



## Relevant Aspects of Mohs Surgery in Patients with Skin Cancer Aspectos Relevantes De La Cirugía De Mohs En Pacientes Con Cáncer De Piel

Ferrero AZ<sup>1\*</sup>, Salgado LR<sup>1</sup>, Bermudez LS<sup>2</sup>, Cárdenas SV<sup>1</sup> and Celis LG<sup>1</sup>

<sup>1</sup>Department of Medicine, Universidad de la Sabana, Colombia

<sup>2</sup>Department of Medicine, Universidad de los Andes, Colombia

### \*Corresponding author:

Andreina Zannin Ferrero, Department of Medicine, Universidad de la Sabana, Calle 134 bis #19 - 80. Bogotá, Colombia..

Tel: (+57) 313 - 320 - 6759; E-mail: andreinazafe@unisabana.edu.co

### 1. Abstract

**1.1. Introduction:** The skin, known as the most extensive organ of the human body, has multiple functions that help the human being to make vital and transcendental mechanisms. That is why it is essential to take care of the skin in order to prevent the appearance of various types of cancer. There are multiple treatments for skin cancer, one of which is Mohs Surgery. This is a procedure used in patients with skin cancer since it provides us with multiple advantages, including precise visualization of the edges, low recurrence rates and preservation of healthy tissue. This surgery consists of surgically removing the minimum amount of tissue to resect the tumor with precise mapping of the surgical margin while preserving healthy skin. The objective of this article is to know the main surgical method with histological control used in patients with skin cancer, to understand its utilities and advantages as well as, to know the surgical technique, the indications and contraindications that the medical specialist must take into account at the moment of making this approach.

**1.2. Objective:** Understanding the micrographic surgery of Mohs as the principal surgical method with histological control used in patients with skin cancer, knowing its utilities and advantages as well as learning the surgical technique, the indications and contraindications to be considered by the medical specialist at the time of making this procedure.

**1.3. Materials and methods:** A literature search was conducted using Mesh terms in the following databases: Pubmed, Ovid, Clinical Key, Science Direct, for its analysis and selection according to its relevance in relation to Mohs Micrographic Surgery and the new contributions to the disease to be treated in order to make the review article.

**1.4. Results:** MMC has cure rates of up to 99% for cbs and 95% for recurrent ones. The recurrence rates for primary CBC treated with standard excision are 10%, while with CMM the rates are 1% and for recurrent CEC the rates with CMM are 3 to 8%, while with standard excision they are 5 to 40%. All of the above demonstrates one of the most important advantages provided by Dr. Mohs' technique, which are its high cure rates and low recurrence rates.

**1.5. Conclusion:** MMC is an innovative procedure that has demonstrated cure rates of up to 99% and much lower recurrence rates than standard excision. In addition, it allows maximum preservation of healthy tissue, an advantage in the aesthetic field since it facilitates early reconstruction and lower risk

of functional complications. As for the indications, it has been possible to specify more and more the usefulness of this technique for each neoplasm and variations of the technique have emerged that allow a better approach to certain tumor masses.

### 2. Keywords

Skin neoplasms; Mohs surgery; Margin of excision; Carcinoma; Basal cell

### 3. Introduction

The skin, known as the most extensive organ of the human body, has multiple functions that help the human being to develop vital and transcendental mechanisms such as: protection against mechanical and chemical effects, production of vitamin D, fat reserve, elimination of waste, hydro electrolytic maintenance, among others [1-4]. That is why it is essential to take care of the skin in order to prevent the development of various types of cancer. Every year 3.5 million cases of non-melanocytic skin cancer (NMSC) are diagnosed in the USA, where 20% correspond to the squamous cell type (SCLC), this being one of the most aggressive and with a global incidence for 2002 of 387/100,000 inhabitants [5]. On the contrary, basal cell carcinoma (BCC) is the most frequent but not the most malignant and its incidence rate has been increasing in the last four decades in different parts of the world [6]. Melanocytic skin cancer (MSC) whose main pathology is Malignant Lentigo Melanoma (LMM) is very invasive and has a high risk of tumor metastasis [2]. There are multiple treatments for skin cancer, one of them being the surgical method with histological control of the lesion margins called Mohs Micrographic Surgery (MMS), a procedure used in skin cancer patients [2]. This procedure provides us with multiple advantages including: precise visualization of the edges, low recurrence rates and preservation of healthy tissue. In recent years it has been increasingly used, even in the pediatric population [3] and its micrographic name comes from the microscopic evaluation of "micro" tumor margins and the detailed mapping of "graphic" tumor orientation [7]. The objective of this article is to know the Mohs Micrographic Surgery as the main surgical method with histological control used in patients with skin cancer.

