

Errors in the interpretation of Mohs histopathology sections over a one-year fellowship.

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ABSTRACT

Background: Errors can occur in the interpretation of Mohs histopathology sections. Errors in the interpretation of Mohs histology can lead to incomplete removal of cancer and cancer persistence or the unnecessary removal of uninvolved tissue. Extensive proctored training is required to reduce these errors to an absolute minimum level.

Objective: To analyze and quantify the number of cases and the amount of time required to obtain expertise in the reading and interpretation of Mohs histopathology.

Methods: A single institution pilot study was designed to track errors in the interpretation and mapping of Mohs histopathology sections. Mohs cases were independently pre-read by the Mohs surgery fellow with an interpretation rendered on the Mohs map. Subsequently, all cases were graded by the Mohs program director. Errors were scored on a graded scale and tracked over the one-year fellowship to determine the number of cases and amount of time necessary to reduce errors to a baseline minimal level.

Results: 1491 Mohs surgery cases were required to generate 1347 pathology specimens for review and grading over 6 months of Mohs surgery fellowship in order to reduce errors to a minimal acceptable level.

Limitations: This is a single-institution pilot study. The future direction of this study is to expand it to a multi-institutional scope in order to control for individual bias.

Conclusions: The number of cases and time required to reduce errors in the interpretation of Mohs histology is significant. These results can act as a guide for Mohs surgery training programs to help determine the minimum number of directly proctored cases required to obtain expertise in this crucial component of Mohs surgery.

INTRODUCTION

Mohs surgery achieves the highest cure rate for most common cutaneous cancers. However, to be effective, this highly specialized surgical technique requires expertise in cutaneous oncology, Mohs surgical technique and mapping, Mohs histopathology, and cutaneous reconstruction. Proficiency in Mohs surgery is requires time, teaching, and a sufficient quantity of cases from which to learn.

Errors in the interpretation and mapping of Mohs histopathology sections can lead to cancer persistence and local recurrence. In one study, technical and interpretation errors accounted for 77% of cases with local recurrence.¹ Errors of any kind have a direct and deleterious effect on the cure rate of Mohs surgery. The goal of all Mohs surgeons is to minimize potential errors in order to achieve the highest cure rate possible.

This study is a single institution pilot study examining the number of cases and the amount of time needed to become proficient in the interpretation and mapping of Mohs histopathology sections.

METHODS

This was a prospective single institution study examining the frequency of errors occurring in the interpretation and mapping of Mohs histopathology sections. The study was designed to track errors involving the reading of Mohs pathology sections based on a graded scale. The study did not start until the second month of fellowship when the concept was developed. The study proceeded in the following fashion.

The Mohs histopathology sections were initially independently read by the Mohs fellow-in-training and a commitment to his interpretation was made on the Mohs map in pencil. Subsequently, all cases were reviewed by the Mohs program director and fellow-in-training together at a dual headed microscope. The Mohs program director marked all maps definitively in red ink. All cases were graded and scored based on the scale shown in Table 1.

Serious errors were errors in reading Mohs sections or mapping residual tumor which could potentially lead to a recurrence of the cancer were scored as 3 points. Examples of a serious error included when tumor was missed or incorrectly mapped by the fellow-in-training.

Errors in reading and mapping of Mohs sections which could lead to taking additional layers when it was not necessary were scored as 2 points. Examples of an error included when the fellow felt tumor was still present but the program director determined that it had cleared.

The fellow's judgment vs. Program director's judgment on issues where there was no clear cut right or wrong answer were considered equivocal errors. These were scored as 1 point. A classic example in this category was equivocal cases of follicular basaloid proliferation vs. basal cell carcinoma.

A score of 0 points was given for every case in which the program director and the fellow concurred in the reading and mapping of the Mohs section.

Grades were tallied daily at the microscope. Data was entered into an Excel spread sheet to calculate all types of errors and the frequency of their occurrence over time. Serious errors committed per 100 cases graded were also calculated. This statistic was important to control for the month to month variability in the number of cases graded.

