

ORIGINAL ARTICLES

Mohs Micrographic Surgery: Our First 100 Patients

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Abstract. *Introduction.* Mohs surgery was first described by Frederic Mohs in 1941 to eliminate high-risk cutaneous tumors. The technique involves histological examination of the margins.

Objective. The aim of this study was to describe the clinical findings and compare the grade and subclinical extension of the tumor—as measured by the number of Mohs stages needed for complete elimination—according to whether the tumor presented high-risk factors.

Methods. We included 100 patients with 105 tumors. In all cases, age, sex, tumor site, tumor type, histological subtype in the case of basal cell carcinoma, size, recurrences, number of Mohs stages, and reconstruction technique were recorded.

Results. The study group comprised 44 men and 56 women aged between 28 and 88 years (mean, 72.6 years). Of the tumors, 80% corresponded to basal cell carcinoma, 12.38% to squamous cell carcinoma, 4.76% to dermatofibrosarcoma protuberans, 0.95% to Merkel cell carcinoma, 0.95% to microcystic adnexal carcinoma, and 0.95% to lentigo maligna melanoma. Most tumors were located on the head and 60% required more than one Mohs stage for complete elimination.

Conclusion. This series is characterized by a high percentage of high-risk cutaneous tumors. After assessing the risk factors independently, we found that the size of the tumor is the risk factor most closely related to grade and subclinical extension in the case of basal cell carcinoma, although similar conclusions cannot be drawn for the other types of tumor studied.

Key words: Mohs surgery, cutaneous tumors, surgery, treatment.

CIRUGÍA DE MOHS: NUESTROS PRIMEROS CIEN PACIENTES

Resumen. *Definición.* Descrita por Frederic Mohs en 1941, la cirugía de Mohs es una técnica quirúrgica con control histológico de los bordes, utilizada para eliminar tumores cutáneos de alto riesgo.

Objetivo. El objetivo de este artículo es informar de los hallazgos clínicos y comparar la agresividad-extensión subclínica del tumor, medida como número de estadios de Mohs necesarios para eliminar completamente el tumor, en función de que el tumor presente o no factores de alto riesgo.

Métodos. Se incluyen 100 pacientes con 105 tumores y en todos los casos se obtuvieron las variables de edad y sexo del paciente, localización, tipo de tumor y subtipo histológico en el caso del carcinoma basocelular, tamaño, existencia de recurrencias, número de estadios de Mohs y técnica de reconstrucción.

Resultados. Se incluyen 44 hombres y 56 mujeres de edades comprendidas entre los 28 y 88 años (media 72,6). El 80 % eran carcinomas basocelulares, el 12,38 % carcinomas espinocelulares, el 4,76 % dermatofibrosarcomas *protuberans*, el 0,95 % carcinoma de células de Merkel, el 0,95 % carcinoma aneural microquístico y el 0,95 % lentigo maligno melanoma. La mayoría estaban localizados en la cabeza y el 60 % precisó más de un estadio de Mohs para ser eliminado.

Conclusión. Esta serie se caracteriza por presentar un alto porcentaje de tumores cutáneos de alto riesgo. Valorando estos factores de riesgo de forma independiente podemos concluir que el tamaño del tumor es el factor de riesgo que más se relaciona con la agresividad y la extensión subclínica en el caso del carcinoma basocelular, no pudiendo llegar a conclusiones similares para el resto de los tumores incluidos en este trabajo.

Palabras clave: cirugía de Mohs, tumores cutáneos, cirugía, tratamiento.

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Introduction

Mohs surgery, described in 1941 by Frederick Mohs,¹ is a surgical technique used to excise high-risk skin tumors and involves histological examination of the borders. In contrast to other techniques used for the treatment of skin cancer,

Mohs surgery allows us to analyze 100% of the borders and to respect a maximum of healthy tissue, thus achieving the highest cure rates and the best functional and esthetic results. High-risk skin tumors are those that present a higher probability of recurrence after treatment.²

The aim of this article was to report clinical findings and to compare the grade and subclinical extension of the tumors, defined by the number of Mohs stages necessary to excise the tumor completely, depending on whether or not the tumor presented factors of high risk. We compared the number of Mohs stages required according to a tumor size larger or smaller than 20 mm, whether or not the tumor was situated on embryonic fusion planes, and, in the case of basal cell carcinoma, whether or not it presented an aggressive histological subtype.

