully (Figure 2).

Defining Squamous Cell Carcinoma

Squamous Cell Carcinoma (SCC) is a malignant skin tumor of keratinocytes located in the epidermis or appendages. This malignancy is the second most common skin tumor following basal cell carcinoma.[1,2] SCC is linked to exposure to ultraviolet light, its most common etiology.[3] The UVL (ultra-violet light) acts as both a tumor promoter and initiator by suppressing the tumor suppressor gene.[5] For this reason, the location of SCC typically involves areas of sun-exposed skin, with only 2.4% occurring on the foot.[7] As latitude increases, so does the amount of UVL exposure; therefore, for every 8-10 degree in-

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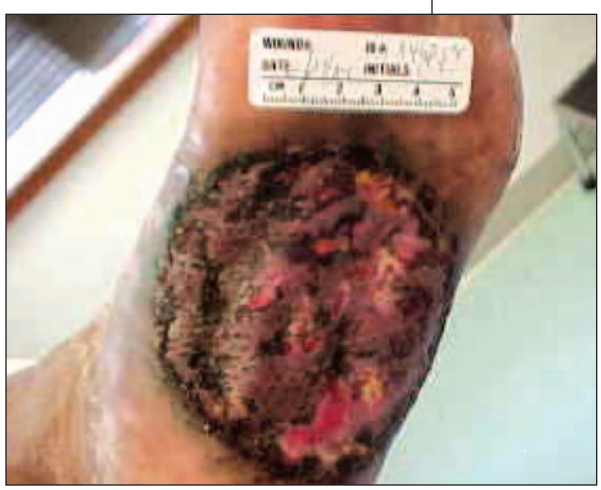

Figure 1: Squamous cell carcinoma following excision and placement of full-thickness skin graft to site.

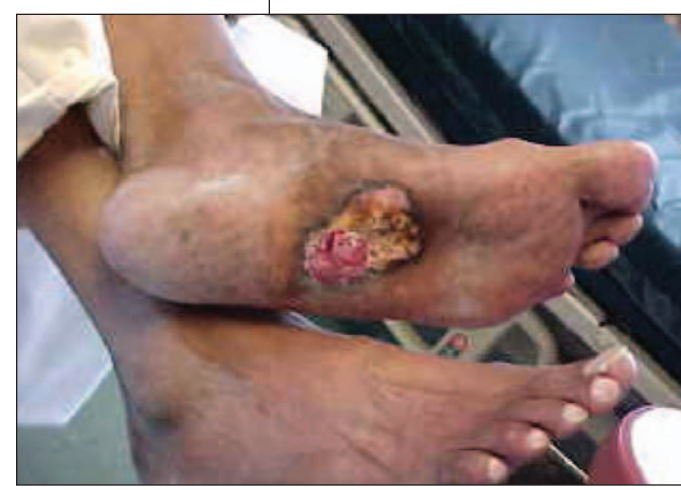

Figure 2: Squamous cell carcinoma three months after full excision and placement of skin graft.

crease in latitude, the incidence of SCC doubles.[3] The highest incidence of SCC occurs in countries with high sun exposure.[4]

There exists a strong link between immuno-compromised patients and the development of SCC. Patients receiving immunosuppressive therapy for organ transplant have an occurrence rate 65-250 times more than the general population.[4] Renal transplant patients have the highest occurrence.[6] Research has shown that cyclosporine in combination with other medications exhibits a higher likelihood for development.[7] Studies are needed to determine any links between the more recent immunosuppressive agents and subsequent increased incidence of SCC.

Currently there is not a defined standard of care relating to the biopsy of suspicious lesions and wounds.

Marjolin's Ulcer

A subset of SCC arises from previously injured areas of skin and is referred to as Marjolin's ulcer, the majority of which are located in the lower extremity. Marjolin's ulcer is a term used to describe malignancy involving a post-traumatic scar and frequently has been primarily associated with development with a burn scar.[8-11] Currently, the term has broadened to include malignancy involving any previously degenerated or compromised chronic cutaneous alteration. The majority of Marjolin's ulcers, around 60%, are located on the lower extremity. It is imperative that clinicians be aware of the capacity to develop SCC from chronic neuropathic wounds, venous stasis, sinus tracts, osteomyelitis, decubitus ulcerations, warts, burns, or any previously injured skin.[9-13,33-4]

The exact mechanism for pathogenesis of SCC within compromised skin has yet to be determined. The three main theories on the development of Marjolin's ulcers have been cited in literature and built upon since their construction.[11] Virchow's theory reflects the concept that damaged tissue may incur vascular compromises, which may lead to nutritional deficits, creating an environment suitable for development of an ulcer. Both the surrounding vascular and lymphatic channels are compromised, which may lead to a decrease in surveillance of cellular mutations occurring at the site.[9] In essence, there is an area of which the immune system is unaware.

