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Late and Most Severe Complication of Burn Injury: Marjolin Ulcer

Mustafa Akyürek, Güneş Hafız

ABSTRACT

OBJECTIVES: **We analyzed the demographic characteristics, surgical interventions, results, and complications of patients in our clinic diagnosed with squamous cell carcinoma that developed on the base of burn scars. Our aim was to enhance the understanding and improve therapeutic strategies for the management of Marjolin ulcer.**

MATERIALS AND METHODS: **We conducted a comprehensive review of patients who underwent surgery for squamous cell carcinoma from May 2013 to May 2023. We specifically identified those with squamous cell carcinoma originating from burn ulcers. For these patients, we systematically collected data, which encompassed demographic details, photographic evidence, details of surgical interventions, lymph node outcomes (if dissection occurred), and any recurrences or complications observed during postoperative follow-up.**

RESULTS: **Of the 741 patients diagnosed with squamous cell carcinoma, 11 had a burn-related Marjolin ulcer. Average age was 53 years, and average time from burn to squamous cell carcinoma diagnosis was 12.2 years. Six patients had excisions with lymph node dissections. In 6 patients, the excision material was removed with a clean margin, whereas 3 patients had margins with pseudoepithelial hyperplasia and dysplastic epithelium. Local recurrence developed in 2 patients during postoperative follow-up, with an average follow-up period of 4.8 years.**

CONCLUSIONS: **Marjolin ulcers derived from burn scars present major clinical challenges. A thorough surgical and clinical approach, coupled with careful follow-up, is essential for optimal management. In contrast to prevailing literature suggesting a poor prognosis for squamous cell carcinoma from burn scars, our findings showed no distant metastasis among our patients. For a more comprehensive understanding and improved patient care, multicenter studies are recommended and enhanced patient education is needed on protective measures and the importance of regular follow-up.**

KEY WORDS: *Burn, Skin ulcer, Squamous cell carcinoma, Treatment*

INTRODUCTION

Marjolin ulcer, first delineated by Jean Nicholas Marjolin in 1828, is a distinctive and significant clinical entity associated with scar tissues, Marjolin ulcer can extend beyond mere scar tissue but also from the basis of chronic osteomyelitis and from fistula openings.[1]

This ulcerative condition possesses a profound clinical importance, particularly when pathologists have identified its surface to bear invasive squamous cell carcinoma (SCC) or precursors leading to this invasive pathology.[2] The transformative potential of this ulcer, transitioning from benign scar tissue to a malignant lesion, underscores its importance in clinical and pathological landscapes.

In the context of burn injuries, especially severe ones where the dermis layer has experienced profound damage, the healing process can be unpredictable. Scar tissues resulting from such injuries often present as depigmented regions devoid of melanin.[3] These scars are characterized by a weakly adherent epithelium due to the underlying dense bindings, rendering them particularly vulnerable to external stressors such as ultraviolet radiation and repetitive trauma.[4] Consequently, these are labeled as "unstable scar tissues," emphasizing their propensity to undergo pathological changes.[5]

From Çanakkale Onsekiz Mart University, Department of Plastic Reconstructive and Aesthetic Surgery, Canakkale, Türkiye

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CORRESPONDING AUTHOR: Mustafa Akyürek, Çanakkale Onsekiz Mart University Hospital, Çanakkale, Türkiye, 17100

Phone: +90 506 702 23 17 **E-mail:** drmustafaakyurek@gmail.com

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Even with careful grafting techniques, extensive burn wounds can still present challenges. Secondary healing areas might emerge, potentially transforming into the unstable depigmented scar regions aforementioned.[6] Unstable scars, one of the sequelae of burns, should be closely monitored clinically, and, if any ulceration develops on the scar tissue, the patient should be advised to immediately seek medical consultation.[7]

In this study, we present and discuss the demographic characteristics of patients diagnosed with SCC developing on the base of burn scars in our clinic, the surgical interventions applied, and patient results and complications. Through this, we aimed to offer valuable insights that could guide future therapeutic strategies and enhance patient care outcomes.

MATERIALS AND METHODS

This study followed the principles of the Declaration of Helsinki. Ethical approval for this study was obtained from Local Clinical Research Ethics Committee. Written informed consent was obtained from all patients before the study. We reviewed patients who underwent surgery in our clinic with a diagnosis of SCC between May 2013 and May 2023. We searched data on patients in the hospital's information management system. By examining the medical histories of the patients diagnosed with SCC, we identified cases of SCC that developed on the basis of burn ulcers. We systematically investigated demographic characteristics, photographs, the surgical interventions performed, lymph node results if a dissection was done, and the recurrences and complications during patient follow-up.