Patients and Methods

All skin tumors treated using Mohs surgery in the Dermatology Department of Hospital de León in Leon, Spain, between July 2002 and May 2006 were included in the study. Each tumor was confirmed histologically prior to inclusion. In all cases, excision was performed under local anesthesia by the dermatologist, making an incision at an angle of 45° and leaving a margin of 2 to 3 mm. The surgical specimen was studied by frozen section with hematoxylin-eosin staining. The sections were examined by a single pathologist, reviewing 100% of the borders. If malignant cells were observed in any of the borders, further excision was undertaken (second stage), repeating this procedure as many times as was necessary to achieve complete elimination of the tumor. Reconstruction of the surgical defect was performed immediately by the dermatologist under local anesthesia.

The following variables were recorded in each case: age and sex of the patient, site and type of the tumor, with the histological subtype in the case of basal cell carcinoma, size of the tumor, whether or not the tumor was recurrent, number of Mohs stages, and reconstruction technique.

Statistical analysis was performed by calculating the confidence interval of the difference in proportions using the exact method, considering a confidence interval that did not include zero as statistically significant.

Results

One hundred five tumors were included from 100 patients (44 men and 56 women) with ages between 28 and 88 years (mean, 72.6 years). There were 84 (80%) basal cell carcinomas, 13 (12.38%) squamous cell carcinomas, 5 (4.76%) dermatofibrosarcoma protuberans tumors, 1 (0.95%) Merkel cell carcinoma, 1 (0.95%) microcystic

adnexal carcinoma, and 1 (0.95%) lentigo maligna melanoma.

Basal Cell Carcinoma

Eighty-four basal cell carcinomas were treated in 80 patients (46 women and 34 men) aged between 28 and 89 years (mean, 74.15 years). All the tumors were located on the head, the majority on the nose (52.38%, $n = 44$) or forehead (15.47%, $n = 13$); less common sites included the periocular region (10.71%, $n = 9$), periauricular region (4.76%, $n = 4$), cheek (4.76%, $n = 4$), perioral region (4.76%, $n = 4$), scalp (3.57%, $n = 3$), and perimandibular region (3.57%, $n = 3$). Aggressive histological subtypes (sclerodermiform and micronodular) were found in 47.61% ($n = 40$) and nonaggressive subtypes (nodular or superficial) in 52.38% ($n = 44$). Size varied between 7 and 65 mm, with 56% ($n = 47$) greater than 20 mm and 44% ($n = 37$) less than or equal to 20 mm. In 94.04% ($n = 79$) of cases, the tumor had recurred on 1 or more occasions and only 5.9% ($n = 5$) were primary tumors. Complete excision with a single Mohs stage was achieved in 45.24% ($n = 38$), and 54.76% ($n = 46$) required 2 or more stages. Closure of the surgical defect was performed using local flaps in all except 4 cases in which a full-thickness skin graft was required.

Figure 1 shows the number of Mohs stages required according to the size of the tumor. One stage of Mohs surgery was sufficient to eliminate 29.87% of tumors larger than 2 cm and 64.86% of tumors smaller than or equal to 2 cm; this difference was statistically significant (difference of proportions, 35.08%; 95% confidence interval [CI], 14.89%-55.27%; $P < .05$). Two or more Mohs stages were required to eliminate 70.21% of tumors greater than 2 cm and 35.13% of tumors less than or equal to 2 cm; this difference was statistically significant (difference of proportions, 35.08%; 95% CI, 14.89%-55.27%; $P < .05$).

The number of Mohs stages required according to the histological subtype of the tumors is shown in Figure 2. Elimination after 1 stage of Mohs surgery was achieved in 35% of tumors with an aggressive histological subtype compared to 54.55% of nonaggressive tumors; this difference was not statistically significant (difference of proportions, 19.55%; 95% CI, -1.31%-40.40%). Two or more Mohs stages were required to eliminate 65% of tumors with an aggressive histological subtype and 45.45% of nonaggressive tumors; this difference was not statistically significant (difference of proportions: 19.55%; 95% CI, -1.31%-40.40%).