Treves and Packs theorized in 1930 that epithelium for a multitude of reasons may become dry, thin, and delicate, allowing even slight trauma to cause destruction.[11,14] As this area is regenerating, neoplastic changes may occur due to the loss of the tissue's normal characteristics. The exact cause of cellular mutation remains unclear but may be the result of chronic irritation and adaptation, or the release of toxins from the damaged tissue.[9,15]

Ribbet's theory associates the misplaced and inferior epithelium to the chronic irritation and breakdown of epithelium.[11] The duration between the initial alteration of skin components to the development of malignancy varies dependent on the type of alteration and possibly is associated with the host's systemic factors. A burn scar becomes an isolated area in regards to immunology due to the obliteration of surrounding lymphatic channels.[9] This isolation causes the surveillance mechanism for cellular mutations to become less effective and efficient. In turn, the tumor may grow to very large sizes before detection by the body's immune system. The lag period between development of malignancy and the age at time of burn is thought to be inversely proportional.[11]

SCC arising from a Marjolin's ulcer initiated from a pressure wound can be more aggressive than carcinomas associated with other chronic wounds.[16] There appears to be an increased metastatic rate with pressure, ulcer-related SCC and increased mortality. An atypical cellular occurrence within the wound-healing process could be responsible for the malignant transformation.

Clinical Manifestations

With focus on the lower extremity, certain features should trigger the physician into a wider differential diagnosis, to include SCC, based on etiology, physical appearance, and morphology of chronic wounds. While Marjolin's ulcer is associated with previous burns, repeated trauma, radiotherapy, and diabetes mellitus, lack of etiology also raises concern. As the physician follows the course of a chronic wound, physical morphologic change should be assessed.

Marjolin's ulcer is associated with two main physical descriptions.[8,9] The first is a shallow, well-defined ulcer with nodular elevations at the periphery. The SCC component is typically located at the margins in this form. The second is an aggressively growing exophytic tumor with papillary granulations.[10] This may also have the ap-

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TABLE 1
SQUAMOUS CELL CARCINOMA STAGES

Stage	Percentage based on number of differentiated cells	
I	>75%	well differentiated
II	50-75%	well differentiated
III	25-50%	differentiated
IV	<25%	differentiated

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pearance of a dermatitis-like plaque.[18] Most skin pathologies have a preferential area of involvement; therefore, wounds occurring at unusual locations also warrant suspicion.

With subungual or digital involvement, physical symptoms of the tumor may lead to misdiagnosis of nail pathology, such as onychomycosis or paronychia to soft tissue masses such as pyogranuloma or subungual exostosis.[19,20] Bone involvement of the distal phalanx should be considered high due to the very limited soft tissue envelope of the digit. For this reason, proximal amputation, either partial or full digit, is a definitive cure with little post-operative ambulatory modifications for the patient.

Staging of SCC

Staging of SCC is based on a gradient determined by the percentage of differentiated cells present within a biopsy of the tumor.

The staging should include SCC borders assessing the boundary of the tumor.[6] Prognosis, aggressiveness, and metastatic potential worsens with each degree of differentiation.[5] Different fields of the tumor may exhibit varied differentiation, and thus grading is based on the least-differentiated portion.

Biopsy Protocol

To date there exists no protocol defining requirements for the need of biopsying chronic wounds to determine the presence of malignancy. There is literature to support routinely biopsying all wounds, determining the need for biopsy based on length of time the wound has been present, and only biopsying those wounds that appear suspicious. Suspicious is a vague term for the description of the appearance of a wound and therefore can be very misleading. On the other end of the spectrum, biopsying all wounds is neither efficient nor cost-effective. So then how does a clinician define a protocol for biopsying wounds? There is a need to closely follow chronic ulcers and a recognition that changes within the ulcer do warrant baseline and repeat biopsies. The indications for biopsies have been defined in table two. Although not inclusive, they do provide some guidelines for biopsy.

Marjolin's ulcer is a term used to describe malignancy involving a post-traumatic scar and frequently has been primarily associated with development with a burn scar.

Sentinel Node Biopsy

Sentinel node biopsy allows for mapping and identification of the lymph node that drains the site of primary malignancy.[2] The sentinel lymph node (SNL) is the first node in the lymphatic channel to receive lymph from a tumor site. Concerning the lower extremity, it generally would be considered either the popliteal or inguinal node. If the SNL is found to be free of cancer, then no further dissection of the lymph node is needed. The clinician should continue to closely monitor the lymph node for any change.

Imaging Modalities of SCC

Squamous cell carcinoma invading bone by metastasis through soft tissue may be visualized by plain film radiography. Plain films should be ordered for any patient presenting with either a previously diagnosed SCC of the lower extremity or for those whose diagnosis has yet to be confirmed (Figure 3). An SCC involving the lower extremity, especially the foot, warrants plain films due to the limited soft tissue envelope surrounding the bone structures. If the SCC presents in the form of Marjolin's ulcer, there should also be concern about the presence of osteomyelitis.