RESULTS

Over a span of 10 years, of 741 patients diagnosed with SCC in our clinic, 11 were identified to have a burn-related Marjolin ulcer. Among these, 9 underwent treatment at our facility. Average age of patients was 53 years, and average time from the formation of the burn to the diagnosis of SCC was 12.2 years. Four of the lesions were in the lower extremity, 2 in the upper extremity, 1 on the scalp, and 2 on the torso. Six patients underwent excision along with selective lymph node dissection. In 6 patients, the excision material was removed with a clean margin; in 3 patients, the margins were continuous with pseudoepithelial hyperplasia and dysplastic epithelium. Among the dissection materials, only 1 had macro-metastasis. The defects formed after excision were repaired with split thickness skin graft in 5 patients. One patient required above-knee amputation. Two patients had defects repaired with local flaps, and 1 patient had defect repaired with a free flap. Local recurrence developed in 2 patients during postoperative follow-up. The average follow-up period was 4.8 years (Table 1).

Patient 6

Patient 6, a 32-year-old fisherman, sustained severe flame burns covering 40% of his body at the age of 14 years. The burns spanned across his chest, both upper extremities, and legs. He presented to our clinic with a notable exophytic ulcer on his arm measuring 12 cm × 10 cm (Figure 1). Clinical examination was suboptimal because of burn scars present in the left axillary and cubital regions.

To accurately diagnose and manage the lesion, a 4-quadrant biopsy was performed, which further confirmed the moderately differentiated SCC. An excision with a 2-cm margin was performed. For the subsequent reconstruction, the primary goal was not only to ensure adequate tissue coverage but also to preserve the smooth gliding of the tendons. A fasciocutaneous flap was contemplated. However, because of scars present at the potential donor site, the use of an anterolateral thigh flap was deliberately avoided. Foreseeing the potential for the defect to enlarge, given the

TABLE 1. Demography, Localization and Surgical Intervention Among Study Patients

Patient No.	Age, y, Sex	Time From Burn to Diagnosis, y	Location	Surgical Intervention
1	64, female	11	Lower extremity	Amputation
2	59, female	9	Abdomen	Local flap
3	53, male	12	Scalp	Local Flap
4	49, male	9	Upper extremity	Split-thickness skin graft
5	62, female	13	Anterior thoracic	Split-thickness skin graft
6	32, male	18	Upper extremity	Free flap
7	46, female	13	Lower extremity	Split-thickness skin graft
8	58, male	10	Lower extremity	Split-thickness skin graft
9	54, male	9	Lower extremity	Split-thickness skin graft

characteristics of scar tissue, a combined parascapular and scapular flap was employed. The radial artery served as the recipient artery, and an anastomosis with the circumflex scapular artery was done. Postoperatively, the donor site experienced wound dehiscence, and no lymphedema and no lymph node metastasis were observed. No recurrence was reported during a follow-up duration of 6 years.

Of note, several alternative reconstruction methods were diligently evaluated. The groin flap remained a consistent consideration. However, given its future potential utility to address scars on the sternum, the groin was judiciously reserved. The patient's surgical journey also entailed a reverse abdominoplasty. This highlighted the intricate and comprehensive surgical approach necessary when managing complex Marjolin ulcer cases. This case underscored the importance of a forward-thinking surgical approach, emphasizing both immediate surgical needs and potential future challenges.

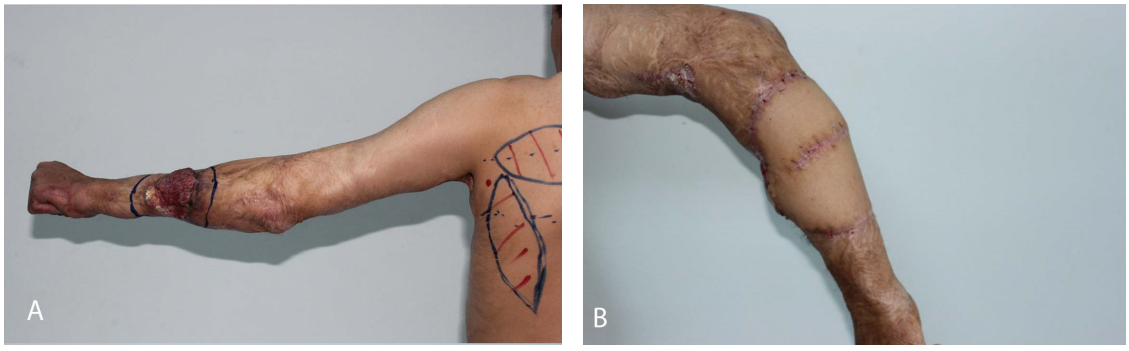
Patient 1

Patient 1, 64-year-old female who sustained flame burns covering 25% of her body, had burn scars on both of her lower extremities. The lesion exhibited fixed, nonmobile properties. (Figure 2). Magnetic resonance imaging revealed bone destruction in the anterior cortex of the tibia, accompanied by increased infiltration within the bone marrow. Biopsies were performed on both lower extremities. Histopathological examination of the right extremity confirmed a diagnosis of SCC. Given the extent of the defect, which reached the bone in a circular pattern, an above-knee amputation was deemed necessary. To further evaluate the possible metastatic spread of SCC, an inguinal dissection was conducted concurrently with the amputation procedure. The dissected lymph nodes tested negative, indicating no evident spread of the carcinoma.

