

The Role of Mohs Surgery in the Treatment of Skin Cancer

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American College
of Mohs Surgery
*Fellowship trained skin cancer
and reconstructive surgeons*



Disclosures

- None

Objectives

- Describe Mohs surgery and its role in cancer therapy, its utilization and capabilities
- Discuss the technique of Mohs including the role of pathology in the procedure
- Understand the differences between Mohs and excision
- Review the impact of prior radiation exposure and immunosuppression on skin cancer surgery
- Discuss the risks and complications related to Mohs
- Review cost-effectiveness and insurance coverage

The Skin Cancer Epidemic

- Keratinocyte carcinoma:
 - *Basal cell (BCC) and squamous cell (SCC) carcinoma*
 - Most common malignancies worldwide
- **Melanoma**
 - Most serious form of skin cancer caused by uncontrolled growth of atypical melanocytes
- More people are diagnosed with skin cancer each year in the U.S. than all other cancers combined.
- One in five Americans will develop skin cancer by the age of 70.

Nonmelanoma Skin Cancer (NMSC)

Squamous cell carcinoma

Basal cell carcinoma

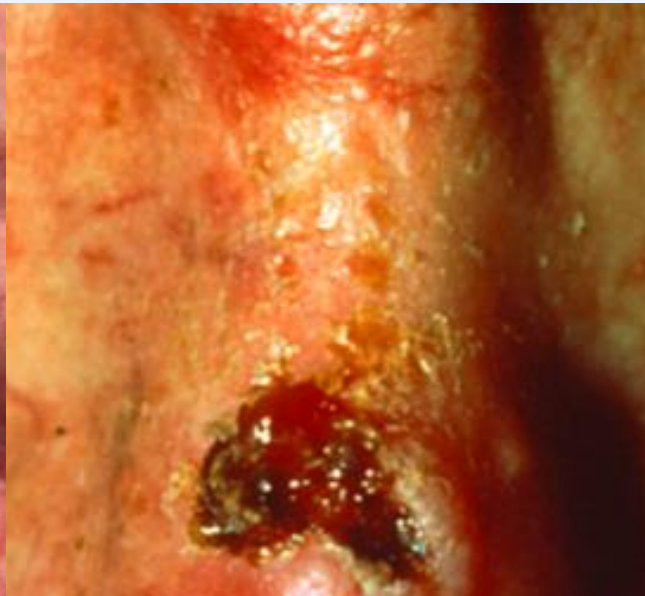
Basal Cell Carcinoma



Basal Cell Carcinoma

- Most common malignancy in the US
- Approximately 80% of diagnosed skin cancer
 - 4 million cases in US annually
- Although it rarely metastasizes, untreated BCC may continue to grow, with local destruction

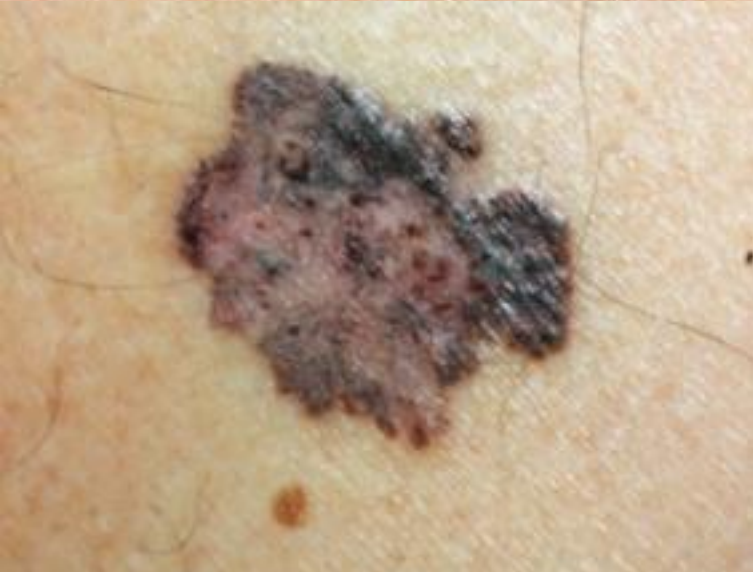
Squamous Cell Carcinoma



Squamous Cell Carcinoma

- 2nd most common skin cancer
 - Approximately 700,000 cases annually
- Subset of aggressively behaving cSCC
 - 4% nodal metastasis
 - 1.5% death

Malignant Melanoma



Malignant Melanoma

- One person dies of melanoma every hour
- An estimated 9,320 people will die of melanoma in 2018
- The estimated five-year survival rate for patients whose melanoma is detected early is about 99 percent in the U.S.
- The survival rate falls to 63 percent when the disease reaches the lymph nodes and 20 percent when the disease metastasizes to distant organs

Skin Cancer Treatment Options

Treatment Options for NMSC

- Various treatment options exist
- Depends on tumor classification as high or low risk according to NCCN guidelines, Appropriate Use Criteria, American Academy of Dermatology

Treatment Options for NMSC

Low risk

- Standard Excision
- Electrodesiccation and curettage

High risk

- Mohs micrographic surgery

- Additional treatment options:

- Topical therapy
- Intralesional chemotherapy
- Cryotherapy
- Photodynamic therapy
- Radiation therapy
- Oral systemic chemotherapy

Melanoma Surgical Treatment Options

Wide local excision

- Standard vertical tissue processing
- 2% margin evaluation

Staged excision aka “slow Mohs”

- 100% peripheral margin evaluation
- Delayed repair with permanent processing

Mohs Micrographic Surgery

- 100% peripheral margin evaluation
- Immediate frozen tissue processing with use of immunostains for melanocytes

What is Mohs micrographic surgery?