Metastatic lesions of the bone are characterized by the presence of diffuse demineralization and extensive destruction.[20] Note that there is difficulty in the distinction between necrotic and metastatic bone by radiograph alone. Plain films may also mislead one to the assumption that bone is not involved with an absence of osseous changes, when, in fact, the periosteum may have been invaded.[10] A metastatic development within bone complicates both the primary treatment of the cancerous lesion, but also the ability to save a limb.[13]

The clinical value of MRI for SCC lies in its non-invasive capacity and the ability for high resolution definition of soft tissues.[23] MRI

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TABLE 2
INDICATIONS FOR BIOPSY OF A CHRONIC WOUND

- Chronic wound refractory to healing by standard wound care
- Wounds with increasing size despite appropriate treatment
- Malodorous or painful wounds
- Wounds with excess granulation tissue that exceeds beyond margins
- Wounds with irregular base or margins
- Wounds with a change in drainage, excess bleeding, or exophytic growth
- Dermatitis unaffected by anti-fungal or steroid creams[18]
- Warts unresponsive to therapy[5]
- Wounds whose etiology can not be linked to neuropathy, pressure, vascularity, or an underlying systemic disease

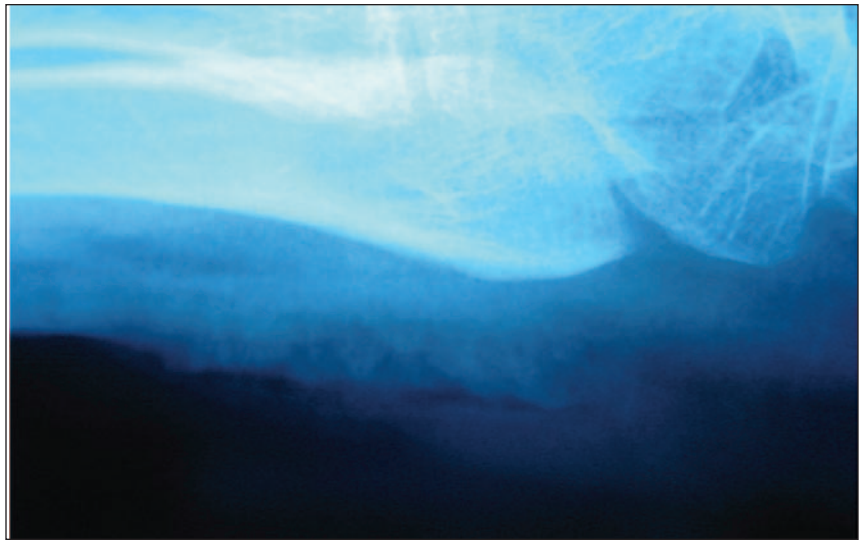

Figure 3: Plain lateral radiograph showing soft tissue irregularity on the plantar foot. There is no evidence of bone involvement with intact plantar cortices seen.

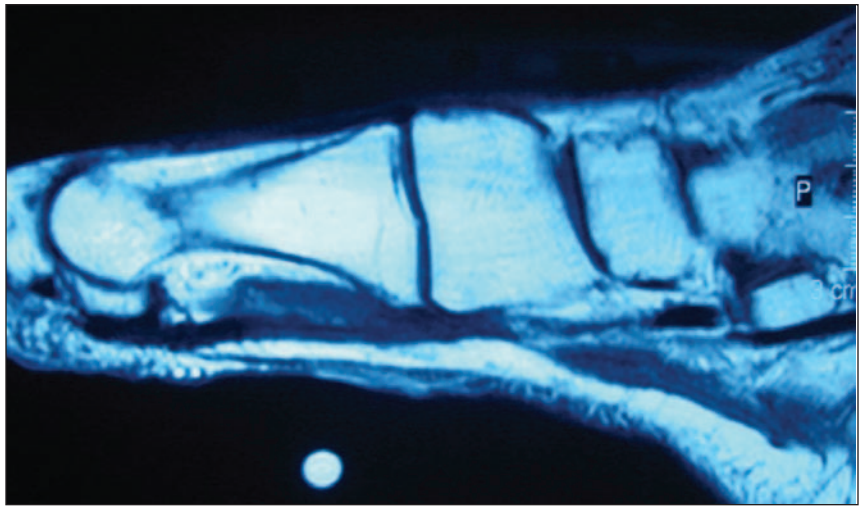

Figure 4: T1 weighted sagittal MRI image with round marker shown plantarly at the site of SCC. The apparent decrease in signal is seen plantarly within the subcutaneous tissue. It also shows an intact plantar fascia and no evidence of bone involvement.