### 4. Materials and Methods

In this literature review, the ethical and methodological principles that safeguard authors' rights were evaluated, as well as their contribution to science. The description of several studies does not violate the privacy of the

**Citation:** Andreina Zannin Ferrero. *Relevant Aspects of Mohs Surgery in Patients with Skin Cancer Aspectos Relevantes De La Cirugía De Mohs En Pacientes Con Cáncer De Piel. J SurgSurg Tech. 2020;1(1):1-5*

**Copyright:** © 2020 Andreina Zannin Ferrero. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

individuals reported there. A literature search was conducted using Mesh terms in the following databases: Pubmed, Ovid, Clinical Key, Science Direct, for its analysis and selection according to its relevance in relation to Mohs Micrographic Surgery and the new contributions to the disease to be treated in order to make the review article.

We will now learn about the most relevant aspects of Mohs Micrographic Surgery (MMS) including its history, usefulness, indications and multiple advantages.

## Mohs surgery

This surgery consists of surgically removing the minimum amount of tissue to remove the tumor with precise mapping of the surgical margin while preserving and caring for healthy skin [4]. Therefore, the entire lesion can be removed by sequentially removing the tumor and examining 100% of the margin in the same plane under the microscope [8]. MSC is considered in a wide variety of tumors, especially in cases of basal cell carcinoma and squamous cell carcinoma [9]. Other tumors that can be treated include dermatofibrosarcoma protuberans, atypical fibroxanthoma, extramammary Paget's disease, Merkel cell carcinoma, and microcystic adnexal carcinoma [8,9].

## History

In 1930, surgeon Frederic Edward Mohs, a medical student, worked as a research assistant in the department of Zoology at the University of Wisconsin [7-10]. Together with Professor Guyer, they studied the antineoplastic effects of injecting various substances into different tissues [11]. Mohs observed that injecting 20% zinc chloride into rats resulted in tumor necrosis and fixation without altering the histological architecture. Based on the above, he determined that this fixation effect could be combined with surgical excision to eliminate neoplasms in a serial and microscopically controlled manner [11]. The first technique described was in situ fixation, where the zinc chloride coagulated the neoplastic tissue without altering the cellular architecture, with subsequent elimination of the devitalized tissue [12]. The described technique was mainly used in skin tumors [7]. As for the cuts, it found that the horizontal cuts allowed evaluating 100% of the margins of the sample, while the vertical cut only evaluated 0.01% of the total surface of the removed tumor area [9,11]. Within the limitations of this technique was time, since each layer took at least one day to set, so patients requiring multiple layer excision had to return daily for at least 5-7 days. In addition, the paste caused swelling, local pain and lymphadenopathies [11]. Based on the limitations previously set forth regarding the in-situ technique, the fresh tissue technique with freezing cuts was created in 1953, where they used local anesthesia, which allowed for the excision of multiple layers of a tumor in one day and reconstruction could be performed in that same time surgically [7,11,12]. The publication of Tromovitch and Stegman in 1974 in the journal "Archives of dermatology" was a key factor in the wide acceptance of this new technique, since of the 102 patients with basal cell carcinoma who underwent this technique, only three recurrences were found in a follow-up of 3-8 years after the procedure [11,12]. Although the fresh tissue technique had become the predominant way of performing MSCs, Mohs continued to use the fixed tissue technique for melanoma, large neoplasms involving bone, osteomyelitis, penile carcinoma, and gangrene. He concluded that for small to moderately sized lesions the fresh tissue technique was indicated, while if the lesion was extensive, in situ fixation was preferable [11,12]. Today, Mohs surgery is considered a standard practice, the Mohs legacy was created from all the contributions it provided for the emergence of surgery in the field of microsurgery and dermatology [13].