RESULTS

The number of serious errors per one hundred cases graded was the critical statistic of the study. During the first month of the study (the second month of fellowship) 6.78 serious errors/100 cases graded were committed. Errors decreased in a logarithmic fashion over the year long fellowship to a minimal and consistent baseline. (See figure 1)

We chose to monitor when the serious error rate per one hundred cases read dropped below 1. We chose this threshold because of the 98- 99% cure rate of Mohs surgery for most common primary tumors.²⁻⁴ December was the first month in which serious errors/100cases dropped below the 1 serious error/ 100 cases graded threshold. That was 6 months into the Mohs surgery fellowship.

While time may be a significant factor in learning to read Mohs surgery pathology sections correctly, the quantity of cases reviewed and graded may be of even greater importance. The cumulative number of Mohs cases performed and Mohs histopathology sections graded over the one year fellowship can be seen in Figure 2. In December, the first month when the threshold of 1 serious error per one-hundred cases read was crossed, the fellow-in-training had either performed or assisted in 1491 Mohs surgery cases which generated 1347 Mohs histopathology sections which were reviewed and graded by the fellow before review by the program director. These numbers differ slightly because not all cases were able to be pre-read by the fellow.

All other error types were similarly graded and followed. The average error score per case read is noted in Figure 5. This includes serious errors, errors, equivocal errors and cases which were concordant based on the graded scale and averaged. (See figure 3) The average error score also decreased in a logarithmic fashion settling to a minimal baseline around the 5th to 6 month of fellowship.

Several landmark events in the learning curve of Mohs histopathology were noted during the year long fellowship. The first day of fellowship with no recorded errors of any type was August 22nd, approximately 7 weeks into fellowship training. At that point in time 466 Mohs surgery cases had been completed and 416 Mohs pathology specimens were graded. The week ending November 10th was the first week with no serious errors recorded. This was 4 ½ months into fellowship and at that point 1157 Mohs surgery cases had been completed and 948 Mohs pathology specimens graded. The first month with less than 1 serious error noted per 100 Mohs specimens graded was in December which was 6 months into fellowship with 1491 Mohs cases completed and 1347 Mohs specimens graded.

DISCUSSION

We conclude that the time and number of cases needed to reduce errors in reading Mohs pathology sections is significant. Most importantly, the fellow interpreted pathology slides on nearly 1500 Mohs cases and was the initial reviewer of 1347 pathology specimens over 6 months before decreasing errors to an acceptable level. Currently the minimum number of cases required for the American College of Mohs Surgery and ACGME credentialed one year Mohs surgery fellowships is 500. When the current fellow in training involved in this study reached that minimum number of 500 cases, the error rate was still unacceptably high.

The one potential source of bias within this study is that it involves only one individual's errors. This will be addressed in the future by expanding this study to a multi-institutional basis. However, it is worth addressing the prior dermatopathology training of the fellow involved in the study. The fellow-in-training who participated in this study was a board certified dermatologist. The fellow's dermatopathology training from residency included weekly unknown sessions, quarterly cumulative timed glass dermatopathology exams over all 3 years of residency, annual completion of an entire dermatopathology text, and 2 months of concentrated dermatopathology training at the Armed Forces Institute of Pathology. The fellow-in-training scored in the top 5% on the dermatology inservice examination during all three years of residency. So while individual bias is a potential confounder, the fellow in question was prepared to interpret Mohs histopathology.

The key components for improvement in the interpretation of Mohs histopathology are independent interpretation of Mohs histology sections and mentored correction of errors. Without an experienced program director correcting pathology errors with the Mohs surgery fellow there is no reason to believe that those errors would be noticed and corrected over time. If the fellows in training are not required to independently interpret the Mohs histopathology and then be graded, they miss the opportunity to learn from mistakes and have a false sense of proficiency gleaned from the program director's abilities.