Mohs Micrographic Surgery

The Basics

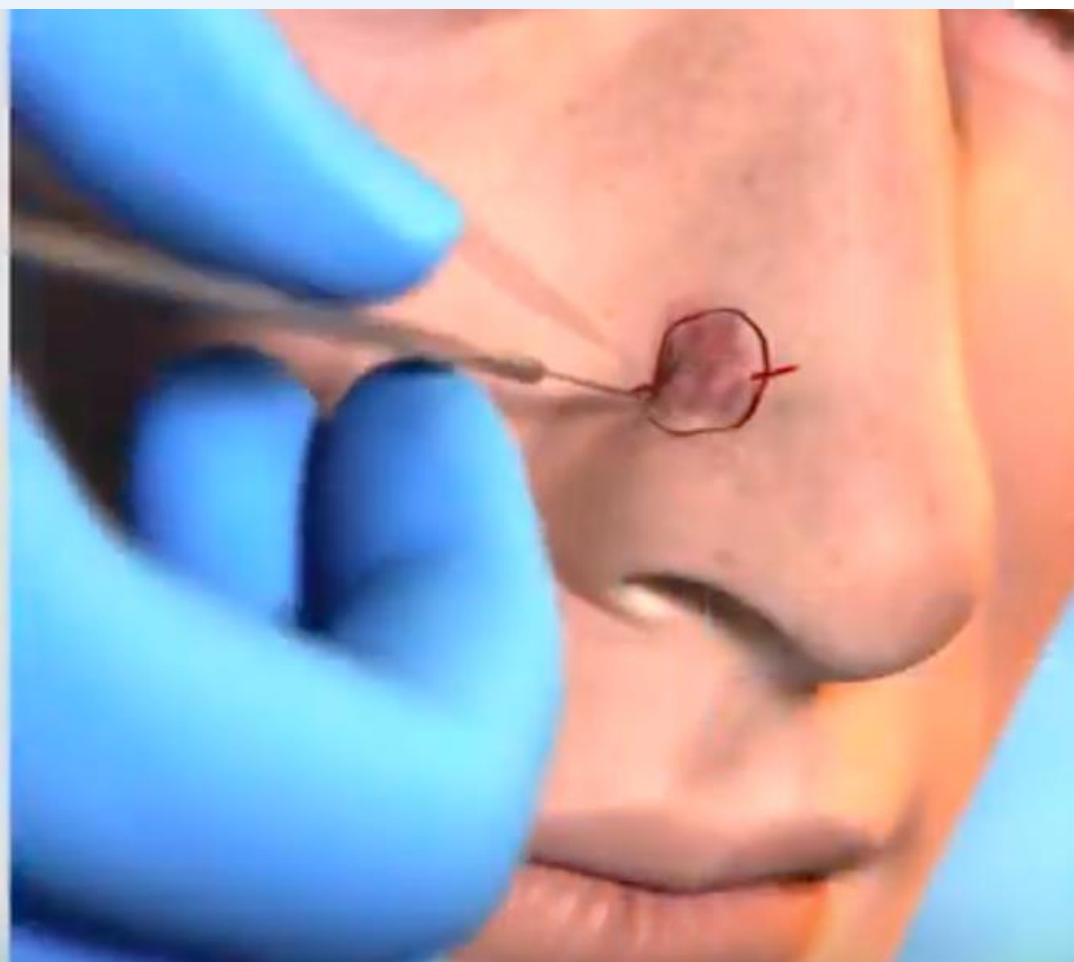
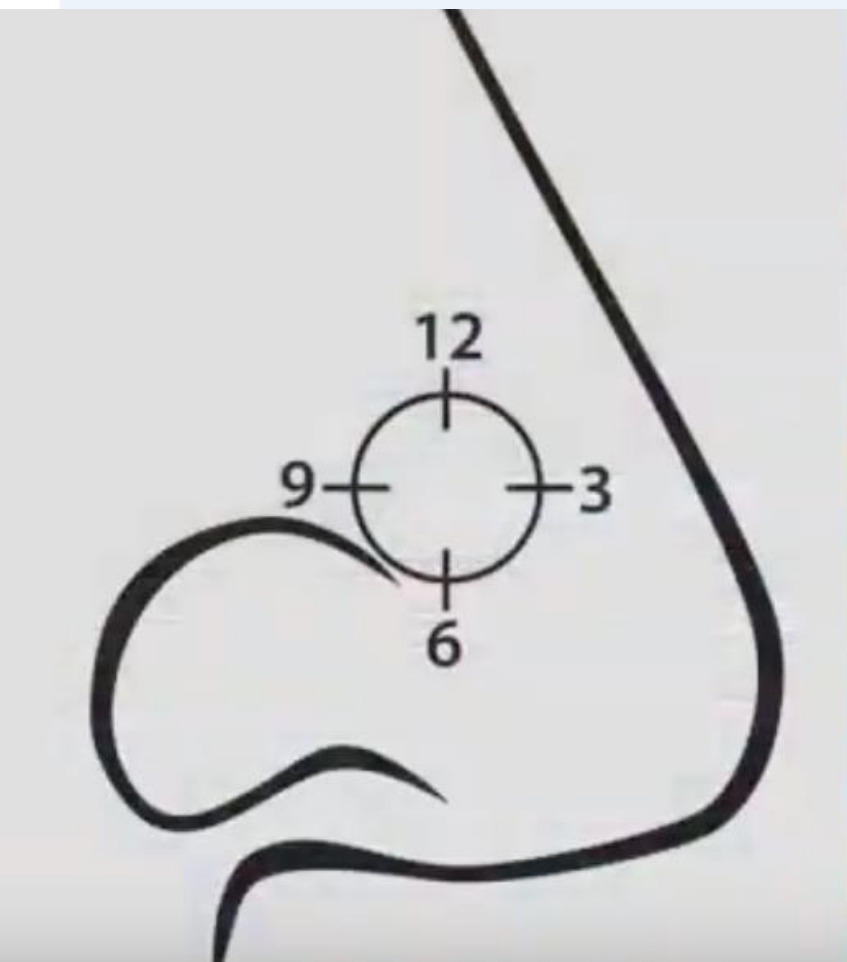
- Developed in the 1930s
- Most effective, precise and advanced treatment for skin cancer
 - Precisely identify cancerous cells, leaving healthy tissue intact
 - Gold standard for non-melanoma skin cancer in cosmetically sensitive areas and high risk skin cancers
- Goal: tumor eradication and tissue sparing
- Fellowship trained physician performs cancer removal, pathologic evaluation of tissue, and reconstructive surgery

