

# Strategies to Minimize Scarring After Mohs Micrographic Surgery and Other Cutaneous Procedures

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Surgeons can employ various strategies to minimize the appearance of scars from Mohs micrographic surgery and other cutaneous procedures. Preoperative evaluation should be conducted to determine risk factors that may impede wound healing. Intraoperative techniques such as resurfacing can be used to improve scar appearance, and postoperative repair can be done both surgically and via mechanical and laser resurfacing. Ultimately, the cosmetic outcome should be optimized and individualized based on the needs and expectations of each patient.

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**M**ohs micrographic surgery is the preferred technique for complete removal of cutaneous neoplasms in areas of high recurrence and cosmetically sensitive regions of the body. When compared to surgical alternatives such as wide excision, Mohs surgery often results in minimized postoperative surgical defects and reduced scar lengths. Although scarring is inevitable, the Mohs surgeon may take steps to optimize the appearance of the scar before, during, and after surgery. This article highlights preoperative risk factors that may complicate scarring and discusses intraoperative techniques that may improve scar appearance. We also evaluate postoperative techniques used for cosmetic scar alteration.

## PREOPERATIVE SCAR PREVENTION

The surgeon should review the patient's complete medical history and conduct a physical examination before the procedure to determine possible risk factors that may complicate intraoperative and postoperative management. Through acute inflammation and epithelial proliferation, the steps of wound healing are particularly sensitive to systemic factors. Diseases that may complicate wound healing include connective-tissue disorders such as Marfan syndrome or Ehlers-Danlos syndrome, protein malnutrition, vitamin deficiencies, or endocrinopathies such as diabetes mellitus or Cushing syndrome. Common conditions that lead to an altered inflammatory state, such as a metabolic syndrome or arthritis, may have adverse effects on wound healing. Medications including antineoplastic agents and antibiotics also may impair wound healing, but the effects generally are not clinically apparent. Patients with a known personal or family history of keloid formation should be counseled regarding this risk.

One factor that can impair optimal postoperative wound healing is the presence of a hematoma; therefore, it is important to screen for antiplatelet or anticoagulant medications to prevent unnecessary postoperative

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bleeding. Although more Mohs surgeons are agreeing to operate on patients taking medically necessary antiplatelet or anticoagulant medications than in the past,<sup>1</sup> many still advise patients to discontinue use of prophylactic aspirin and nonsteroidal anti-inflammatory drugs prior to surgery. Although many studies report conflicting data,<sup>2-7</sup> Lewis and Dufresne<sup>8</sup> demonstrated in a 2008 meta-analysis of the literature that both aspirin and warfarin have been shown to increase the risk for major postoperative bleeding. Studies on clopidogrel, a newer antiplatelet medication, are mixed; both an increased bleeding risk<sup>9</sup> and similar risk<sup>10</sup> as patients taking aspirin as monotherapy have been documented. In our practice, we do not stop patients from taking medically necessary antiplatelet or anticoagulant medications prior to surgery; instead we prefer to keep the initial pressure dressing on for 48 hours versus 24 hours used for traditional patients. This method has decreased the incidence of hematoma formation and subsequent disruption of cutaneous healing.

Another common risk factor is tobacco use, which is common in the United States. In 2006, an estimated 20.8% of US adults were current cigarette smokers.<sup>11</sup> The overall body of evidence indicates that cigarette smoking has adverse cardiovascular effects, which can lead to numerous health risks that should be considered prior to surgery. In a multinational meta-analysis of randomized trials, postoperative complications (ie, wound healing time, risk for infection, wound healing complications) were reduced by 41% when smoking was stopped at least 1 day prior to surgery.<sup>12</sup> Because patients can present with a variety of medical comorbidities, cigarette smoking is one modifiable risk factor that can be eliminated to optimize wound healing and scar cosmesis; therefore, we recommend discussing smoking reduction or cessation with patients prior to surgery. When confronted with the immediate issue of scarring, we have found that most patients agree, at least in principle, to attempt to decrease tobacco use prior to surgery and throughout the healing process.

Patients also should be advised that postoperative scarring often can be minimized with proper at-home wound care. Surgeons should be aware of possible limitations that patients might face, such as a physical disability, a wound site that is subject to stress or trauma, or a need for assistance from a caregiver. Detailed instructions on proper dressing and bandaging techniques should be provided to the patient and his/her caregivers, and written instructions should be provided at discharge to improve and reinforce at-home adherence.

An intervention technique that can be employed preoperatively to improve wound healing is the injection of botulinum toxin<sup>13,14</sup> in the areas around the surgical site, particularly on the forehead or frontal scalp. It is

hypothesized that paralysis of the muscles surrounding the incision with botulinum toxin improves healing by decreasing the shear and flexing forces around the postoperative wound. One blinded randomized study showed improvement in the appearance of postoperative scars when the area surrounding the surgical site was pretreated with botulinum toxin.<sup>14</sup>

## PERIOPERATIVE SCAR PREVENTION

A good surgical technique is the primary method by which the Mohs surgeon can control the final outcome of a scar. During the procedure, the surgeon must use appropriate judgment to determine the optimal method for closing the surgical defect depending on the characteristics of the patient (eg, age, race, gender) as well as the location and size of the wound. Surgical defects that are closed primarily should have well-approximated, everted edges with an ample surrounding vascular supply. The surgical defect should be appropriately placed so that sutures are within natural folds or wrinkles, taking care not to cross cosmetic units. Wounds left to heal by secondary intention have a better final cosmetic appearance when the incision site is at a natural concavity (eg, conchal bowl) or near a cosmetic unit edge than at other sites. If applicable, undermining can be used to reduce wound tension. Appropriate closure materials should be chosen to maximize the structural support of the wound during the healing process while minimizing both trauma to the skin and disruption of the vascular supply.