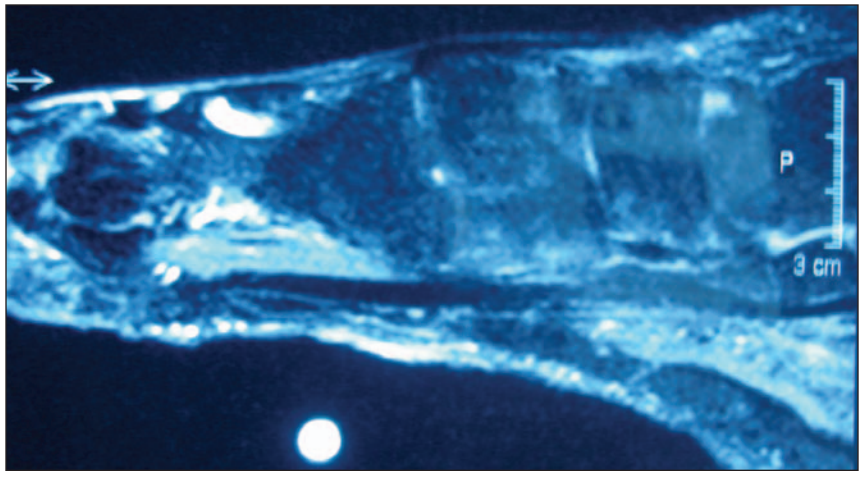

Figure 5: STIR sagittal MRI image with marker evident at site of SCC. The apparent hypointense signal plantarly at the area of subcutaneous tissue may be confused with cellulitis, but is in fact the SCC.

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is an inferior modality for the delineation of bones involved in SCC when compared to CT scanning; however, the ability to clearly define soft tissue anatomy makes it a powerful tool for the imaging of SCC. MRI allows for the defining visualization of the tumor margins, including depth, and its anatomic relationship to the surrounding soft tissues.[23,24] Cellular water content is the distinguishing factor that allows for the differentiation between normal soft tissues and those afflicted with SCC. On T1 weighted images, SCC and metastatic lesions will appear hypo-intense (Figures 4 and 5).[24]

Ultrasound may be used for a "real-time" examination of soft tissue close to the skin surface. Although to date there has been limited application of ultrasound for the lower extremity, its use is becoming more recognized. With use of high frequency ultrasound, high resolution and magnification of soft tissue structures can be achieved.[25] The epidermal band and underlying dermis are considered hyper-reflective, allowing for the distinction between a skin tumor appearing as a homogenously echo-poor area. Tumor borders may be defined; however, these are easily misinterpreted. Determination for the type of skin tumor to date is not available with ultrasound.

Sentinel node biopsy allows for mapping and identification of the lymph node that drains the site of primary malignancy.

SCC and Osteomyelitis

SCC is the most common malignancy arising from sites of chronic osteomyelitis. Chronic osteomyelitis is associated with sinus tracts formed within the soft tissue surrounding affected bone. Clinical

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and radiographic signs that arouse suspicion of a malignant transformation include: increased pain with foul or bloody discharge from a sinus tract, an enlarging mass around the sinus tract, and/or progressive osseous destruction.[17,29]

Treatment

Cure rates have been estimated at around 90% for SCC treated with the available modalities.[20] As there are many documented treatments for SCC, each case must be addressed on an individual basis, factoring in the location and presence of underlying systemic diseases of the patient. Curettage of the tumor, followed by electro-cauterization of the base, is indicated for smaller lesions occurring on sun-exposed areas.[35] This modality is less effective for those lesions that have invaded subcutaneous fat or are recurrent.[1] Re-occurrence after curettage of a lesion usually occurs at the margins, due to a lack of aggressiveness.[6]

Cryologic surgery, with use of liquid nitrogen, lowers the temperature of the tumor cells to tumorcidal levels.[1] To be effective, the temperature range must be around 50 degrees Celsius below zero, and should involve at least two freeze-thaw cycles.[5] Indications include SCC in situ and those lesions that are less than one cm in diameter and on sun-exposed areas. The margin of the periwound normal skin should also be frozen to ensure eradication. This modality is ideal for patients who are unstable for surgery. Complications include hypertrophic scarring and post-inflammatory pigment changes.

Intra-lesional injections of interferon alpha-2b have been shown to be efficacious in patients with SCC.[26] The interferon appears to enhance natural killer cells' cytotoxicity against neoplastic cells. The injections are done over a three to five-week period, and both clinical and histological improvement is seen around eight to sixteen weeks. A higher individual or total dose may be needed for eradication of larger or more aggressive tumors.

Squamous cell carcinoma invading bone by metastasis through soft tissue may be visualized by plain film radiography.

Wide excision of the SCC is a common surgical option for treatment, and is considered, by some, the treatment of choice for verrucous carcinoma.[5] This type of excision involves an incision deepened through the subcutaneous fat for superficial SCC with recommended margins of at least 4 mm. with 6 mm. being standard in high-risk tumors. For SCC that invades the deeper structures of the lower extremity, excision may involve the resection of muscle and bone. Frozen sections may be reviewed intra-operatively; however, they do not have the highest accuracy.

