Mohs micrographic surgery

Cirurgia micrográfica de Mohs

ABSTRACT

Mohs Micrographic Surgery is regarded as a very useful technique for the excision of difficult to handle skin cancers. The procedure is divided into clearly defined steps: tumor evaluation and marking, tumor exeresis, tissue preparation and mapping, histologic processing and analysis, and closing of the surgical wound. The histologic analysis of all surgical margins leads to higher cure rates and tissue conservation, which make the procedure safer and more reliable.

Keywords: skin neoplasms; Mohs surgery; frozen sections.

RESUMO

A técnica cirúrgica micrográfica de Mohs é modalidade muito útil para excisão de cânceres de pele de difícil manejo. Desde que corretamente realizada, oferece vantagens sobre os outros métodos de tratamento para malignidades cutâneas. O procedimento é dividido em etapas bem definidas: avaliação e marcação da lesão, exérese, preparação e mapeamento da peça cirúrgica, processamento e análise histológica e fechamento da ferida cirúrgica. A avaliação histológica de todas as margens cirúrgicas leva a maiores taxas de cura e maior conservação tecidual, conferindo ao procedimento segurança e confiabilidade.

Palavras-chave: *neoplasias cutâneas; cirurgia de Mohs; seções congeladas.*

INTRODUCTION

Mohs Micrographic Surgery (MMS) is considered to be the most reliable conservative method for treating cutaneous malignancies. It is a surgical procedure carried out in progressive stages; sections are made observing meticulously mapped margins until the tumor is completely removed. In addition to boasting higher cure rates than other treatment types, MMS helps preserve the maximum amount of healthy tissue [1].

The MMS technique has continuously evolved since it was first described and is currently the treatment of choice for tumors located in critical areas, sites that have previously undergone radiotherapy, large or recurring tumors, and tumors with aggressive histological characteristics In 1941, Frédéric Mohs described a new surgical technique for the phased removal of skin cancers through *in situ* fixation of cutaneous tissue [2]. After fixing the tumor, Mohs excised the cancer and cut the excised piece into tangential sections that included as much of the epidermis as the underlying tissue. These cuts were carried out with enough depth to allow microscopic analysis of the margins.

Continuing Medical Education

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Several types of procedures, such as curettage and electrodissection (CE), cryotherapy, photodynamic therapy, radiotherapy, conventional surgery and MMS, have been used to treat skin cancers. Cryotherapy, CE and radiotherapy are destructive procedures based on visual and clinical assessments of the extent of the tumor; there is only a limited ability to check the free margins when using these methods. With 3-6 mm safety margins, conventional exeresis is used in the majority of skin cancers [3]. Although conventional exeresis is systematically followed by histological analysis of the surgical margins [4], these assessments are limited compared to those of MMS, in which all peripheral and deep margins are analyzed (Figure 1).

