The Webb and Rivera (WAR) Score

A Preoperative Mohs Surgery Assessment Tool

Albert E. Rivera, DO; J. Michael Webb, MD; Lloyd J. Cleaver, DO

Objective: To make available a simple, quantitative formula for preoperative assessment of both the complexity and the associated time required to complete Mohs surgical cases. It will improve office efficiency, technical performance, and resource management.

Design: Surveys were sent to 94 Mohs surgeons requesting information on 10 consecutive cases, including tumor size, recurrence, location, aggressiveness, stages required, and case duration. The data were then aggregated, scored, and statistically evaluated.

Setting: Private practice dermatology offices performing Mohs surgery were included.

Participants: Sequential randomized selection of Mohs College and Mohs Society fellows was used for inclusion. Sequential selection of patients for data acquisition was performed by the surgeons.

Main Outcome Measure: The statistical significance of a proposed preoperative assessment tool was to be determined.

Results: The score ρ values were 0.34 and 0.41 for the time and number of stages, respectively. In addition, the Mohs score obtained a statistically significant *P* value of $<.001$ for both the time and number of stages required.

Conclusions: The Webb and Rivera (WAR) score is a low-effort, efficient, reproducible tool to be used in preoperative Mohs surgery planning and office efficiency improvement. The components of the score include maximum tumor dimension, recurrence, location, and aggressiveness. Each is assigned a numerical value that is totaled, resulting in a final quantitative score.

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TWO OF THE PROFESSIONALLY intriguing and rewarding properties of Mohs micrographic surgery are that one never fully knows the final defect presentation until all specimens on the slides are declared to be free of tumor, and then the subsequent creativity required during the repair process. With experience, the Mohs surgeon begins anticipating the complexity of a given case even as early as the time of biopsy. However, this "gut feeling" could be more beneficial if it were able to be quantified. One of us (J.M.W.) has been using such a system for several years with noted improvement in office efficiency, case load, resource allotment, and the surgical practice as a whole.

This system was based on personal experience, and no known grading scale is in existence. A search of PubMed including combinations of the terms "Mohs," "score," "scoring," "tool," "predict," "predictive," and "preoperative" did not reveal any similar formula associated with Mohs micrographic surgery. Prior to writing this report, we found 3 articles that were somewhat relevant to this project: One article[1] determined the predictors of advanced reconstruction, a second[2] correlated treatment delay to defect size, and a third[3] assessed the predictors of extensive subclinical spread. During submission of this report, a fourth article[4] was published. It suggested a triage system for case complexity, supporting the usefulness for surgical planning. However, none of these studies, within 1 article, fully considered the specific time and resources for both the defect and the repair along with proposing a quantitative scoring system for accurate prediction.

Therefore, we propose the Webb and Rivera (WAR) score as a quantitative, presurgical assessment and planning tool for Mohs micrographic surgery. This scoring system takes into account both obtaining total clearance of the cutaneous tumor as well as the decision and completion

Author Affiliations: Department of Dermatology, Northeast Regional Medical Center, Kirksville, Missouri (Drs Rivera and Cleaver); and Tennessee River Dermatology, Florence, Alabama (Dr Webb).

of an appropriate repair for the resulting defect. Its purpose is to improve office efficiency and technical performance of Mohs surgery. This is achieved since the score reduces the likelihood that more difficult and time-consuming cases will be scheduled simultaneously. In addition, a more predictable daily case load will allow the Mohs surgeon to better direct his or her surgical and histologic staff resources in anticipation of difficult cases.

A preoperative Mohs surgery planning tool can be of benefit to both the physician and the patient. Knowledge of the case complexity will hopefully prevent patient overbooking; unexpected visit duration; and lack of anticipation of time, staff, or resources required. Multiple variables are potential contributors to the complexity and time of any particular surgical extirpation and repair. However, not all of the variables are easily quantifiable or obtained. Also, inclusion of too many variables makes usage too cumbersome and time consuming for integration into a busy medical practice. It is important to note that the scoring system should be simple enough that any staff member, particularly the scheduling assistant, can use it at the time of booking. In summary, the objective of the score is to quantitatively allow simple preoperative prediction of the complexity and duration of Mohs micrographic surgery cases to increase office efficiency and performance.

