

Mohs micrographic surgery for male genital tumors: Local recurrence rates and patient-reported outcomes



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Background: Local recurrence rates (LRRs) after Mohs micrographic surgery (MMS) for male genital cancers have been reported in only a few small case series, and patient-reported outcomes (PROs) have not been studied.

Objective: To determine the LRR and PROs after MMS for male genital skin cancers.

Methods: Retrospective review of all male genital skin cancers removed with MMS between 2008 and 2019 at an academic center. LRR was determined by chart review and phone calls. PROs were assessed by survey.

Results: A total of 119 skin cancers in 108 patients were removed with MMS. Tumors were located on the penis (90/119) and scrotum (29/119). Diagnoses included squamous cell carcinoma in situ (n = 71), invasive squamous cell carcinoma (n = 32), extramammary Paget disease (n = 13), melanoma (n = 2), and basal cell carcinoma (n = 1). The LRR was 0.84% (1/119), with a mean follow-up time of 3.25 years (median, 2.36 years). The majority of survey respondents reported no changes in urinary (66%) or sexual functioning (57.5%) after surgery.

Limitations: Retrospective single-center experience; short follow-up time; low survey response rate; no baseline functional data.

Conclusion: MMS for male genital skin cancer has a low LRR and high patient-reported satisfaction with urinary and sexual function. (J Am Acad Dermatol 2021;84:1030-6.)

Key words: AJCC staging; local recurrence; male genital cancer; Mohs micrographic surgery; NCCN guidelines; patient-reported outcomes; penile cancer; recurrence rates; scrotal cancer; urinary and sexual functioning.

Surgical treatment for male genital skin cancer has traditionally been conventional excision for scrotal skin cancer¹ and total or partial amputation for penile cancer.² For scrotal skin cancer, conventional excision has high rates of positive

margins (45%) and local recurrence (12.5%).³ For penile skin cancer, total or partial penectomy has low local recurrence rates (LRRs) (3%-10%),⁴⁻⁷ but it disfigures patients,⁸⁻¹⁰ causes depression and anxiety,^{8,11-13} and impairs sexual activity and

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Funding sources: None.

IRB approval status: Reviewed and approved by the Hospital of the University of Pennsylvania IRB.

Accepted for publication November 3, 2020.

Reprints not available from the authors.

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Published online December 3, 2020.

0190-9622/\$36.00

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<https://doi.org/10.1016/j.jaad.2020.11.060>

function.^{11,12,14} Organ-sparing conventional excision improves sexual and urinary function and quality of life⁹ but has historically higher rates of positive margins (19.2%)¹⁵ and local recurrence (6.0%-34%).^{4-6,16-22} Incomplete excision of penile tumors has been associated with increased risk for local recurrence and death.¹⁵

Mohs micrographic surgery (MMS) is an organ-sparing technique that uses comprehensive microscopic margin evaluation to confirm complete tumor removal before reconstruction. LRRs after MMS for male genital tumors have been reported in only small case series,^{17,23,24} and patient-reported outcomes (PROs) have not been investigated. In addition to the small number of reported cases, inconsistent staging systems and treatment guidelines are another impediment to developing clear indications for MMS of male genital cancers. As an example of inconsistent staging, the 8th edition of the American Joint Committee on Cancer (AJCC) staging system for penile cancer stratifies squamous cell cancers (SCCs), the most common male genital cancer, based on anatomic depth of invasion, tumor grade, and presence or absence of lymphovascular or perineural invasion; but it does not consider tumor diameter and does not apply to scrotal SCC or other tumor diagnoses.²⁵ By contrast, the Brigham and Women's Hospital (BWH) staging system for SCC applies to both penile and scrotal SCC, and its staging criteria include tumor diameter in addition to degree of differentiation, presence or absence of perineural invasion, and anatomic depth of invasion.²⁶ There are no staging systems for genital extramammary Paget disease (EMPD) or basal cell carcinoma (BCC).

