

Impact of the COVID-19 Pandemic on Characteristics of Cutaneous Tumors Treated by Mohs Micrographic Surgery

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PRACTICE POINTS

- Mohs surgeons should follow best practice guidelines dictated by our governing professional societies in selecting skin cancers for treatment by Mohs micrographic surgery (MMS) during the COVID-19 pandemic and beyond.
- The COVID-19 pandemic has impacted the characteristics of skin cancers treated by MMS, largely driven by new guidelines.
- Changing characteristics of skin cancers treated by MMS are of clinical significance, potentially affecting the extent of reconstructive surgery, cost, operating time, and future tumor characteristics.

The COVID-19 pandemic has impacted the practice of Mohs micrographic surgery (MMS). We sought to determine the characteristics of skin cancers treated by MMS during the pandemic compared with prepandemic controls. A retrospective chart review was conducted. Tumors included were all treated in accordance with best practice guidelines set forth by state- and national-level professional governing bodies. Bivariate and multivariate analyses were performed to compare outcome variables. Changes in tumor characteristics during the pandemic are of clinical significance, potentially affecting extent of reconstructive surgery, cost, operating time, and future tumor characteristics.

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The COVID-19 pandemic has brought about unprecedented changes and challenges to medical practice, including new public health measure legislation, local and national medical authority recommendations, nursing home and other ancillary health center protocols, and novel clinical decision-making considerations.¹⁻³ In July 2020, the American Academy of Dermatology (AAD) addressed the changing landscape in dermatologic surgery, in part, by publishing recommendations on practice protocols during the COVID-19 pandemic.⁴ The guidelines recommended deferred treatment of superficial basal cell carcinomas (BCCs) for 6 months and all other BCC subtypes for 3 to 6 months. Furthermore, the guidelines recommended deferring treatment of all actinic keratoses and squamous cell carcinomas (SCCs) in situ “for now.” Squamous cell carcinoma treatment was to be guided by prognostic variables, such as location, size, depth, differentiation, perineural or lymphovascular invasion, recurrence, and immunosuppression. The guidelines recommended melanoma in situ (MIS) treatment be deferred for 3 months and invasive melanoma with histologic clearance obtained on excisional biopsy for 3 months. Other general recommendations included triaging clinics, rebooking according to clinical priority, using telehealth where possible, screening patients for COVID-19 signs and symptoms, staggering appointment times, spacing patient chairs, limiting support persons to 1, removing possible sources

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of infection in the waiting room, ensuring all patients sanitized their hands on arrival, rationing personal protective equipment, considering N95 masks for periorificial surgery, and using dissolving sutures to minimize multiple presentations.⁴

The American College of Mohs Surgery (ACMS), with guidance from its sister societies and the National Comprehensive Cancer Network, also communicated COVID-19–related recommendations to its members via intermittent newsletters during the initial peak of the pandemic in March and June 2020.⁵ General social distancing and office recommendations were similar to those released by the AAD. Recommendations for skin cancer treatment included deferring all BCCs for up to 3 months, with exceptions for highly symptomatic cancers and those with potential for substantial rapid growth. Squamous cell carcinoma in situ and small, well-differentiated SCCs were deferred, with priority placed on SCCs that were rapidly enlarging, poorly differentiated, demonstrated perineural invasion, were ulcerated, or were symptomatic. Patients with major risk factors were prioritized for treatment. Melanoma in situ was deferred for 2 to 3 months.⁵

State-level guidance from the Texas Dermatological Society (TDS) communicated in April 2020 stated that skin cancers with a potential for rapid progression and metastasis, such as melanoma and SCC, may require treatment as determined by the physician.⁶ The potential risk of serious adverse medical outcomes from not treating these cancers should be carefully documented. General practice measures for preventing the spread of COVID-19 were also recommended.⁶