Moh's micrographic surgery is a form of wide excision that is associated with the lowest chance of re-occurrence and the highest cure rate (99%) of any treatment modality, except amputation.[2,5,6] For this reason. it is considered the treatment of choice for high-risk and recurrent SCC.[2,4,15] Horizontal sections of excised tumor tissue are reviewed intra-operatively for histologic features of SCC.[6] This allows for observance of the entire lesion, including all lateral and deep margins.[1] Application to conserve all normal tissue is a principle important for limb salvage.

Limb salvage is a principle concept in the evaluation of SCC involving the lower extremity. There are limitations to this principle that are important to recognize that mandate amputation. Choice of amputation may be based on the tumor grade or size. Those that are high risk and involve muscle and bone to which adequate excision involves loss of function of the limb warrant amputation.[19,22] Refer to table three for a list constructed by Fleming concerning appropriate reasoning for amputation.[9]

Plantar Foot Reconstruction

SCC involving the plantar aspect of the foot poses a complicated situation for reconstruction. Adequate reconstruction following resection of the malignancy focuses on providing an adequate contour, durable skin, protective sensation, and resistance to shearing forces.[22] Those properties allow for uninhibited ambulation. While each patient must be evaluated individually and a customized reconstructive plan formulated, certain principles remain for all patients. The soft tissue envelope of the foot and ankle is limited. Any compromise of this soft tissue could jeopardize the integrity of the interactions of the small bones of the foot, along with the articulations of the small joints.

The plantar aspect of the foot may be divided into three distinct zones. Each zone is comprised of specific properties unique to this re-

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TABLE 3
REASONS TO CONSIDER AMPUTATION AFTER DIAGNOSIS OF SCC

- Hemorrhage due to the erosion of an ulcer into a large vessel
- Cancer that has invaded so deep that excision is impossible
- Involvement of a large joint, such as the ankle or knee
- Large areas of necrotic bone exposed
- Systemic toxemia caused by uncontrollable infection of the ulcer
- Local excision would result in a non-functional limb

gion designed for its function in ambulation. The first zone is described as distal to the proximal one-third metatarsal shafts. Simple V-Y skin flaps allow for advancement of the plantar skin proximally to cover deficits as large as 4-5 cm. Neurovascular flaps involve the lateral sub-hallux skin innervated by the deep peroneal for coverage of 2-3 cm. Digital skin flaps with intact plantar digital vessels sacrifice the digit allowing for coverage of a 3 cm. area. The forefoot may be sacrificed and the patient still able to ambulate. Amputation may be needed if salvage is not conceivable and can be done at the transmetatarsal level. This remains functional; however, an Achilles tendon lengthening will augment the amputation by preventing adductovarus from developing.

The plantar midfoot comprises the medial non-weight bearing surface area and the lateral weight-bearing structures. Split-thickness skin grafts (STSG) are adequate if the deep structures of the non-weight-bearing transverse area of the arch are intact.[28] Skin grafts may not be placed directly over periosteum or tendons lacking sheath or paratenon. Studies have shown that STSG on the weight-bearing become unstable over time, requiring revision in roughly half the cases.[28] Care should also be taken to avoid covering a residual tumor that may have gone undetected.

Moh's micrographic surgery is a form of wide excision that is associated with the lowest chance of re-occurrence and the highest cure rate (99%) of any treatment modality, except amputation.

Glabrous skin grafts are those in which the donor site is the plantar aspect of the foot.[31] The sole of the foot has skin qualities that allow one to sense position and protect against environment and shear forces. If unable to replace plantar tissue with like tissue, long-term sequelae regarding ambulation may occur. Surgical technique involves the sole of the foot for donation, and therefore the deficit must be small enough to allow coverage. Donor site preparation requires multiple debridements to provide skin free of hyperkeratotic tissue. Return of sensation is probable if underlying innervation has not been destroyed. Biopsies of the area post-application and incorporation show histologically similar components to normal plantar skin.

For coverage of areas around 4-5 cm., a free flap reconstruction may be used.[28] The gracilis, latissimus dorsi, rectus abdominus, and serratus anterior may be utilized for these small or large defects.[32] For involvement of deeper tissues, such as muscle, bone, circulation, or innervation, amputation at the following levels is a consideration. A LisFranc's disarticulation occurs at the tarso-metarsal level. A higher occurrence of adductovarus may occur with this disarticulation related to the resection of major tendons.

A concern with muscle flaps involves the maintaining of the contour of the plantar foot. These flaps may be bulky. This change in contour may lead to compensation of gait and require further revisional surgeries.

With a confirmed SCC of the lower extremity, steps must be taken to determine the presence and potential of metastasis.