METHODS

Specific information was required from each Mohs physician's surgical procedures to accurately score each lesion. Case data included (1) the size of the *original lesion* biopsied (not the biopsy specimen size); (2) if the tumor was a recurrence (defined as treatment by any other method with the *intent to cure*, including electrodessicaion, cryotherapy, or surgery); (3) if the lesion was located on the nose, eyelids, ear, or mouth and lips; (4) if the tumor type or subtype was aggressive (as provided by the initial biopsy report, which standardizes the occasional more unpredictable variable of upstaging that occurs clinically); (5) the number of stages required to obtain clear margins; and (6) the running time elapsed from initial cut to final closure (or decision to allow secondary intent healing). This method of time measurement (rather than a time summation per case segment) was specifically chosen to allow for individual physician practice styles regarding concurrent cases and case priority (just as in real clinical practice) as well as to simplify data acquisition for the practices. Information concerning the operating surgeons included name, geographic location, and years in practice. No identifying patient information was requested or obtained, and since no patient interventions or changes in medical care (ie, no control groups) were undertaken, an institutional review board was waived.

Selection of physicians was done through the Web sites of both the Mohs College (http://www.mohscollege.org) and Mohs Society (http://www.mohssurgery.org) with both allopathic (MD) and osteopathic (DO) physicians included. Only Mohs surgeons in the United States with Fellow status were chosen. Sequential random selection was used for physician inclusion. An attempt to include primarily private practice physicians, rather than academic programs or fellowships, was made to prevent variation in data due to educational pursuits. The initial decision regarding the minimum number of physicians to survey (assuming 10 case analyses per physician) to have a power of 80% (ie, an 80% chance that we correctly confirm our theory if it was true and only a 20% chance that we would falsely reject our theory if it was true) was based on consultation with the statistician prior to communicating with any offices. Collection took place from September of 2009 until June 2010, when the predetermined, sufficient amount of data had been obtained.

Once the data were received, a numerical value was assigned to each variable and a total score calculated. Lesions 0 to 0.9 cm in maximum diameter received 0 points; lesions 1.0 to 1.9 cm in maximum diameter, 1 point; lesions 2.0 to 2.9 cm in maximum diameter, 2 points; and lesions 3.0 cm or greater, 3 points. If the tumor had previously been treated (ie, a recurrence), then a point value of 1 was given. Primary tumors were graded as 0. If the tumor involved the nose, eyelid, ear, or lip, then 1 point was added. Any other anatomic location was scored with a 0. For any aggressive type or subtype of skin cancer, an additional 1 point was given. Tumors considered aggressive included morpheaform, infiltrative, and micronodular basal cell carcinomas as well as acantholytic, spindle cell, adenosquamous, basosquamous, and desmoplastic squamous cell carcinomas. Although not seen in this study, malignant melanoma, Merkel cell carcinoma, sebaceous carcinoma, and other known aggressive tumors would have been included. All other nonaggressive tumors, such as nodular basal cell carcinoma or well-differentiated squamous cell carcinoma, were given 0 points. **Figure 1** shows the questionnaire used (along with a combination of different physicians' submissions).

RESULTS

The offices of 49 Mohs Society fellows and 45 Mohs College fellows were contacted. The response rate for the survey was approximately 22%, with a total of 21 participating physicians (12 from Mohs College and 9 from the Mohs Society). A total of 211 cases were reported via the provided survey (1 physician returned 11 cases). Participating physicians consisted of a varied distribution representing 18 states (Alabama, Arkansas, California, Florida, Georgia, Iowa, Idaho, Missouri, North Carolina, North Dakota, Ohio, South Carolina, South Dakota, Texas, Utah, Virginia, Washington, and Wyoming).

