Successes, Revisions, and Postoperative Complications in 446 Mohs Defect Repairs

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Abstract

Objective To determine factors predictive of complications and the need for adjunctive treatments repair of facial Mohs defects.

Methods Charts of patients undergoing repair of facial defects from 2000 to 2010 in an academic facial plastic surgery practice were reviewed for patient medical history, tumor type, defect site and size, method of repair, postoperative sequelae, and adjunctive treatments.

Results A total of 446 Mohs defect repairs were analyzed. Average patient age was 61.54 ± 14.81 years. The average defect size was 17.55 ± 10.48 mm. Overall complications were fairly uncommon and required intervention in only 18.74%; other than postoperative corticosteroid injections, additional procedures were necessary in only 6.95% of patients. Female sex; Fitzpatrick skin type 3; upper lip and nasal defects; glabellar, superiorly based nasolabial, bilobed, and rhombic flaps; and dermal suture extrusion were associated with increased complications. The most common complications seen were scar erythema and flap pincushioning. The most common revision techniques performed/recommended were selective laser photothermolysis (3.59%) and scar excision (3.59%).

Conclusion Repair of Mohs defects uncommonly requires adjunctive/revision techniques to reach satisfactory appearance. By understanding certain factors related to the patient, the defect, and the method of repair, surgeons can better choose reparative techniques and anticipate patient postoperative needs.

Keywords
- local flap
- Mohs defect
- complications

Reconstruction of facial skin defects after removal of cutaneous malignancies is a common procedure in facial plastic surgery. Most reconstructive methods have long been described and standardized. Seminal works by Burget and Menick,[1–4] Baker,[5] and Sherris and Larrabee,[6] among others, have refined and defined methods of repair, some described 75 years ago or more, to yield excellent results on a routine basis.

With any reconstructive method, follow-up or revision procedures may be necessary to optimize the cosmesis of the result. Some authors have described typical "pitfalls" of certain surgical methods or perils associated with the reconstruction of certain areas. However, there is not a well-defined standard for the incidence of these complications or the need for further treatment.

This study examines a 10-year experience in facial defect reconstruction by one surgeon to develop a baseline of expectations for adverse events and the necessity of revision procedures as well as to better delineate the nuances and

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requirements for various defect sites and reconstructive methods.

Methods

Operative logs of one of us (A.P.S.) from September 1, 2000, through August 31, 2010, were reviewed to identify patients who underwent repair of Mohs defects of the face, head, and neck. Charts were redacted for patient demographic and past medical information, skin and tumor type, operative details, and postoperative course until acceptable healing (defined as judged inconspicuous without cosmetics by both patient and physician) was assured. This included recorded patient and physician observations, as well as all revision or adjunctive treatments recommended or performed to maximally improve the appearance of scars and tissue contour associated with the repair of the Mohs defect. Charts that did not contain all of this information were excluded from review. Any suboptimal finding at any time was considered a complication if noted by either the patient or the treating physician.

Data were tabulated in an Excel spreadsheet (Excel 2007, Microsoft, Redmond, WA) and analyzed using a statistical software package (GraphPad InStat version 3.00 for Windows 95, GraphPad Software, San Diego , CA, www.graphpad.com). All statistical comparisons were made using Fisher exact test unless otherwise specified.

Surgical Repair of Mohs Soft Tissue Defects

Repair of facial soft tissue defects after Mohs surgery was performed by the senior author in a uniform way over the study period. Defects were repaired within 24 (generally within 3) hours of completion of Mohs surgery, under locoregional anesthesia in an office setting or, more rarely, under intravenous sedation or general anesthesia in an operating room. Unless patients presented emergently, all had been seen preoperatively, at which time appropriate surgical goals were discussed, as was the option of postrepair adjunctive procedures to maximize the appearance of the reconstruction.