In the setting of emerging novel recommendations, the practice of Mohs micrographic surgery (MMS) was notably impacted by the COVID-19 pandemic. According to one survey study from the United Kingdom conducted in April and May 2020, 49% of MMS services ceased and 36% were reduced during the infancy of the COVID-19 pandemic.⁷ Mohs micrographic surgery was largely suspended because of a lack of personal protective equipment and safety concerns, according to respondents. Additionally, respondents reported 77% of departments experienced redeployment of physicians and nurses to intensive care and medical wards. Thirty-five percent reported a reduction in the proportion of flaps/grafts to primary closures performed, 74% reported a decrease in outside referrals for repair by other specialties, 81% reported increased usage of dissolvable sutures, and 29% reported an increase in prophylactic antibiotic prescriptions.⁷ Another study from Italy reported a 46.5% reduction in dermatologic surgeries performed during the initial lockdown of the COVID-19 pandemic. Patients canceled 52.9% of procedures, and 12.5% were cancelled because of confirmed or suspected COVID-19 infection.⁸ Patient perceptions of MMS have also been impacted by the COVID-19 pandemic. According to a survey study of patients in

the United Kingdom undergoing MMS during the pandemic, 47% were worried the hospital would cancel their surgery, 54% were anxious about using public transportation to attend their appointment, 30% were concerned about transmitting COVID-19 to household or family members, and 19% were worried about their ability to socially distance in the hospital.⁹

Evidence is also emerging that suggests the potential negative impact of the COVID-19 pandemic on morbidity and mortality outcomes in patients with skin cancer. One European study found an increase in Breslow thickness in primary melanomas diagnosed following the initial COVID-19 lockdown (0.88-mm average thickness prelockdown vs 1.96-mm average thickness postlockdown).¹⁰ An Italian study observed similar results—an increase in median Breslow thickness during the initial COVID-19 lockdown period of 0.5 mm from 0.4 mm during the prelockdown time period.¹¹ Also providing evidence for potentially poor patient outcomes, one study modeled the impact of backlog in cutaneous melanoma referrals in the United Kingdom on patient survival and predicted 138 attributable lives lost for a 1-month delay and 1171 lives lost for a 6-month delay. The model further predicted a 3.1% to 12.5% reduction in 10-year net survival incurred from a 3-month delay in melanoma treatment, with the largest reduction seen in the patient population older than 80 years.¹²

Although the COVID-19 pandemic has been observed to impact MMS practice, patient perceptions, and clinical outcomes, it is unknown how the COVID-19 pandemic and corresponding rapidly evolving recommendations in dermatologic surgery have impacted the characteristics of cutaneous tumors treated by MMS.

Our study sought to determine the characteristics of skin cancers treated by MMS during the peak of government-mandated medical practice restrictions and business shutdowns in response to the COVID-19 pandemic and to compare them with characteristics of skin cancers treated during a prepandemic control period.

Methods

A retrospective chart review was conducted with approval from our institutional review board at the University of Texas Medical Branch (Galveston, Texas). Included in the chart review were all cutaneous malignancies treated by MMS at our outpatient, office-based surgical center from March 15, 2020, to April 30, 2020; this period corresponded to the peak of the COVID-19–related government-mandated medical and business shutdowns in our geographic region (southeast Texas). All cases performed were in compliance with national- and state-level guidance. Data were also collected for all cutaneous malignancies treated by MMS at our office from March 15, 2019, to April 30, 2019, as well as March 15, 2018, to April 30, 2018; these periods represented prepandemic control periods.

Data were collected for 516 surgeries performed on 458 patients and included patient age, preoperative clinical size, postoperative defect size, number of Mohs stages to achieve clearance, MMS appropriate use criteria (AUC) location (categorized as high-, medium-, or low-risk tumor location),¹³ and tumor type (categorized as BCC, SCC, or MIS). All variables were examined for unusual or missing values. Five patients with rare tumor types were observed and removed from the data set.

Statistical Analysis—An a priori power analysis for a power set at 0.85 determined sample sizes of 105 per group. Bivariate analyses were performed to compare variables for patients undergoing MMS during the pandemic vs prepandemic periods. Continuous outcome variables—Mohs stages, preoperative size,

postoperative size, and patient age—were categorized for the analysis. Preoperative tumor size was dichotomized, with less than 2 cm² as the referent category vs 2 cm² or greater, and postoperative defect size was dichotomized with less than 3.6 cm² as the referent category vs 3.6 cm² or greater. Mohs stage was dichotomized as 1 stage (referent) vs more than 1 stage, and patient age was dichotomized as younger than 65 years (referent) vs 65 years or older.