Metastasis

With a confirmed SCC of the lower extremity, steps must be taken to determine the presence and potential of metastasis. SCC has been conceived as having a relatively low rate of metastasis at around 4%.[21] Those that involve the lower extremity, however, have a higher rate at around 30%.[10,15] Tumor size and depth have been found to influence the metastatic potential of SCC. Lesions greater than 2 cm in diameter are three times more likely to metastasize than smaller counterparts.[2] The risk of metastasis is directly related to the depth of the tumor. Deeper lesions, which invade the reticular dermis or underlying fat, are more likely to metastasize.[2,15] Lesions less than 2 mm. in depth have virtually no risk, those 2-6 mm. in depth have a low risk, while those that are greater than 6 mm. are characterized with the greatest risk.[21] Location and etiology of the SCC must also be considered in determination of metastatic potential. SCC occurring on sun-exposed areas of the skin is less likely to metastasize as those related to degenerative or inflammatory processes, such as a Marjolin's ulcer.[5] SCC with perineural involvement shows an increased likelihood of lymph node involvement. Recurrent SCC lesions are also more likely to metastasize.

If metastasizing, 85% will occur around the regional lymph nodes whereas the other 15% will involve distant viscera.[2,5,10] Dissection and biopsy of regional lymph nodes through various techniques brings up factors influencing the need and the technique used to determine metastasis of SCC. With SCC of the lower extremity, the lymph nodes most regional to this area, the popliteal and inguinal, should clinically be monitored closely. Lymph node dissection/biopsy in a clinically lymph node-positive patient is generally accepted as standard of care to rule out metastasis to these regions. The protocol is vaguer in patients who are lymph node-negative by exam. Literature varies on this subject, some recommending that prophylactic dissection should occur only in grade 2 or 3 SCC lesions.[22]

Recurrence

Not withstanding the choice of treatment modality, recurrence of

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SCC is a threat that can not be underestimated. The prognostic factor that appears most significant for the reoccurrence of SCC is the histologic grading of the tumor.[5,10,22] Grade II tumors are moderately differentiated and have a predilection of recurrence with rapid, usually fatal spread to lymph nodes. Grade I SCC typically will not recur if adequate primary treatment is chosen.

For this reason, patients who have been diagnosed and treated with SCC of the lower extremity should be followed throughout their lifetime by a foot and ankle specialist. Recurrence of a SCC can be as damaging, if not more so, than the original tumor. Patients should be monitored for any signs of metastasis. Those who have undergone a reconstructive procedure will need assessment of the grafts and/or flaps for the duration of their lifetime. ■

Bibliography

[1] Drake L: Guidelines of care for cutaneous squamous cell carcinoma. J Am Acad Dermatol 28:628, 1993.

[2] Ozcelik D, Tatlidede S, Hacikerim S, Ugurlu K, Atay M: The use of sentinal lymph node biopsy in squamous cell carcinoma of the foot: a case report. JFAS 43:60, 2004.

[3] Johnson T, Rowe D, nelson B, Swanson N: Squamous cell carcinoma of the skin (excluding lip and oral mucosa). J Am Acad Dermatol 26:467, 1992.

[4] Euvrard S, Kanitakis J, Claudy A: Skin cancers after organ transplantation. N Engl J Med 348:1681, 2003.

[5] Cancer: Principles and practice of oncology. Philadelphia, Lippincott Williams and Wilkins, 1993.

[6] Haskell CM: Cancer treatment. Philadelphia, W.B. Saunders Company, 2001.

[7] Price ML, Tidman MJ, Ogg CS, Macdonald DM: Skin cancer and cyclosporine therapy. N Engl J Med 313:1420, 1985.

[8] Konigova R, Rychterova V: Marjolin's ulcer. Acta Chirurgiae Plasticae 42:91, 2000.

[9] Fleming M, Hunt J, Purdue G, Sandstad J: Marjolin's ulcer: a review and reevaluation of a difficult problem. J Burn Care Rehabil 11:460, 1990.

[10] Sabin S, Goldstein G, Rosenthal H, Haynes K: Aggressive squamous cell carcinoma originating as a Marjolin's ulcer. Dermatol Surg 30:229, 2004.

[11] Novick M, Gard D, Hardy S, Spira M: Burn scar carcinoma: a review and analysis of 46 cases. J Trauma 17:809, 1977.

[12] Holgado R, Ward S, Suryaprasad S: Squamous cell carcinoma of the hallux. J Am Podiatr Med Assoc 90:309, 2000.

[13] Smith J, Mello L, Nogueira N, Meohas W, Pinto L, Campos V, Barcellos M, Fiod N, Rezende J, Cabral C: Malignancy in chronic ulcers and scars of the leg (Marjolin's ulcer): a study of 21 patients. Skeletal Radiol 30:331, 2001.

[14] Treves N, Pack GT: The development of cancer in burn scars. Surg Gynecol Obstet 51:749, 1930.

[15] Kwa R, Campana K, Moy R: Biology of cutaneous squamous cell carcinoma. J Am Acad Dermatol 26:1, 1992.

[16] Stankard C, Cruse C, Wells K, Karl R: Chronic pressure ulcer carcinomas. Ann Plast Surg 30:275, 1993.