These inconsistencies in tumor staging cause confusion with indications for MMS. For example, in the National Comprehensive Cancer Network (NCCN) guidelines for penile SCC, indications for MMS are limited to select cases of 8th edition AJCC penile cancer stage Tis (carcinoma in situ) and T1 tumors with well or moderately differentiated pathology.²⁵ By contrast, in the NCCN guidelines for SCC, MMS is indicated for any male genital SCC, regardless of AJCC stage.²⁷

This retrospective study reports the LRRs and PROs after MMS for male genital skin cancers of varied diagnoses, locations, and stages. This cohort adds important data about the efficacy of MMS and

may be useful to develop clearer indications for MMS of male genital skin cancers.

METHODS

This retrospective study was approved by the institutional review board at the Hospital of the University of Pennsylvania. A prospectively updated database was used to identify men 18 years or older with a genital skin cancer removed with MMS between 2008 and 2019 at the Hospital of the University of Pennsylvania.

All MMSs were performed under local anesthesia with frozen section evaluation of 100% of the peripheral and deep microscopic margins and either same-day reconstruction by the Mohs surgeon or separate-day reconstruction by a surgical colleague under general

anesthesia. The following data were recorded from the MMS database and patient electronic medical records: patient demographics, clinical and pathologic tumor characteristics, details of MMS, reconstruction, follow-up time, local recurrence, and regional or distant metastases.

SCC and melanomas of the penis were retrospectively staged according to their respective 8th edition AJCC staging system,²⁸ and SCCs were also retrospectively staged with the BWH staging classification.²⁹ There is no staging system for male BCC or EMPD. Tumor location was categorized as either glans, prepuce, shaft, or scrotum. If a tumor involved more than 1 of these locations, it was classified by the most distal location.

The primary outcome was local recurrence, which was defined as a tumor arising within the MMS scar.³⁰ Local recurrence was determined either from the last physical examination documented in the patient's medical record and/or from a phone call, whichever was most recent. Patients contacted by phone were asked if they had any visible or palpable changes in or around their scar, whether they had seen a dermatologist or other provider to assess their scar, and whether their health care provider had diagnosed a local recurrence. If patients were concerned about local recurrence, they were evaluated in the clinic for definitive diagnosis. Follow-up time was calculated from the date of MMS to the last time the scar was assessed via physical examination in the electronic medical record or phone call. Regional and distant metastasis and death were also recorded.

CAPSULE SUMMARY

- Mohs micrographic surgery for male genital skin cancers has low local recurrence rates and high patient-reported satisfaction with functional outcomes.
- Developing consensus guidelines with clear indications for Mohs micrographic surgery may benefit more men with genital skin cancers.

Abbreviations used:

AJCC:	American Joint Committee on Cancer
BCC:	basal cell carcinoma
BWH:	Brigham and Women's Hospital
EMPD:	extramammary Paget disease
LRR:	local recurrence rate
MMS:	Mohs micrographic surgery
NCCN:	National Comprehensive Cancer Network
PRO:	patient-reported outcome
SCC:	squamous cell carcinoma

The secondary outcome was patient-reported sexual and urinary function assessed with a questionnaire administered via email and/or telephone, according to the patient's preference. The full questionnaire is available in the supplementary materials (available via Mendeley at <https://doi.org/10.17632/bsds4wkrmj.1>). The questionnaire included 12 questions about sexual function from the International Index of Erectile Function—15³¹; 8 questions about urinary functioning from the Patient-Reported Outcome Measure for Urethral Stricture Surgery³²; and 4 nonvalidated questions about changes in sexual and urinary function, the ability to void while standing, and satisfaction with scar appearance. The International Index of Erectile Function—15 was designed for patients with erectile dysfunction, and the Patient-Reported Outcome Measure for Urethral Stricture Surgery was designed to assess patients after urethral stricture surgery, so irrelevant questions were excluded for our cohort.

Statistical analysis

Descriptive statistics were generated for patient demographics, tumor characteristics, and surgical details. The frequency of responses was calculated for each survey question based on the total number of participant answers for each question. Demographics of survey responders and nonresponders were compared using Wilcoxon's rank sum testing for lesion diameter and length of follow-up and Fisher's exact test for tumor diagnosis, tumor location, AJCC T stage for SCCs, BWH stage for SCCs, presence of urethral involvement, and repair type. Logistic regression was used to associate tumor size and location with odds of survey response choices for the 2 questions assessing change in function since surgery.

