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Secondary Intention Healing Over Periosteum: Challenging the Reconstruction Algorithm for Supraperiosteal Defects

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INTRODUCTION

Dermatologic surgeons often encounter defects with exposed periosteum, especially when treating skin cancers on the scalp, temples, and shins. These sites are traditionally considered challenging due to limited vascularity, which can delay granulation and slow re-epithelialization. Consequently, the prevailing dogma "you cannot heal over bone"[2] often leads surgeons to favor primary closure, local flaps, or full- or split-thickness skin grafts to expedite wound closure and minimize prolonged wound care. These approaches, however, may not be suitable for all patients, particularly those with advanced age, comorbidities, or limited caregiving support, and may necessitate the use of secondary intent healing (SIH).[1,2] Still, there remains a critical gap in recent literature characterizing healing outcomes and timelines for supraperiosteal wounds managed with SIH. Here, we describe the successful management of a 98-year-old patient with a post-Mohs surgery defect of exposed periosteum that was successfully managed with SIH. We discuss wound management strategies and clinical decision-making to guide the use of SIH based on our experience and the available literature.

Clinical Observation

A 98-year-old male with atrial fibrillation on rivaroxaban presented with a large 3.4 × 2.2-cm exophytic mass with poorly defined surrounding erythema, ultimately found to be a cutaneous squamous cell carcinoma (cSCC) of the left frontal scalp (Figure 1). The patient, otherwise active and independent for his age, elected with his family to undergo Mohs surgery, resulting in a final defect measuring 5.5 x 2.7 cm with depth down to cortical bone. Repair options were discussed, outlining risks and benefits of healing via primary versus secondary intent. Given the patient's age, independence, the size and location of the lesion, risks associated with more complex reconstruction, and the patient and family's preference, the final decision was made to heal via secondary intent.

A simple repair was performed with purse string closure to decrease the size of the resultant surgical defect and allow the center of the wound to heal via granulation. A dehydrated human amniotic membrane fenestrated graft was placed over the base of the wound bed over cortical bone, and the wound was dressed with gentian violet, white petrolatum, and non-stick gauze. One week later, the site was debrided, cortical bone scraped with a 3 mm disposable curette to elicit pinpoint bleeding, the desired endpoint, and the fenestrated graft was replaced. The wound was then dressed with silver-impregnated hydrofiber dressing, non-adherent dressing, transparent film dressing, and pressure dressing. The following week, the patient underwent bone debridement of necrotic tissue with a 3 mm curette, and the site was dressed with medical-grade honey, hydrocolloid dressing, and transparent film dressing. For the following 2.5 months, the patient presented for weekly in-office nurse-performed wound care consisting of gentian violet, medical-grade honey, and calcium alginate dressing. Then, for the next 3 months, the patient came in every 2 weeks for continued wound checks and simple petroleum jelly wound care (Figure 1). Of note, at 6 months post Mohs, his clinical course was complicated by a small foci of hypergranulation tissue, which is currently undergoing treatment with topical corticosteroids.

DISCUSSION

SIH predates modern medicine, having been the default method of healing since humans first existed.[3] Reluctance to use SIH for supraperiosteal wounds persists due to concerns about limited vascular support, delayed granulation, and risks of desiccation or osteonecrosis,[2,4] compounded by limited literature and the emergence of newer reconstructive techniques.[5]

Early case series from the 1980s and 1990s reported successful SIH over periosteum in dozens of patients, particularly on the scalp, with acceptable cosmetic and functional outcomes. Two

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studies utilized regular hydrogen peroxide cleansing followed by bacitracin ointment, ultimately achieving complete healing by 13 to 16 weeks.[2,6] Other studies instead highlighted the use of mild shampoo and antibiotic ointments,[7] and subsequently incorporating soap and water cleansing, antibiotic ointment, and nonadherent dressings, which achieved a 95% success rate for SIH.[8]

FIGURE 1. Cutaneous squamous cell carcinoma of the left frontal scalp prior to mohs micrographic surgery. The exophytic portion of the tumor measured 3.4 × 2.2 cm and was surrounded by an approximately 0.4-1.4 cm rim of poorly defined erythema, representing the visible tumor edge (dotted line). A 0.5-cm clinical margin was then marked circumferentially around this boundary (solid line) prior to excision following the standard Mohs approach.