The number of Mohs stages required according to the site of the tumor is shown in Figure 3. The percentage of tumors eliminated after 1 stage of Mohs surgery was 41.89% for tumors located on embryonic fusion planes (H-zone) and 40% for tumors in other areas. The percentage of tumors

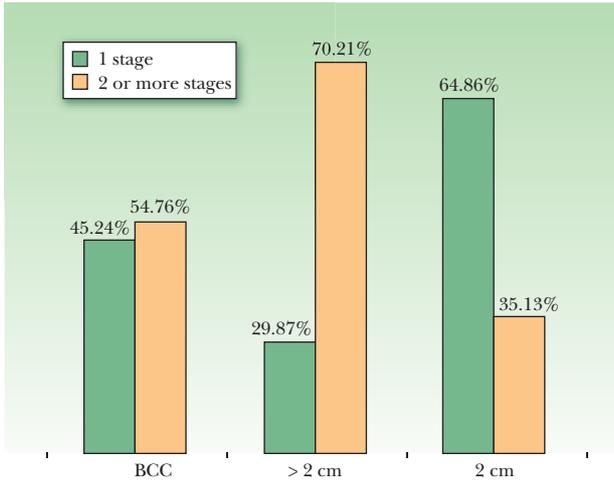


Figure 1. Basal cell carcinoma: Mohs stages required as a function of size. BCC indicates basal cell carcinoma.

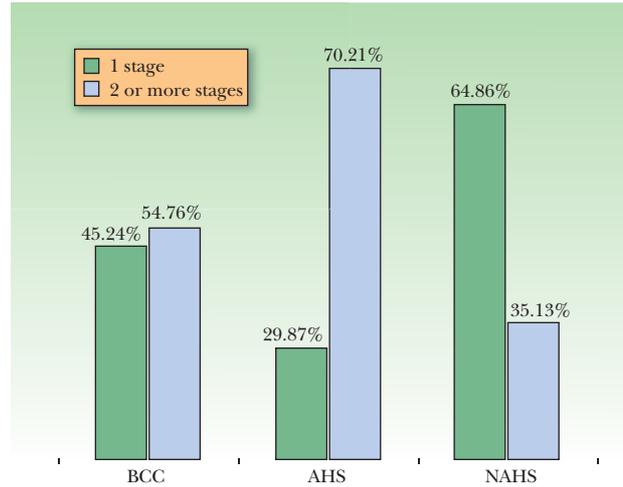


Figure 2. Basal cell carcinoma: Mohs stages required as a function of histological subtype. BCC indicates basal cell carcinoma; AHS, aggressive histological subtype; NAHS, nonaggressive histological subtype.

eliminated after 2 or more Mohs stages was 58.10% for tumors located on embryonic fusion planes and 60% for tumors in other areas. No differences were found in the number of Mohs stages required between the tumors located on embryonic fusion planes and those located in other areas.

Squamous Cell Carcinoma

A total of 13 squamous cell carcinomas were treated in 13 patients (7 men and 6 women) aged between 63 and 87 years (mean, 77.54 years). All the tumors were located on the head, the most common site being the periauricular region (n = 5), followed by the nasal region (n = 4), periocular region (n = 3), and forehead (n = 1). The size of the tumors varied between 12 and 60 mm, with 15.38% (n = 2) less than or equal to 2 cm and 84.61% (n = 11) greater than 2 cm. In 92.30% (n = 12), the tumors were recurrences after 1 or more conventional surgical interventions and 7.69% (n = 1) were primary tumors. Complete elimination of the tumor was achieved after 1 Mohs stage in 23.07% (n = 3), and 2 or more stages were required in 76.92% (n = 10). Closure of the surgical defect was performed in all cases using local flaps.

Figure 4 shows the number of Mohs stages according to the size of the tumor. The percentage of tumors eliminated after 1 Mohs stage was 50% for tumors less than or equal to 2 cm and 18.18% for tumors greater than 2 cm; this difference was not statistically significant (difference of proportions, 31.82%; 95% CI, -1.31%-40.40%). The percentage of tumors eliminated after 2 or more Mohs stages was 50% for tumors less than or equal to 2 cm and 81.81% for tumors greater than 2 cm; this difference was

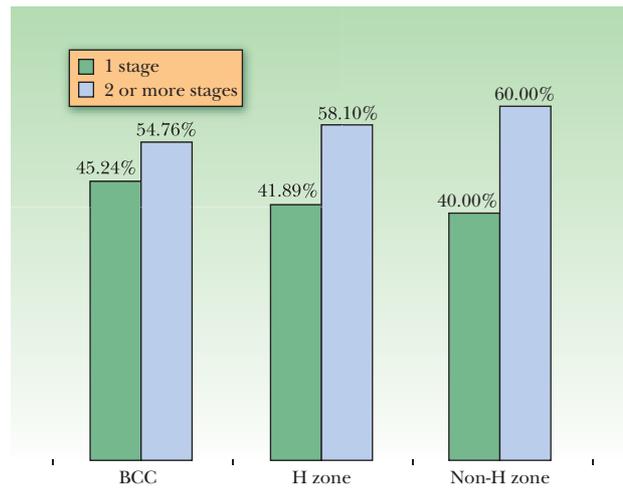


Figure 3. Basal cell carcinoma: Mohs stages required as a function of site. BCC indicates basal cell carcinoma; H zone, embryonic fusion planes; non-H zone, outside embryonic fusion planes.

not statistically significant (difference of proportions, 31.81%; 95% CI, -41.13%-104.77%).