The steps in repair were uniform, beginning with outlining a minimum of two possible methods of repair. Skin laxity surrounding the defects was assessed, and layered closure after undermining was always attempted. If this failed to yield a tensionless closure along relaxed skin tension lines (RSTLs), small defects in concave areas were considered for healing by secondary intention; this method was employed if the wound was an appropriate candidate for this type of closure and the patient was amenable to it. Extensive defects in cosmetically noncritical areas or smaller symmetric defects occupying most or all of an aesthetic subunit were generally treated with a full-thickness skin graft from the postauricular, preauricular, or supraclavicular areas. Defects in more cosmetically sensitive areas were considered for closure with a local skin flap; a minimum of two flap designs were drawn on the skin and assessed, and the flap was ultimately chosen that would yield sufficient skin to close the defect and allow donor site closure along RSTLs or aesthetic unit junctions with the most simple scar possible. In general, forehead defects were repaired with advancement, bilateral advancement or, when close to the hairline, rotation flaps. Cheek defects were typically closed with advancement, rotation, island pedicle, or rhombic flaps, and chin repairs were most commonly accomplished with advancement or rotation flaps. Lip defects were typically repaired with advancement, nasolabial fold, or rhombic flaps. Defects of the nose were most commonly repaired with advancement flaps (when possible), rotation, rhombic, or bilobed (more commonly) flaps or paramedian forehead flap (PMFF) when necessary for defects larger than 2.75 cm.

The skin was prepped with either povidone-iodine (Betadine, Purdue Products, Stamford, CT) or chloroxylenol (Techni-Care, CareTech Laboratories, Inc., St. Louis, MO), after which the base and edges of the defect were debrided with the belly of a No. 15 scalpel blade. Hemostasis was achieved as needed with judicious use of electrocautery. Wide undermining was generally performed circumferentially at the same depth as the defect itself (generally in a subdermal plane) but was limited in areas of highly mobile structures (such as eyelids, lips, and nasal alae).

Flaps were inset and donor sites closed with 4–0 or 5–0 polyglactin 910 (Vicryl, Ethicon, Inc., Somerville, NJ) interrupted sutures in a dermal plane and interrupted or running 5–0 or 6–0 polypropylene (Prolene, Ethicon, Inc.) sutures. External closure along the vermilion border or on the lips was also performed with 4–0 polyglactin 910 or chromic sutures, and closures near the eyelid margin were performed with 5–0 or 6–0 plain gut sutures. Skin grafts were typically secured with interrupted 6–0 polypropylene sutures and a 3% bismuth tribromophenate in petrolatum gauze (Xeroform, Covidien AG, Mansfield, MA) bolster dressing sutured in place with 3–0 or 4–0 nylon (Ethilon, Ethicon, Inc.) sutures.

Patients were generally treated with topical bacitracin or mupirocin (Bactroban, GlaxoSmithKline, Middlesex, UK) ointment three times daily and were seen in follow-up between postoperative days 5 and 7, at which time external sutures and bolster dressings were removed. Patients were followed until wounds were adequately healed. At all postoperative visits, wounds were assessed for appropriate healing, scar quality and color, tissue contour, and postoperative tissue distortion. All patients were evaluated for potential benefit of adjunctive treatments, such as intralesional corticosteroids, scar revision, laser or mechanical dermabrasion, and photothermolysis. Corticosteroid injections or scar abrasions were generally administered after 6 to 8 weeks postoperatively or later,[5] and scar revision and phototherapy no earlier than 12 weeks after repair.

Results

Charts detailing 490 repairs of facial soft tissue defects after Mohs micrographic surgery were identified. Forty-four cases were excluded from review because of incomplete information. Of the remaining 446 cases, the majority (56.0%) of patients were women. The average age of all patients at the time of surgery was 61.75 (standard deviation [SD] 14.81) years. Most patients were Fitzpatrick skin type 2 or 3. Most patients (52.24%) had previously been treated for at least one cutaneous cancer, with the overwhelming majority (96.14%)

of these cancers being located on the face. The incidence of significant medical diseases, anticoagulant use, and history of tobacco abuse are also listed in ►**Table 1**. The average Mohs defect size was 17.55 (SD 10.48) mm, and patients were available for follow-up for an average of 7.74 (SD 11.97) months (►**Fig. 1**). By the final visit, all patients expressed satisfaction with the cosmesis of the reconstructive result.

Most (83.0%) patients were treated after excision of a basal cell carcinoma, although other tumor types were treated (►**Table 1**). The nose was the most common site of repair (45.29%; ►**Table 2**). The most common repair methods were advancement flaps (27.35%), rhombic flaps (21.52%), and rotation flaps (15.92%; ►**Table 3**).