Recent reports have revisited SIH while incorporating adjuvant techniques in periosteal wounds, typically when flaps or grafts were less desirable. Many emphasize the importance of maintaining a moist wound environment to promote granulation tissue formation and epithelialization.[9,10] Mechanical stimulation of granulation tissue and cortical bone fenestration has been shown to be effective in overcoming wound healing stagnation and accelerating SIH in scalp wounds with periosteal exposure.[8,11] Others used an acellular porcine bladder matrix, such as a biologic scaffold, to support granulation with full resolution within six months.[12] Additionally, amniotic membrane grafts have demonstrated efficacy in promoting healing for larger or nonhealing wounds, as demonstrated in this patient and previous reports.[13] Rich in collagen, growth factors, angiogenic mediators, and interleukin-10, amniotic membranes promote epithelialization and angiogenesis while adding a protective, anti-inflammatory layer to the healing wound.[14] Such support helps promote timely and effective healing in larger bone-exposed wounds. However, these allografts can be expensive.[15] Lastly, bone debridement has shown efficacy as an adjunctive measure to promote SIH in periosteal wounds. The surgical removal of necrotic bone reduces biofilm and bacterial burden, allowing for granulation and revascularization that can optimize the wound bed to better support subsequent interventions

FIGURE 2. Timeline of progressive wound healing via secondary intention.