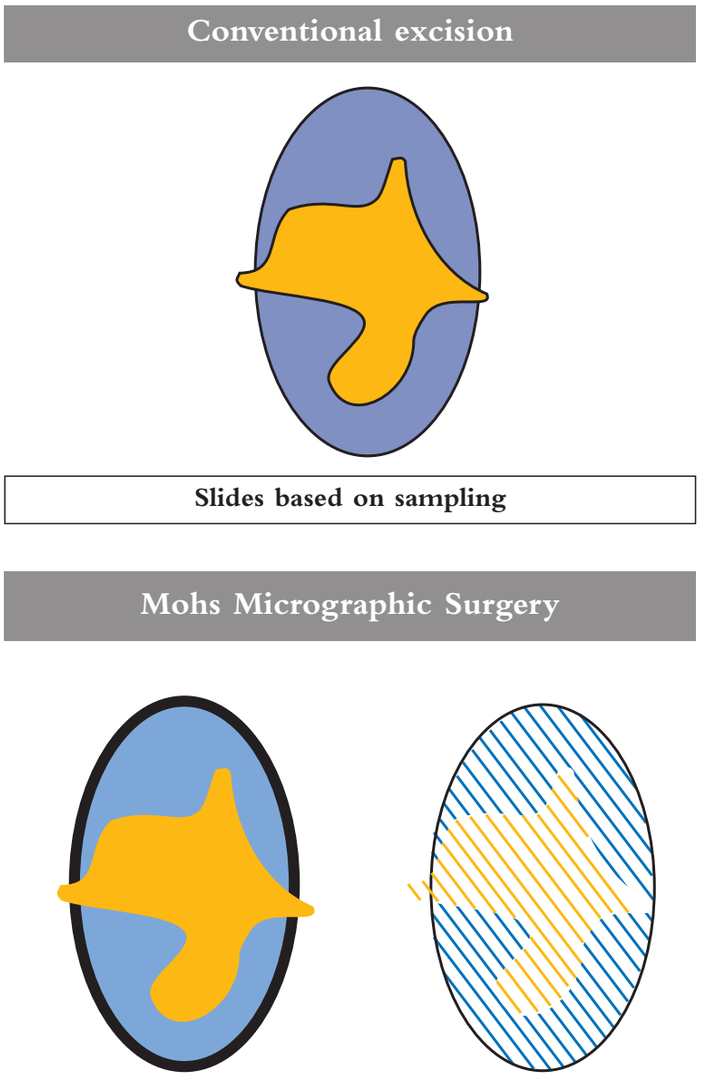

Figure 1 - Comparison of histological analysis carried out through conventional surgery and Mohs Micrographic Surgery (MMS). Note that in the conventional excision, the cut of the tissue is made by sampling, which can lead to flaws in the analysis of tumor-free margins. Conversely, given that all peripheral and deep margins are analyzed in MMS, the entire extent of the tumor is analyzed

Although conventional treatments yield high cure rates for small and well-delimited skin cancers in general, MMS yields higher cure rates for both primary and recurrent tumors [5,6]. The 5-year recurrence rates for primary and recurrent basal cell carcinomas treated conventionally are 10% and 17%, respectively. When treated with MMS, those rates fall to 1% and 6% [6].

Besides presenting considerably higher cure rates than conventional surgery, MMS allows greater preservation of healthy tissue around the lesion. In order to obtain cure rates similar to those achieved with MMS, conventional surgery frequently needs much more extensive margins. For instance, the cure rate for conventional excisions of basal cell carcinomas with less than 10 mm with 3-mm margins is 85%. A 4-mm margin would increase the cure rate to 95%7. For large sclerosing or recurrent basal cell carcinomas, sections with 13-15 mm margins are necessary in order to obtain a 99% cure rate [8].

A biopsy to confirm a skin cancer diagnosis is usually carried out before MMS is recommended. The indications for MMS are well established, especially for non-melanoma skin cancers (Table 1). The role of MMS in the treatment of other tumors such as melanoma and Merkel Cell Carcinomas is more controversial; its indication depends on the dermatologist's preference and comfort.

TECHNIQUE

The MMS technique includes the examination and marking of the area to be excised, the removal and mapping of the surgical piece, and the histological processing and microscopic examination (Figure 2). The procedure is repeated until there are no traces of tumor in the surgical margins. Once the tumor is completely removed, the surgical wound is closed.

When examining the patient, the clinical margins of the

Table 1. Main indications for MMS

Tumors > 2 cm in diameter
Recurrent tumors
Tumors that have not been completely excised
Tumors located in areas with a high risk of local recurrence (e.g., central areas of the face, periocular, periorbital and periauricular areas)
Tumors located in areas where tissue preservation and high cure rates are important
Tumors with poorly defined clinical margins
Tumors with aggressive histological subtypes (e.g., micronodular, infiltrative, squamous or sclerodermiform basal cell carcinomas or poorly differentiated squamous cell carcinomas) or that have evidence of perineural infiltration
Tumors on irradiated areas or scars

tumor are initially delimited using a surgical marking pen. The tumor's location is then confirmed by the patient with the help of a mirror. Once confirmed, local anesthesia, usually with lidocaine and epinephrine, is applied. Curettage can be used before the excision to remove any excess tumorous tissue and check for any subclinical expansion of the tumor [9,10]. Nonetheless, curettage should not be considered as a necessary step, since it does not always benefit the procedure.

A study analyzing the effectiveness of curettage before MMS in non-melanoma skin cancers concluded that, although it is useful for removing excess friable tumorous mass before MMS, it does not completely delimit the extent of the tumor [11]. In addition, pre-operative curettage might not reduce the number of MMS phases. When treating a patient with MMS, one should take into account the fact that 24% of non-melanoma skin cancers are completely removed when histologically examined [12]. For those tumors, aggressive curettage can cause more damage to the surrounding tissue without necessarily increasing the accuracy of the procedure.