Previous studies have shown that technical and interpretation errors are the most important factor affecting the recurrence rate of cancer after Mohs surgery.¹ Similarly in this study, one can calculate the proportionate potential recurrence rate after different lengths of fellowship training and after different number of cases performed and graded. For example, after 2 months of training, 565 Mohs cases performed and 436 Mohs histology cases graded the fellow-in-training had a serious error/100 cases rate of 6.78. This is more than six times the eventual baseline of less than 1 serious error/100 cases rate that was achieved by months 6-10. If training was stopped at the end of 2 months and no further mentored correction of errors occurred the recurrence rate would mostly likely remain at this elevated level.

This study is timely because of the recent increased emphasis on the reduction of medical errors. All medical specialties including Mohs surgery have some minimal baseline of errors which occur. The goal is to make that baseline error rate as small as possible.

In conclusion, proficiency in interpretation of Mohs histopathology cannot be achieved in a matter of a few months, weeks or days. Nor can it be achieved by looking a few cases, 10's of cases and not even a few hundred cases. Mentored correction of errors is essential to improvement. All Mohs surgery fellowship training programs should institute mandatory independent interpretation of Mohs histopathology sections by the fellow followed by grading by the program director. We believe this study gives objective validity to the current Mohs College and ACGME requirement that 500 cases is the minimum number required in a Mohs surgery fellowship and believe that a higher number of cases will help reduce errors to the lowest possible level.

Figure 1

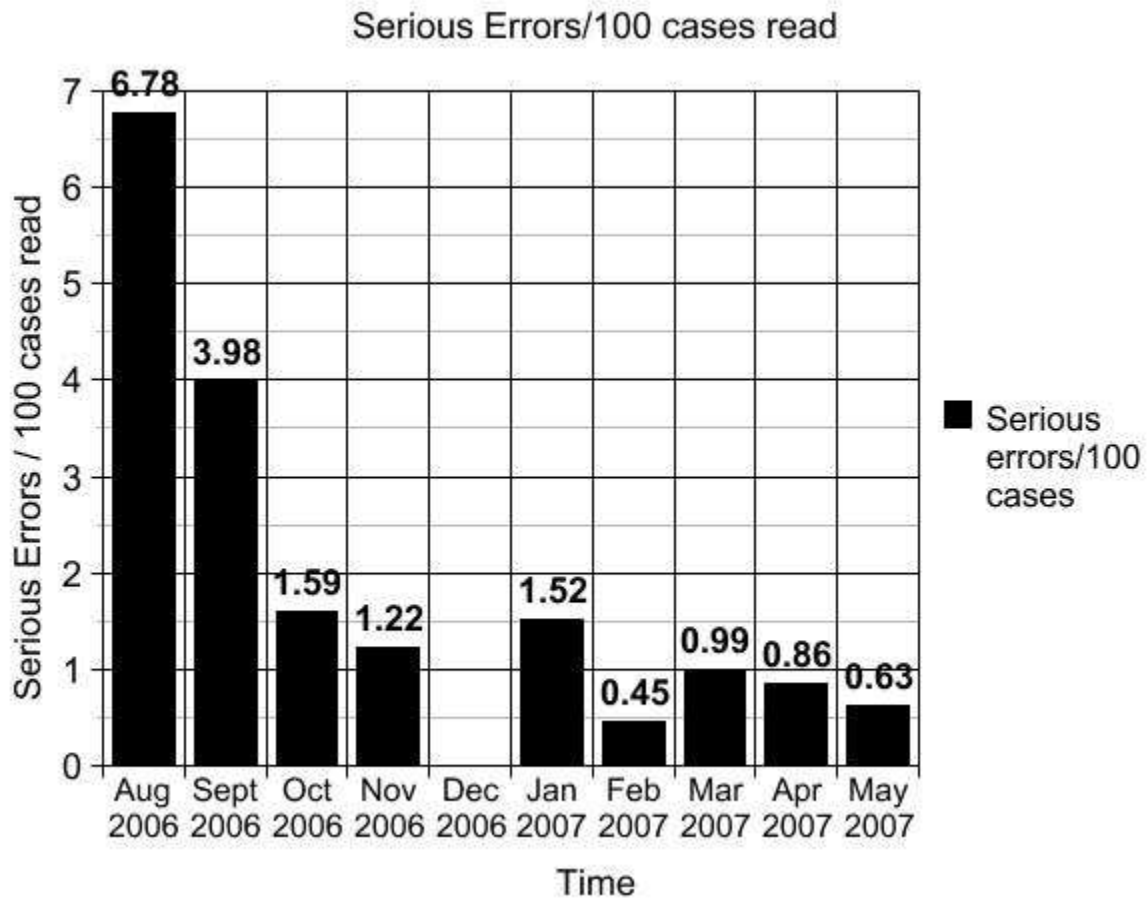


Figure 1 Legend

Serious errors/100 cases read over time. December was the first month that errors dropped below the threshold of 1 serious error/100 cases read. That was six months into Mohs surgery fellowship.

Figure 2

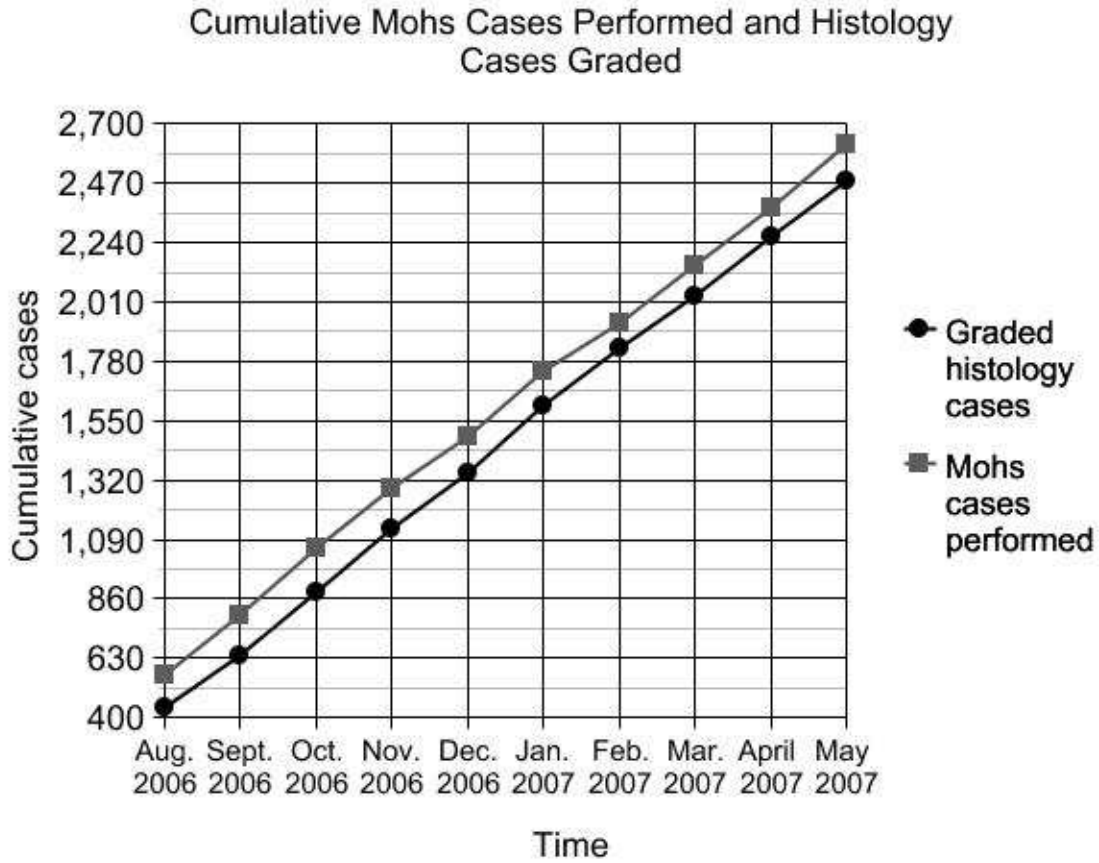


Figure 2 Legend

Cumulative mohs cases include cases in which the fellow was the primary surgeon or the assistant. The number of cumulative mohs histology sections graded are slightly less than the number of mohs cases performed because not every case was able to be pre-read by the fellow.

Figure 3

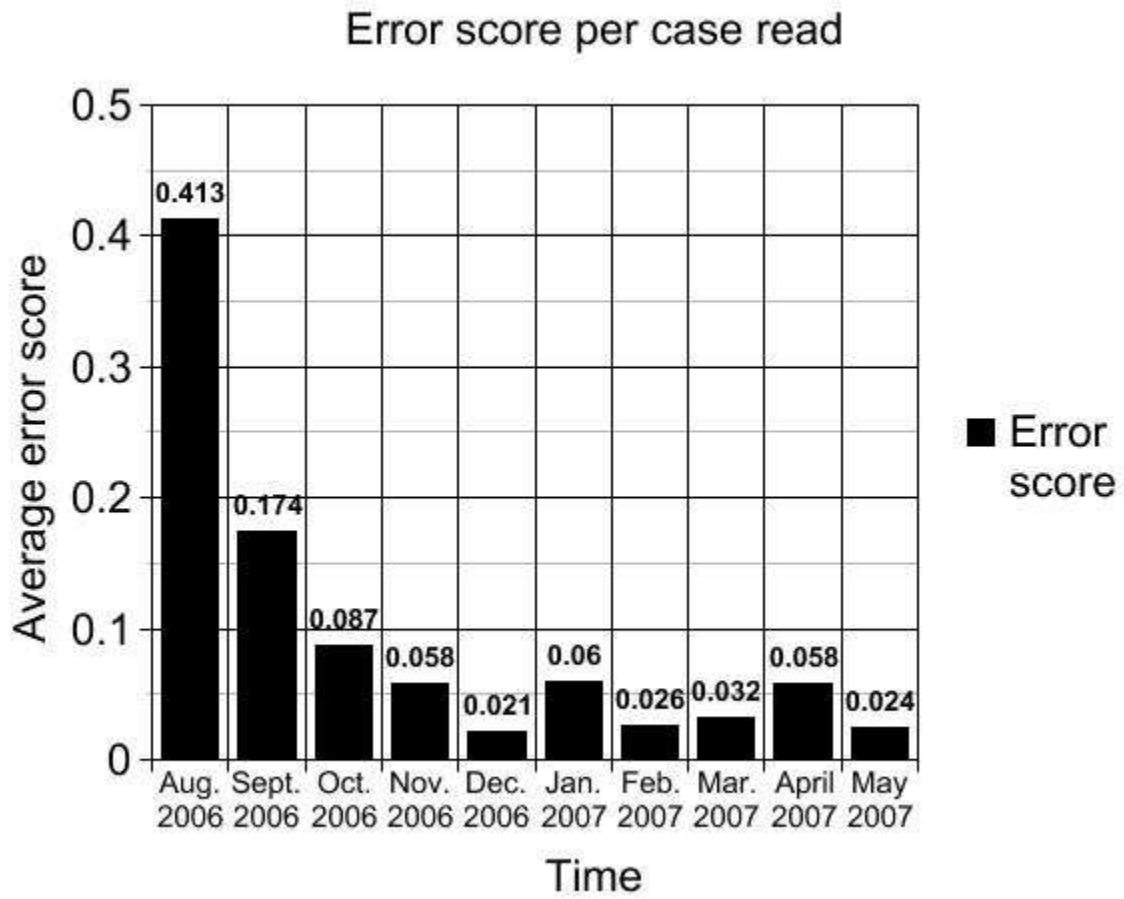


Figure 3 Legend

This graph depicts the average error score per case read. This included all types of errors

Table 1

Type of error	Score
Serious error	3
Error	2
Equivocal error	1
Concordance	0

Table 1 Legend

The grading scale used for the interpretation of Mohs histopathology sections

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