Multivariate analyses were also performed to compare preoperative and postoperative sizes for patients undergoing MMS during the pandemic vs prepandemic periods, controlling for Mohs AUC location. Bivariate unadjusted and multivariate analyses were performed using a GENMOD logistic regression procedure in SAS (SAS Institute) to account for correlation in clustered

TABLE 1. Bivariate Analysis of the Effect of the COVID-19 Pandemic on Characteristics of Tumors Treated by MMS

Outcome	Pandemic period ^a	Prepandemic period ^b	P value	Odds ratio	95% CI
Median preoperative tumor size (IQR), cm ²	1.7 (0.9-3.7)	1.4 (0.9-2.9)	.13	1.38	0.91-2.07
Median postoperative defect size (IQR), cm ²	4.1 (2.1-9.3)	3.4 (2.1-5.8)	.12	1.38	0.92-2.07
Mean tumor stage (SD)	1.6 (0.9)	1.5 (0.8)	.067		
No. of MMS stages (%)					
1 (referent)	71 (52.2)	231 (61.6)	.056	1.46	0.97-2.19
>1	65 (47.8)	144 (38.4)			
AUC location, n (%)					
Low risk (referent)	17 (12.3)	42 (11.2)	.58	0.84	0.46-1.54
Medium risk	45 (32.6)	130 (34.7)			
High risk	76 (55.1)	203 (54.1)			
Tumor type, n (%)					
BCC (referent)	56 (41.2)	204 (54.4)	.007	1.76	1.17-2.66
SCC	73 (53.7)	165 (44.0)			
MIS	7 (5.2)	6 (1.6)			
Patient age, n (%)					
<65 y (referent)	26 (19.1)	71 (18.9)	.84	1.06	0.62-1.79
≥65 y	110 (80.9)	304 (81.1)			

Abbreviations: AUC, appropriate use criteria; BCC, basal cell carcinoma; IQR, interquartile range; MIS, melanoma in situ; MMS, Mohs micrographic surgery; SCC, squamous cell carcinoma; SD, standard deviation.

^aPandemic period defined as March 15, 2020, to April 30, 2020.

^bPrepandemic period defined as March 15, 2019, to April 30, 2019, and March 15, 2018, to April 30, 2018.

data because a patient could be included for more than 1 surgery in the data set. Data were analyzed using SAS 9.4 for Windows. Because outcome variables tended to be skewed and not distributed normally, outcome variables were recorded as medians with interquartile ranges where possible to give a more accurate representation of the data than could be demonstrated with means with standard deviations.

Results

One hundred thirty-eight skin cancers were treated during the COVID-19 pandemic from March 15, 2020, to April 30, 2020, and 378 skin cancers were treated during the prepandemic control periods of March 15, 2019, to April 30, 2019, and March 15, 2018, to April 30, 2018. Tumor type treated during the pandemic period was more likely to be SCC or MIS (representing generally more severe tumor types) vs BCC when compared with the prepandemic periods, with an odds ratio (OR) of 1.763 (95% CI, 1.17–2.66). This outcome was statistically significant ($P=.01$).

Tumors treated during the pandemic period were more likely to have necessitated more than one Mohs stage for clearance compared to the prepandemic periods, though this difference was not statistically significant (OR, 1.461; 95% CI, 0.97–2.19; $P=.056$). Neither AUC location of treated tumors nor age were significantly different between prepandemic and pandemic periods ($P=.58$ and $P=.84$, respectively). Table 1 includes all bivariate analysis results.

Additionally, although mean preoperative and postoperative sizes were larger for each AUC location during the pandemic vs prepandemic periods, these differences did not reach statistical significance on multivariate analysis ($P=.71$ and $P=.50$, respectively)(Table 2).

Comment

Our practice has followed best practice guidelines dictated by our governing professional societies during the COVID-19 pandemic in the treatment of skin cancers by MMS, specifically highly symptomatic BCCs (in accordance with ACMS guidance), SCCs with high-risk features (in accordance with AAD, ACMS, and TDS guidance), and tumors with high risk for progression and metastasis such as melanomas (in accordance with TDS guidance). Melanoma in situ was also treated during the COVID-19 pandemic in accordance with the latter TDS guidance, particularly in light of the potential for upstaging to melanoma following resection (a phenomenon demonstrated to occur in 5%–29% of biopsied MIS lesions).¹⁴

In following best practice guidelines, our results suggested tumors treated by MMS were more severe, as evidenced by a statistically significant higher proportion of SCC and MIS tumors (representing more severe tumor types) vs BCC when compared to the prepandemic period. Supporting this conclusion, we observed larger pretreatment and posttreatment tumor sizes for all AUC locations and more tumors necessitating 2 or more stages for clearance during the pandemic vs prepandemic periods,

TABLE 2. Multivariate Analysis of the Effect of the COVID-19 Pandemic on Preoperative and Postoperative Tumor Size by AUC Location

MMS AUC location	Mean size (SD), cm ²		Median size (IQR), cm ²		P value
	Pandemic period ^a	Prepandemic period ^b	Pandemic period ^a	Prepandemic period ^b	
Preoperative results					
Low risk (n=59)	4.92 (2.46)	4.64 (4.04)	3.7 (3.1–5.3)	3.2 (2.9–4.6)	.71
Medium risk (n=175)	3.20 (2.41)	2.85 (3.17)	2.4 (1.3–4.2)	2.0 (1.3–3.2)	
High risk (n=277)	1.81 (1.95)	1.49 (1.34)	1.0 (0.7–2.0)	1.0 (0.7–1.8)	
Postoperative results					
Low risk (n=59)	11.25 (7.47)	8.76 (7.30)	8.4 (6.2–10.6)	6.4 (5.0–10.2)	.50
Medium risk (n=175)	7.85 (5.91)	5.77 (5.26)	5.7 (3.6–10.5)	4.4 (2.7–6.7)	
High risk (n=277)	4.46 (5.57)	3.42 (3.56)	2.4 (1.4–4.6)	2.5 (1.4–4.0)	

Abbreviations: AUC, appropriate use criteria; MMS, Mohs micrographic surgery; IQR, interquartile range; SD, standard deviation.

^aPandemic period defined as March 15, 2020, to April 30, 2020.

^bPrepandemic period defined as March 15, 2019, to April 30, 2019, and March 15, 2018, to April 30, 2018.

though these differences did not reach statistical significance. We postulate these findings may be attributed to allocation of finite medical resources to the treatment of larger and more aggressive skin cancers. Additionally, these findings may be explained, in part, by limitations on patient case load imposed by social distancing measures and governing body regulations in effect during the study period, including those put forth by the AAD, ACMS, and TDS. Of note, our practice observed no hospitalizations or 911 calls during the studied period. This suggests no allocation of precious hospital resources away from patients with COVID-19 in our treatment of high-risk skin cancers.

The changing characteristics of cutaneous tumors treated by MMS during the pandemic are of clinical relevance. Larger postoperative wound sizes as observed during the pandemic, albeit not statistically significant, presumably affect reconstructive decisions. With larger wounds tending to necessitate repair by techniques higher on the reconstructive ladder, greater patient morbidity and cost are expected.¹⁵ As the cost-effectiveness of dermatology services remains a critical issue, this is an area ripe for future follow-up research. Furthermore, our observation that tumors tended to necessitate 2 or more stages for clearance during the pandemic more often than pre-pandemic periods, though not statistically significant, presumably affected operating times. Longer operating times during the pandemic may be of importance when making clinical decisions for patients for whom limiting health care exposure may be of particular concern. With more SCC and MIS tumors being treated relative to BCCs during the pandemic, one might expect greater size and severity of the BCCs we observe in the proceeding months to years.

As the ongoing COVID-19 pandemic continues to impact the landscape of cutaneous oncology, the need for adaptability is imperative. With 3- and 6-month skin cancer treatment deferrals lapsed, uncertainty surrounds ideal management of existing and new skin cancers arising during the pandemic. This study adds to a growing body of literature elucidating the impact of the COVID-19 pandemic on MMS practice; however, further studies and a tincture of time are needed to guide future best practice standards.

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