I am going to share a micrographic surgical case performed earlier this month as an example of why meticulous adherence to the micrographic surgical core principles of orientation, proper inking of nonepidermal specimen margins, and excising a layer with adequate overlap leads to unequalled cure rates for skin cancer.

A 72-year-old white man with a history of dozens of prior nonmelanoma skin cancers presented in May 2022 with a 1 cm keratotic nodule on the left posterior neck. The lesion was saucerized, curetted, and electrodesiccated on that day using 6, 4, and 2 mm curettes. The postoperative defect was 1.4 cm and healed well over the following three weeks. The pathologic diagnosis was well-differentiated squamous cell carcinoma (SCC). The site was unremarkable at follow-up visits every three months until May 2023 when a rapidly enlarging keratotic nodule arose within the site. The 1.5 cm lesion was deeply shave biopsied and curetted once for hemostasis. There were no palpable lymph nodes to the level of the clavicles. This specimen was diagnosed as a moderately differentiated SCC. The patient was referred for micrographic surgical excision of a recurrent stage T1 SCC using the Brigham and Women’s Hospital tumor staging system. Review by the Mohs surgeon confirmed the diagnosis one week prior to the scheduled surgical date.

On the day of surgery, after discussing the procedure, a surgical time out, and anesthetic injection, the site was vigorously curetted creating a defect of 1.6 x 2.4 cm. Orientation nicks were placed; two at 12:00 and one each at 3:00, 6:00, and 9:00. The layer was excised with a thickness of 2 mm without fenestration. After bisecting the specimen from the 3:00 to 9:00 nicks in the lab, marking inks were placed; blue in the two 12:00 nicks, red at 6:00, blue from 3:00 along the bisecting incision to the center of the specimen, and red from 9:00 along the bisecting incision to the center. Eight sections of 6 micrometers thickness were placed on microscope slides for examination. Nine wafers were discarded between each one placed on the slide.
Along the bisection incision at the level of the reticular dermis, there was a similar absence of tissue evidenced by a definite hole on the first two wafers that was outlined by tissue marking ink until the findings in Figure 6 were seen on the third wafer. A higher power view is presented in Figure 7.

Thus, the first layer of tissue had islands of moderately differentiated SCC in the mid dermis at 2:00 and 4:00 and as seen in Figures 1 and 2 near 3:00, as well as deeper along the bisecting incision across the center of the specimen. The tumor island in Figures 3-5 was located along the horizontal bisection incision approximately two-thirds of the way from the epidermis toward the midline of the specimen (where the blue and red inks meet at the midpoint of the bisecting incision when the specimen is carefully and properly inked).

The map was correspondingly marked. A second micrographic surgical layer was performed, excising a 2 mm thick layer with 2 mm of additional skin edge included from 12:00 to 6:00 and fatty tissue generously excised extending beyond the midline of the first layer as can be seen in Figure 8.
Figure 8. Defect after two stages of micrographic surgery. Orientation nicks are highlighted with the marking ink color and green delineates the extent of the horizontally generous incision used to ensure the deep focus of tumor depicted in magenta along the bisecting incision (which was made from 3:00 to 9:00) was encompassed by the overlap taken.

Meticulous technique enables proper interpretation and ensures an appropriately low recurrence rate, even in cases of recurrent tumors.

Take away points from this case:

1) Only bisect when necessary because making an incision across, or even into a specimen as in the creation of a Pac-Man specimen, creates a non-epidermal edge that must be carefully and fully inked to delineate it and creates tissue edges that are prone to tissue drop out at the interface of tissue and embedding medium. These newly created non-epidermal edges are also subject to edge lift and roll errors (see Quality Corner “How Many Pieces”- 2016 for full discussion).

2) Absent tissue should be compulsively minimized. Many times, tissue holes are caused by tumor retracting tissue away from the surgical margin before embedding is complete as in Figure 6 in this case. Be very suspicious along the non-epidermal edge if you see a clear ink line but no tissue inside it. Enough levels should be cut to see that such an area is examined for possible tumor retraction, especially in fat. (See Quality Corner “Absent Tissue”- 2016 and “Don’t Lose the Fat” - 2020 for full discussion).

3) Be especially vigilant in recurrent tumor cases. The quality of the produced sections is paramount to ensure that all tissue can be securely examined. Any absent tissue should be assumed to be due to tumor retraction and subjected to an additional layer.

4) Overlap must consist of 2 mm or 2:00 face positions along the circumference of the layer beyond identified tumor near the epidermis. As tumor is found deeper (reticular dermal/fat interface or subcutaneous fat) or more toward the center of the specimen, overlap toward the center of the specimen must be taken into account. This is most important in the case of tumor in the mid to deep subcutaneous fat. Tumor in very distensible fatty tissue should be given a wider overlap due to the increased uncertainty of its location (see Quality Corner “Overlap Revisited” - 2021).

There are many things about which one must remain vigilant while performing micrographic surgery. There are no easy cases. Each one can become a problem, either at the time of surgery or later if a deep recurrence occurs. Meticulous surgical and lab technique and adherence to the key concepts outlined in the Quality Corner can provide peace of mind that the Mohs surgeon has done everything possible to produce a good result for each patient under his or her care.
This issue of Quality Corner is devoted to a topic stressed by Dr. Lee Portnoff in his lectures at the recent Fundamentals of Mohs Surgery Annual Training Course for Physicians and Technicians and ongoing concerns of ASMS Peer Review Committee members. Overlap inadequacy, improper design and harvest of a layer following a tumor-positive layer, and inadequate laboratory processing of the subsequent layer continue to plague members who participate in the Peer Review Program. Although satisfactory performance is achieved by greater than 90 percent of participants after submission requirements were strengthened several years ago, cases of unsatisfactory performance related to these specific procedural shortfalls continue to occur. Methods to prevent these problems have been reviewed in Quality Corner over the years but will be presented herein as a comprehensive review of the key principles consolidated in one location.