## Usefulness and advantages

Between Mohs surgery and local excision is the use of the fresh fixation technique with horizontal cuts that allow the complete visualization of the lesion margin, while the other technique uses vertical cuts at various intervals where it only evaluates 1-2% of the sample margin [4]. By preserving more tissue using precise mapping, it expands reconstruction options earlier, with less aesthetic compromise and decreased risk of functional defects [4,10]. In addition, MMS is generally performed on an outpatient basis [8], which reduces the time spent in hospital and the use of resources, thus reducing costs for the health system. On the other hand, more than 95% of skin malignancies are limited to the epidermis and dermis. This allows the surgeon to safely preserve the underlying soft tissue, which simplifies the reconstruction and thus improves the aesthetic and functional results [8]. Finally, it is important to mention that some studies have found that when the method of choice is MMS, the average cost for patients and for the health system in general is equal to or less than the

traditional excision technique, a great advantage in developing countries [14]. MMS has become the ideal treatment for skin malignancies mainly for non-melanocytic skin cancer, however, its use in melanoma has increased more and more [4].

## Indications

The use of MMS has increased during the last 2 decades, and its use has grown disproportionately compared to other types of treatment [4]. For this reason, several bodies including the American Academy of Dermatology (AAD), European and Australian guidelines formed different working groups to develop appropriate use criteria. Before the indications for this procedure can be defined, the high, medium and low risk anatomical sites illustrated in



**Figure 1:** Anatomical sites of high, medium and low risk: red - high; intermediate - yellow; low - green.



**Figure 2:** Anatomical sites of high, medium and low risk: red - high; intermediate - yellow; low - green.

(Figure 1,2). The general and specific indications are listed in (Table 1). The indications for cutaneous squamous carcinoma (SCLC) and melanoma remain controversial. In the case of squamous cell carcinoma (SCLC), the recommendations for MMS differ substantially between the different guidelines. According to the American Academy of Dermatology (AAD), it is indicated in all tumors in high- and intermediate-low risk areas except actinic keratoses, squamous cell carcinoma in situ, and invasive squamous cell carcinoma less than 1cm. On the other hand, in the Australian guide they take a less lax stance indicating only for tumors with poorly defined borders, in high-risk areas, with aggressive histology, recurrent and large size. Finally, the European guide for the diagnosis and treatment of invasive squamous carcinoma states that the indications should be more limited because no statistically significant prognostic differences have been shown between conventional surgery or MMS [8]. In the case of melanoma, it is known that some time ago the use of MMS was debated since several studies had described local recurrences, metastasis and survival rates in head and neck greater than those of standard excision [10]. However, it has also been found that staged excision with permanent sections (deferred Mohs) demonstrated superiority over conventional MSC in patients with melanoma over lentigo maligna and the AAD recommendations within the usefulness of Mohs surgery are focused on cases of melanoma in situ and lentigo maligna [8].