[17] Saglik Y, Arikan M, Altay M, Yildiz Y: Squamous cell carcinoma arising in chronic osteomyelitis. International Orthopedics 25:389, 2001.

[18] Barnett C, Barnett J, Schwartz R: Dermatitis-like squamous cell carcinoma. Dermatol Surg 30:334, 2004.

[19] Peterson A, Layton E, Joseph A: Squamous cell carcinoma of the nail unit with evidence of bony involvement: a multidisciplinary approach to resection and reconstruction. Dermatol Surg 30:218, 2004.

[20] Nasca M, Innocenzi D, Micali G: Subungual squamous cell carcinoma of the toe: report on three cases. Dermatol Surg 30:345, 2004.

[21] Breuninger H, Black B, Rassner G: Microstaging of squamous cell carcinomas. Am J Clin Pathol 94:624, 1990.

[22] Lifesco R, Bull C: Squamous cell carcinoma of the extremities. Cancer 55:2862, 1985.

[23] Ono I, Kaneko F: Magnetic Resonance Imaging for diagnosing skin tumors. Clin Dermatol 13:393, 1995.

[24] Rajeswari M, Jain A, Sharma A, Singh D, Jagannathan N, Sharma U, Degonkar M: Evaluation of skin tumors by magnetic resonance imaging. Lab Invest 83:1279, 2003.

[25] Ruocco E, Argenziano G, Pellacani G, Seidenari S: Noninvasive imaging of skin tumors. Dermatol Surg 30:302, 2004.

[26] Kim K, Yavel R, Gross V, Brody N: Intralesional interferon alpha-2b in the treatment of basal cell carcinoma and squamous cell carcinoma: revisted. Dermatol Surg 30:116, 2004.

[27] Sonmez A, Bayramicli M, Sonmez B, Numanoglu A: Reconstruction of the weight-bearing surface of the foot with non-neurosensory free flaps. Plast Reconstr Surg 111:2231, 2002.

[28] Uroske T, Colen L: Soft tissue reconstruction for the heel and plantar foot. Foot Ankle Clin N Am 6:801, 2001.

[29] Ziets R, Evanski P, Lusskin R, Lee M: Squamous cell carcinoma complicating chronic osteomyelitis in a toe: a case report and review of the literature. Foot and Ankle 12:178, 1991.

[30] Biersack HJ: Nuclear Medicine in Clinical Oncology. New York, Springer-Verlag,1986.

[31] Banis J: Glabrous skin grafts for plantar defects. Foot Ankle Clin J Am 6:827, 2001.

[32] Langstein H, Chang D, Miller M, Evans G, Reece G, Kroll S, Robb G: Limb salvage for soft-tissue malignancies of the foot: an evaluation of free-tissue transfer. Plast Reconstr Surg 109:152, 2001.

[33] Imitiaz K, Khaleeli A: Squamous cell carcinoma developing in necrobiosis lipoidica. Diabet Med 18:325, 2001.

[34] Miller S, Brandes B, Mahmarian R, Durham J: Verrucous carcinoma of the foot: A review and report of two cases. JFAS 40:225, 2001.

[35] Whelan C, Deckers P: Electrocoagulation for skin cancer. Cancer 47:2280, 1981.

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EXAMINATION

Continuing Medical Education

See answer sheet on page 199.

1) Which of the following best describes a squamous cell carcinoma:
   A) Benign tumor that involves the keratinocytes of the epidermis
   B) Benign tumor that involves the hypodermis of the skin
   C) Malignant tumor that involves the keratinocytes of the epidermis
   D) Malignant tumor that involves the hypodermis of the skin

2) Which of the following has been cited to cause a Marjolin's ulceration:
   A) Warts
   B) Venous stasis
   C) Chronic sinus tracts
   D) All of the above

3) Which of the following is not associated with the staging of squamous cell carcinoma:
   A) Percentage of differentiated cells
   B) Prognosis, aggressiveness, and metastatic potential worsens with each degree of differentiation
   C) Prognosis, aggressiveness, and metastatic potential gets better with each degree of differentiation
   D) Both a and c.

4) Which of the following statements is correct:
   A) Lower extremity squamous cell carcinoma has a higher rate of metastasis when compared to the average rate of metastasis
   B) The rate of metastasis is independent of size and depth
   C) The rate of metastasis is independent of the location of the tumor
   D) The rate of metastasis is independent of the presence of a recurrent SCC

5) Plain film radiographs of the foot and ankle are indicated in patients suspected of squamous cell carcinoma for which of the following reasons:
   A) To determine the presence of osseous invasion of the tumor
   B) To determine the presence of osteomyelitis in cases of Marjolin's ulcer
   C) To determine the amount of soft tissue involvement of the tumor
   D) Both a and b