1. Reference nicks are absolute reference points on the patient, but they are not a barrier to tumor. When reference nicks are made, ideally a double nick at 12:00, and a single nick at 3:00, 6:00, and 9:00 enable equal localization accuracy along the entire circumference of the specimen. But you must bear in mind that these are reference incisions that you are creating on the patient in order to orient your specimen during microscopic examination of the layer. If you incise a reference nick near tumor, you shouldn’t presume that because the proximity of the nick allows you to localize tumor very accurately along the circumference of the specimen that you can skimp on the standard overlap. Standard overlap, geometrically derived by Dr. Sharon Tiefenbrunn for three-dimensional space, requires 2 mm of overlap in all directions. This applies to the distance along the circumference of the specimen (or two clock hours in each direction if you prefer) irrespective of the presence of an orientation nick within that distance. A frequent error is failing to overlap toward the center of the specimen. Because of this need to overlap toward the center, essentially every second and subsequent Mohs stage should contain fat deep to the dermis. Even a papillary dermal positive tumor will require fat to be excised because the thickness of the skin doesn’t exceed 2 mm on the body areas most often treated with Mohs surgery. There are always exceptions, but fat should be sacrificed to ensure adequate overlap. This becomes more imperative if the tumor is located at the level of the sebaceous glands or deeper. Tumor seen in a Mohs layer at this level, when visualized in three dimensions, is abutting the fat deep to it making excision of fat necessary to achieve proper overlap. Maintain a three-dimensional connection from stage to stage.

2. When crossing from the epidermis into the defect on a subsequent Mohs layer, the incision should cross the edge of the defect at an angle of 45° or less. Some Mohs surgeons will design the incision of a subsequent layer to cross from the epidermis into the defect at 90°. But this won’t work because it is physically impossible to flatten the specimen so that the outer circumference of the new layer and the edge incised at 90° from it both end up in the same plane for sectioning. Instead, incising this transition at an acute angle allows flattening of the transition at the edge of the defect. Figures 1 and 2 depict two Mohs cases in which these principles are carefully followed. Note the angle of the solid line of the second stage crossing the dotted line depicting the first stage defect in both cases. In Figure 1(on page 5), the tumor is noted to be in deep dermis/subcutaneous fat so the horizontal overlap in the fat is very generous (i.e., 5-8 mm) owing to the increased uncertainty of tumor localization in a deformable tissue such as fat. Also note the placement of two new orientation nicks at the points where the incision for stage II crosses into the stage I defect. These two nicks and the extended 12:00 nick maintain the connection of stage II to stage I. In Figure 2 (on page 5), the overlap of 2 mm coincides with the 6:00 nick but the angle of the incision crossing the 6:00 nick is 45°. This is critical because if the tumor was spreading parallel to the circumference rather than radially and a 90° incision at 6:00 couldn’t be flattened, you would unknowingly miss tumor to the 5:00 side of the 6:00 nick. In addition, despite the mapped tumor being entirely in the 6:00 to 9:00 quadrant, due to the uncertainty of localization of tumor in fat, the incision is carried 3 mm into the adjacent quadrants. These fat excisions are incised with a smooth deep surface and a thickness of ~3 mm to guard against fat shredding in the operatory. Good quality fat excision enables the technician to produce sections with intact fat, which is necessary to declare these layers clear on microscopic examination. Nick extension, placement of new nicks when crossing the defect edge, and properly excised fat maintain connection in this setting.
3. Ink should be applied to the edge of the fat in the stage II specimens of Figures 1 and 2 (see below) from above instead of the side. This may be a difficult concept to visualize until you deal with it in the lab. The non-epidermal edge ink is applied to the stage I bisected specimen in Figure 1 by applying it along the sides of the incision bisecting the specimen as shown on my stage I map. In the stage II specimens for both Figures 1 and 2, there is a floppy fatty edge. You cannot apply ink to the outside edge of such a specimen because the fat lobules will wick the ink onto the surgical margin for quite a distance. As discussed in previous Quality Corner articles, getting any ink onto the surgical margin is a serious error because it will lead to misinterpretation of the true tissue margin. Ink is used to delineate all non-epidermal tissue edges. If ink spreads onto the surgical margin and the true edge lifts out of the plane of section during embedding, you will mistakenly interpret the ink you see as the true tissue edge. It is best to prepare specimens on filter paper rather than gauze. Unlike gauze, tissue will adhere to filter paper creating a seal that prevents wicking of ink onto the surgical margin. In addition, when ink is applied using an applicator stick held parallel to the cutting board and drawn along and toward the free edge of the fat, there is less tendency to lift the edge of the fat and get ink on the surgical margin.

4. If orientation nicks are extended for a subsequent stage, maintain the ink color in that nick for each stage. Consistency of an inking scheme throughout a case is the most straightforward method of maintaining a visual connection between layers as a case proceeds. The inking of the 12:00 nick, which is blue in Figure I, follows this principle. Another example is illustrated in Figure 2. In stage I, green and black mark the 6:00 and 9:00 nicks. In stage II, the non-epidermal edge extending from 6:00 is inked green and that from 9:00 is inked black. The consistent ink colors lead to a clearer mental picture when interpreting sections. If tumor was near the blue ink in stage I, you would be extra vigilant near the blue ink in stage II. Inconsistency introduces the possibility of error.

In summary, anticipate that errors will occur and guard against them. Consistency in technique is the key to immediately recognizing errors when they occur. Do all you can to maintain a mental and visual connection from one stage to the next; it will make interpreting slides less stressful.
Quality specimen processing has been reviewed in Quality Corner on several occasions. Proper techniques for processing specimens that are difficult to obtain or render suitable for microtome sectioning will yield sections as good as those from a routine specimen. A routine specimen is one that can be harvested as a uniformly thin specimen containing little, if any, fat without any drastic tissue texture disparities adjoining one another such as fat, muscle, or cartilage. The composition of the tissue layer harvested depends on the anatomic location and depth of tumor penetration. Since we cannot control those variables, we must understand the techniques for dealing with difficult specimens.