| General Information  | Specific Information  |
|--|---|
| <p>1.Non-melanocytic skin cancer:</p> <p>1.1. High risk areas</p> <p>Recurring cases</p> <p>1.2. Aggressive histology:</p> <p>1.3. Basal cell: morphiform, infiltrative, micronodular, basosquamous</p> <p>1.4. Squamous cell: more than 4 mm deep, poorly differentiated, perineural or lymphovascular infiltration, acantholytic (adenoid), desmoplastic, sarcomatoid, clear cell, small cell or invasive Bowen's disease.</p> <p>2. Immunosuppressed patients.</p> <p>3. Genetic syndromes with predisposition to skin cancer.</p> <p>4. Tumors that settle on traumatic scars, skin ulcers, regions that have received previous radiation therapy.</p> | <p>1.Squamous cell carcinoma</p> <p>2.Melanoma*</p> <p>3.Basal cell carcinoma:<br/>Recurrent cases.<br/>Greater than 6 mm located in high risk areas.<br/>Greater than 10 mm located in intermediate risk areas.</p> <p>3.1. Greater than 20 mm located in trunk or extremities</p> <p>3.2. Histological pattern of aggressive characteristics.</p> |
| *See article for more detail.  |   |

**Table 1:** General and specific indications of MMS[4,8,10].

## Contraindications

Although there is no expert consensus guidance that specifically mentions contraindications for this procedure, there are not the first line of treatment. In a study in Spain that included 3011 patients who were candidates for MMS, the procedure was not performed in 85 patients. The reasons for being considered an unsuitable patient were: giant tumors and bone invasion (15.3%), low risk tumors (18.8%) and medical contraindications (27.1%). Of the 85 patients considered unfit, 34.1% underwent conventional surgery, 28.3% underwent radiotherapy, 4.7% underwent Hedgehog inhibitors and 2.4% underwent palliative treatment [15]. Additionally, some relative contraindications described are tumors that present a non-contiguous growth that can create problems with the margins, a tumor that cannot be identified histologically in a clear way, and large tumors or the presence of bone invasion [8].

## Technique

The technique is based on the systematic and orderly execution of serial cuts of the surgical margins of the removed tumor. This sequence as a whole is called "pass" or "stage" [8]. The technique described is found in detail in (Table 2). Additionally, there are several modifications of the technique, which are described in (Table 3). Regarding the recommended margins, a retrospective observational study studied what the appropriate margins should be and found that nodular BCC <6 mm can be eliminated with 3 mm margins instead of the current recommendation of 4 mm margin [16].

|  |
|--|
| 1. Delimit the margins of the tumor, since at the moment of infiltration of the anesthetic the limits of the tumor are lost due to edema.  |
| 2. Asepsis and antisepsis of the surgical field with 4% chlorhexidine, iodopovidone or alcohol.  |
| 3. Anesthetic, it is recommended to start with lidocaine at 2% and later bupivacaine can be added at 0.5%.   |
| 4. Macroscopic tumor extraction, which is called debulking, or cytoreduction.  |
| 5. Plate-shaped incision with the cold scalpel angled at 45 degrees. Before extracting the specimen, reference marks are made clockwise on both the surgical specimen and the patient's skin in order to preserve spatial orientation. |
| 6. Making of traced graphic identical to the resected piece in shape, number of cuts and orientation marks made on the patient and the tumor piece.  |
| 7. The material is colored live and, on the map, with different pigments.  |
| 8. Use of a fixing medium called OCT (optimal cutting temperature) and placement in cryostat with a variable time according to the size and number of pieces to be frozen.   |
| 9. When frozen, 4 - 10-micron cuts are oriented horizontally and stained with hematoxylin and eosin (H&E) or toluidine blue (in cases of CBC).   |
| 10. They analyze the histological sections to detect possible residual tumor foci or free margins.   |
| 11. If infiltration by neoplastic cells is observed, the exact site of the residual tumor is marked on the patient's map and it is called the second stage and only what is marked on the map as a tumor is removed.                   |
| 12. Once 100% of the margins free of infiltration by neoplastic cells have been obtained, the different options for closing the surgical defect are evaluated.   |

**Table 2:** Description of the technique [7].

| Technique                  | Descriptions   |
|----------------------------|--|
| Mohs surgery at 90 degrees | Excision with a 90-degree angle instead of the usual 45 degrees because with the 45-degree technique the tumor piece cannot be completely flattened in the cryostat and some margins may not be represented on the lamellae. It is indicated for anatomical areas that have little skin laxity and deep or large tumors. |
| DeferredMohs Surgery       | The cuts are made in kerosene, the results usually take longer. The cuts that are made are also at 90 degrees. With this procedure the sample can be larger and the quality of microscopic visualization is improved, allowing better differentiation of the neoplastic tissue.  |
| DeferredMohs Surgery       | Tumour margins are removed with immediate closure of the resulting defect without debulking, and histological analysis in kerosene of the fragments obtained. It is indicated in the case of malignant lentigo and lentiginous acral melanoma.   |

Table 1: Variations of the MMS technique [20].

## Reconstruction

As options are mentioned closure by second intention, simple closure with edge facing, use of grafts and flaps. The selection of the closure technique will depend on the primary defect, its anatomical site, the oncodermatological control required by the patient and the skill of the surgeon (5-7).

Some reconstructive options described in the literature include bilobed or "warhorse " transposition flaps for defects in the distal third of the nose, helical edge advancement flaps, island advancement flaps and paramedian forehead flaps [17].

## 5. Results

MMS has cure rates of up to 99% for bcbs and 95% for recurrent ones. The recurrence rates for primary bcbs treated with standard excision are 10% while with mms the rates are 1% and for recurrent bcbs the rates with mms are 3 to 8% while with standard excision they are 5 to 40% [3]. All of the above demonstrates one of the most important advantages of Dr. Mohs' technique, which are its high cure rates and low recurrence rates [3]. Squamous cell carcinoma (SCLC) of less than 2 cm has a 99% cure rate with MSC, and those of 2-3cm have a cure rate of 82% at 5 years; however, tumors larger than 3cm have a 59% cure rate [3]. As for qualitative results, the PROM-QOL scale (Patient-reported outcome measures - patient satisfaction and quality of life) was created to evaluate the quality of life of the operated patients. This scale includes 12 items to evaluate social, emotional, functional and aesthetic consequences perceived by the patient based on the surgical treatment and its post-operative period [18]. This could be a useful tool in future studies to minimize morbidity and maximize quality of life in patients with malignant skin tumors.

active bleeding requiring the intervention of a healthcare professional, infection, flap necrosis, hematoma, or wound dehiscence. On a scale of 0 to 10, the average level of maximum postoperative pain was 1.99 [19]. In another study, it was found that when there are complications in this procedure, most involve infection (61.1%) and surgical wound dehiscence (20.1%). Postoperative bleeding and the appearance of hematomas occurs in 15.4% of cases [8].

## 6. Complications

A prospective multicenter cohort study was conducted that evaluated the rate of major and minor complications and postoperative pain associated with skin cancer treatment by MSC in 1550 patients with 1792 tumors. No major complications occurred, and 2.6% of minor complications included

## 7. Conclusion

The MMS is an innovative procedure in terms of its method of fresh fixation and horizontal cuts of the tissue, which has demonstrated healing rates of up to 99% and much lower recurrence rates than standard excision since 100% of the skin margin can be evaluated in a single surgical time, reducing in-hospital costs and providing a comfortable recovery for the patient. In addition, it allows maximum preservation of healthy tissue, an advantage in the aesthetic field because it facilitates early reconstruction and lower risk of functional complications. As for the indications, the usefulness of this technique for each neoplasm has become increasingly clear, and based on this, variations of the technique have emerged that allow a better approach to certain tumor masses. One of the characteristics of MMS is its low rate of complications, the benefit being greater than the risk.

## References

- González EFG, Jiménez DNP. Manual para la detección temprana del cáncer de piel y recomendaciones para la disminución de exposición a radiación ultravioleta [Internet]. Instituto Nacional de Cancerología ESE. 2015;11-71.
- Andres AS, Alvaro AH. Lentigomaligno: clínica, histopatología y tratamiento. Rev la Asoc Colomb Dermatología. 2008;16(2):135-42.
- Mansouri B, Bicknell LM, Hill D, Walker GD, Fiala K, Housewright C. Mohs Micrographic Surgery for the Management of Cutaneous Malignancies. Facial Plast Surg Clin North Am. 2017;25(3):291-301.
- Tolkachjov SN, Brodland DG, Coldiron BM, Fazio MJ, Hruza GJ, Roenigk RK, et al. Understanding Mohs Micrographic Surgery: A Review and Practical Guide for the Nondermatologist. Mayo Clin Proc. 2017;92(8):1261-71.

