

# Mohs Micrographic Surgery for tissue preservation in facial oncologic surgery

## *Cirurgia Micrográfica de Mohs para preservação tecidual nas cirurgias oncológicas da face*

### ABSTRACT

**Introduction:** The most common type of skin cancer is basocellular carcinoma, which frequently occurs on the face. Aesthetic and functional damage during treatment are of great concern to patients; Mohs Micrographic Surgery is a safe treatment that allows tissular preservation with minimum aesthetic damage.

**Objective:** To evaluate whether using Mohs Micrographic Surgery to treat basocellular carcinomas located in aesthetically important areas of the face preserves healthy tissue.

**Methods:** Surgical procedures (n = 49) performed in the ABC Medical School in 2008 to treat tumors located in the peribuccal, periocular and alar areas, and in the ears, were evaluated. The tumors were classified according to clinical and histological features, and the surgical margins were analyzed and compared to those recommended by the literature. The patients were re-evaluated 2 years after treatment.

**Results:** The margins removed by Mohs Micrographic Surgery were much smaller than those recommended for excisional surgery, with important tissular preservation.

**Conclusion:** Mohs Micrographic Surgery permitted the preservation of healthy tissue (56-86%) in the treatment of basocellular carcinomas located in aesthetically important areas of the face, with minimal damage. Thus it is a safe therapeutic and aesthetical option in the treatment of facial basocellular carcinomas.

**Keywords:** mohs surgery; carcinoma, basal cell; esthetics, face, skin neoplasms.

### RESUMO

**Introdução:** Os cânceres de pele mais comuns são os carcinomas basocelulares, que ocorrem frequentemente na face. Os pacientes se preocupam muito com os danos estéticos e funcionais, sendo a cirurgia micrográfica de Mohs terapêutica segura que permite preservação tecidual com mínimos danos estéticos.

**Objetivo:** Avaliar se o uso da cirurgia de Mohs no tratamento dos carcinomas basocelulares, localizados em áreas esteticamente importantes da face, preserva tecido sadio.

**Métodos:** Foram incluídas 49 cirurgias para tratar tumores com localização peribucal, periocular, orelha e asa nasal, em 2008, na Faculdade de Medicina do ABC. Os tumores foram agrupados conforme características clínicas e histológicas, e as margens obtidas foram analisadas e comparadas com as recomendadas pela literatura. Os pacientes foram reavaliados após dois anos.

**Resultados:** As medianas das margens removidas com a cirurgia de Mohs foram muito menores do que as recomendadas para cirurgia excisional, com importante preservação tecidual.

**Conclusão:** A cirurgia de Mohs permitiu importante preservação de tecido sadio (56%-86%) no tratamento dos carcinomas basocelulares localizados em áreas esteticamente importantes face, com mínimos danos. Indicamos a cirurgia de Mohs como opção terapêutica segura e estética no tratamento dos carcinomas basocelulares faciais.

**Palavras-chave:** cirurgia de Mohs; carcinoma basocelular; estética; face; neoplasias cutâneas.

## Original Article

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Received on: 20/09/2010

Approved on: 15/11/2010

This study was carried out at the Faculdade de Medicina do ABC – Santo André (SP), Brazil.

Financial support: none  
Conflicts of interests: none

## INTRODUCTION

The diagnosis of skin cancer is very distressing for patients, who are concerned with the possibility of dying and/or becoming disfigured by the surgical removal of tumors, especially when located on the face.<sup>1,2</sup>

Basal cell carcinoma (BCC), the most common malignant tumor that occurs in humans, is comprised of cells similar to those that constitute the basal layer of the epidermis. BCCs develop in individuals above 40 years old; risk factors include fair skin and exposure to sunlight.<sup>3</sup> The tumors are usually located in the upper two-thirds of the face, near the free margin areas (ocular canthi, nasal wings, eyelids, labial commissure, lips and ears). BCC rarely metastasizes, but it does cause progressive local destruction, which necessitates early treatment.<sup>4</sup>

The standard treatment is the surgical removal of the tumor with safety margins ranging from 3 to 13 mm, according to the clinical, histological and recurrence condition characteristics of the lesion.<sup>1,5</sup> These margins were defined by analyzing thousands of tumors; they ensure the removal of most BCCs with specific characteristics. In this technique, it is not known for several days after surgery (when the histological analysis is complete) whether the tumor was completely removed. Even if the free margins are verified by the histological examination results, it is still uncertain whether the tumor has been totally removed, given that these fragment margins are analyzed by sampling 6. This can explain the recurrence of tumors after conventional exeresis with safety margins and expert reports describing uncompromised resection margins.