Fatty Specimens. The most commonly encountered difficult specimen is the highly fatty specimen. In the operating room, harvesting a very fatty specimen requires great care to avoid perforation by tearing the flimsy connective tissue of a mainly fatty layer. Since I have recommended processing your own layers in the lab before handing them off to your technician, you should be familiar with the high deformability of a fatty specimen. This deformability enables you to harvest a thicker specimen in a fatty area and still be able to flatten it easily for optimal sectioning. There are two other factors that can be used to advantage in the operatory when harvesting a fatty specimen. First, vertically incising the dermis to separate it from the sidewall of the defect provides strong tissue at the periphery of the specimen to prevent tearing, as well as the benefits outlined in Excising a Proper Mohs Layer after a “Deep Only” Positive Mohs Stage - Quality Corner Fall 2017. Second, take advantage of the local anatomy by excising a fatty layer just above a limiting denser fascial plane. When a defect overlies an area of denser tissue, such as fascia (i.e., the sternocleidomastoid, superficial temporal, periosteum, perichondrium, or galea) or muscle (i.e., the frontalis, occipitalis, or a well-developed platysma), the fatty tissue may be dissected cleanly from the denser tissue by gently retracting the Mohs layer while holding the scalpel blade at 90° and scraping the blade over the denser tissue’s surface to release the fat. As the dissection progresses forward with the blade at 90°, fold the layer over the defect to clearly expose the area being dissected to ensure dissection is progressing in the proper anatomic plane. Continually check the thickness of the layer to ensure it is excised without perforation. If perforation is a concern, reassess the anatomy of the area and attempt to identify any critical structures, especially named nerves (i.e., frontal, marginal mandibular, and spinal accessory) that lie just deep to the superficial fascia. Proceed to excise the fascia that is necessary to prevent perforation of the layer, but no more. Once the layer is removed without perforation, it can be transported to the lab where it is carefully flattened, and the dermis inked for orientation.

Proper microtome technique will be critical to produce sections with intact fat that can be quickly and confidently interpreted. If the fat is tearing, move to a new, sharp section of the microtome blade. In fact, moving to a sharp section of blade is the best solution for most sectioning difficulties. Secondly, either allowing more time for the fat to freeze or using cryospray should be the second step. As a last resort, if neither of these remedies produce tear-free fat, the technician can increase the thickness of the section. Because this will likely render the dermis and adnexal structures unreadable, only employ it once full dermal tissue has been placed on the slides. Remember to think three-dimensionally when performing Mohs. When fat sections are of poor quality, a layer can be deemed clear in error. If tumor in fat is not identified, it will recur in a deep tissue plane, allowing growth to occur for a prolonged period before it manifests as a recurrence.

Cartilage-containing Specimens. Cartilage of the nose or ear commonly creates problems in producing quality microscope sections. When cartilage has been excised, it tends to easily separate from the adjacent areolar tissue, creating a significant

by Jim Schiro, M.D., F.A.A.D.
problem in interpreting a clear margin. The cleft formed by this artifactual separation represents the plane in which tumor spread is likely to occur when tumor is deflected horizontally along the perichondrium rather than allowing tumor to penetrate. Nerves and vessels also travel in this tissue plane. Failing to identify perineural or perivascular tumor in ear or nose locations may lead to a recurrence with a poor outcome. Allow a slightly greater peripheral rim of dermis beyond the amount employed for a routine specimen. Exert minimum traction when dissecting the layer to avoid cleft formation. Once in the lab, make enough relaxing incisions through the cartilage to enable it to be flattened without tension on the skin as this could lead to clefts. It is unlikely that an irregular piece of cartilage will lie flat on the microscope slide long enough to permit freezing in a single plane, which is our goal in producing quality sections. Just as when a persnickety epidermal area of a routine specimen refuses to lie flat on the slide, it helps to apply gentle directed pressure to the specimen to guide it into a single plane against the microscope slide as it freezes.

In this scenario, what I refer to as the freeze flash method must be employed.

- The method starts with placing as many relaxing incisions in the cartilage as possible without destroying its integrity. These relaxing incisions will not create problems in interpretation. When they appear in the tissue sections, they appear as a sharply incised line that gradually widens as sections progress deeper into the block in contrast to a cleft that follows tissue planes or the ragged appearance of a tissue tear. They can be recognized for what they are, incisions purposefully made, not processing defects.

- If there are protruding areas of cartilage on the deep surface of the specimen, trim them sharply with scissors to avoid the shearing force that would be produced if a scalpel blade was used to trim this cartilage. The surgical margin should be smooth without any step-offs.

- Place as much of the epidermis as possible in contact with the flattening microscope slide and then carefully place it on the freeze bar of the cryostat. Observe the edge of the specimen where it is in contact with the slide to identify when the freeze flash occurs, generally in 20-30 seconds.

- When the freeze flash occurs, which appears as a sudden whitening of the tissue edge, begin to apply gentle pressure to the specimen adjacent to the area that has frozen to the slide.

- Proceed around the periphery of the specimen until the entire edge and the adjacent cartilage is adhered to the slide.

- Using the pulp of the finger over the entire specimen, apply firm downward pressure to compress the cartilage flat. Maintain pressure until the specimen is fully frozen, which usually occurs when your finger begins to throb from the cold.

This process will yield specimens without problematic clefting and can be confidently interpreted as clear of tumor.

Too Thick/Thin Specimen. Although a thick or thin specimen is not as vexing to deal with as the fatty or cartilage-containing specimen, it can still be difficult to process. The thick specimen was reviewed with photos in Tissue Flattening - Principles and Practice - Quality Corner Spring 2020. A thin specimen requires clear communication between the Mohs surgeon and the technician that the specimen is thin. It’s an indication to the technician that the block should be faced minimally, such that only a partial section is shaved from the tissue face by the blade, before placing tissue sections onto slides. Once sections are being placed on slides, the number of sections discarded between each section placed on the slide should be half the normal number. This allows more tissue sections to be examined before the tissue block is exhausted.

An additional issue regarding this practice should be considered. If we are discarding half as many tissue sections between placing one on the microscope slide, do we need to double our criteria for deciding that a margin is clear? I require three tissue wafers to be free of tumor to declare the margin clear of tumor. I do not alter this criterion to require six wafers to be free of tumor to declare the margin clear when discarding half as many wafers between those examined in a thin specimen. Most Mohs surgeons require four negative sections to declare a margin clear (discussed in How Many Tumor-free Tissue Sections are Sufficient to Declare a Clear Margin? - Quality Corner December 2016). In theory and in the opinion of many pathologists I have queried, one clear section means a margin is clear. Mohs surgeons are not as dogmatic and allow for some uncertainty in declaring a clear margin. I believe that with quality slides, three wafers free of tumor is adequate to account for uncertainties in processing and interpretation of adnexae regardless of the distance between the wafers viewed.