RESULTS

Clinicopathologic characteristics

A total of 119 discrete skin cancers in 108 patients were removed with MMS. All diagnoses were confirmed by pathology, and 59.66% (71/119) of

tumors were interpreted by pathologists affiliated with our institution.

Table I summarizes cohort characteristics. The average age (standard deviation) at surgery was 61.6 (14.38) years. Ninety tumors were located on the penis, including 63 (70%) SCCs in situ, 22 (24.44%) invasive SCCs, 3 (3.33%) EMPDs, and 2 (2.22%) malignant melanomas. Table II contains AJCC and BWH staging for the 22 invasive penile SCCs. The 2 penile melanomas were AJCC stage T2a and T2b. There were 29 tumors located on the scrotum, including 8 (27.59%) SCCs in situ, 10 (34.48%) invasive SCCs, 10 (34.48%) EMPDs, and 1 BCC (3.45%). The BWH stages of the 10 scrotal invasive SCCs were T1 (n = 4), T2a (n = 5), and T2b (n = 1). The average time from biopsy to surgery was 87.29 days (median, 67 days; range, 0-880 days).

Circumcision was performed in 9% (11/119), and complete glansectomy was performed in 4% (5/119) of patients. A collaborating surgeon reconstructed 23.53% (28/119) of tumors, including 100% (6/6) of SCCs with AJCC stage T1b or greater. Of the 10 (8.40%, 10/119) tumors involving the urethra, all had margins cleared by MMS, and 8 of these 10 cases were reconstructed by urology.

Local recurrence

The LRR was 0.84% (1/119), with a mean follow-up time of 3.25 years (median, 2.36 years). The sole local recurrence was detected 7.35 years after MMS of a low-grade pT1aN0 SCC of the glans penis without urethral involvement. The local recurrence was confirmed with pathology and treated with partial penectomy at an outside institution. There were no local recurrences for SCCs with AJCC stage T1b or higher, SCC in situ, EMPD, BCC, or malignant melanoma. The absence of local recurrence was determined by patient report in 63 patients (58.33%, 63/108) and physician documentation in 45 patients (41.67%, 45/108).

Two patients (1.68%) developed regional nodal metastasis. One patient developed a regional inguinal nodal metastasis 223 days after MMS of a stage Ib (T2a) malignant melanoma of the glans penis and distal urethra. A second patient developed regional inguinal nodal metastasis 797 days (2.18 years) after MMS plus inguinal lymph node dissection for a grade 2 stage IIa (T1b) SCC of the glans penis.

Eight patients died of causes unrelated to their genital cancers and had no local recurrences in their last follow-up documented in the electronic medical record.

Table I. Patient demographics and tumor characteristics

Case characteristics	Overall	Penis*	Scrotum
Patients, n	108	80	28
Tumors, n	119	90	29
Age at surgery, y			
Mean (range)	61.6 (27-87)	60.58 (27-87)	64.54 (34-82)
SD	14.38	15.17	11.59
Diagnosis, n (%)			
Squamous cell cancer in situ	71 (59.66)	63 (70.0)	8 (27.59)
Invasive squamous cell cancer	32 (26.89)	22 (24.44)	10 (34.48)
Extramammary Paget disease	13 (10.92)	3 (3.33)	10 (34.48)
Malignant melanoma	2 (1.68)	2 (2.22)	0 (0.00)
Basal cell cancer	1 (0.84)	0 (0.00)	1 (3.45)
Preoperative diameter, mm			
Mean (SD)	33.6 (27.3)	28.73 (21.61)	48.72 (36.77)
Median	25	24	30
Postoperative diameter, mm			
Mean (SD)	50.6 (35.6)	44.14 (27.14)	71.39 (49.9)
Median	40	35.5	58.5
Number of MMS stages			
Mean (range)	1.55 (1-6)	1.58	1.45
Repair type, n (%)			
Secondary intention	6 (5.04)	4 (4.44)	2 (6.9)
Linear closure	66 (55.46)	50 (55.56)	16 (55.17)
Local flap	32 (26.89)	24 (26.67)	8 (27.59)
Skin graft	6 (5.04)	6 (6.67)	0 (0.00)
Graft and flap	9 (7.56)	6 (6.67)	3 (10.34)
Reconstructive surgeon, n (%)			
Mohs surgeon	91 (76.47)	68 (75.56)	23 (79.31)
Collaborating surgeon	28 (23.53)	22 (24.44)	6 (20.69)

SD, Standard deviation.