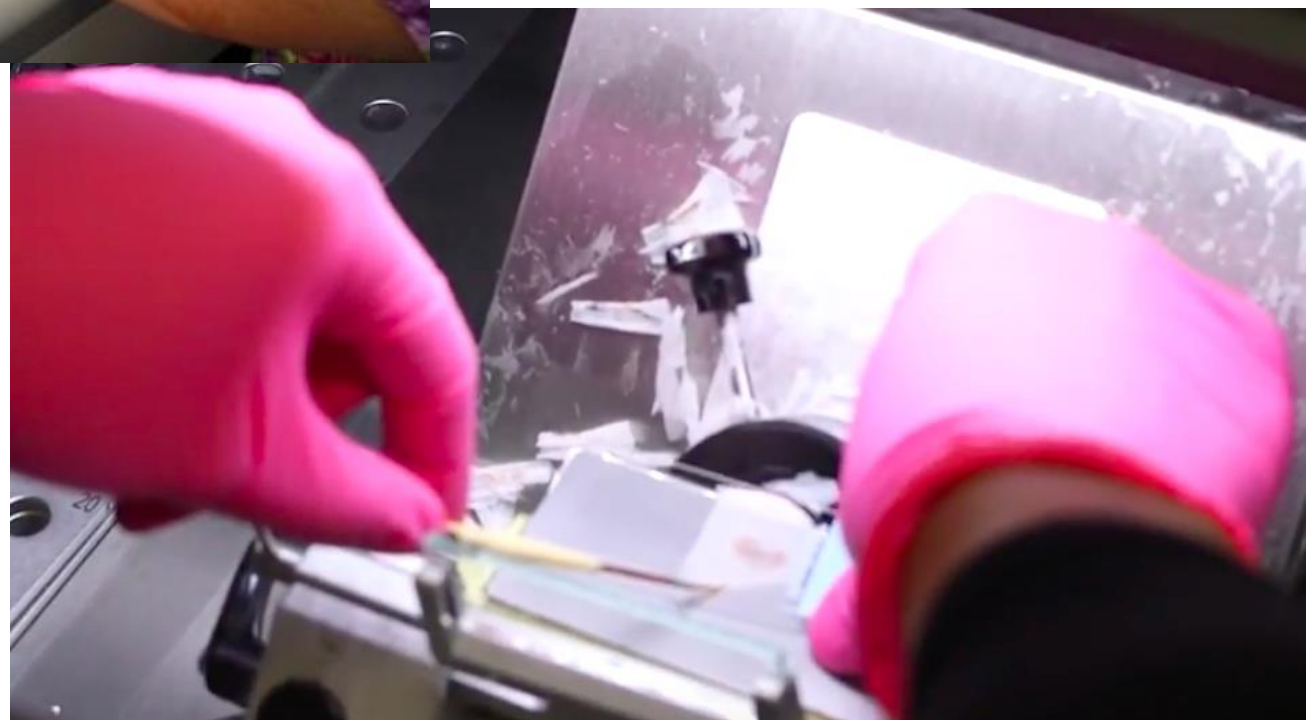
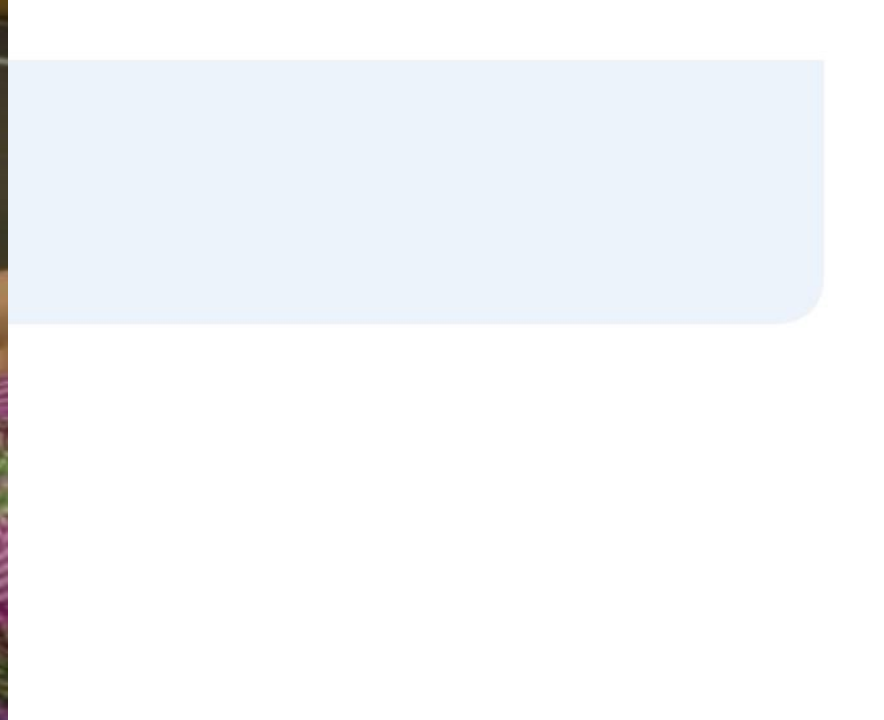
Mohs Surgical Technique

- Site marked and infiltrated with local anesthetic
- Tumor debulking
- Saucerized layer of tissue excised
 - Tissue nicks vital for orientation
- Precise labeling and inking of tissue
- The cut surface is flattened and imbedded in a cryostat

Mohs Surgical Technique

- Entire horizontal surface is frozen, cut, stained
 - Full visualization of lateral and deep margin
- Microscopic examination used to visualize the tissue and evaluate for presence or absence of tumor
 - If tumor present, another layer taken
 - Repeat until tumor no longer present
- Once removed, reconstruction performed same day

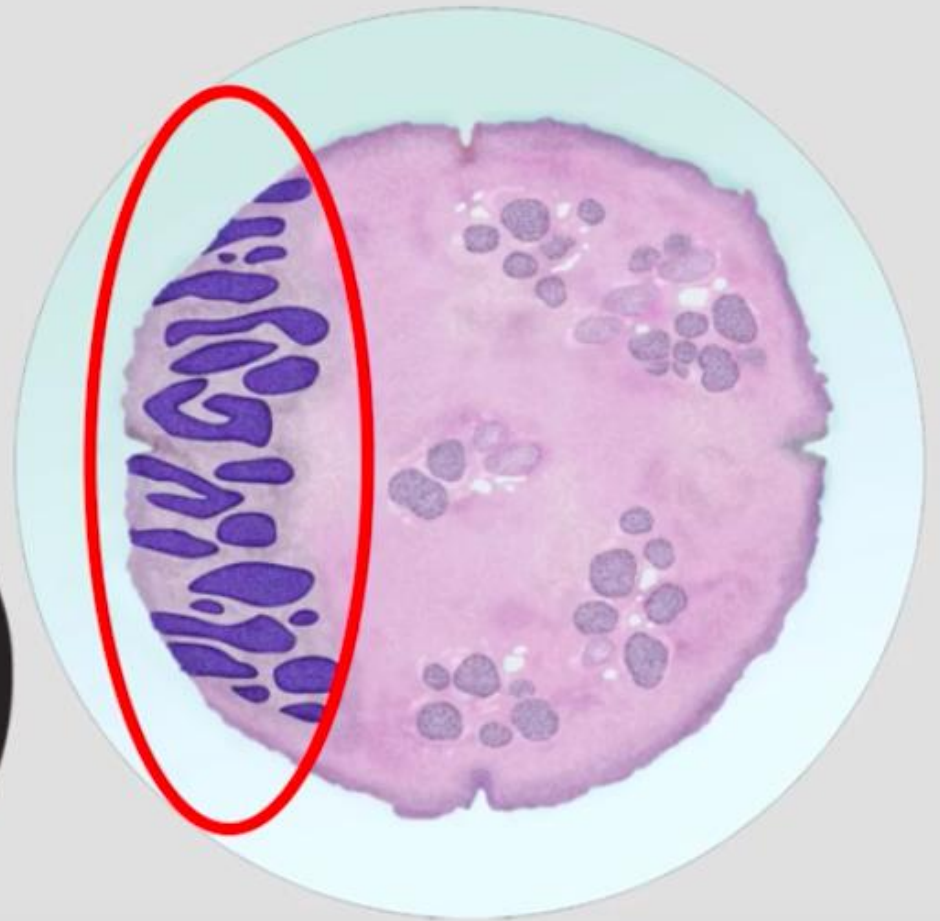
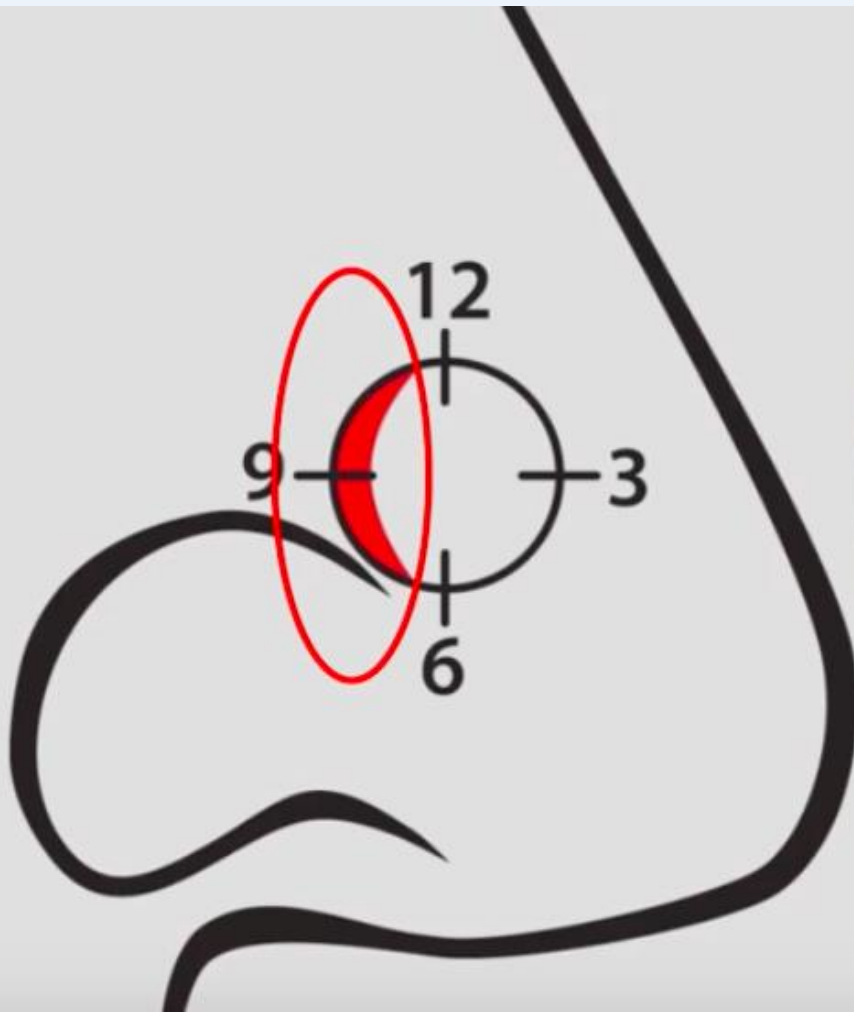