If the sections being provided to you are of lesser quality and you are seeing tumor recurrences, you need to be introspective about the techniques being used in your office from start to finish to improve the quality of slides produced. Until that is accomplished, it would be wise to increase your required number of clear wafers to declare a margin free of tumor.
While preparing to testify before the American Board of Medical Specialties’ Committee on Certification, a thorough review of the application presented by the American Board of Dermatology (ABD) in support of the Micrographic Dermatologic Surgery (MDS) subspecialty certification yielded some surprises. The most striking was a paper entitled “Trends in the Mohs surgery literature: 1994–2013” by Kershenovich et al.1 that appeared on page 85 of the MDS application. This article was exemplary in the judgment of the ABD of the growth and importance of the published literature in the field of Mohs micrographic surgery (MMS). One reason the ABD justified the creation of the MDS subspecialty was due to an increase in publications regarding Mohs. However, Kershenovich et al. state that the increase in Mohs publications is comparable to the overall increase in dermatology publications. Furthermore, the authors note that the increase in Mohs publications was due to a significant increase in the number of case reports in non-melanoma skin cancer and an increase in their designated “others” group, consisting mainly of case reports, observational studies, and reviews. Kershenovich et al. wrote that “The increase in the number of publications was largely attributed to studies of lower scientific value.”

While I do not believe that such a body of literature supports a certifiable subspecialty there is no denying the recent proliferation of publications regarding the use of Mohs surgery to treat melanoma. With the quality of studies varying, each one must be carefully assessed on its own merits.

In the past 18 months alone, several papers have been published on this topic. Most refrain from stating the conclusion in the title and thus prompt you to read the study to ascertain the outcome of the analysis. One study did not conform to this standard and thereby draws attention. Hanson et al.2 published an article entitled “Improved overall survival of melanoma of the head and neck treated with Mohs micrographic surgery versus wide local excision.” The conclusion in the abstract stated that “MMS is a valid treatment option for melanoma of the head and neck. This is a reasonable assessment of the data. The data presented unarguably demonstrate the non-inferiority of MMS compared to wide local excision (WLE) but the support for improved overall survival is less certain despite the statistics presented. I do not profess to have more than remedial statistics knowledge but several points in the study population characteristics table deserve careful scrutiny. The MMS and WLE groups are generally comparable with respect to age, sex, race, positive surgical margin, and insurance type. However, there were significant differences between the two groups in four critical characteristics. The WLE group had more individuals with one or more comorbidities (16.4%) compared with the MMS group (10.6%). Nodular melanoma histology was present in 10.67% of the WLE group versus 3.28% in the MMS group. Mean Breslow tumor depth was 1.7 mm in the WLE group versus 0.8 mm in the MMS group. Most notable was the 18.82% frequency of tumor ulceration in the WLE group versus 7.32% for the MMS group. In their analysis, tumor ulceration was the factor most highly associated with a poor outcome (hazard ratio 1.687 95% CI 1.616-1.760). Since the National Cancer Database reports only all-cause mortality after the first 90 days from tumor diagnosis, those four adverse risk factors being significantly skewed toward the WLE cohort does not bode well for that group. I cannot vouch for the statistical analysis, but it appears that confounding variables were inadequately controlled to bolster the assertion of improved overall survival for the MMS cohort.

Another analysis of the literature regarding the use of MMS in the treatment of melanoma identified study bias.3 Adalsteinsson et al. examined studies published between 1989 and 2019 for bias using the Risk of Bias in Non-randomized Studies of Interventions assessment tool. The use of this tool was necessary because there are no randomized trials in the literature; a major shortcoming of the MMS literature. The authors determined that 47 of the 48 studies (97.9%) had serious or critical bias and they provide suggestions for improving studies in the future.

Miller et al.4 suggest employing best practices in order to improve the quality of the literature, and with it patient care decisions, for treatment of melanoma in anatomic locations where it is difficult to conform to standard surgical excision margins. In those anatomic locations, the use of MMS would be advantageous because tissue sparing without higher recurrence risk can be assured due to meticulous margin examination. A minority of Mohs surgeons utilize MMS to treat melanoma. We should be open to referring our patients to a center that adheres to best practices as outlined: uses vetted indications, follows the standard technique of submitting the central specimen for permanent sections, uses immunohistochemical stains or is engaged in a study to compare their use to hematoxylin and eosin, and has standardized training followed by tracking of case volume and outcomes data compared to benchmarks. Optimally, this type of highly specialized care is best rendered in a referral practice taking part in a multicenter prospective study. If this type of care can be realized, the literature can be relied upon to be free of bias, supporting sound evidence-based treatment decisions.

References
While preparing my lecture for the ASMS Micrographic Dermatologic Surgery Review, I came across several photomicrographs illustrating the rules of adequate overlap of tumor identified in a Mohs layer. This topic was first covered five years ago in Quality Corner and it remains a highly ranked topic revisited by Peer Review Program reviewers.

Primary non-melanoma skin cancers grow in a contiguous fashion from the point of origin; the growth direction of tumor identified on a tissue section is uncertain. The tumor may be growing at an approximately 90° to the surgical margin or it may be growing tangentially to the surgical margin.

The uncertainty of the direction of growth, as well as the fact that skin is a deformable material, requires the Mohs surgeon to excise a subsequent tissue layer such that it adequately overlaps tumor identified at the surgical margin to ensure that all tumor has been removed.

Sharon Tiefenbrunn, M.D., former Chair of ASMS’ Peer Review Program, quantified the excision overlap necessary for Mohs layers using a mathematical proof. Generally, the minimum overlap should be 2 mm in all directions around an identified tumor in a Mohs layer. This overlap must be made in all three directions around the tumor focus: along the circumference of the defect, deep to the identified tumor, and toward the center of the Mohs defect. The following case illustrates how difficult it can be to think in three dimensions.
This is how the map should be drawn and stage II excised, allowing adequate overlap along the circumference of the defect, toward the center of the defect, and deep to the identified tumor. The specified 2 mm overlap assumes that you can accurately locate the area of positive tumor in the wound bed. Accuracy is dependent on the number of reference points (orientation nicks) and the deformability of the tissue.

If you only use a single orientation nick, the accuracy with which you can locate a tumor focus decreases as the tumor focus gets further from your single reference mark. Using four orientation nicks (two nicks at 12 o’clock and one nick at 3, 6, and 9 o’clock) enables equal accuracy around the entire circumference of the defect. Orientation nicks heal without scarring if they are incised into the superficial papillary dermis so there is no disadvantage to using four nicks, or more, if the layer is large or involves complex anatomic structures.