All patients were ultimately satisfied with the appearance of the reconstructed area. Complications were generally mild. Persistent scar erythema/dilated periscar telangiectasias (13.23%), and flap pincushioning (11.66%) were the most common complications. Intralesional corticosteroid injections were administered to 12.6% of patients, with treated patients averaging 2.0 (SD 1.3, range 1 to 6) treatments. Other than corticosteroid injections, 6.95% of patients required at least one revision treatment; selective photothermolysis of scar hyperemia/pericicatricial telangiectasia was required in 3.59%; and 4.04% of patients required surgical scar revision techniques (►**Table 4**).

When results were analyzed in terms of overall complications, age less than 60 years, Fitzpatrick skin type 3, nasal defects, and certain flaps (superiorly based nasolabial, bilobed, glabellar, and rhombic flaps) were associated with higher risk, and repair with full-thickness skin graft or rotation flaps were associated with lower risks (►**Table 5**).

Pincushioning was more commonly noted on the nose and upper lip, in defects greater than or equal to 15 mm, after bilobed or rhombic flap repair, and when dermal sutures extruded postoperatively. Erythema was more common with nasal or cheek repairs, women, and age less than 60 years. Hypertrophic scars were more commonly seen in patients with rosacea or rhinophyma (►**Table 6**).

Because nasal defects accounted for almost half of the repairs in this study, they were analyzed separately. Of the nasal subunits, the nasal ala was more likely to develop a complication (relative risk [RR] = 1.747, 1.435; ►**Table 5**), more likely to develop flap pincushioning (RR = 4.765, 3.504; ►**Table 6**), and more likely to require intralesional corticosteroid injection (RR = 2.423, 1.931) than either the entire face or other areas of the nose, respectively. The nasal sidewall, conversely, was less likely to require intralesional corticosteroid treatment than the rest of the nose (RR = 0.3473; ►**Table 6**). These differences were independent of differences in reconstructive methods used in different nasal subunits.

In terms of requiring adjunctive treatment to attain a result acceptable to both physician and patient, rhombic flaps were more likely (RR = 2.734, $p = 0.0001$) to require intralesional corticosteroid injections than other flaps (►**Table 6**), and PMFFs were associated with a higher risk (RR = 5.202, $p = 0.0192$) of requiring adjunctive procedures.

Table 1 Parameters of Patients, Mohs Defects

Average age at surgery (y)	61.75 ± 14.81
Tumor size (mm)	17.55 ± 10.48 (5–80)
Tumor type (%)	
Basal cell carcinoma	83.0
Squamous cell carcinoma	14.1
Basosquamous cell carcinoma	0.9
Melanoma	1.6
Sebaceous carcinoma	0.2
Atypical fibroxanthoma	0.2
Pertinent medical history (%)	
Heart disease	17.94
Hypertension	25.78
History of poor wound healing	3.59
Diabetes mellitus (requiring medication)	4.26
Anticoagulant use	14.80
Active tobacco use	8.97
Prior facial skin cancer	50.22
Anemia	0.22
Rosacea or rhinophyma	8.74
Follow-up period (mo)	7.74 ± 11.97