BCCs have unexpected subclinical extensions: while sometimes they do not reach 1 mm, at other times they extend more than 15 mm beyond the visible clinical margins; they can be restricted to the superficial dermis or spread into deeper tissues such as muscle, cartilage and bone.

Removing tumors in areas of free margins using the recommended margins can involve the unnecessary removal of healthy tissue, both laterally and below the tumor. This can result in a surgical wound that is larger than necessary, with aesthetic and functional damage and more complex reconstruction processes.

For the treatment of facial skin tumors, especially in areas of free margins, we indicate Mohs Micrographic Surgery (MMS). This technique allows the tumor's surgical margins to be fully and immediately visualized, which facilitates its complete removal. MMS promotes an individualized treatment for each tumor and succeeds in identifying their subclinical extensions accurately, avoiding both the unnecessary removal of tissue and the incomplete removal of the lesion. According to several studies published in the specialized literature, this technique is the safest and has the lowest risk of recurrence; it also allows the reconstruction of the wound during a single surgery.<sup>1,2,5,7-10</sup>

MMS was developed by Dr. Frederic Mohs, who pioneered its use at the University of Wisconsin (US) in the 1930s.<sup>7</sup> This technique is used to treat histologically aggressive BCCs (such as micronodular and sclerodermiform), recurrent or incompletely removed tumors, tumors located in areas with

higher recurrence risk (H facial zone), and when it is desirable to preserve the healthy tissue (areas of free margins). It is also used in squamous cell carcinoma (SCC) and other cutaneous tumors such as dermatofibrosarcoma protuberans, adnexal tumors and leiomyosarcoma.<sup>7</sup>

MMS involves removing the tumor and the minimum amount of tissue beyond its clinical margins; all margins (lateral and deep) are mapped and histologically evaluated during the procedure. The mapping, with the aid of a color code, allows the exact location of any possible residual tumor to be determined. When any margin is positive, a new round of MMS is carried out, removing tissue only in the compromised area, mapping and analyzing all of its margins. New rounds are carried out until the tumor is completely removed.<sup>5,8,10</sup>

## OBJECTIVE

The objective of this study was to evaluate whether the use of MMS in the treatment of localized BCCs in aesthetically important areas of the face (free margins) leads to the preservation of healthy tissue.

## MATERIALS AND METHODS

We carried out a retrospective analysis of 137 records of patients who underwent MMS, from January to December 2008, at the Dermatology Department of the Faculdade de Medicina do ABC, SP, Brasil. The ethical determinations of the Declaration of Helsinki 2000 were observed in this study.

All patients who presented BCCs in the free margin areas (around the mouth, corners of the eyes, ears, eyelids and nasal wings) were included regardless of their clinical and histological characteristics, or recurrence condition, totalling 49 surgical procedures performed in 48 patients. Patients who underwent BCC surgical procedures in other sites, as well as those who presented SCC or other types of tumors, were excluded.

For each of the 49 surgical records included in this study, we studied the location of the tumor, number of surgical stages performed, pre and post procedure size of the wound, its histological type, and the reconstruction technique employed. The patients were grouped according to the location of the tumor (periocular, nasal wing, ear, peribuccal), the number of surgical stages (one, two, three, four or more), pre-operative dimensions (< 1 cm, 1.1 to 2 cm, 2.1 to 3 cm, > 3 cm), histological type (solid or adenoid, sclerodermiform, micronodular, with squamous differentiation), and reconstruction technique employed (flap, direct suture, graft). When more than one histological subtype was detected in the same tumor, we classified the tumor according to the most aggressive subtype, as is usually done in the treatment of these types of lesions.

We reviewed the specialized literature to determine the recommended margins for removing BCCs, according to the size, histological type and recurrence condition of the tumor, and compared the data with the mean margins obtained in our study for each of the groups.

Before executing the surgery's first round marking, the

tumor margins were delimited either clinically or through curettage, and its pre-operative size was measured. For each surgery, we analyzed the pre-operative lesion and post-operative (after MMS) wound dimensions. The diameters of the lesion's two main axes were measured with a sterilized ruler on the day of the surgery to best capture the dimensions of irregular and/or oval-shaped tumors.