If the tumor focus is in subcutaneous fat or the wound bed consists of fat at the location deep to an identified tumor focus, the overlap must be considerably larger. Since fat is extremely deformable, the accuracy of locating a residual tumor focus is poor. This is especially true for a deep only positive Mohs layer. In the case of a deep only layer, prudent excision of the next layer would dictate excising the entire expanse of subcutaneous fat in the defect in contiguity with the beveled dermis around the circumference of the defect up to the epidermis. This dermal tissue is sacrificed in the process of de-beveling the defect for repair. Its excision and examination unequivocally demonstrate that all the subcutaneous fat in the defect was excised and examined. In addition, it permits examination of the sloped wall of the defect to ensure all blood vessels and nerves traveling parallel to the skin surface, and thus exiting the walls of the defect, have been examined for tumor.

Here’s another case.

An instant quality check of overlap adequacy can be performed by placing a second-stage slide on top of a first-stage slide superimposing corresponding orientation nicks and locating the epidermis of the second stage 1 mm to 2 mm outside that of the first. By focusing up and down through the sections, you can determine whether you have indeed overlapped by the recommended 2 mm or more.

In summary,
Unfortunately, the COVID-19 pandemic has prevented the ASMS from hosting an in-person Micrographic Dermatologic Surgery (MDS) review course and led to cancellation of the Annual Meeting Dermatologic Surgery: Focus on Skin Cancer for the second consecutive year. As I write this column, course directors are planning a virtual meeting that will include substantial content to prepare for the MDS examination in the autumn 2021. Mohs layer harvest technique was not a subject I had planned on reviewing until I was asked by the Director of our MDS Review, Dr. Lee Portnoff, to prepare a lecture reviewing that topic for the virtual meeting.

In previous Quality Corner columns, I have mentioned that producing sections with a complete surgical margin on microscope slides enables accurate and efficient interpretation of a tumor-free margin. There are principles that must be followed to realize that goal. Many of them involve operative techniques while harvesting Mohs layers. Open communication with the Mohs lab technician is also critical if quality slides are to result. I recommend the following tips to enhance your technique.

- Bevel the specimen edge at 45°.

This tenet is so ingrained – dating back to our first exposure to Mohs surgery – it can almost be overlooked. Why is the scalpel held at a 45° angle to the skin rather than 90° as in excisional surgery? The reason is that it is the critical first step in ensuring that the entire surgical margin is in a single plane for sectioning. When a block of skin is examined, its mechanical properties exhibit anisotropy with respect to flexibility along the surface compared to the axis along the thickness from stratum corneum to fat. Thus, at a right angle to its peripheral edge, the outer surface of a Mohs layer is relatively inflexible. Techniques that introduce flexibility to this surface are required to flatten the specimen (i.e., relaxing incisions parallel to the epidermal edge). When harvesting a layer, the scalpel must incise through the full thickness of the skin at a consistent angle until the fat is reached. Otherwise, it will be very difficult to produce a planar surgical margin for sectioning. If a Mohs layer is harvested to the level of the reticular dermis without entering the subcutaneous fat, a smooth contour of the outer surface is even more imperative. Such a specimen will be composed entirely of tissue with limited flexibility.

Adherence to incising the skin at 45°, although an appropriate answer for testing, is too rigid in practice. Skin varies in thickness and elasticity within a given patient. Defects may cross anatomic boundaries into areas of different mechanical properties and may be excised at varying incident angles in order to conserve tissue. The best example of this is a tumor involving the lower eyelid. It is imperative to conserve eyelid skin to enable the least cosmetically disruptive and most functional reconstruction. When a defect involves the cheek and lower eyelid, the involved tissue varies dramatically in character. Cheek dermis can be thick and inelastic. An eyelid has a very thin, flexible dermis. The differing properties of these two tissues demand a thoughtful approach. The circumferential of the Mohs layer should be incised at 45° in the cheek until the eyelid is reached at which point the scalpel should be raised to 90° to incise the much thinner and also more precious eyelid skin. Eyelid skin with its generous subjacent fat and very thin dermis can be easily flattened into a plane for sectioning despite the 90° incision in contrast to the thick cheek skin. This takes advantage of the concept of the fat hinge. Fat is extremely deformable and can be likened to a door hinge running along the dermal/subcutaneous interface of a Mohs layer. This hinge can be opened without any relaxing incisions and minimal effort is required to flatten the surgical margin.

This next part involving eyelid margin tumors gets considerably more complicated to explain. It is the most anatomically complex tumor excision performed in Mohs surgery and requires meticulous three-dimensional visualization in your mind’s eye before making any incisions. The surgical approach varies depending on where the borders of the tumor project in relation to the relatively rigid tarsal plate and its firmly adherent palpebral conjunctiva. Full thickness eyelid specimens involving skin and conjunctival tumor are difficult to incise at an outwardly beveled 45° angle on the conjunctival side; the scalpel butt would need to be angled toward the conjunctival fornix to do so. To make an outwardly beveled 45° incision through the conjunctiva into the tarsus and mount the specimen in a way that the conjunctiva and tarsus would lie in the same plane is exceedingly difficult. An alternative approach is needed.

When the tumor border on the conjunctival and cutaneous sides lay entirely within the vertical height of the tarsal plate or projects equally below it on the cutaneous and conjunctival sides, it is best to incise from the conjunctival surface at 90° through the conjunctiva, entirely through the tarsus and skin at the same time. This will produce a boat-shaped specimen the ends of which merely need to be brought down into the same plane as the central portion. If the border of the tumor extends significantly inferior to the lower border of the tarsal plate on the
skin side while still only overlying the tarsus on the conjunctival side, it is better to make an incision beveling 45° on the skin side that meets the 90° conjunctival incision within the soft tissue layer of the eyelid. If the tumor projects minimally onto the conjunctiva with significant extension below the tarsus on the skin side, an incision can be made with the scalpel inwardly beveling at 45° on the conjunctival portion that transitions through 90° as it crosses the tarsal margin and becomes a 45° outwardly beveling incision as it enters the skin of the eyelid. The reverse beveling on the conjunctival surface of such a specimen poses no problems in processing due to the tight adherence of the tarsal conjunctiva to the tarsal plate. Whew! That was difficult to explain. Hopefully, diagrams will help during my virtual presentation.

- Incise to include 1–2 mm of normal epidermis beyond the delineated tumor.