DISCUSSION

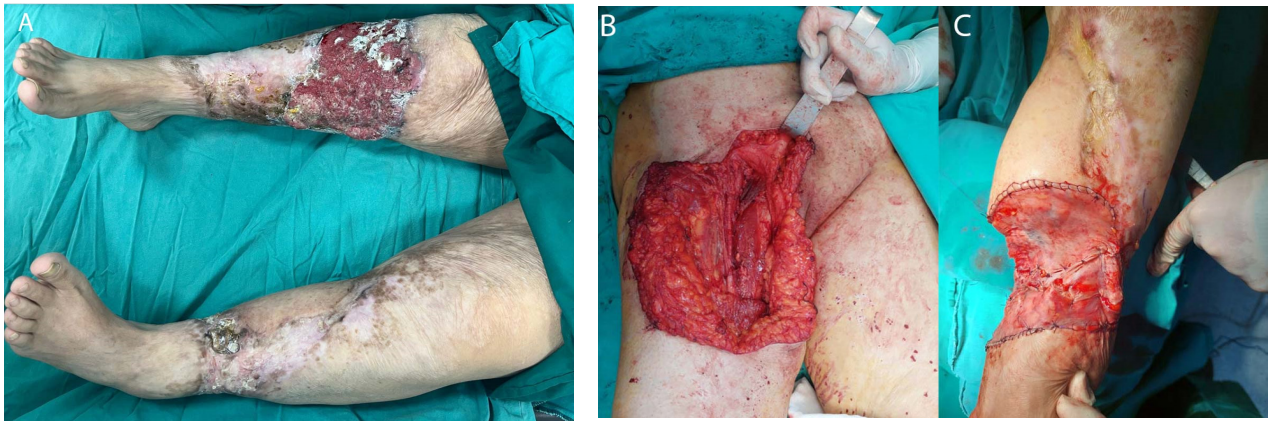
The pathophysiology of Marjolin ulcer has been discussed for more than 100 years. Various etiological factors are responsible for malignant transformation. Of note, the pathogenesis of Marjolin ulcer is likely multifactorial, weaving together elements of chronic irritation[8] and local toxins,[9] which foster neoplastic changes. These changes find a sanctuary to proliferate, particularly in settings

FIGURE 1. Patient 6



A, preoperative image of lesion. **B,** postoperative image of reconstruction with scapular and parascapular fasciocutaneous flap.

FIGURE 2. Patient 1



A, preoperative image of lesion. **B,** inguinal dissection. **C,** postoperative split thickness graft.

where immune mechanisms are altered or compromised.[10] When a chronic refractory wound or unstable scar, characterized by atrophic scarring, depigmentation zones, or hyperkeratotic zones, is apparent, 4-quadrant biopsies should be done. Multiple 4-quadrant biopsies remain the gold standard for diagnosis of Marjolin ulcer; such biopsies should be performed for all suspicious lesions and shared with an expert histopathologist.[11]

Occasionally, despite the use of a 4-quadrant biopsy, the histopathological findings, such as pseudoepithelial hyperplasia, chronic irritation, and hyperkeratosis, might not confirm SCC. However, when the physical appearance of the lesion suggests atrophy and scarring, which are indicative of malignancy, especially in the absence of specific staining patterns, a clinical judgment call might necessitate treatment of the lesion as SCC. It is imperative to always suspect SCC in the context of atrophic scars, regardless of biopsy outcomes. In chronic burn wounds, pseudoepitheliomatous hyperplasia can be challenging to differentiate from SCC. Given its potential as a transitional state toward malignancy, such findings should be approached and treated with the same caution as malignancies.[12]

Imaging and physical examination in regions such as the axilla and inguinal areas, particularly when dealing with scars resulting from burns, cannot be overstated.[13] The underlying scarring can impede both ultrasonograph imaging and thorough physical examination, necessitating a reliance on clinical suspicion and adjunct imaging modalities.[14]

The formulation of a careful reconstruction plan is crucial, and alternative plans in place are needed, acknowledging that the journey with these patients might necessitate additional interventions in the future because of the persistent nature of the condition. With the expectation for the defect to enlarge because of the inherent nature of scar tissue, the surgeon's foresight in planning and flexibility in the management of such challenging cases can substantially improve patient outcomes.

Reconstruction of alopecic areas on the scalp is often done using an expander.[15] The bases of these alopecic areas should be meticulously examined for Marjolin ulcer. The fundamental rationale behind tissue expansion is to increase the turnover of epidermal cells by physically exerting pressure on the skin, thereby inducing them to undergo mitosis.[16] When lesions on the scalp are addressed, the decision to use an expander should be made with caution; consequently, treating a SCC located near the expander could be in complete contradiction to oncological principles.

In contrast to literature that SCC, especially those originating from burn scars, inherently progresses toward a poor prognosis, patients in our series interestingly did not have distant metastasis.[17-19] Furthermore, the recurrences that we did encounter were predominantly superficial, enabling us to manage them effectively with appropriate excisions.

The weakest aspect of our study was the small sample size. Multicenter studies are needed to better evaluate our results. A crucial aspect of treatment is patient education. Patients should learn to avoid ultraviolet exposure and should perform necessary moisturizing procedures to protect scar tissue from the irritation caused by the sensation of itching. They must also be aware of the risks that they carry, and follow-up appointments should be scheduled.

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