Once the clinical delimitation of the tumor is defined, with or without using curettage, the surgical marking is carried out 2 mm outside the previous marking to indicate the scalpel's point of incision.

In classic MMS, the scalpel blade forms a 45° angle with the skin during the excision of the tumor's margins. This allows the epidermis, dermis and deep tissues to be cut in a straight line by the cryostat, allowing the examination of a single plane [13]. The excision of peripheral margins at 90° is a variant of the original technique. In that variant, the surgical piece is divided into peripheral and deep margins, with a separate analysis of each 14 (Figure 2).

The processing of the excised tissue efore the microscopic examination includes marking it with dye, leveling, freezing, cutting and staining. Once the tumor is excised, the removed tissue is divided into fragments to allow its inclusion underneath a coverslip.. The fragments must be mapped and color-coded with tissue dye to produce a map of the tissue in order to orient the surgeon while he or she analyzes the tissue under the microscope. A study carried out in the USA 15 showed that most Mohs surgeons use hand-drawn maps of excised tissue. This is a straightforward, cheap and fast method, which allows the surgeon greater flexibility to illustrate the size and format of the tumorous tissue and the surgical defect. However, hand drawings are not as accurate when analyzing the skin in recurrent cases. Digital pictures allow more precise representations of the excised tissue and surgical defect, and provide better dimensions and information for the follow-up. Digital pictures are currently used by a minority of Mohs surgeons (less than 2%), a number that will certainly rise with the increasing use of digital pictures and electronic medical records.

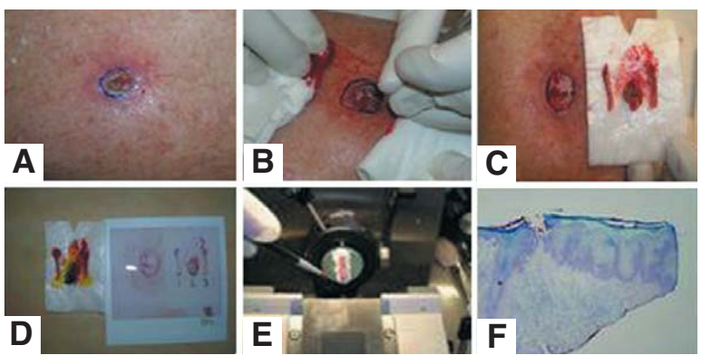

Figure 2 - Stages of the preparation of excised tissue, according to a variant of the Mohs technique (incision at 90º). **(A)** Clinical marking of the lesion. **(B)** Exeresis with 2-mm margins. **(C)** Fragmentation of the removed tissue. **(D)** Mapping of the lesion. Note that each stain color of the excised tissue to the left corresponds to a different marking in the picture to the right. **(E)** Cutting of the tissue using a cryostat. **(F)** Slide showing the red marking of one of the fragment's extremities.

The excised tissue must be level on the microscope slide in order to cut the combined epidermis and dermis in a single plane. Although in most cases the tissue is leveled spontaneously or by using light mechanical pressure, it is sometimes necessary to relax the tissue by making cuts on its surface – a particularly useful technique for thick tissue.

The tissue is then sectioned, and the slides are prepared for histological analysis. Hematoxylin-eosin is the most commonly used stain in MMS, and can be used for all cutaneous neoplasias. Toluidine blue is a particularly useful alternative stain for basal cell carcinomas, since it clearly demarcates the islands of tumorous cells by staining the surrounding mucopolysaccharides pink.

Dermis and epidermis sections are usually 5-6 mm thick, while those of adipose tissue normally measure 15-25 μm [16]. Exceptionally thick sections are difficult to analyze and can lead to misinterpretation. Conversely, details in the cells are more clearly defined in thinner sections.

Oblique sections of adnexal structures can be mistaken with basal cell carcinomas. However, serial cuts help distinguish the two.

Laboratory technicians play a key role in the process and should always position the tissue so that the correct section is made in the epidermis' surface. Mohs surgeons must know how to flatten, freeze, cut and stain the tissue in order to communicate efficiently with laboratory technicians in case the quality of damaged tissues needs to be discussed.