Incising the circumference of the Mohs layer 1–2 mm outside the tumor strikes a balance between tissue conservation and the realities of tissue processing in the laboratory. Tumor should be delineated in some manner preoperatively. Whether you visually assess then curette or utilize an episcope is personal preference. The purpose of delineating gross tumor is to eliminate layers that will have avoidably positive margins. Theoretically, you could use 0.5 mm beyond the gross tumor since most Mohs surgeons examine approximately 0.5 mm of tissue on the pathology slides for a given case. This assumes perfection in flattening, facing, and processing the tissue block. The epidermis must be 95% to 100% intact around the periphery of your step sections to be certain of a clear margin. Given that processing perfection is rarely achieved, 1–2 mm is reasonable. Hruza found that 30% of the time absent epidermis was responsible for tumor recurrence after Mohs surgery.¹

- Make sure the Mohs layers are uniformly thin for ease of flattening.

This topic was included in the Quality Corner column in the spring 2016 issue of The Beveled Edge. The source discussion can be found in an open access article.² The exception to thin layer harvesting is in situations of disparate tissue types with a tendency to separate along tissue type interfaces. The most common site to encounter this problem is on the auricle. The tissue plane between the perichondrium and subcutaneous fat is easily separated and must be handled carefully, especially since this may be a plane of tumor invasion necessitating meticulous examination. This problem also is encountered in the subcutaneous fat/galea interface on the scalp. In these locations, increasing layer thickness slightly and minimizing traction during layer removal will result in layers without disparate tissue separations.

- Don’t compromise cure for ease of reconstruction.

The Mohs surgeon’s duty to the patient is to cure the treated skin cancer. Although there are instances in which Mohs surgery should be terminated, a Mohs surgeon must respect their own standard of judging when a layer should be called clear. My personal standard is the examination of three clear step sections to declare absence of tumor. That standard equates with 0.3 mm of tissue in my lab (i.e., 10 micrometer thick sections with nine discarded between each one placed on the microscope slide). According to Cartee et al.,³ only 16% of respondent Mohs surgeons would compromise their accepted standard and not perform an additional Mohs layer if doing so would make the resulting repair more difficult. Terminating Mohs surgery without a clear margin is advisable, for example, in cases involving penetration of tumor into a bony nerve foramen, tumor extension into the bony ear canal, deep penetration into the parotid where a formal parotidectomy has the possibility of preserving facial nerve function, or an inability to adequately anesthetize the surgical field.

- Communicate with your technician any peculiarities involving a particular specimen.

Communicating with your technician, especially if they perform the mapping and specimen preparation prior to sectioning, is critical in cases of unusual specimens. Anatomic considerations may result in layers being thinner than usual, for example, especially in periosteum-only specimens. In areas of critical anatomy, a particularly difficult reconstruction would result if poor quality slides are produced and an additional layer was needed such as on an eyelid margin adjacent to the lacrimal punctum. In cases that have varying thicknesses of dermis, eyelid versus cheek as in the aforementioned example, the thinner area should be pointed out so that it can be cut by the microtome blade last. Notifying your technician of these deviations from the routine will alert them to a need to face the block less and perhaps discard fewer step sections between those placed on the slides.

- Remember that most sectioning difficulties can be remedied by moving to a fresh section of the microtome blade.

References


The inaugural administration of the Micrographic Dermatologic Surgery (MDS) subspecialty examination by the American Board of Dermatology (ABD) is less than one year away. Mohs surgeons passing the examination will be granted the title of board-certified micrographic dermatologic surgeon. The ABD has represented to ASMS leadership that this credential will supersede all prior credentials pertaining to Mohs surgery and would therefore provide a uniform credential among Mohs surgeons. If this is indeed the case, credentialing issues that have vexed ASMS members will cease. If not, there may still be credentialing difficulties encountered due to lack of fellowship training. As fellowships continue to produce additional Mohs surgeons that enter practice, some localities may develop an oversupply of MDS-certified dermatologists. If credentials are equivalent, payers must rely on other factors to determine which MDS surgeons to retain on physician panels. Favorable metrics for your practice will provide an advantage in securing a slot on a desirable payer's panel. Payers will not retain all equally credentialed physicians in a given locality once an oversupply is evident. Restricting the availability of MDS providers limits a payer's financial exposure for Mohs surgery in a given market. Once a locality has an adequate network to provide sufficient patient access, additional providers are seen as superfluous cost centers.

Ensuring favorable treatment when such scrutiny is directed at your practice begins now. The metrics reviewed in previous Quality Corner articles should already be something you can provide if the need arises. This would include number of cases performed per year and the average number of stages it takes to clear a tumor (ANSC) for both the 17311 and 17313 code series. Equally important to the payer will be the ratio of second intention, intermediate, and complex and advanced (flap/graft) closures performed on Mohs surgical cases.

The formula for ANSC has been presented previously and can be found here. This can easily be calculated from the cumulative year-end financial reports for your practice. ASMS staff has performed this analysis for all ASMS members on the publicly available 2017 Medicare billing database. The aggregate ANSC for ASMS members was 1.61 stages for the 741 members billing the 17311 code series. For the 380 ASMS members utilizing the 17313 code series, the ANSC was 1.31. Both of these ANSC are consistent with the means defined in the papers by Krishnan et al.\textsuperscript{1} and Tsai et al.\textsuperscript{2}.

A more recently defined metric is the proportion of cases in which the Mohs surgeon utilizes the add-on code of a series, which I will refer to as PCAC. In this example, PCAC is the proportion of cases in which 17312 is billed when 17311 is billed. If the surgeon takes a second stage 50% of the time, that represents a PCAC score of 0.5. Whether that surgeon then most commonly takes only one subsequent stage to clear tumor or takes many more is not discriminated by this metric because in both cases the PCAC score is 0.5. For Mohs surgeons with a significant proportion of complex tumors, PCAC is a more equitable metric since it eliminates the skew in ANSC caused by complex tumors that may require a significantly higher number of stages to clear. PCAC should be used in addition to ANSC to prevent identifying a Mohs surgeon as an outlier due to operating on complex cases. Unfortunately, to calculate a PCAC score for a Mohs surgeon requires access to the primary source data, all Mohs claims for a particular surgeon. The publicly available aggregated claims data does not permit the level of detail necessary to properly calculate PCAC for an individual Mohs surgeon. Payers have the submitted claims data and may employ PCAC if it garners widespread acceptance as an index of quality as has the ANSC metric.