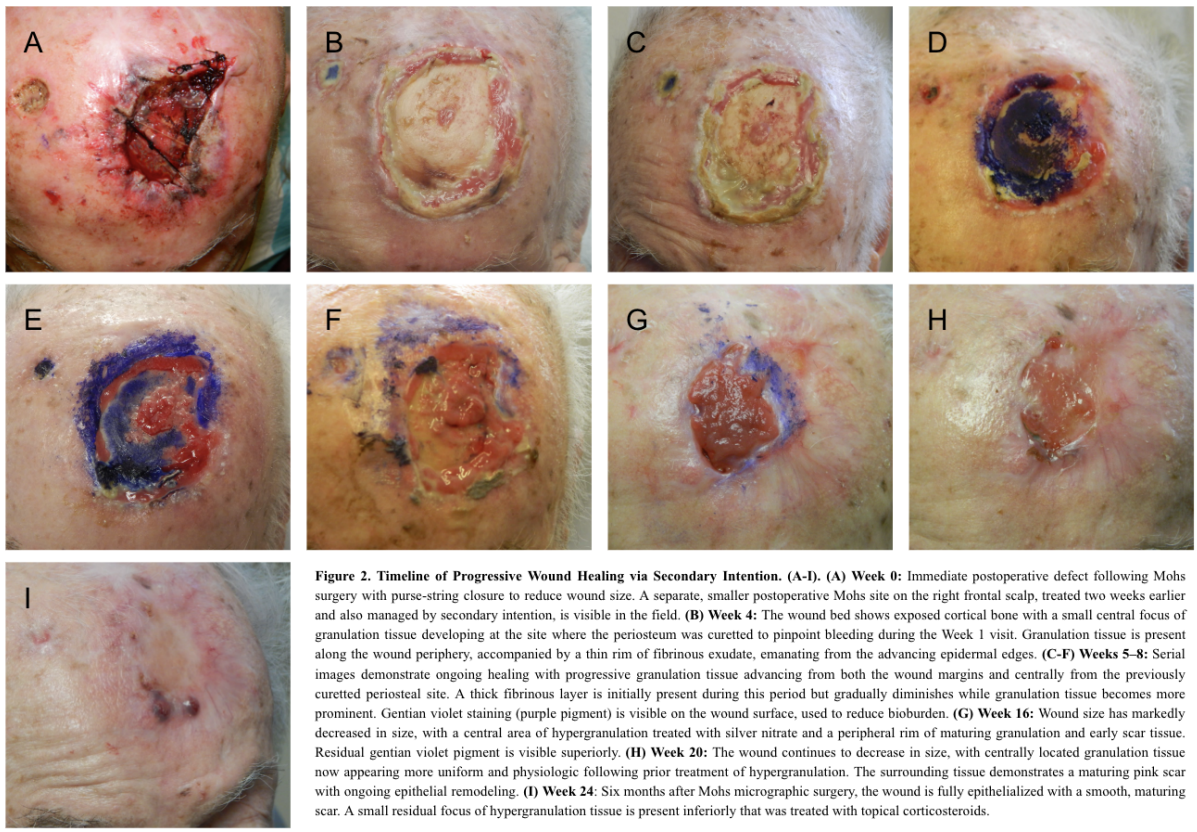

Figure 2. Timeline of Progressive Wound Healing via Secondary Intention. (A-I). (A) Week 0: Immediate postoperative defect following Mohs surgery with purse-string closure to reduce wound size. A separate, smaller postoperative Mohs site on the right frontal scalp, treated two weeks earlier and also managed by secondary intention, is visible in the field. **(B) Week 4:** The wound bed shows exposed cortical bone with a small central focus of granulation tissue developing at the site where the periosteum was curetted to pinpoint bleeding during the Week 1 visit. Granulation tissue is present along the wound periphery, accompanied by a thin rim of fibrinous exudate, emanating from the advancing epidermal edges. **(C-F) Weeks 5–8:** Serial images demonstrate ongoing healing with progressive granulation tissue advancing from both the wound margins and centrally from the previously curetted periosteal site. A thick fibrinous layer is initially present during this period but gradually diminishes while granulation tissue becomes more prominent. Gentian violet staining (purple pigment) is visible on the wound surface, used to reduce bioburden. **(G) Week 16:** Wound size has markedly decreased in size, with a central area of hypergranulation treated with silver nitrate and a peripheral rim of maturing granulation and early scar tissue. Residual gentian violet pigment is visible superiorly. **(H) Week 20:** The wound continues to decrease in size, with centrally located granulation tissue now appearing more uniform and physiologic following prior treatment of hypergranulation. The surrounding tissue demonstrates a maturing pink scar with ongoing epithelial remodeling. **(I) Week 24**: Six months after Mohs micrographic surgery, the wound is fully epithelialized with a smooth, maturing scar. A small residual focus of hypergranulation tissue is present inferiorly that was treated with topical corticosteroids.

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(negative pressure wound therapy, open wound therapy, and surgical revisions).[16] The adjunctive techniques employed in these cases echo our experience–SIH was successful, albeit prolonged, and required diligent wound care and follow-up. Collectively, these results have reinvigorated interest in SIH for periosteal-associated lesions.

While SIH has demonstrated favorable outcomes in many cases, its success can be dependent on multiple factors. Patients with risk factors such as smoking, diabetes, malnutrition, or obesity might not be good candidates for SIH, as these conditions often impair oxygen delivery, angiogenesis, and collagen synthesis, leading to delayed and suboptimal healing.[17,18] However, these risk factors can also increase the likelihood of graft or flap failure[19]; therefore, diligent preoperative assessments and counseling are critical, regardless of the closure method.

When deciding whether to pursue SIH vs other repair techniques over periosteum, careful assessment of the patient's wound healing capacity and clinical context is essential. SIH should be strongly considered when the patient has healthy surrounding tissue, the defect is small to moderate or can be reduced via use of purse string closure, the site is not in a cosmetic priority area, the patient is elderly, frail, or anticoagulated, and the patient can be relied upon for wound care. Discussions of SIH should be held with the patient and their family, addressing concerns such as the expected healing timeline. Notably, our review showed an average of 28.3 weeks to epithelialization or complete healing as reported in the included 62 patient cases.

Based on the authors' collective experience, as well as a review of the literature, the authors propose the following regimen to optimize outcomes when pursuing SIH of a periosteal wound: *1. Minimization of wound area* with purse string closure *2. Close monitoring* with weekly to biweekly in-office wound checks to optimize granulation tissue while controlling for hypergranulation *3. Stimulation of granulation tissue* via debridement as needed during the first month *4. Hydration of wound bed* via occlusive dressings consisting of non-adherent petroleum gauze, hydrogel, or moist dressings to avoid desiccation. Gentian violet and medical-grade honey can be added to aid in promotion of an antibacterial milieu.

CONCLUSION

Here, we describe successful management of SIH following Mohs for a deep scalp defect with exposed periosteum and review the wound management strategies and outcomes reported in similar cases. Our findings, together with the available literature, demonstrates that SIH for periosteal wounds can be successful in select candidates when the wound environment is optimized. As the population ages and the burden of skin cancer increases, understanding when to leverage the benefits of SIH becomes increasingly important.

DISCLOSURES

MDM, SR, BL, JWM, JLF, DMS have no conflicts of interest to disclose.

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