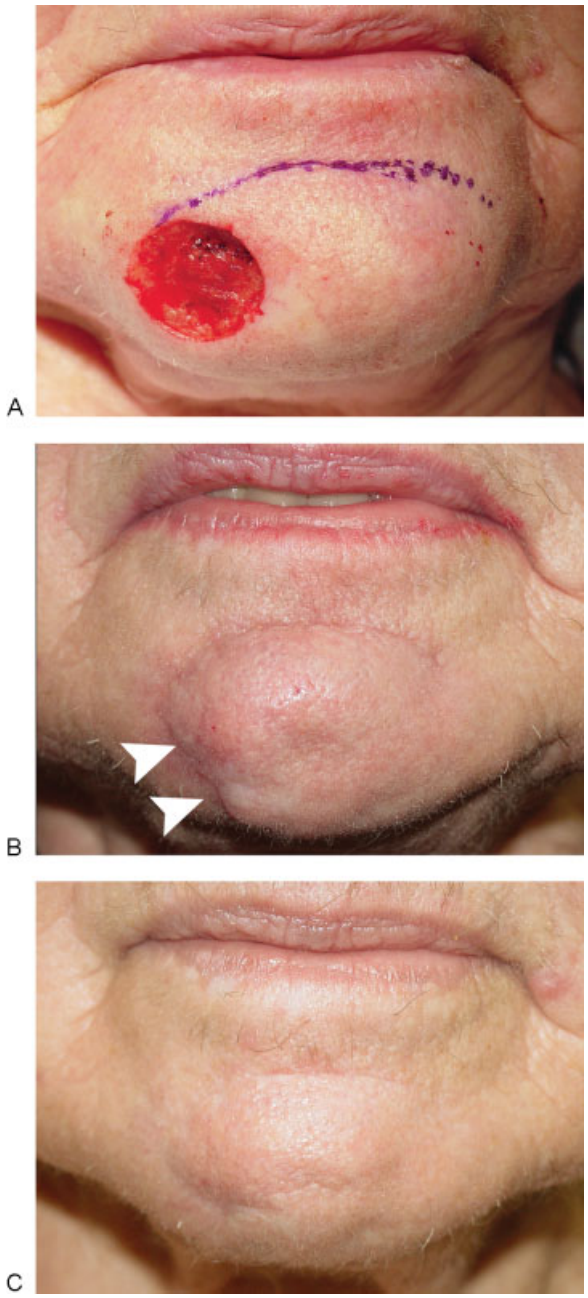

Figure 1 (A) Mohs defect of the chin repaired with a rotation flap. (B) Persistent pincushioning 4 months postoperatively at the right inferior portion of the flap (arrowheads). (C) Appearance after two intralesional triamcinolone acetate (10 mg/mL) injections (6 weeks after the first injection).

Discussion

Facial defects following Mohs micrographic surgery can cause significant cosmetic, functional, and psychological issues for patients. Although most defects can be closed with a variety of procedures, success repair of a Mohs defect requires a result in which the natural contours of the face and its components are respected, reconstituted, and restored and scars placed so as to be acceptably inconspicuous when fully healed. In the senior author's practice, patients are told that they should expect the final result of a Mohs repair to pass the "supermarket" or "bank" test: although even inconspicuous scars may be visible if pointed out, the patient should be able to wait on line at a supermarket or bank and not feel self-conscious about his or her appearance and the repair should be inconspicuous to the casual observer (J. R. Thomas, personal communication). This is discussed with the patient by the senior author during the preoperative visit, and examples of possible postoperative adjunctive treatments are detailed. Patients are informed that most scar issues will significantly improve/resolve over the first 12 to 18 months postoperatively, but most are unwilling to wait this long if simple treatments can improve the appearance of the reconstruction earlier.

In the postoperative period, any distortion of anatomic features, contours, or volumes are noted when present at any visit, and many of these resolve without treatment during this time. Dermabrasion/laser skin abrasion is typically considered at 6 to 8 weeks postoperatively, and scar erythema and postoperative telangiectasias are observed for regression over the first 12 weeks postoperatively, typically before consideration is given to selective photothermolysis. Intralesional corticosteroids (triamcinolone acetate, 10 to 40 mg/mL) typically are not given until postoperative week 6 to 8; scars that widen are typically treated 6 to 8 weeks after surgery. Although patients are told that over the following 6 to 9 months the wounds will continue to mature, few if any patients are willing to wait for spontaneous scar improvement, and early intervention is chosen.

It is interesting that nasal defects accounted for 46.4% of repairs in this study, a proportion that reflects a typical facial plastic surgery practice, as the Mohs excision was performed by a dermatologist and cases referred to the senior author for repair. This selection bias ensured that larger, more difficult repairs were referred to the facial plastic surgeon for repair. The most common repair technique utilized for facial Mohs defects were advancement, rotation, and rhombic flaps, accounting for approximately two-thirds of repairs. No hematomas were noted, and wound infections were rare. The rate (0.45%) of flap/graft failure was quite low, reflecting the reliable nature of these techniques. Only two patients developed distortion of surrounding tissue, developing nasal valve compromise from either a flail ala after repair with a full-thickness skin graft or a bulky rotation flap pivot point.[7] The absence of alar retraction was presumably due to the routine use of nonanatomic cartilage grafting when alar cartilage was involved or the skin defect was within 5 mm of the alar margin.

The rate of complications in this study may seem high for what is typically an in-office procedure; it should be remembered, however, that any unplanned finding at any time point was recorded as a complication. Flap pincushioning and scar erythema/telangiectasias were fairly frequent. However, only 16.82% of patients required any treatment; of these, most (12.6% of all patients) required intralesional corticosteroid injections (►**Fig. 1**), and only 6.96% required operative or laser revisions (►**Fig. 2**).