Dermatofibrosarcoma Protuberans

We treated 5 dermatofibrosarcoma protuberans tumors in 5 patients (2 men and 3 women) aged between 39 and 70 years (mean, 48.6 years). The most common site was the shoulder (60%), followed by the upper part of the back

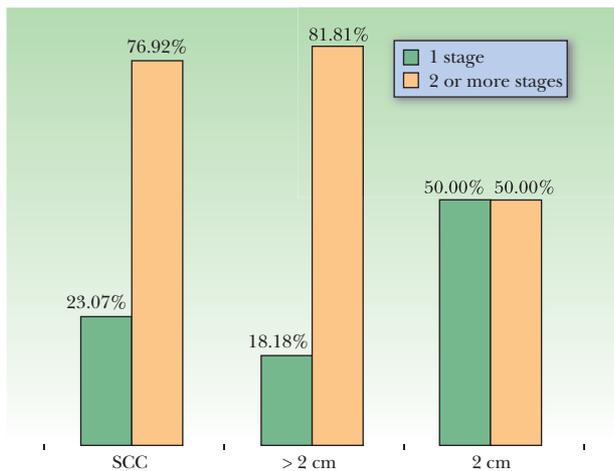


Figure 4. Squamous cell carcinoma: Mohs stages required as a function of size. SCC indicates squamous cell carcinoma.

(20%) and the arm (20%). The tumors were between 30 and 60 mm in diameter. All were primary tumors with no previous treatment. Two or more Mohs stages were required in all cases to completely excise the tumor. Closure of the surgical defect was performed by local flaps or skin grafts.

Microcystic Adnexal Carcinoma

Mohs surgery was performed for a single primary microcystic adnexal carcinoma with a size of 18 × 16 mm, located on the upper lip of a 58-year-old woman. Three Mohs stages were required for its complete elimination. The surgical defect was closed using a double advancement flap.

Merkel Cell Carcinoma

Mohs surgery was used to treat a single primary Merkel cell carcinoma located on the right upper eyelid of a 45-year-old woman, and with a size of 11 × 9 mm. Two Mohs stages were required for its complete excision. The surgical defect was closed using a double advancement flap.

Lentigo Maligna Melanoma

Mohs surgery was performed for a single case of lentigo maligna melanoma situated on the right cheek of an 82-year-old man. It had recurred on 3 occasions after conventional surgery and had a size of 25 × 40 mm. A single stage of Mohs surgery was sufficient for its complete excision. The surgical defect was closed with an advancement flap.

Discussion

Cancer of the skin is the most common tumor in humans.² The high incidence of nonmelanoma skin cancer leads to considerable morbidity and some deaths, with a substantial use of health resources.³ It is well known that Mohs surgery offers the highest percentage cure rate in the treatment of nonmelanoma skin cancer and it is therefore the treatment of choice in high-risk skin cancer.²

Basal Cell Carcinoma

Basal cell carcinoma accounts for 80% of skin tumors and most commonly arises on exposed areas. It is more common in men and usually appears between the sixth and eighth decades of life.⁴⁻⁸ A nodular histological pattern is found in 70% of cases; morpheaform and basosquamous tumors are less common but more aggressive.⁵⁻⁷ Basal cell carcinoma represented 80% of all tumors in our case series; the majority occurred in women and the most common site was the nose. The most frequent histological variant was the nodular subtype. More than 1 stage of Mohs surgery was required in 54.76% of cases to completely excise the tumor.

Comparing the number of Mohs stages as a function of the size of the tumor, statistically significant differences were found between tumors larger than 2 cm and those smaller than or equal to 2 cm. We may therefore conclude that tumors larger than 2 cm require more Mohs stages, leave a larger surgical defect, and therefore have greater subclinical extension. Comparing the number of Mohs stages as a function of the histological subtype, differences were found but they were not statistically significant. No differences were observed in the number of Mohs stages required for tumors located on embryonic fusion planes and tumors located in other regions. On analysis of these data, we may deduce that, after independent evaluation, the size of the tumor is the risk factor most closely related to the grade and subclinical extension of the tumor.