The mean (SD) length of experience for the surgeons was 12.7 (9.1) years in practice, with the least experience being 2.5 years and the most being 30 years. There was neither a statistically significant difference in the number of stages taken nor for the time to case completion when comparing the number of years in practice for all of the physicians (Spearman correlation coefficient, $\rho = 0.11$, $P = .12$ and $\rho = 0.03$, $P = .63$, respectively).

In this particular study, cases submitted from the Mohs College and Mohs Society physicians were of similar scope in regard to the reported stages required for clearance, total time, for the procedures and the total score. Therefore, the data submitted from all of the physicians were included within this study and pooled together for further analysis.

The mean (SD) maximum dimension (width or length) was 1.19 (0.89) cm with a range of 0.2 to 7.0 cm. When area was considered, the mean was 1.73 (4.06) cm^2, with a large range of 0.02 to 42.0 cm^2 reported.

Of the 211 case characteristics reported, 25 (12%) were recurrent tumors; 98 (46%) were on the ear, nose, eyelid, or lip; and 12 (6%) were of an aggressive tumor type

Mohs Surgery Questionnaire

Patient No.	Original Lesion Size Biopsied (h x w)	Recurrent Y/N	Nose, Eyelid, Ear or Lip Y/N	Tumor Type (subtype if aggressive)	No. of Stages	Time–Initial Cut to Final Suture (or Second Intent Decision)	Score
1	8 x 6 mm 48 mm^2	N	N	N	3	2.5	0
2	9 x 6 mm 54 mm^2	N	N	N	1	1.5	0
3	9 x 8 mm 72 mm^2	N	N	N	1	1.5	0
4	20 x 9 mm +2 180 mm^2	Y +1	N	N	2	5.25	3
6	8 x 4 m 32 mm^2	N	Y (nose) +1	N	2	3.66	1
7	11 x 9 mm +1 99 mm^2	N	N	N	2	3	1
7	9 x *10 mm* +1 90 mm^2	N	Y (ear) +1	N	1	0.617	2
8	10 x 10 mm +1 100 mm^2	Y +1	Y (nose) +1	N	3	3.4	3
9	6 x 7 mm 42 mm^2	N	N	Y (adenosquamous) +1	2	4	1
10	19 x 19 mm +1 2261 mm^2	Y +1	Y (ear) +1	Y (morpheaform) +1	6	5.33	4

Name ____ XXXXXX XXXXX ____ City, State ____ XXXXX, XXXXX ____

Years in practice of primary surgeon (post residency) ____ XX ____

Figure 1. Mohs surgery questionnaire.

or subtype. Primary tumors took a mean (SD) of 1.5 (0.7) stages to clear and 2.25 (1.28) hours to complete. An increase in both, as expected, was seen for recurrent lesions, requiring 2.3 (1.2) stages and 3.03 (1.21) hours. Cutaneous cancers on the ear, nose, eyelid, or lip required 1.8 (0.9) stages to clear within 2.50 (1.40) hours, whereas tumors at any other anatomic location took 1.4 (0.7) stages and 2.22 (1.18) hours. A nonaggressive tumor type necessitated 1.5 (0.8) stages within 2.29 (1.25) hours. In contrast, a cancer with aggressive histologic characteristics was cleared in 2.3(0.6) stages and 3.33 (1.65) hours.

Based on the Mann-Whitney test, both recurrent tumors and aggressive tumors are statistically significant predictors or time ($P<.001$ and $P=.007$, respectively) and number of stages ($P<.001$ for both comparisons). Tumor site was a statistically significant predictor of stages ($P<.001$) but not for time ($P=.15$).

There was a mean of 1.6 (0.8) stages required for complete tumor clearance. A total of 118 tumors (56%) were removed in 1 stage, 72 (34%) in 2 stages, 13 (6%) in 3 stages, 5 (2%) in 4 stages, 1 (<1%) in 5 stages, and 1 (<1%) in 6 stages (1 physician did not report the number of stages for 1 case). Neither the greatest maximum dimension ($\rho=0.11$, $P=.10$) nor the area ($\rho=0.11$, $P=.10$) were statistically significant predictors of the number of stages performed.