This study is intended to present an overview of and to quantify postoperative conditions that may require

Table 2 Incidence of Mohs Defects, by Site

Site	Incidence(%)
Auricle	5.83
Brow	2.24
Cheek	13.00
Chin	0.90
Eyelid, upper	0.22
Eyelid, lower	1.12
Forehead	9.19
Glabella	0.45
Jawline	0.45
Lip, upper	10.54
Lip, lower	2.47
Nasolabial fold	0.45
Neck	1.12
Nose	
All sites	45.29
Nasal ala	15.25
Nasal dorsum	8.30
Nasal sidewall	9.86
Nasal tip	12.78
Nasal sill	0.22
Occiput	0.22
Scalp	1.57
Temple	3.81

Table 3 Methods of Repair

Methods of Repair	Incidence (%)
Advancement flap	27.35
Rhombic flap	21.52
Rotation flap	15.72
Full-thickness skin graft	6.95
O-T flap	6.28
Bilateral advancement flap	5.60
Bilobed flap	3.59
Nasolabial flap (superiorly based)	3.14
Rieger (dorsal nasal) flap	2.47
Paramedian forehead flap	2.02
O-Z flap	1.57
Antia-Buch chondrocutaneous auricular flap	1.12
Nasolabial flap (inferiorly based)	0.90
Glabellar flap	0.67
M-plasty	0.45
Rintala (dorsal nasal advancement) flap	0.45

Table 4 Incidence of Postoperative Adverse Events and Adjunctive Procedures Performed after Repair of Mohs Defects

Adverse Events and Adjunctive Procedures	Incidence (%)
Postoperative adverse events	
Persistent scar erythema > 14 wk	13.23
Pincushioning	11.66
Hypertrophic scar	6.28
Widened scar	5.38
Standing cone deformity	1.79
Wound infection	0.67
Keloid scar	0.45
Distortion of surrounding tissue	0.45
Graft/flap necrosis	0.45
Adjunctive procedures	
Intralesional corticosteroid injection(s)	12.6
Scar excision/revision	4.04
Selective photothermolysis	3.59
Dermabrasion	0.22
Laser skin resurfacing	0.22

treatment and to provide the surgeon with additional information to plan and facilitate complete care. There was no observed increase in complications in patients with diabetes, hypertension, heart disease, or anticoagulant use. Younger age, Fitzpatrick skin type 3, nasal (especially alar) defects, and use of transposition flaps were associated with a greater risk of complications. Patients with nasal or upper lip defects, rhombic or bilobed flap repairs, and any repair that experienced dermal suture extrusion were more likely to develop pincushioning. Likewise, rosacea, rhinophyma, and dermal suture extrusion were associated with increased rates of hypertrophic scarring, and patients with nasal (especially alar) defects, rhombic flap repair, and dermal suture extrusion were more likely to require intralesional corticosteroid injections. Persistent scar erythema or associated telangiectasias were more likely in younger patients, women, and repairs of the nose or cheek.

The putative mechanisms behind these risk factors are not always known. Patients with Fitzpatrick type 3 skin typically have thicker skin, which has traditionally been considered a risk factor for poor wound healing.[8] This correlates with the observed increase risk of hypertrophic scarring observed in patients with rosacea/rhinophyma; the additional inflammation seen in these patients may also contribute to poor wound healing. Patients developed fewer complications as age increased. Greater skin laxity seen in older patients may provide additional local skin for repair, leading to less tension on the wound. Larger defects were more likely to develop

Table 5 Risk Factors for Any Complication

Risk Factor	Relative Risk	*p* Value
Age <60 vs. ≥60 y	1.438	0.0134
Fitzpatrick skin type 3 vs. type 2	1.425	0.0162
Nasal defect vs. other site	1.593	0.0014
Nasal alar defect vs. rest of nose	1.435	0.0486
Glabellar flap vs. other repair	3.281	0.0292
Sup. based nasolabial flap vs. other	2.153	0.0144
Bilobed flap vs. other repair	1.875	0.0491
Rhombic flap vs. other repair	1.541	0.0061
Full-thickness skin graft vs. other repair	0.3996	0.0259
Rotation flap vs. other repair	0.5963	0.0255