To measure the amount of tissue removed, we subtracted the post-operative from the pre-operative measurements for each diameter. As tumors frequently needed more extensive removals and a greater number of MMS rounds in only one of the lesion's axes, we calculated the average diameter of the removed tissue for each lesion by adding the measurements of the tissues removed from the two diameters and dividing the result by 2. Since the diameter measurement represents the sum of the two margins (each removed from one side of the lesion), the average of the removed tissue's diameters was divided by 2 to obtain the average margin necessary for the removal of each lesion, using MMS.

Statistical analysis was carried out using Stata 10.0 software. The margins' mean values distribution was tested; because normality criteria were not verified, we have chosen to represent the data using its median, minimum and maximum values.

The median, minimum and maximum values of the mean values of the margins obtained in the statistical analysis were compared to the margins recommended in the literature for BCCs with the following characteristics: low risk  $\geq 2$  cm, non-aggressive histology, primary),  $> 2$  cm, aggressive histology, and recurrent. Patients were re-assessed 2 years after surgery to test for recurrences.

## RESULTS

The tumors' characteristics (location, dimensions and histological type) and the MMS parameters (number of stages and operative wound reconstruction) were linked to the number of surgeries (Table 1).

Margins recommended in the literature were studied in light of the following criteria: low risk BCCs ( $\geq 2$  cm, non-aggressive histology, primary), size  $> 2$  cm, aggressive histological type, and recurrent pattern.<sup>11,12</sup> The surgeries carried out in this study were grouped according to the same characteristics, with the margins obtained compared to the margins recommended in the literature for conventional exeresis, which is the standard treatment for BCC.

Some lesions presented characteristics belonging in two or three different groups (dimensions greater than 2 cm, aggressive histology, recurrence), being therefore included in more than one group in this analysis. The margins' mean median, minimum and maximum values obtained in the statistical analysis were compared with those recommended for each group. The results obtained in this study were compared to the mean values recommended in the literature and presented as percentages. These calculations allowed the comparison of preserving margins using MMS (% of the recommended margins that were obtained) with the standard treatment for these tumors (exeresis with recommended margins).

The results obtained in the study were as follows (Table 2):

A. Low risk tumors ( $\geq 2.0$  cm, non-aggressive histology, primary – 15 surgeries) – minimum, median and maximum margins of 0.5 mm, 1.75 mm and 4.5 mm, respectively. The recommended margin for the standard treatment of these tumors is 4 mm<sup>11,12</sup>. With the MMS technique, only 43.8% of the recommended margins were removed, on average.

B. Tumors larger than 2 cm (20 surgeries) – minimum, median and maximum margins of 1 mm, 1.75 mm and 4 mm, respectively. The recommended margin for the standard treatment of these tumors ranges from 10 to 15 mm (mean 12.5 mm).<sup>11,12</sup> Using MMS, only 14% of the recommended margins were removed, on average.

C. Tumors with aggressive histology (squamous differentiation, sclerodermiform or micronodular – 25 surgeries) – minimum, median and maximum margins of 1 mm, 2.25 mm and 8.75 mm, respectively. The recommended margin for the standard treatment of these tumors ranges from 5 to 15 mm (mean 10 mm)<sup>11,12</sup>. Using the MMS technique, only 22.5% of the recommended margins were removed, on average.

D. Recurrent tumors (3 surgeries) – minimum, median and maximum margins of 1 mm, 2.25 mm and 2.5 mm, respectively. The recommended margin for the standard treatment of these tumors ranges from 5 to 15 mm (mean 10 mm).<sup>11,12</sup> With MMS, only 22.5% of the recommended margins were removed, on average.

Two years after surgery, the patients were invited to return to the care service to be reassessed for tumor recurrence. Of the 49 patients, 2 had died and 7 could not attend the appointment. None of the 39 patients (40 surgeries) who were reassessed presented a recurrence.

## DISCUSSION

In MMS, the reconstruction of the operative wound can be performed with great safety due to the meticulous microscopic control of the margins carried out during the procedure. In this way, complex repairs, such as flaps, can be performed in the same surgery, which helps achieve the best aesthetic and functional results. MMS is time consuming and requires specific materials and specialized surgeons. However, these costs are outweighed by the benefits of its high degree of efficacy: it decreases the risk of recurrence and the need for new interventions.<sup>2,6,13,14</sup>

The incidence of skin cancer, especially BCC, has grown during the past decade. A number of treatment methods are used; surgical excision is the standard approach.<sup>1</sup> Smeets and colleagues<sup>1</sup> demonstrated a high cure rate in 5-year follow-ups when high risk BCCs were treated with MMS. According to Sepraul and others<sup>15</sup>, the risk of recurrence of a surgery in the periocular region is considerably high if MMS is not used, or if the freezing and control of the margins are not performed during the procedure.

