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SHORT REPORT

Time to treatment and complexity of Mohs micrographic surgery

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Abstract

The impact of time to treatment (TTT) on the surgical management of keratinocyte carcinoma, specifically the complexity of Mohs micrographic surgery (MMS), is incompletely understood. We performed a retrospective chart review of patients undergoing MMS for keratinocyte carcinoma between July 1, 2019 and February 28, 2021 to examine associations between TTT and surgical characteristics. The median TTT for the 1571 patients treated with MMS during the study period was 42 days (interquartile range 28–61 days). In adjusted analyses, increasing TTT was not associated with increasing utilization of flap or graft repairs. Although a 42-day increase in TTT was associated with a 17.6 mm^2 increase in the post-operative surgical defect size after MMS, TTT was not associated with linear repair length or flap/graft repair area. In conclusion, TTT was not independently associated with the type of repair or repair length after MMS, suggesting that the complexity of Mohs reconstruction is not influenced by TTT within the time range studied in this cohort.

Keywords Skin cancer · Mohs micrographic surgery · Basal cell carcinoma · Squamous cell carcinoma · Reconstruction

The impact of time to treatment (TTT) on the surgical management of keratinocyte carcinoma is incompletely understood. The complexity of Mohs micrographic surgery (MMS) may be influenced by subclinical tumor growth between biopsy and treatment, which may increase the number of Mohs layers required to clear the tumor and lead to differences in choice of reconstruction, aesthetic outcomes, and healthcare costs [1–3]. Patients may delay seeking surgical treatment for a variety of reasons. In a prospective cohort study of 982 patients undergoing MMS, 71% delayed seeking surgical care because they believed their tumor would go away, thought it was not important, were too busy, thought they could self-treat, or were afraid of a serious diagnosis [4]. We sought to examine associations between TTT and surgical characteristics for patients undergoing MMS for keratinocyte carcinoma.

We retrospectively reviewed the medical records of patients > 18 years of age undergoing MMS for basal cell carcinoma (BCC) or squamous cell carcinoma (SCC) between July 1, 2019 and February 28, 2021. TTT was defined as the time between biopsy and MMS. Demographic, tumor, and surgical characteristics were extracted for each patient. Our primary outcome was repair type. Secondary outcomes included post-operative surgical defect size and repair length. Univariate and adjusted linear and logistic regressions were performed to assess associations between the outcome variables and TTT for keratinocyte carcinoma.

The characteristics of the 1571 patients treated with MMS during the study period are provided in Table 1. The median TTT was 42 days (IQR 28–61 days). The median pre-operative tumor and post-operative surgical defect sizes were 78.54 mm^2 (IQR 38.48–176.71 mm^2) and 226.98 mm^2 (IQR 132.73–415.48 mm^2), respectively. When controlling for confounders, increasing TTT was not associated with an increased complexity of repair (flap/graft versus primary/secondary intention, $p = 0.08$). Women were more likely to have flap or graft repairs (aOR 1.84, 95% CI 1.43–2.37), and patients with SCC were less likely to have flap or graft repairs (aOR 0.43, 95% CI 0.33–0.56). A 42-day increase in TTT was associated with a 17.6 mm^2 increase in the post-operative surgical defect size after MMS when controlling for pre-operative tumor size, age, sex, immunosuppression, blood thinner use, and treatment during the SARS-CoV-2 pandemic ($p < 0.001$).

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Table 1 Characteristics of the study population

	N (%)
Patient demographics	
Sex	
Male	1008 (64.3)
Female	560 (35.7)
Age	
18–39	35 (2.2)
40–64	433 (27.6)
65 +	1103 (70.2)
Race	
White	1548 (98.5)
Black	9 (0.6)
Asian/Pacific Islander	7 (0.5)
Other	5 (0.3)
Unknown	2 (0.1)
Primary payer	
Medicaid/Medicare	730 (46.5)
Private insurance	829 (52.8)
Other	12 (0.8)
Immunosuppression	
No	1415 (90.1)
Yes	156 (9.9)
HIV/AIDS	6 (3.8)
Medication/treatment	136 (87.2)
Hematopoietic malignancy	14 (9.0)
Anti-platelet/anti-coagulant	
No	1169 (74.4)
Yes	402 (25.6)
Tumor characteristics	
Tumor type	
BCC	895 (57.0)
SCC	676 (43.0)
Tumor size, median (IQR)	
Pre-operative size (mm^2)	78.5 (38.5–176.7)
TTT median (IQR) (days)	
All tumors	42 (28–61)
BCC	47 (30–69)
SCC	38 (25–53)
Surgical characteristics	
Number of MMS stages	
1	848 (54.0)
2	558 (35.5)
3	116 (7.4)
4 +	49 (3.1)
Number of MMS stages (BCC)	
1–2	783 (87.5)
3 +	112 (12.5)
Number of MMS stages (SCC)	
1–2	623 (92.2)
3 +	53 (7.8)
Surgical defect size, median (IQR)	
Post-operative size (mm^2)	227.0 (132.7–415.5)
Repair type	
Primary/secondary intention	1186 (76.8)
Flap/graft	358 (23.2)
Repair length, median (IQR)	
Linear (cm)	4.5 (3.8–6.0)
Flap/graft (cm^2)	8.0 (4.0–13.6)

BCC basal cell carcinoma, *SCC* squamous cell carcinoma, *IQR* interquartile range, *TTT* time to treatment, *MMS* Mohs micrographic surgery

TTT was not associated with linear repair length ($p = 0.12$) or flap/graft repair area ($p = 0.10$) after MMS.

Although post-operative surgical defect size after MMS increases with longer TTT, TTT was not independently associated with type of repair or final repair length after MMS, suggesting that the complexity of reconstruction is not influenced by increasing TTT within the time range studied in this cohort. Limitations of this study include the retrospective study design and choice of secondary outcomes (post-operative defect size and repair length) which are particularly susceptible to variations based on clinical practice (i.e., curettage, tumor debulking, initial Mohs margin). Moreover, the 42-day median TTT is relatively short. Future research is needed to characterize growth of keratinocyte carcinoma during longer treatment delays and the impact on surgical complexity, aesthetic outcomes, and healthcare costs.

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Author contributions All authors contributed to the study conception and design. Data collection and analysis were performed by Rumsha Salman. The first draft of the manuscript was written by Rumsha Salman and Jeffrey Scott and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

IRB This study was approved by the Johns Hopkins IRB (IRB00251853).

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