Payers use metrics to identify outliers - Mohs surgeons with a practice pattern that deviates significantly from peers. Low outliers will score very close to zero on the PCAC since a very low proportion of cases will have a second stage taken. As discussed by Krishnan et al.\textsuperscript{1}, low outliers can occur for any number of reasons, including “(1) incorrect coding, e.g., failing to code any subsequent stages (17312) or inappropriate use of the MMS code (17311) instead of standard excision codes when the surgeon is not personally performing the pathologic evaluation; (2) inappropriate tumor selection; or (3) unnecessarily aggressive first stages.” They also state that “[l]ow outliers pose a quality concern because Mohs surgery should be reserved for complex tumors for which cost-effectiveness has been demonstrated. Treating simple tumors that could be managed differently or that can predictably be cleared in a single stage undermines the value of Mohs surgery, as does harvesting even appropriate tumors with excessively wide layers that would require larger repairs. Mohs...
surgery is intended to both provide the highest cure rates for complex tumors in challenging anatomic sites and to necessarily preserve critical tissue to allow the most functional and cosmetic outcomes. Low outliers likely negate these benefits.

Having a very low PCAC due to harvesting generous layers would be reasonable during the time a new technician is perfecting their ability to provide the surgeon with high quality slides for interpretation. That period should not be prolonged beyond the point that reliably high quality tissue sections are provided for interpretation. If there are prolonged technical difficulties, an alternative coding scenario would be to bill an excision code based on tumor size and location with a frozen section interpretation code (CPT 88331).

PCAC also will bolster ANSC identification of high outliers. Mohs surgeons who rarely clear a tumor on the first stage will have a PCAC score very close to 1. Evidently payers have been issuing outlier letters to Mohs surgeons with high PCAC scores. Unlike the more accessible ANSC data, PCAC distributions are only known to payers or perhaps larger practices analyzing their own claims data. If one receives a high outlier letter from a payer, there is little recourse due to the lack of knowledge about the comparator group. If payers continue insisting on decreases in the PCAC score, the ultimate outcome is that only single layer Mohs cases will be permitted. In that case, all Mohs surgeons will be subject to the criticisms levied against the aforementioned low outliers. From a quality patient care perspective this is clearly an unfortunate circumstance.

Having a favorable metrics profile may determine whether you are included on an insurer’s physician panel. Knowing these important values also will indicate whether your technique needs some refinement from a quality perspective.

References

In a 2016 Quality Corner column, the microscopic examination of “as close to 100% of the surgical margin as possible” was emphasized as the guiding principle behind the Mohs Micrographic technique. It is this meticulous margin examination that makes the Mohs technique superior to all other techniques for treating difficult skin cancers.

Absence of fat has proven to be the most persistent error in the collective experience of ASMS peer reviewers. The attestation form for Peer Review case submission states that “the deep tissue must be fully represented (>95%) to be considered satisfactory.” This includes any fat harvested in the specimen layer. A number of individuals attest to having intact deep tissue yet they submit specimens with large voids where there should be lacy appearing fat cells.

Which of these sections would you feel confident in declaring clear with 99% certainty? The correct response should be evident.

It is true that fat is more difficult to properly process than dermis, fascia, or muscle but this should not lead to tolerating its absence as acceptable. The most important factor in achieving intact fat in sections is a sharp microtome blade. Paraphrasing an oft repeated sentiment of dermatopathologist Dr. John Campbell: A sharp blade cures many processing problems.

A sharp section of microtome blade will more cleanly section fat as well as eliminate “venetian blind” artifact and torn or moth-eaten sections. If a sharp section of blade still doesn’t yield an adequate quality section, freezing with cryospray or liquid nitrogen followed by partial rewarming may help to cut a difficult fat section more easily. As a last resort, the tissue sections can be made somewhat thicker. This results in trading intact fat for the loss of definition of dermal structures. However, the entire case shouldn’t be cut more thickly. Only one or two sections should be cut thicker to allow interpretation of the fat compartment with a return to standard section thickness for the remaining sections (six sections for microscopic examination is most common).

The following slides demonstrate quality processing with a partial first cut at lower left to ensure the block hasn’t been excessively faced. The next section is placed toward the label (60 micrometers deeper into the block showing that the tissue was properly flattened) with complete dermis and epidermis. The two sections on the second slide have complete dermis/epidermis with some deep dense connective tissue. The two thicker sections on the third slide show the faulty fat compartment followed by alternating standard and thicker sections.

Why all the fuss over absent fat? Fat is a malleable substance and denser tissue, including tumor strands, has a tendency to retract away from the surgical margin plane of section as demonstrated in the following case. These photos are three successive sections provided for examination during Mohs surgery for an infiltrating basal cell carcinoma on the shin of a 40-year-old woman. This tissue represents a 0.12mm depth progression into the surgical margin.

The first two sections show inflammation and absent tissue in the perifollicular fat. The third section, which is the first one we are able to fully assess the perifollicular fat, clearly shows infiltrating basal cell carcinoma.

Thus, absence of tissue does not equate with absence of tumor. This is especially important in the assessment of the fat compartment of a specimen.
In the last *Quality Corner*, I indicated that preparing top quality slides saves you time. The reason is that the microscopic interpretation of a case proceeds most quickly if tissue sections are of impeccable quality. Quality Mohs sections are those that have no holes and a complete epidermis. The only way to accomplish this in the fewest number of wafers is to properly flatten the tissue prior to sectioning in the cryostat.

Tissue preparation difficulties may be encountered due to characteristics of the tissue harvested in the operatory. Although this occasionally results from poor harvesting technique, there are instances that make it difficult to harvest a thin tissue layer. Harvesting a one or two millimeter thick layer in areas with tissue types that tend to separate from one another, such as the disparate tissues present in an ear layer containing cartilage or an eyelid with orbicularis muscle, is nearly impossible. In these situations, harvesting the layer without tissue separation outweighs the thinness called for by Ellis et al.¹ Processing such specimens can be accomplished by thinning the tissue layer in the lab, using relaxing incisions or judiciously applying pressure to a layer while freezing. The following are illustrative cases:

Vigorous debulking curettage wasn’t performed for this eyelid squamous cell carcinoma due to the soft tissue beneath the tumor and severe dermal elastosis. Note that the epidermal edges retract away from the filter paper transfer device at a 45° angle.

This specimen was easily thinned using a double-edge razor blade when there was no bleeding and the tissue was stabilized on the cutting board. The double-edge razor or a Dermablade device may be bent to more deeply debulk the specimen, if necessary.

The final result was a tissue layer that flattened without any further manipulation.

Inelastic tissues, such as scalp or scar, may prevent proper flattening. Partial thickness incisions sever the connective tissues and allow the specimen to be flattened with minimal distortion. A gridwork of relaxing incisions generally works best.