While no formal study has demonstrated a correlation between MMS and the best aesthetic and functional results, that relationship seems natural to us. In this study, BCCs were located in aesthetic and functionally delicate areas of the face (free mar-

**Table 1 – Characteristics of the tumors and the 49 MMS performed at the Dermatology Service of the Faculdade de Medicina do ABC in 2008, for the removal of BCCs in facial areas with free margins, according to the number of surgeries.**

Tumor location	Number of surgeries	%
Periocular	22	44.9
Nasal wing	21	42.8
Ear	4	8.2
Peribuccal	2	4.1
Number of surgical stages	Number of surgeries	%
One	7	14.3
Two	32	65.3
Three	4	8.2
Four or more	6	12.2
Lesion dimensions	Number of surgeries	%
< 1cm	10	20.4
1.1-2cm	19	38.8
2.1-3cm	11	22.4
> 3cm	9	18.3
Histological type	Number of surgeries	%
Solid or adenoid	24	49
Sclerodermiform	12	24.5
Micronodular	11	22.4
With squamous differentiation	2	4.1
Reconstruction	Number of surgeries	%
Flap	25	51
Direct suture	12	24.5
Graft	9	18.3
Second intention	3	6.1

gins): 44.9% in the periocular region, 42.8% in the nasal wing, 8.2% in the ear, and 4.1% in the peribuccal region (Table 1). In the treatment of such tumors with MMS, a single stage was necessary in 14.3% of the surgeries, two stages in 65.3%, and three or more stages in 20.4% (Table 1). In the first stage it was possible to treat 14.3% of the BCCs and demarcate the locations of additional tumors. With only one further stage and the removal of small amounts of tissue, most of the tumors (65.3%) were removed. The remaining lesions – which presented great subclinical extensions – could be identified and mapped by MMS, which achieved their safe removal after 3 or more stages (20.4%).

The lesions measured up to 2 cm in 59.2% of the cases and were indicated for MMS due to their location and aggressive histological subtype (Table 1). The solid and/or adenoid histological subtype predominated in 49% of the cases, followed by the aggressive types – sclerodermiform (24.5%), micronodular (22.4%) – and those with squamous differentiation (4.1%). The high rate of aggressive tumors (52%) can be explained by the fact that patients with those tumors are usually referred to MMS treatment (Table 1).

Using MMS, 30.6% of the simple reconstructions involved secondary intention healing and direct sutures, since we succeeded in obtaining small and/or superficial operative wounds. Flaps were carried out in 52% of the cases, with minimal chance of tumoral implantation or recurrence, due to the safety offered by this technique. The surgeries that needed a single stage had surgical margins of only 0.5 to 2 mm removed – much smaller than those that would be obtained with conventional surgery – resulting in significant tissular preservation and minimal aesthetic and functional damage.

For the tumors that needed 3 or more stages (20%), the margins varied from 4 to 8.75 mm, demonstrating a tumoral invasion far beyond their clinical margins. In such cases, a simple exeresis using the recommended safety margins might not remove the tumor completely, thus risking a high probability of recurrence. An even worse scenario would be if a wound with residual tumor was reconstructed with a flap; the tissular detachment and movement could cause tumoral cells to implant far beyond their initial location. In such cases, a recurrence would inevitably further aggravate the condition, with potentially dis-

**Table 2 – Comparison between mean values of margins obtained in this study (with MMS) vs. those recommended in the literature for the removal of BCCs according to their clinical and histological characteristics.**

Characteristics	Margins in the literature	Mean values of the margins obtained with MMS			MMS % margin*
		Minimum	Median	Maximum	
≥ 2 cm	4mm <sup>15,16</sup>	0.5mm	1.75mm	4.5mm	43,8
> 2 cm	10 a 15mm <sup>15,16</sup>	1mm	1.75mm	4mm	14
Aggressive histology	5 a 15mm <sup>15,16</sup>	1mm	2.25mm	8.75mm	22.5
Recurrent	5 a 15mm <sup>15,16</sup>	1mm	2.25mm	2.5mm	22.5

\* Percentage of the recommended margins achieved with the use of MMS

astrous consequences. This damage can be avoided by using MMS, which offers a much greater prospect of removing the tumor completely in the first intervention.