*Twenty (22.22%) were located on the glans, 19 (21.11%) were located on the prepuce, and 51 (56.67%) were located on the shaft.

Table II. Staging of invasive penile SCCs by staging system (n = 22)

AJCC stage	n (%)	BWH stage	n (%)
T1a	16 (72.72)	T1	6 (27.27)
T1b	2 (9.09)	T2a	12 (54.54)
T2	3 (13.64)	T2b	4 (18.18)
T3	1 (4.55)	T3	0 (0.00)

AJCC, American Joint Committee on Cancer; BWH, Brigham and Women's Hospital; SCC, squamous cell carcinoma.

Patient-reported outcomes

A total of 41 (41/100, 41%) surviving patients responded to the survey; 36 completed the entire survey, and 5 completed all but the sexual functioning questions. Cohort characteristics did not differ between survey responders versus nonresponders except that survey responders had longer follow-up time ($P = .003$).

Overall, 97.56% (40/41) of patients were very satisfied (n = 30) or satisfied (n = 10) with the outcome of their MMS operation. The single patient

with a local recurrence was the only patient unsatisfied with MMS. In addition, 65.86% (27/41) of patients strongly agreed (n = 13) or agreed (n = 14) that they were satisfied with the appearance of their surgical scar, and 17.08% (7/41) strongly disagreed (n = 2) or disagreed (n = 5).

Overall, 57.5% (23/40) of patients agreed (n = 11) or strongly agreed (n = 12) that their sexual functioning had not changed since surgery. The level of agreement was not associated with tumor size or location, although our study was not powered to detect any definite differences. Of responders, 56% (20/36) were very satisfied (n = 12) or satisfied (n = 8) with their overall sexual function, and 66.67% (24/36) of responders experienced sexual desire almost always (n = 10) or most of the time (n = 14).

A total of 66% (27/41) agreed (n = 12) or strongly agreed (n = 15) that their urinary function had not changed significantly since surgery. Ten of 15 (66.67%) who strongly agreed had tumors located on the scrotum (n = 5) or shaft (n = 5). Tumor location and lesion size were not significantly

Table III. What are indications for MMS according to NCCN Guidelines?

Diagnosis	Yes/no	Current guidelines
SCC	Yes	NCCN guidelines for penile cancer: MMS is indicated for select cases of Tis, Ta, and T1a penile SCC; guidelines do not comment on scrotal SCC. NCCN guidelines for SCC: MMS is indicated for any SCC of the penis or scrotum, regardless of tumor stage.
EMPD Melanoma	Uncertain Uncertain	There are no NCCN guidelines. Current NCCN guidelines do not comment on MMS for genital melanomas.
BCC	Yes	NCCN guidelines for BCC: MMS is indicated for any BCC of the penis or scrotum, regardless of tumor stage.

BCC, Basal cell carcinoma; EMPD, Extramammary Paget's disease; MMS, Mohs micrographic surgery; NCCN, National Comprehensive Cancer Network; SCC, squamous cell carcinoma.

associated changes in urinary function, although our study was not powered to detect definite differences. Of the 12 who disagreed ($n = 8$) or strongly disagreed ($n = 4$) that their urinary function had not changed, 3 (25%) had tumors involving the urethra. Overall, 75.61% (31/41) of respondents indicated that their urinary symptoms did not at all interfere with their current life, including 4 of 6 surveyed patients with tumors involving the urethra. In addition, 70.73% (29/41) of patients were able to void while standing more than half of the time ($n = 9$) or all of the time ($n = 20$).

DISCUSSION

This study is the largest published cohort of MMS for male genital skin cancers, to our knowledge, and it shows that MMS has low rates of local recurrence and satisfactory urinary and sexual function outcomes in most patients. We report a LRR of 0.84% (1/119) with a mean follow-up time of 3.25 years (median, 2.36 years). The majority of surveyed patients were satisfied with the overall outcome and reported no changes in urinary (66%) or sexual function (57.5%) after surgery.