5. [Guía de Práctica Clínica con evaluación económica para la prevención, diagnóstico, tratamiento y seguimiento del cáncer de piel no melanoma: carcinoma escamocelular de piel. MinistSalud y Protección Soc - Colcienc. 2014;32\(32\).](#)
6. [Sanchez Vanegas Guillermo, Buitrago Garcia Diana Carolina, Acosta Madiedo De Hart Alvaro, Rueda Cadena Xavier. NVJA. Guia de práctica clínica con evaluación económica para la prevención, diagnóstico, tratamiento y seguimiento del cáncer de piel no melanoma: carcinoma basocelular. MinistSalud y Protección Soc - Colcienc. 2014;3\(31\):1-460.](#)
7. [Marecos RM, Fawcett AG, Celías GML. Cirugía micrográfica de mohs: Un enfoque completo. Dermatología Cosmet Medica y Quir. 2016;14\(1\):42-7.](#)
8. [Conde-Ferreirós A, Cañueto J, Santos-Durán JC. Indicaciones de la cirugía de Mohs en la práctica clínica habitual. Piel. Formación continua de dermatología. 2019;34\(7\):427-35.](#)
9. [Garcés Gatnau JR. Cuáles son las indicaciones de la cirugía de Mohs? Piel - Form Contin endermatología. 2010;25\(5\):233-5.](#)
10. [Dzubow LM. Dermatologic Surgery. Andrews Dis Ski. 1995;21\(37\):13.](#)
11. [Trost LB, Bailin PL. History of Mohs Surgery. Dermatol Clin. 2011;29\(2\):135-9.](#)
12. [DePaolo C, Frederic E. Mohs and the history of zinc-chloride therapy. Clin Dermatol. 2018;36\(4\):568-75.](#)
13. [Bobotsis R, Guenther L. How Mohs surgery transformed into a first-line treatment of skin cancer. J Cutan Med Surg. 2017;21\(1\):40-1.](#)
14. [Benedetto PX, Poblete-Lopez C. Mohs Micrographic Surgery Technique. Dermatol Clin. 2011;29\(2\):141-51.](#)
15. [Ruiz-Salas V, Garcés JR, Alonso-Alonso T, Rodríguez-Prieto MA, Toll-Abelló A, Eusebio Murillo E, et al. Description of patients excluded for Mohs surgery after pre-surgical evaluation: data from the Reges Mohs Spanish registry. Actas Dermo-Sifiliográficas. 2018;109\(4\):346-50.](#)
16. [Cerci FB, Kubo EM, Werner B, Tolkachjov SN. Surgical margins required for basal cell carcinomas treated with Mohs micrographic surgery according to tumor features. J Am Acad Dermatol. 2020;83\(2\):493-500.](#)
17. [Kaufman AJ. Tips to Avoid Complications Following Mohs Reconstruction. Facial Plast Surg Clin North Am. 2019;27\(4\):571-9.](#)
18. [Kavanagh KJ, Christophel JJ. Development of a Patient-Reported Outcome Measure for Mohs Reconstruction. Facial Plast Surg Aesthetic Med. 2020;22\(4\):274-80.](#)
19. [Merritt BG, Lee NY, Brodland DG, Zitelli JA, Cook J. The safety of Mohs surgery: A prospective multicenter cohort study. J Am Acad Dermatol. 2012;67\(6\):1302-9.](#)
20. [Rozas-Muñoz E, Toll A. Modificaciones de la cirugía de Mohs convencional: Mohs a 90 y Mohs diferido. Técnicas e indicaciones. Piel. 2014;29\(1\):49-55.](#)