One of the biggest advantages of MMS for the dermatologic surgeon is that it maximizes the preservation of normal tissue. The surgeon must analyze the microscope slides to determine whether the margins are affected. If the tumor has been completely excised, the surgical defect can be reconstructed. If tumorous cells are present in the tissue sample, their corresponding location is marked on the map. If the lateral margin is compromised, an additional 1-2 mm of tissue is removed. If the tumor is present in the deep margin, an incision along the base of the surgical wound is made in order to remove a thin slice of its bottom. These steps are repeated until the margins are found to be tumor free; reconstruction follows.

MMS does not require prophylactic antibiotic therapy afterwards. This type of treatment is restricted to specific cases and is not linked to the MMS surgical technique [17].

FINAL CONSIDERATIONS

The MMS technique was developed to allow the complete histological control of the margins of excised cutaneous tumors. In spite of significant variations in the techniques used by different Mohs surgeons, these techniques share several common points, including: (1) the complete histological control of both peripheral and deep margins, (2) tissue preservation due to the use of narrow margins, (3) clinical-pathological correlation and surgical/histopathologic assessments that are carried out by the same physician. Since its introduction, techniques used in MMS have evolved continuously. In spite of some technical differences, the accuracy and meticulousness applied in each step of the procedure lead to consistently high, replicable cure rates. When carried out by properly trained professionals, MMS is a safe and reliable method that is increasingly used in dermatologist physicians' daily practice. ●

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Questions for continuing medical education (CME)

1. About Mohs Micrographic Surgery (MMS), it is correct to state that:

a) it is the method of choice for the treatment of cutaneous tumors.
b) prophylaxis with antibiotics is suitable when the surgical time exceeds 1 hour.
c) it is not suitable for superficial basal cell carcinomas (BCCs).
d) it presents cure rates similar to those of conventional surgery, yet with greater tissular preservation.
e) none of the above

2. There is consensus on the indication of MMS in the following cases, except for:

a) Nodular BCC located 1 mm from the palpebral border.
b) Merkel cell carcinoma.
c) Squamous cell carcinoma (SCC) on scars.
d) Recurrent micronodular BCC on the nasal wing.
e) Poorly differentiated pre-auricular SCCs measuring 1.5 cm.

3. Regarding curettage carried out before the removal of the tumor, it is possible to state that:

a) it can be useful for reducing the friable tumorous mass.
b) it is a reliable method of delimitating tumors.
c) it is always indicated in BCC cases.
d) it reduces the number of MMS phases.
e) it is more suitable in cases of poorly defined margins.

4. The distance between the clinical tumorous margin and the initial surgical margin must be:

a) 1 mm.
b) 2 mm.
c) 3 mm.
d) it depends on the tumor's histology.
e) it depends on the tumor's location.

5. The excised tissue is leveled on the slide in order to:

a) better visualize the cutaneous annexes.
b) facilitate serial cuts.
c) allow the dermis and epidermis to be cut in a single plane.
d) reduce the cut's thickness.
e) none of the above

6. The most frequently used staining in MMS is hematoxylin-eosin. An alternative is toluidine blue. The type of tumor in which it is particularly useful and its characteristic color are, respectively:

a) BCC – pink stroma
b) BCC – blue tumorous cells
c) SCC – pink tumorous cells
d) SCC – blue stroma
e) SCC – blue tumorous cells

7. The cure rates for treating recurring BCC with conventional surgery and MMS are, respectively:

a) 17% and 10%.
b) 17% and 6%.
c) 17% and 1%.
d) 10% and 6%.
e) 10% and 1%.

8. When analyzing a slide, if it is unclear whether the tissue presents an adnexal structure or BCC, the physician should:

a) request extra cuts of that slide.
b) use a different stain.
c) carry out immunohistochemistry.
d) assume it is a tumor and increase the margins.
e) none of the above

9. If the lateral margin is compromised, the physician should:

a) increase the peripheral margins by 1-2 mm.
b) repeat the procedure carried out in the first phase.
c) increase the compromised border with greater margins (3-4 mm) in order to shorten the length of the procedure.
d) increase the compromised border with a 1-2 mm margin.
e) none of the above

10. Antibiotic prophylaxis is indicated:

a) in all MMS cases.
b) never in MMS cases.
c) it depends on the technique used.
d) in the same situations as conventional surgery.
e) none of the above

Key

Complications in laser dermatologic surgery. Part II: Fractional and non-fractional ablative lasers, and fractional non-ablative lasers. 2011;3(2):135-53

1 e, 2 d, 3 d, 4 c, 5 b, 6 b, 7 c, 8 d, 9 b, 10 d

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