Table 6 Risk Factors for Specific Complications or Treatments

Risk Factor	Relative Risk	*p* Value	Complication
Age < 60 vs. >= 60	1.891	0.0112	Erythema
Female vs. male	1.666	0.0497	Erythema
Smoker vs. nonsmoker	2.128	0.0125	Any revision technique
Smoker vs. nonsmoker	6.459	0.0004	Surgical revision technique
Rosacea/rhinophyma	2.848	0.0268	Hypertrophic scarring
Cheek vs. other site	0.1216	0.0047	Corticosteroid injection
Upper lip vs. other site	2.223	0.0160	Pincushioning
Upper lip vs. other site	2.315	0.0090	Corticosteroid injection
Nose vs. other site	2.445	0.0011	Pincushioning
Nose vs. other site	1.924	0.0143	Corticosteroid injection
Nasal ala vs. rest of face	4.765	<0.0001	Pincushioning
Nasal ala vs. rest of face	2.423	0.0022	Corticosteroid injection
Nasal ala vs. rest of nose	3.504	<0.0001	Pincushioning
Nasal ala vs. rest of nose	1.931	0.0469	Corticosteroid injection
Nasal sidewall vs. rest of nose	0.3473	0.0440	Corticosteroid injection
Defect of nose or cheek vs. other site	2.195	0.0044	Erythema
Rhombic flap vs. other repair	4.405	<0.0001	Pincushioning
Rhombic flap vs. other repair	2.734	0.0001	Corticosteroid injection
Bilobed flap vs. other repair	2.488	0.0286	Pincushioning
Dermal suture extrusion vs. other	2.130	0.0103	Pincushioning

pincushioning, which may have been related to the greater need to use transposition flaps in their repair. Transposition flaps, such as rhombic or bilobed flaps, have long been known to develop pincushioning more frequently, as seen also in our series; this has been attributed to the near circumferential nature of the scars around these flaps and the cumulative inward contractile scar forces at work.[5] This finding also correlates with the increased risk of requiring intralesional corticosteroids after rhombic flaps; the smaller number of bilobed flaps used may have prevented achievement of statistical significance.

From our results, different areas of the face also appear to be at different risk for certain complications. Nasal defects, especially those of the nasal ala, have a higher rate of postoperative complications than other areas of the face; this is especially true for flap pincushioning and the subsequent need for postoperative corticosteroid injections. Nasal skin is fairly inelastic and has limited laxity. An exception to this is the nasal sidewall, which, similar to the cheek, is less likely to require intralesional corticosteroid injections. Both the cheek and the nasal sidewall may be more amenable to wide local undermining given the ease of dissection and relative laxity of cheek and midnasal dorsal skin. In contrast, alar skin is particularly inelastic, and alar defects can be difficult to widely undermine circumferentially without encroaching upon the free alar margin and potentially promoting alar retraction. The upper lip is also more likely to develop pincushioning, which similarly may represent the difficulty in widely undermining without excessively mobilizing areas like the vermilion border.

Interestingly, dermal suture extrusion was also associated with an increased risk of pincushioning, hypertrophic scarring, and the need for postoperative corticosteroid injections. It is possible that an excessive or prolonged inflammatory phase may promote a more vibrant scar response. Alternatively, early loss of dermal suture support may lead to increased wound tension and unacceptable scarring. Zitelli[9] has argued that failure to place buried sutures so as to draw retracted portions of the flap toward the suture line allows this tissue to contract. It is unclear if this increase in pincushioning is due to failure to place sutures properly or to a less stabilized flap postoperatively.

Prolonged postoperative erythema was more common in younger patients and women and after repair of nasal or cheek defects. Younger patients may have greater cosmetic expectations, and estrogen may contribute to the development of telangiectasias. Finally, these patients may have had nascent telangiectasias of the midface,[9] which became more apparent after surgery in these areas. A period of watchful waiting (up to 8 to 12 weeks) is reasonable, as spontaneous regression may occur (seen in 73% of our cases), but laser treatment may be necessary.