The mean (SD) time taken for each case from initial cut to final suture placement or decision to use secondary intent healing was 2.35 (1.29) hours with a range of 0.5 to 8.5 hours. Both the greatest maximum dimension ($\rho=0.21$, $P=.002$) and area ($\rho=0.24$, $P<.001$) were statistically significant determinants of total time required.

As expected, a greater score correlated with a greater length of time until final suture or decision to use secondary intent healing. A score of 0 required a mean (SD) of 1.90 (0.91) hours, a score of 1 equaled 2.09 (0.98) hours, a score of 2 took 2.71 (1.31) hours, a score of 3 required 3.26 (1.47) hours, and a score of 4 averaged 5.25 (2.86) hours.

The mean (SD) WAR score was 1.2 (1.0), ranging from a minimum of 0 to a maximum of 4. Using the Spearkman correlation coefficient, the score was determined to be significantly correlated for both the number of stages ($\rho=0.41$, $P<.001$) and time ($\rho=0.34$, $P<.001$) required. **Figure 2** summarizes all of these data.

COMMENT

The data set in this project is inclusive, consisting of data from dermatologists from varied geographic locations (thus potentially different training backgrounds), professional affiliations, and experience. One limitation is that only physicians from the United States were included. The actual number of physicians (n=21) and overall response rate (22%) in this study were relatively low. Although it is possible that the participating study group might not reflect the overall group, the *P* values are of definite significance, suggesting that the sample size is adequate.

Another limitation of this project is that it depends on self-reported data. Also, not all physicians rounded the data equally (ie, some rounded to a quarter of an hour and some to the minute), although each was consistent within his or her own submitted data. The data set regarding tumor aggressiveness could have been more specifically determined if a list of "aggressive" vs "nonaggressive" tumor types and subtypes had been provided or the specific pathology report requested. Nonetheless, the information obtained seems relevant and adequate as evidenced by the statistical analyses provided.

	Mohs College	Mohs Society	Mean		
Respondents	12 of 21	9 of 21	....		
Stages	1.7±0.8	1.5±0.8	1.6±0.8		
Time (h)	2.45±1.37	2.20±1.17	2.35±1.29		
WAR score	1.2 ± 1.0	1.2±0.9	1.2±1.0		
	Mean	ρ value† (stages)	*P* value† (stages)	ρ value† (time)	*P* value *t* (time)
Maximum diameter, cm	1.19±0.89	0.11	.10	0.21	.002
Area, cm^2	1.73±4.06	0.11	.10	0.24	<.001
	Recurrent Tumors	Primary Tumors	*P* value*		
Stages	2.3±1.2	1.5±0.7	<.001		
Time, h	3.03±1.21	2.25±1.28	<.001		
	Ear, Nose, Eyelid, Lip	Other Anatomic Locations	*P* value*		
Stages	1.8±0.9	1.4±0.7	<.001		
Time, h	2.50±1.40	2.22±1.18	.15		
	Aggressive Tumors	Nonaggressive Tumors	*P* value*		
Stages	2.3±0.6	1.5±0.8	<.001		
Time, h	3.33±1.65	2.29±1.25	.007		
	WAR Score	Mean Time, h			
	0	1.90±0.91			
	1	2.09±0.98			
	2	2.71±1.31			
	3	3.26±1.47			
	4	5.25±2.86			
		WAR Score Statistical Significance			
	P Value†	*P* Value†			
Stages	0.41	<.001			
Time	0.34	<.001			

Figure 2. Data summary. *Mann-Whitney test. †Spearman correlation coefficient. WAR indicates Webb and Rivera.

Based on this study, it seems that there are several relevant factors in predicting the stages and, more importantly, the overall time necessary for a Mohs procedure. As noted, there are other variables that require consideration and could have potentially been included as part of the formula. Other possibilities could have included staffing; available examination or procedure rooms; patient age; mental or physical condition (eg, patient mobility or incontinence); comorbidities; patient experiences with prior surgical procedures; anxiety levels; drug, alcohol, or tobacco use; patient expectations; language barriers; immunosuppression; family presence; variation between biopsy report and histologic findings; additional surgical case load; or medical dermatology cases being seen concomitantly. However, many of those characteristics are difficult to quantify or are subjective and were thus not incorporated into the score.