Relaxing incisions do not cross the epidermal edge. Incise parallel to an edge that does not flatten.
Place the slide on the quick freeze bar and watch for the freeze front to appear at the epidermis in about 20 seconds. Then...

Gently apply finger pressure to the area of the specimen that needs to be brought into contact with the slide. It will freeze to the slide in a matter of seconds. The pressure should not be so great as to create squash error¹, forcing the non-surgical margin tissue into the plane of section. The use of this technique is essential in specimens that contain cartilage.

Employing these flattening techniques will enable you to achieve sections that include disparate tissues without layer separation, tears, or voids. Sections like these can be confidently, quickly, and accurately interpreted.

In the last *Quality Corner* the importance of completely inking the non-epidermal tissue edge was reviewed. To enable you to achieve excellent results, I would like to share my method for reliably inking the non-epidermal margin of tissue blocks. As in all things surgical, there is always more than one way to accomplish a task; this is just the way I do it after years of optimizing my technique. I don’t do a high volume of Mohs surgery, so I prepare all my tissue blocks myself. As we teach in the *Fundamentals of Mohs Surgery Annual Training Course for Physicians and Technician*, it is essential for the surgeon to supervise the lab personnel preparing tissue. In order to best carry out that function, you must be intimately familiar with tissue preparation by performing it yourself until you are proficient. Once that is the case, you may delegate that responsibility to a properly trained and credentialed member of your staff. Preparing tissue develops an appreciation for the difficulties encountered in the lab due to poor tissue harvesting technique in the operatory.

My method is as follows:

- Use a round filter paper with a dot at 12 o’clock, rather than gauze, to transport the specimen to the lab. Clean the epidermal surface of loose debris and clot using saline on a cotton tip applicator. This eliminates floaters and ensures embedding medium adhesion.

- Flip the specimen over to clean the surgical margin with saline on a new cotton tip applicator. Ensure all clot is removed from the surgical margin. This avoids the need for additional levels due to clot obscuring the surgical margin. Remember, clot does not equal clear!

- Turn the specimen right side up. If it’s necessary to cut a Pac-Man or bisect, place a single-edge razor blade into your orientation nick(s) and give it a whack with your Adson forceps. The razor will cut a crisp line through to the cutting board without distorting the tissue, even if it’s fat; unlike when a scalpel is used to slice across a specimen.
• Tissue will adhere to the filter paper forming a seal, which is clearly seen when the filter paper was spread for the photograph below. Gauze cannot form such a seal, thus my choice for using filter paper. This seal prevents the migration of ink onto the deep surface, the surgical margin of the specimen. Clearly marking this non-epidermal edge while preventing the spread of ink onto the surgical margin is imperative to produce sections that unquestionably indicate that the deep tissue has been sectioned to the edge created by bisecting the specimen.

• Use a wooden applicator to apply ink to the entire non-epidermal edge.

• Note that the non-epidermal edge marking inks touch the epidermis at both ends of the incision and the two colors meet in the center of the non-epidermal edge.

• The specimen is then placed onto a microscope slide with the surgical margin in contact with the glass. The surgical margin can be examined through the slide to detect and tease out bubbles, which manifest as holes in tissue sections, and also ensure the epidermis is in full contact with the slide. The trace amounts of ink on the surgical margin visible in this example usually adhere to the glass slide or are removed when the block is minimally faced.

The view of the tissue through the glass slide is exactly what you should see when you examine the tissue sections through the microscope. If there are defects (i.e., bubbles, tears, poor inking, epidermis pulled away from the glass slide, etc.) in the appearance of the tissue now, do not expect them to improve when the tissue is cut into six-micron thick wafers. Preparing the tissue carefully up to this point will leave only microtome issues, poor staining, and coverslip problems to impair your interpretation, but those are subjects to discuss in another column.

I believe that preparing top quality slides saves you time. The reason for this is that interpretation proceeds most quickly if the sections are of impeccable quality.
Many topics have been covered in Quality Corner since its inception four years ago. Feedback from the Peer Review Committee prompts me to repeat the first column with a few updates to illustrate the proper inking of a Mohs specimen. The technique presented here has been vetted through the collective experience of your Peer Review and Quality Committee members over many years. We understand that individuals may have seen a different technique for preparing specimens during their training. However, the procedure outlined below adheres to the principles of the Mohs technique while ensuring – with the highest degree of certainty – that all of the surgical margin tissue is represented in the tissue sections presented to you for interpretation.

Tissue dye (ink) applied to a specimen serves two distinct and interrelated purposes. Inks are applied to a specimen to:
1) asymmetrically mark the specimen to permit accurate orientation, and
2) ensure that the entire face of the tissue block (the surgical margin) has been sectioned.

Asymmetry can be accomplished with only two dyes on either a one- or two-piece specimen as illustrated. A four-piece or larger specimen will require more dye colors or combinations to ensure a unique inking pattern on each piece of tissue. Because slide labeling mistakes occur, having unique inking of each piece allows for the detection of such errors.

To accomplish the second objective, you must place ink on the entire non-epidermal edge of the specimen. To adequately delineate a non-epidermal tissue edge, whether it is the notch used in a Pac-man specimen or the incisions dividing a layer into two or more pieces, dye must be carefully placed along the entire non-epidermal edge of the tissue, not just on a small area of the dermis adjacent to the epidermis. Care should be taken to prevent ink from migrating onto the deep surface, which is the surgical margin, of the specimen. Dye spreading onto the surgical margin can impair visualization of tissue and lead to incorrect interpretation of the true cut margin of the deep tissue. Proper dye application is accomplished by placing the specimen on filter paper, rather than gauze; the moist tissue adheres to the filter paper creating a seal that prevents dye from wicking under the edge and results in a sharp line of dye.

**Pac-Man Specimen**

Place dye along the entire incision

Dye must touch the epidermis at the outer edge of the specimen

The 2 different inks at 3 and 9 o'clock are used to make the inking asymmetrical to ensure the specimen has not been flipped.
Note the continuous, crisp dye on the entire non-epidermal edge without any dye obscuring the tissue.

You should conduct a **specimen integrity assessment** for each tissue block as follows: First, scan the epidermal edge for completeness. Next, confirm that the non-epidermal marking dyes touch the epidermis at both ends and whether the non-epidermal edge marking dye is continuous from one epidermal contact point to the other. