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Mohs Micrographic Surgery in Skin of Color

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ABSTRACT

The United States population is becoming increasingly diverse. Data show increased utilization of Mohs micrographic surgery (MMS) in people of color. Though the incidence of skin cancer in skin of color is low, morbidity and mortality are disproportionately high. Still, published literature on the topic is lacking. In this article, we outline our approach to MMS in skin of color. We review salient topics not published elsewhere in literature in this context, including post-operative postinflammatory hyperpigmentation and suture selection in skin of color. Our goal is to better equip dermatologic surgeons for the rapidly changing demographics of our patient population. We feel this is an important step in addressing the dire health disparities associated with skin cancer in skin of color.

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INTRODUCTION

Skin of color is defined as Fitzpatrick skin types (FST) IV, V, or VI in individuals of Hispanic/ Latino, African, or Asian descent. Over the next two decades, people of color will comprise over half of the United States population.[1] Data show increased utilization of Mohs micrographic surgery (MMS) in African Americans at 44.2%, which far exceeds Caucasian patients at only 9.6%.[2]

Located in the Bronx, NY, our institution serves one of the most diverse populations in the nation. Forty-four percent of the population is Black and 56% is Hispanic/ Latino. Despite the low incidence of skin cancer in reported in Hispanics (5%) and African Americans (2%) in the literature,[3] our institution performs over 100 cases of MMS in individuals with skin of color annually. Compared to numbers reported in the literature, our case load is high. In 10-year single institution retrospective review, Gupta and colleagues report 17 cases of basal cell carcinoma in African Americans.[4] In a 5-year single institution retrospective study, Loh and colleagues identified 115 Hispanic patients with non-melanoma skin cancer (NMSC).[5] Perper and colleagues published one of the largest studies of NMSC in Hispanics. However, 91% of Hispanic patients included in their study were white.[6] This is in contrast to our patient population. All patients we classify as skin of color undergoing MMS have skin types III through VI of Hispanic, African, and Asian descent. Herein we share our experience, clinical pearls, and guidance for performing MMS in skin of color.

Tumor Identification and Extirpation

MMS is the gold standard for the treatment of keratinocyte carcinoma. Pigmented variants are more common in skin of color. Depending on the clinical scenario, pigment may be friend or foe to intraoperative identification of tumor borders. Hyperpigmentation associated with lichen simplex chronicus or postinflammatory hyperpigmentation may be observed in association with cutaneous tumors in skin of color (Figures 1 and 2). This is not surprising as chronic inflammatory processes account for up to 40% of squamous cell carcinoma cases (SCC) in African Americans.[3] In these cases, it is difficult to differentiate background hyperpigmentation from pigmented tumors and we recommend dermoscopy as an aid. SCC arising at sites of chronic scarring and inflammation is inherently more aggressive and contributes to the higher rates of disease specific death from SCC in African American patients.[3]

FIGURE 1. Squamous cell carcinoma on the knee of an African American female with type V skin with background hyperpigmentation and lichenification (A). Defect following one stage of Mohs micrographic surgery (B).

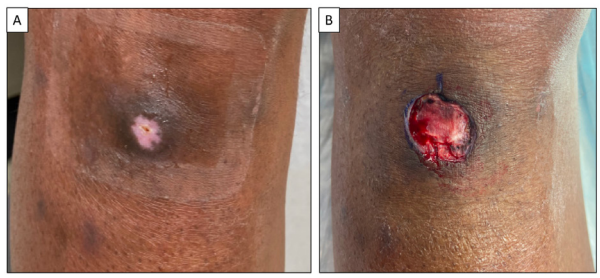


FIGURE 2. Squamous cell carcinoma on the cheek of an African American female with Fitzpatrick type V skin. Background of biopsy proven postinflammatory hyperpigmentation and lichen simplex chronicus.

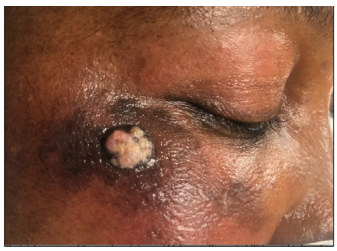
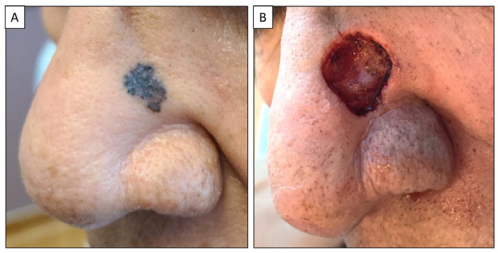


FIGURE 3. Pigmented basal cell carcinoma of the nasal sidewall of a Hispanic male with type IV skin (A). Defect following 2 stages of Mohs micrographic surgery revealing subclinical extension beyond visible pigment (B).



In contrast, pigmented variants in lighter-presenting skin type III–IV patients are quite conspicuous (Figure 3A). However, one should not conflate the border of clinically evident pigment with the border of the tumor. Subclinical extension is not uncommon in skin of color.[7] True borders often extend beyond clinically apparent pigment (Figure 3B). Our group unequivocally performs curettage to aid in the identification of tumor borders in skin of color. Consistent accuracy and tumor clearance are of utmost importance, considering the disproportionately high morbidity and mortality associated with skin cancer in individuals with skin of color.[3]

Approach to Reconstruction following Mohs Micrographic Surgery in Skin of Color

There are several key considerations in the approach to reconstruction following MMS in skin of color. Surgeons should anticipate the risks of post-operative postinflammatory hyperpigmentation and keloids, which are inherently higher in skin of color.[8]

Post-Operative Postinflammatory Hyperpigmentation

Postinflammatory hyperpigmentation (PIH) is highly distressing and long lasting. In fact, data show that dyschromia is the most common patient outcome resulting in malpractice claims in dermatology.[9] This is a salient finding, as surgeons may not associate dyschromia with substantial morbidity.

A literature search on the topic of post-operative PIH yields no results. Currently, no data exist regarding the incidence of post-operative PIH, and neither are there published guidelines to mitigate its development.

PIH is a result of increased melanin production and transfer to keratinocytes in response to tissue injury or cutaneous inflammation.[10] Based on the current understanding of the etiopathogenesis of PIH, we propose that three key factors contribute to postoperative PIH – intraoperative injury, post-operative injury, and post-operative inflammation (Table 1).

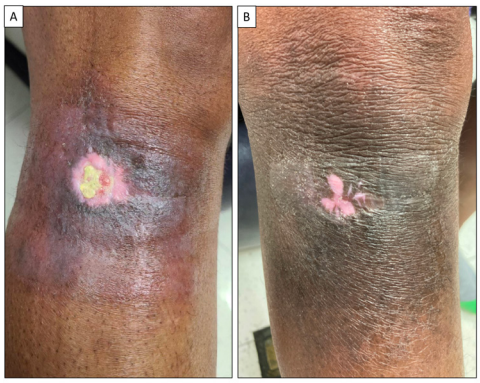
Tumor extirpation inherently 'injures' the skin and triggers the wound healing cascade. Thus, some degree of PIH may be unavoidable in certain skin types in the setting of labile and reactive melanocytes. With the exception of tumor extirpation, all factors identified are modifiable. Though additional studies are needed, the authors propose that mitigation of these factors may decrease the risk or severity of post-operative PIH in individuals of color.

Excess wound edge manipulation, tissue strangulation, and high-tension closures are missteps surgeons should take meticulous care to avoid in skin of color due to the risk of PIH. Eumelanin-rich skin is particularly unforgiving to surgical complications such as wound dehiscence and flap necrosis. The risk of dyschromia should be discussed pre-operatively while obtaining informed consent. The risk of allergic contact dermatitis to adhesives also warrants discussion. An acute eczematous reaction pattern may produce long standing PIH with lichenification in patients

TABLE 1.

Key Contributors to Post-operative Postinflammatory Hyperpigmentation		
Intraoperative Injury	**Post-operative Injury**	**Post-operative Inflammation**
Tumor extirpation	Wound dehiscence	Tissue reactivity in response suture material
Excess wound edge manipulation	Flap necrosis	Post-operative infection
Tissue strangulation	Graft failure	Post-operative allergic contact dermatitis to adhesives or other
High tension closure		

FIGURE 4. Subacute allergic contact dermatitis to adhesive and focal dehiscence following Mohs micrographic surgery on the knee of an African American female with type V skin (A), lichenification, and post-inflammatory hyperpigmentation persist at 3-months post-op (B).



of color (Figure 4). Prompt identification and management with topical steroids and adhesive avoidance is paramount.

Keloids

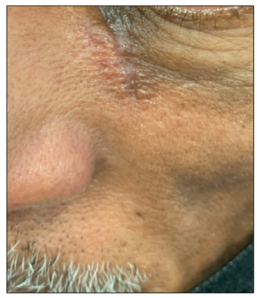
Keloids are a common post-operative complication in patients with skin of color. While a personal and family history of keloids should be obtained pre-operatively, it is important to note that a negative history does not preclude the development of keloids post-operatively. Tissue injury, aberrant wound healing, and wound tension have all been implicated as major drivers of keloid pathogenesis. Surgeons should consider these key mediators during reconstructive planning, with the goal of accomplishing a tension-free closure.[8]

Suture Selection in Skin of Color

We recommend that suture selection be given the highest consideration during reconstructive planning for patients with skin of color – specifically the reactivity of suture material. Synthetic suture materials are degraded by simple hydrolysis.[11,12] For this reason, we recommend non-absorbable epidermal sutures with low tissue reactivity such as nylon and polypropylene (Prolene®) in FST IV, V, and VI patients. It is important that sutures are removed promptly. Prolonged implantation of non-absorbable sutures produces a significant in vivo tissue response known as "frustrated phagocytosis" characterized by fibroblast encapsulation and attempted enzymatic degradation of synthetic non-absorbable suture material mediated by macrophages and foreign body giant cells. Clinically, this presents as an inflammatory suture reaction leaving residual track marks and PIH in skin of color.[13]

Natural absorbable sutures induce the highest degree of tissue reactivity due to neutrophil-mediated degradation. Since cutaneous inflammation is a trigger for PIH, we avoid natural absorbable sutures in skin of color whenever possible - namely gut sutures. Anecdotally we observe higher rates of PIH with gut

FIGURE 5. Primary closure of the lower eyelid with epidermal 5-0 fast absorbing gut in a type V Hispanic male with an inflammatory response still evident at 3-weeks post-op.



sutures in skin of color including chromic and fast absorbing due to the robust inflammatory response (Figure 5). Our observations are supported by the literature. Eisen and colleagues performed a split wound trial comparing 5-0 polypropylene to 5-0 fast absorbing gut and found that polypropylene resulted in small but statistically significant better outcomes. Though the skin types of the study participants were not reported, scar pigmentation was assessed at 3 months and poorer outcomes were associated with fast absorbing gut sutures compared to polypropylene.[14] Clinical studies are needed to confirm this observation in skin of color.

Poliglecaprone-25 (Monocryl®) was introduced in the 1993 as a subcutaneous monofilament suture with "very low" tissue reactivity, exhibiting less reactivity than polygalactin 910.[15] As an absorbable synthetic suture, it is absorbed by hydrolysis. Recently, poliglecaprone-25 has gained popularity as an epidermal suture.[16]

FIGURE 6. Primary closure of the forearm with epidermal poliglecaprone-25 suture in a type IV Hispanic male, inflammatory response evident at 3-weeks post-op (A), appearance at 1-year post-op (B). Primary closure of the lateral cheek with epidermal poliglecaprone-25 suture in a type III Hispanic female, inflammatory response evident at 4 weeks post-op (C), appearance at 2-months post-op (D).

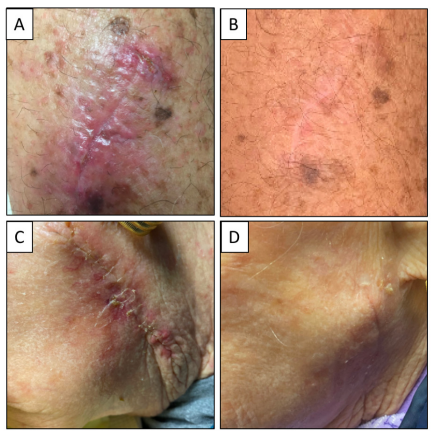


FIGURE 7. East-to-west advancement flap of the nose closed with 6-0 polypropylene running suture in a type IV Hispanic female, immediately (A) and 3-weeks post op (B). Primary closure of the nose with 5-0 polypropylene subcuticular suture in a type IV Hispanic female, immediately (C) and 2-months post op (D).

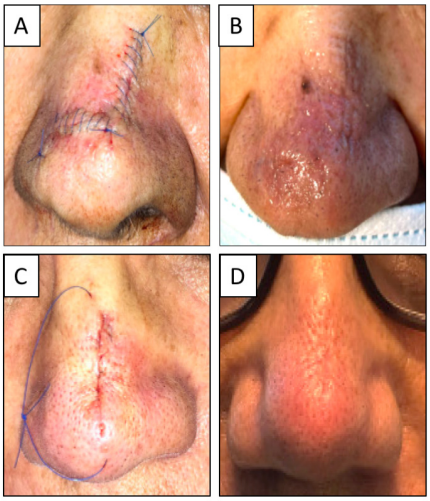
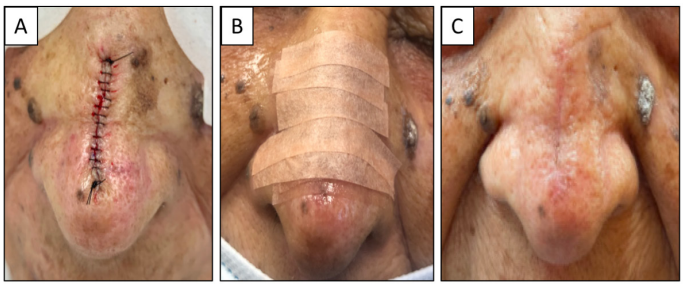


FIGURE 8. Primary closure of the nose with 6-0 nylon running suture in a type IV Hispanic female, immediately post-op (A) surgical strips placed 1-week post-op following suture removal (B), appearance at 2-months post op (C).



In our hands, we observe a brisk inflammatory reaction following the placement of poliglecaprone-25 as an epidermal suture (Figure 6). While inconsequential in patients with skin types (I to III), we observe post-operative PIH in FST V and FST VI patients. Thus, we avoid poliglecaprone 25 as an epidermal suture in these patients. While clinical studies are needed, in vivo studies exist that support our observation. Riberio and colleagues report higher tissue reactions when poliglecaprone-25 is used as an external suture compared to its use as an internal suture.[17] Similarly, an in vivo study by Filho and colleagues found a mild inflammatory reaction within 48 hours of poliglecaprone implantation. This was not observed following polyglactin 910 implantations.[18] While Rosenzweig and colleagues report equal cosmetic outcomes with 5-0 poliglecaprone-25 and 6-0 polypropylene, skin type was not reported. Neither was there mention of the presence of absence post-operative erythema or pigmentation.[16]

Poliglecaprone's absorption time should be considered when used as an epidermal suture in skin of color. The absorption time of poliglecaprone is up 119 days in contrast with 35 days for fast absorbing gut. As discussed above, prolonged suture implantation stimulates a brisk inflammatory reaction even in non-absorbable sutures and may result in PIH in patients with skin of color.

We emphasize that the widely accepted categorization of poliglecaprone as having "low reactivity" is relative to other absorbable subcutaneous sutures and based on studies performed in rat muscle, not epidermis.[15] Nylon has much lower tissue reactivity compared to poliglecaprone 25.[17] Comparative in vivo studies show that poliglecaprone induces an inflammatory reaction mediated by neutrophils and macrophages, in contrast to largely the acellular reactions to nylon.[15]

Based on our experience and evidence in the literature reviewed above, non-absorbable sutures are superior choices for epidermal sutures in patients with skin of color (Figure 7). Sutures should be removed promptly (ie, 5 to 7 days on the face and 10 to14 days on the trunk and extremities) to avoid delayed suture reactions. Table 2 presents suture types in order of increasing tissue reactivity based on published literature to provide an algorithmic guide to suture selection in skin of color.[11,12,17,19]

Suture diameter also warrants consideration. The degree of tissue damage caused by sutures is directly proportional to the suture diameter (assuming closely matched and appropriate needle size) and inversely proportional to the coefficient of friction.[20] Few reports that 6-0 nylon leaves virtually no track marks in skin of color.[21] To further reduce track marks, a running subcuticular suture with polypropylene is preferred to a simple running whenever possible.

Non-Suture Alternatives in Skin of Color

Tissue adhesives octyl cyanoacrylate (Dermabond®) and surgical strips in combination with liquid adhesive (Mastisol®) are safe and effective in patients with skin of color (Figure 8). We have not observed increased rates PIH with the use of these non-suture alternatives, especially in the setting of fastidious wound care and adherence to post-operative instructions. We instruct patients with non-suture alternatives to "let them flake off on their own." Pre-mature forceful removal of non-suture alternatives produce epidermal trauma and PIH.

Scar Revision and Laser Resurfacing in Skin of Color

Scar revision should be considered in patients with skin of color who experience suboptimal aesthetic outcomes.[22] We safely

TABLE 2.

Suture Selection in Skin of Color Based on Tissue Reactivity[11,12,17,19]

- Sutures with ***lower*** tissue reactivity are preferred in skin of color to reduce the risk of postinflammatory hyperpigmentation (PIH)
- Non-absorbable epidermal sutures should be removed promptly in skin of color to avoid tissue reaction
- Absorption time of absorbable epidermal sutures should be considered in skin of color patients

Epidermal Sutures				
Suture	**Category**	**Tissue Reactivity**	**Absorption**	**Comments**
Polypropylene (Prolene®)	Non-absorbable	Lowest[12]	*Remove promptly	Preferred in skin of color
Nylon (Ethilon®)	Non-absorbable	Low - less than Poliglecaprone 25[17]	*Remove promptly	Preferred in skin of color
Poliglecaprone 25 (Monocryl®)	Absorbable	Low - greater than Nylon[17,18]	119 days[13] – longer than gut	In-vivo studies show increased inflammation as an epidermal suture, consider long absorption time
Gut (chromic)	Absorbable	High - less than plain[11,13, 23]	90 days[13]	Consider high inflammatory profile
Gut (fast absorbing)	Absorbable	High - less than chromic[11,13]	42 days[11]	Use caution, consider high inflammatory profile
Gut (plain)	Absorbable	High - greater than chromic[11,13]	70 days[13]	Use caution, consider high inflammatory profile
Silk	Non-absorbable	High - second only to plain gut[12]	*Remove promptly	Appropriateness for mucosal repair may outweigh risk of inflammation

Subcutaneous Sutures			
Absorbable	**Category**	**Tissue Reactivity**	**Absorption**
Poliglecaprone 25 (Monocryl®)	Absorbable	Low	119 days[11]
Polydioxanone (PDS II®)	Absorbable	Low	238 days[11]
Polyglactin 910 (Vicryl®)	Absorbable	Low to intermediate	70 days[11]

*Polypropylene - remains indefinitely in the body[13]
*Nylon - degraded by 15 – 20% per year, frustrated phagocytosis, eventual encapsulation[13]
*Silk - slow biodegradation mediated by foreign body response[13]

use non-ablative fractional erbium 1550 nm laser resurfacing for scar rejuvenation in patients with type IV through VI skin. When using low fluences, we have observed reproducibly safe and effective outcomes. For keloids, we use a combination of intralesional triamcinolone with non-ablative erbium 1550 nm laser resurfacing with satisfactory results.

SUMMARY

In summary, there is a paucity of meaningful data on MMS in patients with skin of color. We have outlined some of the potential surgical complications unique to this population, as well as guidance for mitigation and management.

DISCLOSURES

The authors have no conflicts of interest to disclose.

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