The median of the margins removed from all tumors was 1.75 mm – much smaller than the 4 mm minimum recommended for conventional surgery.

For low risk BCCs (primary,  $\geq 2$ cm, non-aggressive histology), 4 mm margins are sufficient for the complete removal of 95% of tumors 16. In this study we obtained a median removal of 1.75 mm – less than half (43.8%) of the 4 mm margins recommended in the literature.

For the most aggressive tumors, or those with diameters in excess of 2 cm (meaning that they have larger subclinical extensions) margins of more than 13 mm (10 to 15 mm) may be necessary.<sup>11,12,16</sup> For these tumors, our study demonstrated a median of 1.75 mm – less than one seventh (14%) of the mean value of the 12.5 mm margin recommended for conventional surgery. One patient needed 5 rounds of MMS for the removal of a sclerodermiform BCC in the ciliary margin; even so, the mean value of the margins was 3.5 mm (5.5 mm and 1.5 mm in the main axes), with little aesthetic and functional damage, and healing by secondary intention (Figure 1).

In the group of patients with aggressive histology BCCs (micronodular, sclerodermiform, squamous or infiltrative), for which the literature recommends margins of 5 to 15 mm (mean 10 mm),<sup>11,12,16</sup> we obtained a median of 2.25 mm using MMS – less than one fourth (22.5%) of the recommended average. In one MMS procedure, an average margin of only 1 mm was sufficient for the total removal of the tumor; the healthy peritumoral tissue near and below the tumor was well preserved, and there were good aesthetic and functional results with healing by second intention (Figure 2).

The recommendation for recurrent tumors is margins of 5 to 15 mm.<sup>11,12,16</sup> In this case we obtained a minimum of 1 mm, a maximum of 2.5 mm, and a median of 2.25 mm with MMS – 22.5% of the recommended margins, with important tissular preservation.

These data have confirmed the MMS advantage in the preservation of healthy tissue in the treatment of BCC in facial areas with free margins. They have also demonstrated that some tumors presenting subclinical extensions that reached beyond the recommended margins could be identified and completely removed in a single MMS procedure.



**Figure 1 - Sclerodermiform BCC in the inferior eyelid, 8 months after 5 rounds of MMS, healing by secondary intention**





**Figure 2** - Micronodular BCC, 6 weeks after 2 MMS rounds, healing by secondary intention

We have observed that the tumoral infiltration of the BCC is unforeseeable – sometimes greater (8.75 mm) and sometimes smaller (0.5 mm) than expected. MMS allowed the individualized treatment of each tumor, with the amount of tissue removed according to the extension of each lesion. Thus the tumor could be removed completely, with the maximum preservation of tissue, according to each patient's need.

According to Rowe and others, 66% of the BCCs that recurred in the 5-year period following the procedure appeared during the first 2 years.<sup>17</sup> In this study, safety was evaluated during a 2-year post-operative follow-up with no recurrence observed.

MMS individualizes the treatment of facial BCCs by analyzing all of the margins of the removed tumor. Therefore the surgeon is able to either preserve more healthy tissue (as observed in most tumors) or remove greater amounts of tissue (when tumors have greater subclinical extensions, as observed in some patients) compared to the usual recommendation. The individualized treatment described in our study – which offers the maximum level of safety for the patient and the surgeon – allows us to recommend MMS as an excellent therapeutic option for the treatment of facial BCC, especially in aesthetically and functionally important areas.

## CONCLUSIONS

MMS allowed important preservation of healthy tissue (56%–86%) in the treatment of localized BCCs, in facial areas with free margins, when compared to the margins recommended in the literature for standard excisional surgery. We obtained outstanding aesthetic and functional results and the maximum oncologic safety, due to the preservation of tissue promoted by the MMS. The data obtained allow the indication of MMS as an excellent, safe and aesthetic option for the treatment of BCCs in facial areas with free margins. Future studies should be conducted to confirm our findings and to quantify the tissular preservation obtained by using MMS in free margin areas. ●

## ACKNOWLEDGEMENT

We would like to thank Ms Adriana Martins de Lima for her support in the statistical analysis for this study.

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