6) Which of the following modalities allows for the best soft tissue definition in regards to a squamous cell carcinoma of the foot and ankle:
   A) Computerized tomography
   B) Plain film radiography
   C) Ultrasound
   D) Magnetic resonance imaging

7) Which of the following conditions warrants biopsy of the soft tissue:
   A) Warts that are unresponsive to therapy
   B) Wounds with excessive granulation tissue beyond the wound margins
   C) Wounds with increasing size despite appropriate treatment
   D) All of the above

8) What is the appropriate definition of a sentinal lymph node:
   A) The closest geographic lymph node to the area of the squamous cell carcinoma
   B) The largest lymph node in the lymphatic system
   C) The lymph node that drains the site of the primary lesion
   D) This lymph node is always the inguinal lymph node regardless of the area of the SCC

9) Which of the following is the estimated cure rate for SCC if treated by available modalities:
   A) 20%
   B) 50%
   C) 75%
   D) 90%

10) In regards to staging of a SCC tumor, which of the following is correct:
   A) prognosis improves as the percentage of differentiated cells increases
   B) prognosis worsens as the percentage of differentiated cells decreases
   C) metastatic potential becomes greater as the percentage of differentiated cells increases
   D) both a and c

11) Which of the following is true regarding grading of a SCC:
   A) the determination of the grade is based upon the most differentiated portion
   B) the determination of the grade is based upon the least differentiated portion
   C) the determination of the grade of the tumor does not involve the differentiation of cells
   D) none of the above

12) Which of the following wounds should be biopsied to determine if there is a presence of SCC:
   A) chronic wound that does not appear to be healing successfully with wound care
   B) wounds with excess granulation that go beyond the margin of the wound
   C) wounds with irregular borders and/or margins
   D) all of the above

13) Concerning SCC of the lower extremity, which of the following lymph nodes are generally considered possible sentinal nodes:
   A) popliteal
   B) inguinal
   C) both a and b
   D) neither a nor b

14) Which of the following imaging modalities is best for determining soft tissue AND bone involvement for SCC:
   A) Plain radiograph
   B) Tec-99 bone scan
   C) CT scan
   D) MRI

Continued on page 198

Continuing Medical Education

EXAMINATION

(cont'd)

15) Which of the following statements is true:
- A) SCC is the least common malignancy to arise from chronic osteomyelitis
- B) SCC is the most common malignancy to arise from chronic osteomyelitis
- C) SCC never involves the bone so therefore has no association with osteomyelitis
- D) Both a and c

16) Which of the following is true regarding cryologic surgery for SCC:
- A) The tumor only needs to be frozen one time in order for tumor cells to be killed
- B) Freezing of the tumor cells requires a temperature of at least 100 degrees below zero (Celsius)
- C) Care should be taken not to freeze any of the normal tissue immediately surrounding the wound
- D) This type of treatment could lead to hypertrophic scarring

17) What type of treatment for SCC has shown the highest cure rate (99%) and the lowest chance of reoccurrence:
- A) Cryologic therapy
- B) Wide excision
- C) Interferon injections
- D) Moh's micrographic surgery

18) Which of the following warrants consideration for an amputation regarding SCC of the lower extremity:
- A) Involvement of a large joint
- B) Tumor that has invaded so deep that excision would cause loss of function
- C) Large areas of necrotic bone
- D) All of the above

19) Which of the following is true regarding metastatic potential for SCC:
- A) SCC has a relatively low rate of metastasis
- B) SCC involving the lower extremity has increased occurrence of metastasis
- C) SCC involving the lower extremity has decreased occurrence of metastasis
- D) Both a and b

20) What is the most significant factor when determining the prognosis of recurrence after treatment of SCC:
- A) Size of the tumor
- B) Depth of the tumor
- C) Histologic grading of the tumor
- D) Color of the tumor

See answer sheet on page 199.

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EXAM #6/06
Squamous Cell Carcinoma of the Foot
(Rabjohn, Donohue, Montilla, and Lavan)

Circle:

1.	**A**	**B**	**C**	**D**	**11.**	**A**	**B**	**C**	**D**
2.	**A**	**B**	**C**	**D**	**12.**	**A**	**B**	**C**	**D**
3.	**A**	**B**	**C**	**D**	**13.**	**A**	**B**	**C**	**D**
4.	**A**	**B**	**C**	**D**	**14.**	**A**	**B**	**C**	**D**
5.	**A**	**B**	**C**	**D**	**15.**	**A**	**B**	**C**	**D**
6.	**A**	**B**	**C**	**D**	**16.**	**A**	**B**	**C**	**D**
7.	**A**	**B**	**C**	**D**	**17.**	**A**	**B**	**C**	**D**
8.	**A**	**B**	**C**	**D**	**18.**	**A**	**B**	**C**	**D**
9.	**A**	**B**	**C**	**D**	**19.**	**A**	**B**	**C**	**D**
10.	**A**	**B**	**C**	**D**	**20.**	**A**	**B**	**C**	**D**

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