Several interesting findings are of note. First, it was found in this study that Mohs surgeon experience did not affect the number of stages or the total time taken; second, recurrent tumors, anatomic location and aggressive characterization all influenced the number of stages, whereas only recurrence and aggressiveness (but not the location) related to time. This could be due to the decision to use secondary intention healing rather than an extended repair on areas such as the medial canthus or conchal bowl. Since secondary intent would not require the time of a complex repair, the total duration for the submitted cases could be quite variable. The number of stages *were* significantly influenced by the location; thus, the time difference would lie solely with the repair component. Finally, the area of a given tumor is definitely a predictor of surgery duration. Unfortunately, this would be a less attractive variable to include in the score formula since it could require actual calculation of fractionated numbers (1.3 × 1.6 cm) rather than a brief glance at the size then an immediate assignment of value (0.8 cm equals 0, 1.6 cm equals 1, etc).

Although some of the variables independently show significance in relation to total time required for a Mohs surgical case, the combination of each of these variables tremendously magnifies the relevance and accuracy without a noticeable sacrifice in time to score a case. Therefore, it would be advisable to retain each of the significant variables with the exception of area within the scoring system.

It is our hope that this scoring system can be used for optimizing time management, case planning, and discussion of general expectations to the patient. As demonstrated, as the total score increases, so too does the duration to completion. It can be used to prevent an excessive number of difficult, time-consuming cases scheduled on 1 day or at the same time. As an example, 1 author (J.M.W.) schedules 8 cases on surgical mornings: a maximum of two 3+ cases, a maximum of two 2-point cases, and four 0- or 1-point cases (or more if needing to fill empty 3+ or 2-point time slots). In today's health care climate, any method to improve efficiency, office flow, planning, patient outcomes, patient or physician satisfaction, and assist in providing a reasonable daily workload should be a welcome complement.

In addition, the score could be of great potential value in the Mohs surgical training of dermatology residents. Even though the research data were generated from private practice clinicians, the data were tested by 2 of us (A.E.R. and L.J.C.) within a residency training environment with great success. The scoring allowed a quantitative value to be placed on each Mohs case performed

Mohs Surgery WAR Score

Greatest dimension size:	0-0.9 cm	0 points
	1.0-1.9 cm	1 point
	2.0-2.9 cm	2 points
	> 3.0 cm	3 points
Recurrent tumor:		1 point
Primary tumor:		0 point
Nose, eyelid, ear or lip:		1 point
Other anatomic locations:		0 points
Aggressive tumor type/subtype:		1 point
Nonaggressive tumor type/subtype:		0 point
Total WAR score:		____ points

Figure 3. Webb and Rivera (WAR) score summary.

with a gradual increase in case complexity based on the resident's level of experience. For example, a first-year resident could initially be assigned to participate in cases scored as a 0 or 1 and then progressively increase the case intricacy according to their knowledge, skill, and recommendation of the respective attending physicians. As with those in private practice, a specific combination of scores (case load) could be decided on at each individual training program. In addition, consideration could be given to a suggested volume of each type of case (ie, 0, 1, 2, etc) to be performed during residency training to allow for some standardization, either within or between programs, of Mohs experience upon completion of training. Certainly, the proposal and its usefulness would need to be validated by further studies specifically within the academic practice setting.

In conclusion, we propose the WAR score as a low-effort, efficient, reproducible tool to be used in preoperative Mohs surgery planning. The components of the score include maximum tumor dimension, recurrence, location, and aggressiveness, with each being assigned a numerical value that is totaled resulting in a final quantitative score. **Figure 3** is a simple formatting of this system to allow a quick glance for easy calculation until scoring becomes second nature.

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Correspondence: Albert E. Rivera, DO, 6000 University Ave, Ste 450, West Des Moines, IA 50266 (bo_rivera@yahoo.com).
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