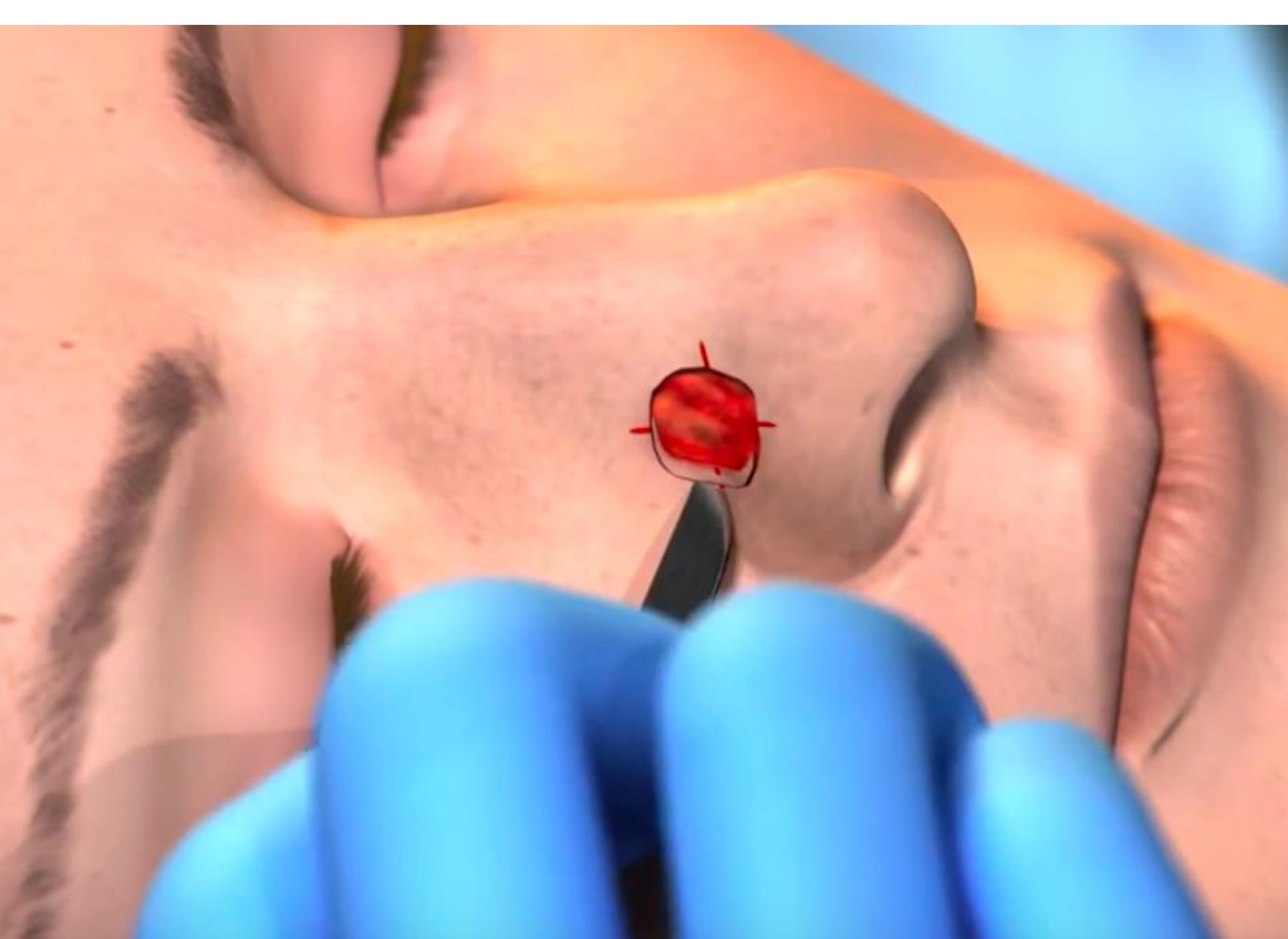














Understanding the difference between Mohs and Standard Excision

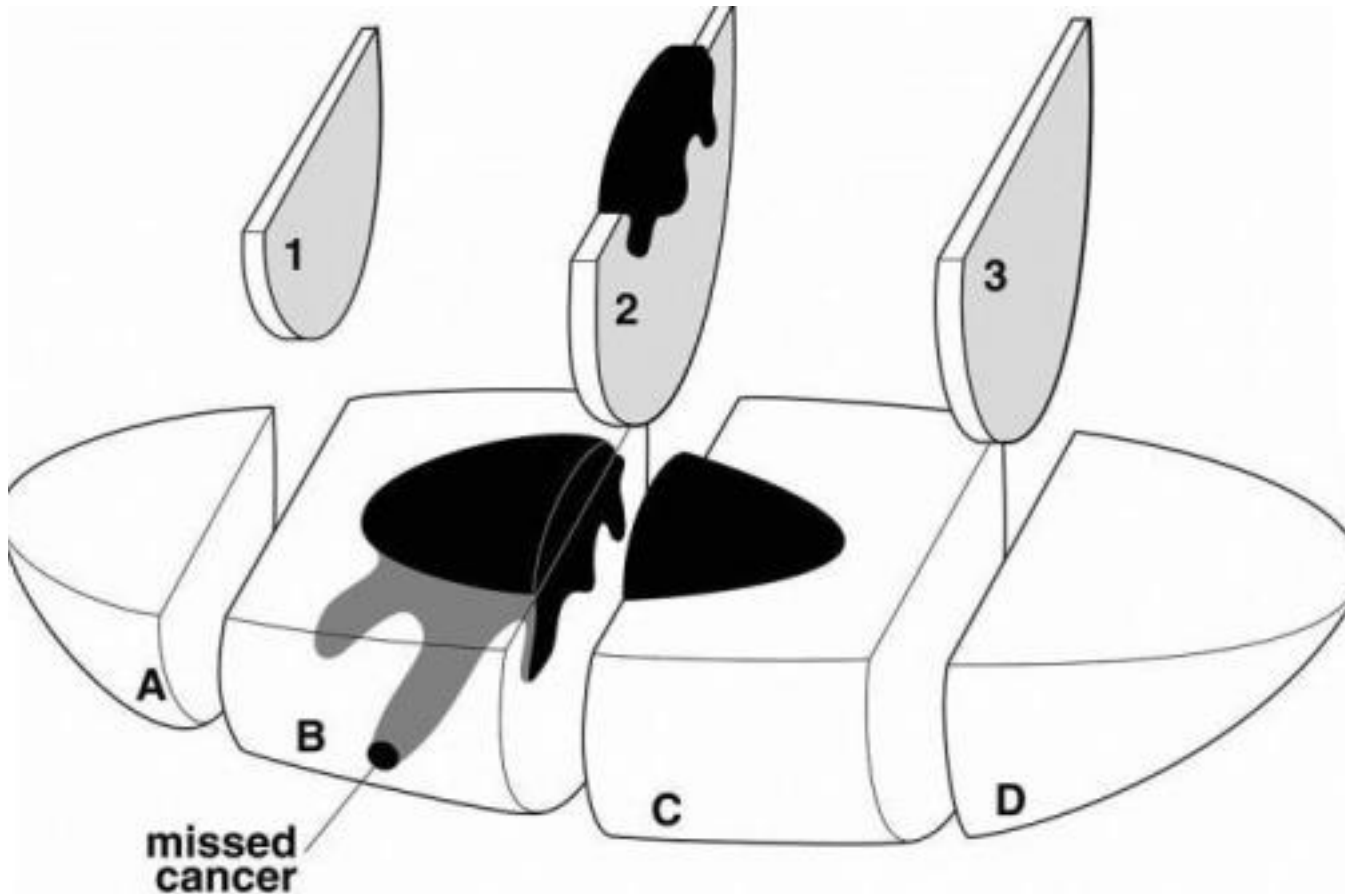
Mohs

- Horizontal sections with fresh frozen technique
- Requires that one person act as both surgeon and pathologist
- Tissue is mapped and processed → 100% of the peripheral and deep surgical margins are viewed microscopically
- ***Complete (100%) margin control***

Excision

- “Breadloafing” of tissue with vertical sections
- Tissue is sent off and processed and read by another specialist
- ***Less than 2% of margin is analyzed***

Standard Excision



Less than 2% of the true margin is assessed

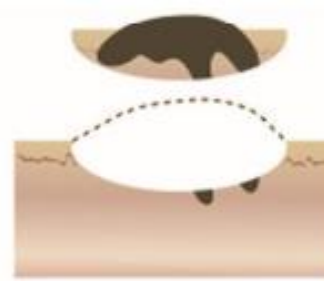
Standard Excision

Vertical sections aka “bread-loaf”

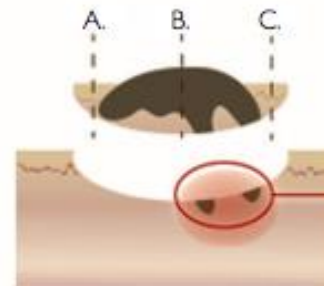
Representative samples with 2-4 mm of intervening skin

Relies on standard wide margin to remove cancer’s roots

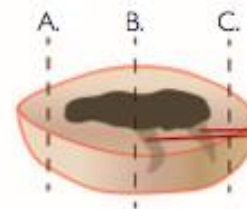
Can be inadequate for cancers with irregular finger-like projections or asymmetric grown patterns



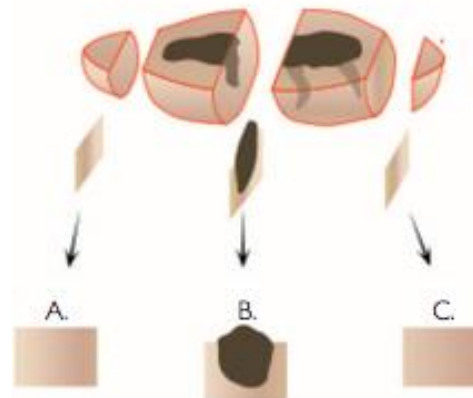
Step 1. An elliptical excision is created with wide margins around the tumor.



Extension of tumor not seen on breadloaf histology sections.



Top view of excision showing lateral and deep extension of subclinical tumor.



Step 2. Breadloaf sections on histologic slides. Extensions of the tumor are not represented in histology sections A and C, resulting in false-negative margins and probable tumor recurrence.

Mohs Micrographic Surgery

Tissue is cut with an angle, and relaxed so that the full margin visualized

100% examination of peripheral and deep margin



Step 1. Skin cancers often extend beyond their visible borders. It is these extensions that cause the tumors to recur if not completely removed.

Step 2. Similar to other surgical procedures, Mohs surgery first removes the visible tumor.

Step 3. A thin layer of normal tissue is then removed, mapped, and evaluated by the surgeon using a microscope.



Step 4. Additional layers may then be taken precisely in the areas of remaining cancer until the tumor is completely removed.



Step 5. Mohs surgery is the only method of removing skin cancer that ensures all of the tumor is removed while preserving the maximum amount of healthy tissue and, therefore, minimizing scars and cancer recurrence.



The role of pathology in Mohs

- Experience with frozen section histopathology is paramount
- Dual role of physician as both surgeon and pathologist allows for highest degree of accuracy of clinico-pathologic correlation

Reconstructive surgery following cancer removal

Reconstruction

Once the margins are clear, the surgeon discusses reconstructive options with patient

- Secondary intention/ granulation
- Linear repair
- Flap (tissue rearrangement)
- Skin graft
- Staged interpolation flap

What are the cure rates with Mohs?