Our LRR of 0.84% (1/119) is lower than previous reports of MMS for male genital cancers.^{17,19,20,33} LRRs after MMS for penile SCC have been reported by Mohs et al³³ (6%, 2/31), Brown et al¹⁹ (6%, 1/17), Machan et al¹⁷ (11%, 4/36), and Shindel et al²⁰ (32%, 8/25). The high LRR by Shindel et al²⁰ may be in part because their small series included 5 patients for

whom MMS was terminated with positive margins. There are only a few case reports dedicated to MMS for scrotal tumors.^{34,35} Our series adds to the literature the largest cohort, to our knowledge, of penile tumors ($n = 90$) and scrotal tumors ($n = 29$) treated with MMS.

MMS may benefit patients who may not be offered the technique because of inconsistent staging criteria and treatment guidelines (see Table III). For example, 5% (6/119) of our patients had advanced penile SCC (AJCC stage T1b, $n = 2$; T2, $n = 3$; T3, $n = 1$), and none had a local recurrence. According to NCCN guidelines for penile cancer, MMS is not indicated for these tumors.²⁵ Our LRR is lower than reports of penectomy (4%-10%)^{4,36} or organ-sparing surgery (7%-42%),^{21,36,37} suggesting that MMS is an effective treatment option for advanced tumors. Our cohort also included many large tumors (average preoperative tumor diameter was 33.6 mm), and size of 2 cm or greater is a risk factor for local recurrence and a criterion for staging in the BWH classification system for SCC.²⁹ Moreover, our results show high local control for SCC on the scrotum, for which MMS indications are uncertain. Developing uniform staging systems for tumors of the penis and scrotum is critical for communication across specialties and for developing indications for MMS. Integrating Mohs surgeons into cancer teams is also important, as our cohort shows that more than 1 out of 5 male genital surgeries involve interdisciplinary care.

Maintaining function is a priority for patients. More than a quarter of men with penile cancer would choose a treatment with lower long-term survival to increase the chance of remaining sexually potent.¹¹ To our knowledge, our study is the first to include PROs after MMS for male genital cancers. Mohs et al¹⁸ reported that “none of our patients reported a functional deficit (either urinary or sexual)”, and Shindel et al²⁰ reported that patients were “generally satisfied with urinary and sexual function”, but neither study surveyed patients. Despite low survey response rates, the majority of survey respondents were satisfied with the outcome of their surgery (97.5%, 40/41) and agreed that their urinary (66%, 27/41) and sexual function (57.5%, 23/40) were unchanged after MMS. Our cohort exhibited moderate sexual desire, satisfaction with overall sexual functioning, and high satisfaction with appearance of the surgical scar in the genital region, which contrasts with low sexual desire and appearance shame reported after both organ-sparing approaches and penectomy.^{12,38}

Our study has limitations. First, data were collected at a single academic center with comparatively high volumes of MMS for male genital cancer,

and our results may not translate to other centers with lower volumes and less interdisciplinary collaboration. Second, the survey response rate was relatively low for urinary (41%) and sexual (36%) outcomes. Although the response rate was lower than in prior studies,^{9,39} the number of patients surveyed is still one of the largest in the literature.^{12,38,40} Additionally, characteristics did not differ between survey responders versus nonresponders, minimizing the effect of nonresponse bias. Third, our mean follow-up time was 3.25 years, and 58.33% (63/108) of patients self-reported recurrence data. We may find more local recurrences with longer follow-up and physical examination of all tumor sites. However, our study likely captured most recurrences, because 73.8% of recurrences occur within the first 3 years after organ-sparing surgery,¹⁶ and educated patients may detect their own skin cancers.⁴¹ Fourth, the majority of tumors in our cohort were early-stage SCC, which may have contributed to our low recurrence rates and satisfactory functional outcomes. However, prior studies reporting higher LRRs, especially after organ-sparing surgery, also have cohorts with mostly early-stage tumors.^{12,20,39,42} Finally, we did not survey patients preoperatively, so we cannot determine how much the change in patient-reported function can be attributed to surgery.

In conclusion, this study is the largest published cohort of MMS for male genital skin cancers and shows that MMS has low local recurrence and high patient-reported satisfaction with urinary and sexual function. MMS may be indicated for tumors that are currently not included in treatment guidelines. Developing consensus guidelines with clear indications for MMS may benefit more men with genital skin cancers.

Conflicts of interest

None disclosed.

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