The majority of published case series agree that large, recurrent tumors with an aggressive histological subtype and those situated on embryonic fusion planes require more Mohs stages and have a greater subclinical extension and probability of recurrence.⁹⁻¹³ We found no differences between the tumors situated on embryonic fusion planes and those on other areas, and the differences between the tumors of different histological subtypes were not statistically significant. This may be explained by the presence of other high-risk factors in the tumors not located on embryonic fusion planes and in tumors with nonaggressive histological subtypes; moreover, these tumors were often recurrences or lesions larger than 2 cm.

Squamous Cell Carcinoma

Squamous cell carcinoma is the second most common skin cancer and mainly affects exposed areas. It develops between the sixth and eighth decades of life, although the age range can be wider; the patients in our series were aged between 63 and 87 years, similar to the majority of series published. It is more common in men.⁵ All our cases were situated on the head, the most common site being the auricular or periauricular region; this is in contrast to the majority of series published, in which the most common site was the nose.^{10,14}

On comparing the number of Mohs stages necessary according to the size of the tumor, we found differences between tumors less than or equal to 2 cm and those greater than 2 cm, although these differences were not statistically significant. This differs from other reports in the literature, in which the majority of authors agree that the larger the size of the tumor, the greater the number of stages that will be required, the greater the subclinical extension, and the greater the probability of recurrence.¹⁵⁻¹⁷ We believe that the fact that there were only 2 squamous cell carcinomas less than 20 mm and that both were recurrences could be the reason that statistically significant differences were not found in our case series.

Dermatofibrosarcoma Protuberans

Dermatofibrosarcoma protuberans is a low-grade sarcoma with little tendency to metastasize and a high propensity to local recurrence. It usually affects young and middle-aged adults and mainly develops on the trunk and proximal parts of the limbs. Treatment usually consists of wide excision, and recurrence varies between 0% and 60% depending on the series published.¹⁸⁻²⁰ Currently Mohs surgery is the technique of choice for its treatment, as the recurrence rate (0%-1%) is much lower than that observed after conventional surgery.²¹

In our case series, dermatofibrosarcoma protuberans accounted for 4.76% of the tumors and mainly affected middle-aged adults. The most common site of the tumor was the shoulders. On analysis of our results, we found that despite being primary tumors, all required more than 1 Mohs stage for complete excision, as these are usually tumors that present eccentric, microscopic spread beyond the surgical border.²⁰ Keyvan and coworkers²² estimated a mean of 2.5 Mohs stages for this type of tumor.

Microcystic Adnexal Carcinoma

Microcystic adnexal carcinoma is a rare tumor that mainly affects young and middle-aged women and is usually located

on the lip.²³ It is a locally aggressive tumor that presents a high rate of local recurrence, estimated at around 47%, despite wide surgical excision.^{24,25} Our series included a single case of microcystic adnexal carcinoma on the upper lip of a middle-aged woman. Despite being a primary tumor, 2 Mohs stages were required for complete excision. In their case series, Leibovitch and coworkers²⁶ estimated a mean of 2.2 Mohs stages for this type of tumor.

Lentigo Maligna Melanoma

Lentigo maligna melanoma usually affects elderly patients and can present clinically as a poorly defined tumor, leading to a high percentage of local recurrences after treatment by conventional surgery. There is a lack of consensus on the use of Mohs surgery in melanoma,²⁷ as the reliability of identifying atypical melanocytes in frozen sections has been questioned. Some authors have resolved this problem using specific techniques such as HMB-45, mel-5, melan-A, or S-100 stains.²⁸

Our study included a single patient with lentigo maligna melanoma that had recurred on 3 occasions. It was situated on the right cheek and required a single Mohs stage for elimination. A mean of 2.7 stages were required in a series of 202 melanomas treated using Mohs surgery by Temple and coworkers.²⁹

Merkel Cell Carcinoma

Merkel cell carcinoma is a rare, malignant skin tumor with a tendency to local recurrence in almost a third of cases and that presents lymphatic spread in up to 75% of cases after conventional surgical excision. It mainly affects elderly individuals, with only 5% of cases occurring in persons under 50 years of age.^{30,31} Our case series included a single primary tumor located on the upper eyelid of a 45-year-old woman. More than 1 Mohs stage was required for its complete excision. In their series, Thomas and coworkers³² estimated a mean of 1.3 Mohs stages for this type of tumor.

Conflicts of interest

The authors declare no conflicts of interest

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