TABLE 1. Cure Rates (5 Years) for Selected Cutaneous Malignancies

Tumor	Cure rates (%)	
	Mohs micrographic surgery	Wide local excision
Basal cell carcinoma ^{11,12,38}	99 (primary) 90-93 (recurrent)	87-96 (primary) 83 (recurrent)
Squamous cell carcinoma ³⁸⁻⁴⁰	92-99 (primary) 90 (recurrent)	92-95 (primary) 76 (recurrent)
Melanoma in situ ^{41,42}	98	83-85
Melanoma (invasive) ^{23,43}	98.7 ^a	97 ^{a,b}

Superior cure rates for most skin cancer

- **BCC/SCC:**
 - **97-99% for primary lesions** (vs. 93% for excision)
- **Malignant melanoma in situ, including lentigo maligna: >98% cure rate**
- Dermatofibrosarcoma protuberans (DFSP) = treatment of choice, 98-100%
- Atypical fibroxanthoma: 95-100%
- Microcystic adnexal carcinoma: 90-95%
- Sebaceous carcinoma: >90%
- Leiomyosarcoma: >90%

When should Mohs be used?

Indications for Mohs: Appropriate Use

- High risk cancers

OR

- Cancers occurring in cosmetically sensitive areas or areas where tissue conservation is crucial

Mohs Appropriate Utilization

- AAD, ACMS, ASDS, ASMS collaboration
- Explore 270 scenarios based on:
 - Cancer characteristics
 - Patient characteristics
- Divided into appropriate (74%), inappropriate (9%), uncertain (17%)
- Telephone application created
- Published by JAAD in 2012

Mohs Appropriate Utilization

- Guides care, but not the standard of care
 - Final decision resides in physician's judgment
- Guides insurance coverage

Mohs Appropriate Use Criteria

- High risk location
- High risk tumor
 - Aggressive histology
 - Size >2 cm
- Patient factors:
 - Recurrent tumor
 - Previously radiated skin
 - Immunosuppressed patient

[Search](#)



Mohs Surgery Appropriate Use...

American Academy of Der...

OPEN



Not Enough Ratings

12+

Age

What's New

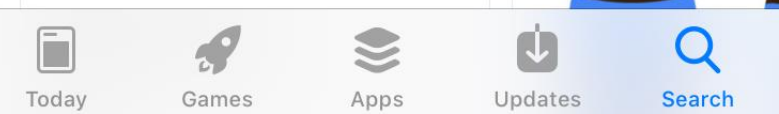
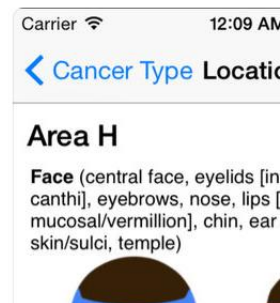
[Version History](#)

Version 1.2

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- Updated body maps for accuracy and clarity
- Privacy statement added to about section
- Minor bug fix

Preview



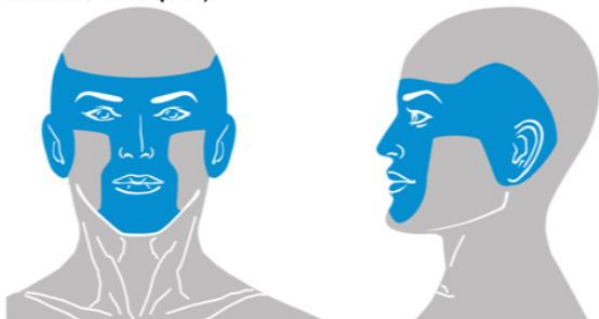
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Area H

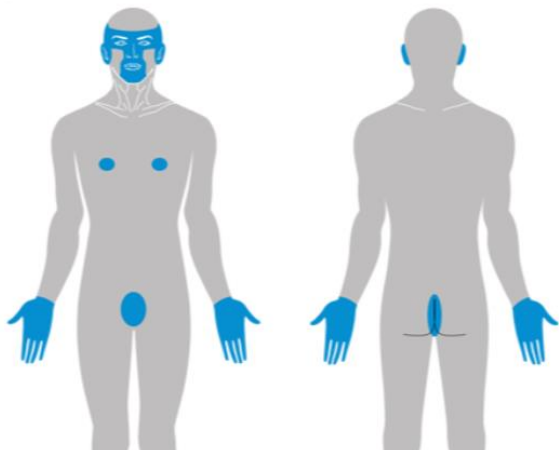
HIGH RISK

?

Face (central face, eyelids [including inner/outer canthi], eyebrows, nose, lips [cutaneous/mucosal/vermillion], chin, ear and periauricular skin/sulci, temple)



Genitalia (including perineal and perianal), **Nipples/areola**, **Hands**, **Feet**, **Ankles**, **Nail units**



Appropriate Use



Appendix

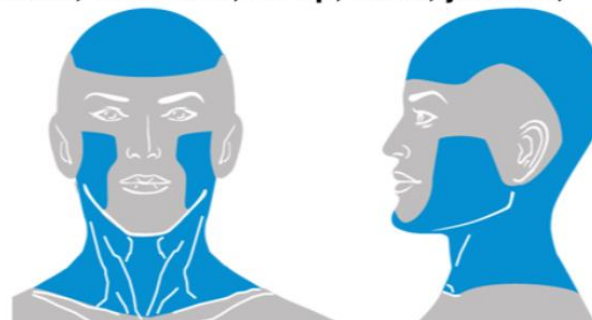
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INTERMEDIATE RISK

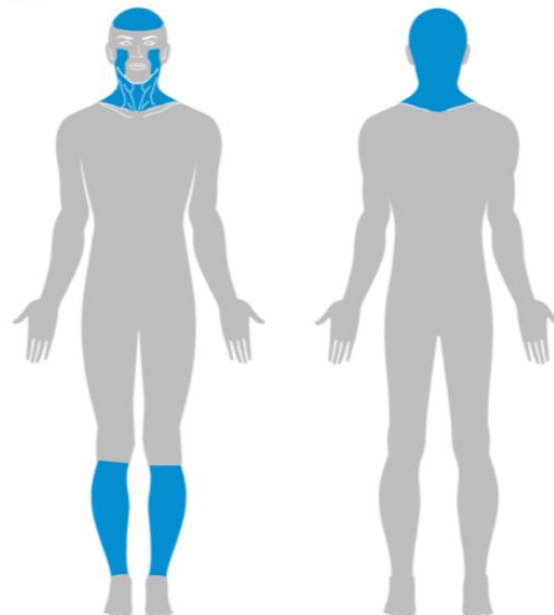
Area M

?

Cheeks, forehead, scalp, neck, jawline,



Pretibial surface



Appropriate Use



Appendix

High Risk Populations and Scenarios

High Risk Populations

- Organ transplant recipients
- Sites of previously radiated skin
- Hematologic malignancy
- Other immunocompromised patients

More frequent, vigilant surveillance

-q 3-6 mo

-Regional lymph node exam

***Mohs surgery as treatment of choice, esp
in higher risk tumors***

Organ Transplant Recipients

- Cutaneous SCC
 - 65-250 fold increased risk in OTR as compared to general population
 - More aggressive behavior/ poorer prognosis
 - 13% risk of metastatic disease compared to 5% general population
- BCC
 - 10-16 fold increased risk in OTR
- Melanoma
 - 0-8 fold increased risk in OTR

Organ Transplant Recipients

Risk Factors for NMSC in SOTR

- Duration and type of immunosuppression
- History of chronic sun exposure
- Fitzpatrick skin type I–III
- Male sex
- Age at transplantation
- Number of actinic keratoses
- Exposure to human papillomavirus
- CD4 lymphopenia

Previously Radiated Skin

What changes are seen in the skin?

- Reduced blood supply
- Fibrosis
- Impaired cellular repair potential
- Increased cancer risk

Radiated Skin

Challenges in wound healing and repair

- More aggressively behaving skin cancer
- Tissue difficulties
 - Poor wound healing
 - Indurated, fibrotic skin
 - Friable tissue
- Tools to help heal wounds
 - Hyperbaric oxygen therapy
 - Special dressings and skin substitutes
 - Use of growth factors

Risks and Complications of Mohs Micrographic Surgery

Surgical Complications

- Bleeding
- Infection
- Dehiscence
- Seroma formation
- Nerve injury
- Flap/graft failure
- Poor/delayed healing

Medication Complications

- Lidocaine → amide anesthetic
 - Allergy
 - Very rare → usually vasovagal response
 - Lidocaine with epinephrine can safely be used on digits
- Chlorhexidine
 - Toxicity to eye, ear
- Antibiotics
 - Allergic contact dermatitis

Pharmacologic Considerations

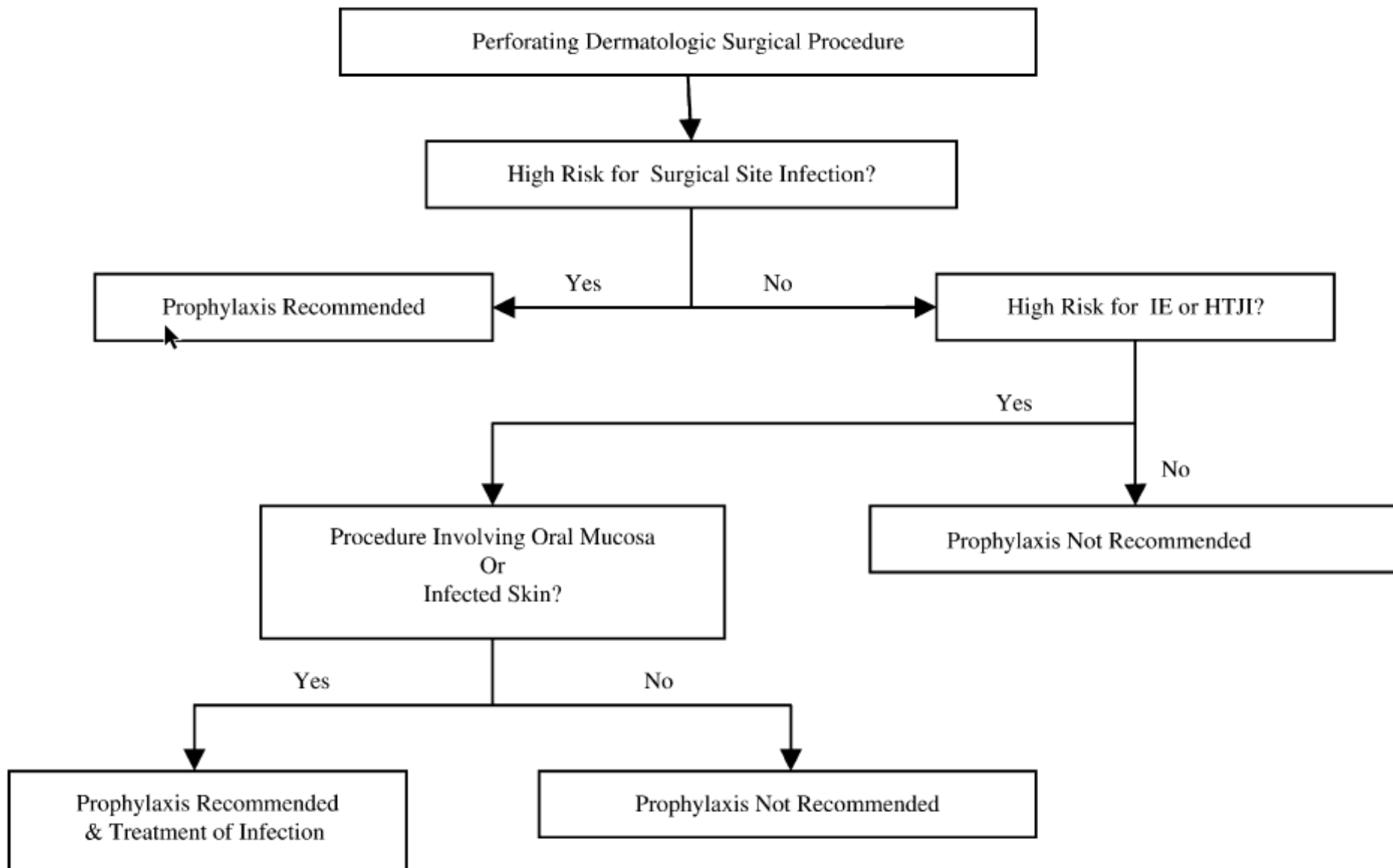
- Anticoagulants
 - *Consensus: continuation of medically necessary anticoagulants recommended*
- Antibiotics
 - Preoperative
 - Postoperative

DERMATOLOGIC SURGERY

Antibiotic prophylaxis in dermatologic surgery: Advisory statement 2008

Tina I. Wright, MD,^a Larry M. Baddour, MD,^b Elie F. Berbari, MD,^b Randall K. Roenigk, MD,^a
P. Kim Phillips, MD,^a M. Amanda Jacobs, MD,^a and Clark C. Otley, MD^a

Rochester, Minnesota



IE = Infective Endocarditis, HTJI = Hematogenous Total Joint Infection

Risks and Complications

- Recurrence
- Metastasis

TABLE 1. High-Risk Factors for BCC Recurrence

Tumor factors

Any BCC on high-risk anatomic sites (the “mask” areas of the face, including the central face, periocular region, eyelid, eyebrow, nose, perioral, lip (cutaneous and vermillion), chin, mandible, ear, preauricular, postauricular, and temple skin, as well as the hands, feet, and genitalia)

BCC >1 cm in diameter on intermediate risk sites (cheeks, forehead, scalp, and neck)

BCC >2 cm in diameter on the trunk and extremities

BCC with poorly defined borders

BCC with aggressive histologic patterns (morphea-like, infiltrative, micronodular, metatypical, basosquamous cell carcinoma)

BCC with perineural involvement

Recurrent BCC

Host factors

BCC on sites of previous radiation therapy, burn scars

BCC in patients younger than 40 years

BCC in immunosuppressed patients

BCC in patients with genetic syndromes

BCC in chronic scars, ulcers, sites of inflammation

BCC in patients with a history of aggressively-behaving tumors

TABLE 3. Risk Factors Associated With Local Recurrence and Metastasis of cSCC

Tumor characteristics

Any cSCC in high-risk sites: central face, periocular region, eyelid, eyebrow, nose, perioral, lip (cutaneous and vermillion), chin, mandible, ear, preauricular, postauricular, and temple
cSCC >1-cm diameter in intermediate-risk sites: cheeks, forehead, scalp, and neck
cSCC >2-cm diameter in any site
Poorly defined borders
cSCC exhibiting rapid growth
Neurologic symptoms
Locally recurrent cSCC after primary therapy

Histology

Depth >4 mm
Poorly differentiated
Aggressive histologic patterns: adenoid (acantholytic), desmoplastic, or spindle-cell cSCC, and invasive Bowen disease carcinoma
Perineural or vascular invasion

Host factors

Sites or previous radiation therapy
Exogenous immunosuppression (medications)
Endogenous immunosuppression (lymphoproliferative disorder, HIV)
Arising in scars or chronic wounds
Arising in sites of chronic inflammation
Genetic propensity for cSCC: XP

Mohs Risks and Complications

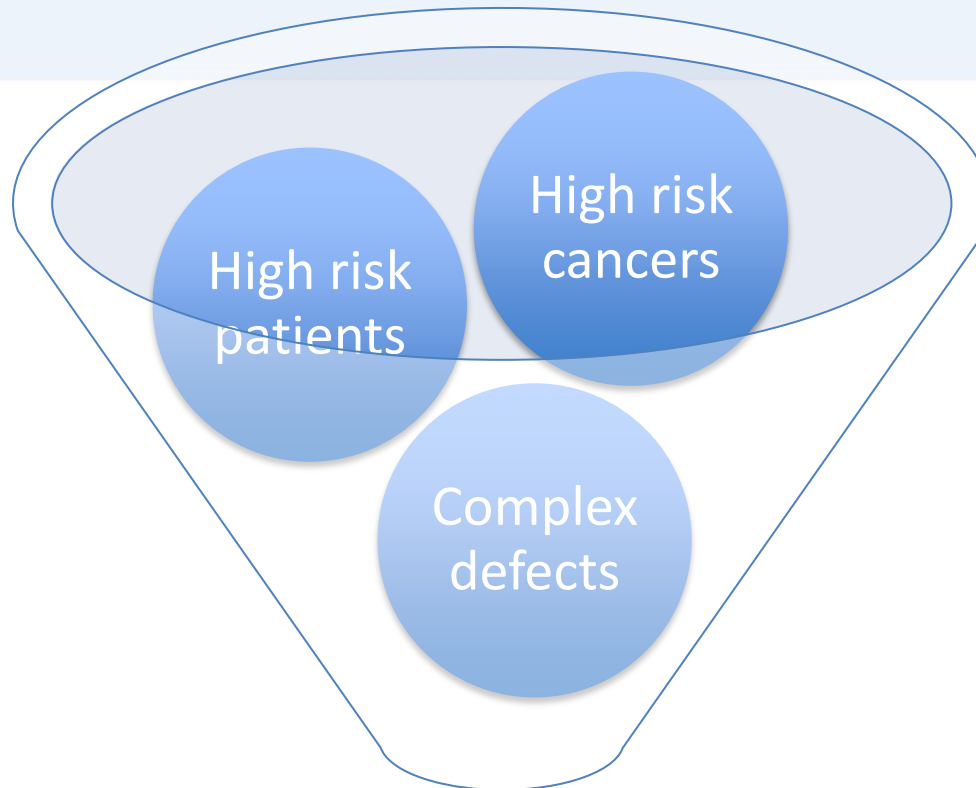
In a nutshell...very safe and effective procedure with minimal risk

- Serious complications rare
- Continue anticoagulants during surgery to avoid thrombotic complications
- Judicious use of antibiotic prophylaxis
- Nerve damage avoided by knowledge of facial anatomy
- Tumor recurrence extremely low
 - Increased monitoring for high risk patients and tumors

Multidisciplinary Care

When is it needed?

Multidisciplinary Care of NMSC



**Radiation oncology, ENT,
oculoplastics, facial plastics,
oncology**

Is Mohs cost effective?

Cost Effectiveness of Mohs

- Due to high cure rate of 99%, patients only require one outpatient surgical visit
- Single payment to single provider, including
 - Pathology fees
 - Laboratory work
 - Anesthesia
 - Surgery
 - Supplies

Cost Comparison

TABLE 2. Estimated Costs of Varied Nonmelanoma Skin Cancer Treatment Modalities and Sites of Service Based on Published Cost Comparison Studies^a

Treatment and site	Estimated costs (\$)				
	Ravitskiy et al, ⁸³ 2012	Bialy et al, ⁸⁴ 2004	Rogers and Coldiron, ⁸⁵ 2009	Wilson et al, ⁸⁶ 2012	Mean
MMS	804	937-956	1197	2085	1258
Exc./Perm./Office	1025	944-1029 ^a	1088	1222 ^b	1081
Exc./Froz./Office	1199	1399 ^b			1299
Exc./Froz./ASC	2507		2267		2387
Exc./Froz./OR			2883		288
Local destructive surgery (ED&C)			432	463	447
Radiation			2575-3446		3011
Imiquimod			945		945

^aASC = ambulatory surgery center; ED&C = electrodesiccation and curettage destruction; Exc. = traditional surgical excision; Froz. = frozen section margin control; Imiquimod = topical 5% imiquimod therapy (6 weeks); MMS = Mohs micrographic surgery; Office = office-based surgical setting; OR = hospital-based operating room setting; Perm. = formalin permanent section margin control; Radiation = radiation therapy treatment based on 12 to 17 fractions.

^bMixed site of service that may include some facility-based treatment.

Cost effectiveness

Least
Expensive

Most
expensive

In a nutshell...

Destruction
(ED&C)

Mohs

Office
Based
Excision

Facility
Based
Excision

Radiation
Therapy

Summary

- **100% evaluation of margins**
- Up to 99% cure rate
- Most effective treatment for non-melanoma skin cancer
 - Squamous cell carcinoma
 - Basal cell carcinoma
- Can be used for margin control for melanoma
- Entire procedure performed on same day
 - Cancer removal
 - Reconstruction

Summary

- Safe
 - Outpatient basis with local anesthesia
 - Low risk of complications/ adverse reactions
- In high risk patients or high risk tumors
 - May require multi-disciplinary care
- Cost effective

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Questions?

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 - Please email with any questions!

Thank you!