Lasers can improve the appearance of both atrophic and hypertrophic scars, and the use of these devices has been studied both intraoperatively and postoperatively.<sup>15</sup> Both ablative and nonablative lasers have been used. In our experience, ablative fractional lasers produce better cosmetic results than nonablative devices while maintaining a low side-effect profile. Ablative lasers have been effectively used for cosmetic improvement of surgical defects closed primarily and secondarily.<sup>16</sup>

Figure 1 shows a patient who underwent surgical excision of a squamous cell carcinoma and was treated intraoperatively with a CO<sub>2</sub> laser at a 2-month follow-up visit. In a randomized, blinded, split-scar study of 10 patients, surgical defects were divided into 2 halves and 1 half was treated with a fractional CO<sub>2</sub> laser prior to placement of the superficial sutures. Statistically significant improvements in the cosmetic results of the laser-treated side were observed both by the patients ( $P=.003$  for elevation;  $P=.014$  for discoloration; and  $P=.008$  for erythema) and 3 blinded physicians ( $P=.003$ ) who rated photographs at 3 months postoperatively.<sup>17</sup>

Another technique that can be used for intraoperative improvement of scar cosmesis is dermabrasion. This



**Figure 1.** A surgical defect on the arm following excision of a squamous cell carcinoma that was closed primarily with (side 1) and without (side 2) a single treatment with a CO<sub>2</sub> laser prior to superficial closure.

technique is similar to ablative laser resurfacing in that the creation of a partial-thickness injury allows the scarred epidermis and dermis to regenerate more smoothly. Some studies have advocated the use of low-grit commercial sandpaper as an inexpensive but equally effective alternative to diamond- or wire-tipped handheld microdermabrasion units for treatment of atrophic and hypertrophic scars.<sup>18</sup> Figure 2A shows sandpaper microdermabrasion in a patient who recently underwent Mohs surgery and had his defect closed with a rhombic flap. The patient tolerated the procedure with only pinpoint bleeding (Figure 2B). The limitations of manual dermabrasion include the potential for hypopigmentation and the possibility of scarring, which increases when used on non-facial sites. A similar technique that has shown promise is needle dermabrasion,<sup>19</sup> or tattooing without pigment, which has been reported with good results.

One medical technique that has shown promise in the prevention of scars is the intraoperative use of avotermin, a recombinant human transforming growth factor  $\beta$  derivative.<sup>20</sup> This family of cytokines is known to be involved in different aspects of wound healing, including modulation of the inflammatory response and differentiation of fibroblasts. So et al<sup>20</sup> described a phase 2 trial in which participants' linear scars were excised and reclosed with adherent strips; avotermin or placebo then were injected interdermally. Avotermin was shown to improve scar surface area, volume, and appearance without notable side effects.<sup>20</sup>



**Figure 2.** A rhombic scar before (A) and after microdermabrasion using sterile 180-grit drywall sandpaper in a patient who recently underwent Mohs micrographic surgery (B).

## POSTOPERATIVE IMPROVEMENT OF SCAR APPEARANCE

Strategies to improve scar cosmesis have largely focused on scar repair long after the initial surgery has been performed. For atrophic scars, filler agents can be used with good results,<sup>21</sup> but care must be taken to create a pocket for filler placement or the product may collect around the scar and create a “doughnut” effect. Therapeutic undermining with subcutaneous incision (subcision) also can be considered as an option,<sup>22,23</sup> but there are few reported cases in which this technique has been used for postoperative cosmesis. Ablative and nonablative lasers continue to be the mainstay for improvement of superficial scars. Nonablative lasers are favored by many patients and clinicians for their noninvasive properties.

One technique that often is used for scar repair is fractional photothermolysis with a 1550-nm erbium:YAG

laser designed to create pinpoint columns of thermolytic damage to the dermis while leaving surrounding structures unaffected. Several trials have reported successful results with fractional photothermolysis for improvement of postsurgical scars.<sup>24,25</sup> A study conducted at our institution directly compared the difference in clinical improvement between scars that were treated with fractional photothermolysis and those that were treated with conventional pulsed dye laser therapy. Results indicated that scars treated with fractional photothermolysis had a superior appearance versus those treated with the pulsed dye laser.<sup>26</sup> Another promising technique is fractionated radiofrequency,<sup>27</sup> which has been shown to improve acne scarring and may be considered as an option for postoperative scarring.

Intralesional corticosteroids remain the treatment of choice for hypertrophic scars,<sup>28</sup> though a number of topical treatment options are available. Onion extract (eg, Mederma [Merz Pharmaceuticals, LLC]) has been shown to increase the expression of matrix metalloproteinase 1,<sup>29</sup> and some studies show evidence of cosmetic improvement in patients with hypertrophic scars.<sup>30-32</sup> A double-blind study of onion extract versus petrolatum used on postoperative surgical sites showed no difference in final scar appearance,<sup>33</sup> suggesting that this topical therapy may be limited in use for the majority of patients. Similar improvement in hypertrophic scars has been shown through the use of silicone gel or silicone sheets, though the evidence for improvement is weak due to biased research.<sup>34</sup>

## CONCLUSION

Optimizing the clinical and cosmetic outcomes of Mohs surgery and other cutaneous procedures requires the surgeon's careful attention to various factors before, during, and after the procedure. Several strategies can be used to improve the appearance of scarring during a procedure and even long afterwards. Currently, most techniques for superficial resurfacing involve laser treatment (eg, fractional photothermolysis) and dermabrasion, but new cytokine-based techniques may be available in the near future.

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