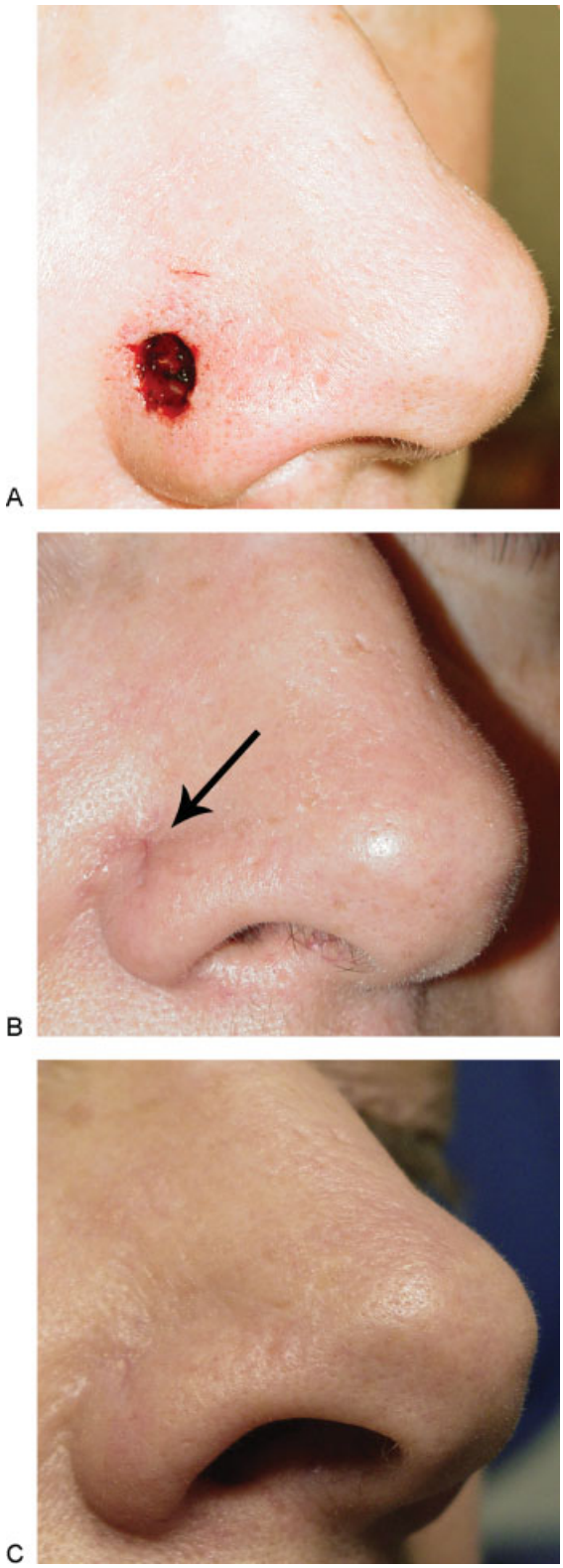

Figure 2 (A) Mohs defect of the nasal ala repaired with a rotation flap. (B) Erythema of the scar persisted along the vertical portion of the scar (arrow) for more than 3 months. (C) Appearance after two treatments with a 1064-nm Nd-YAG laser.

Conclusion

This study presents a snapshot of results of Mohs defect repairs in a typical facial plastic surgery practice and establishes a reasonable baseline of results. Local flaps and skin grafts are hardy, reliable repair methods. The majority of patients require no postoperative intervention to optimize cosmetic results. Postoperative management of flap repair has traditionally included prolonged observation or scar and flap "flattening" and resolution of scar erythema. However, many patients are unwilling to wait 12 to 18 months for resolution and request early intervention. Even with fairly liberal indications for treatment, less than 15% of these patients will require intralesional corticosteroid injections and less than 4% will require laser treatment of scar erythema or scar excisional techniques.

Using this type of outcomes analysis, each surgeon can assess strengths and weaknesses of his or her technique. Important changes in surgical decisions and techniques can be suggested by the results of such an analysis. In the current study, wider undermining and a greater anticipation of corticosteroid injections when transposition flaps are used for repair may lead to a lower rate of pincushioning. From the data in this study, patients with defects of the nose or lip can be told they are more likely to require corticosteroid injections postoperatively, and upper lip and nasal alar defects may be better treated with advancement or rotation flaps than with transposition flaps (whenever possible), to reduce the risk of pincushioning.

The data in this report detail one surgeon's experience over a 10-year period. To our knowledge, this is the first report of its kind in describing the incidence of various adverse events after repair of facial Mohs defects. Additional studies such as this one will help establish a broader baseline of Mohs defect repair results.

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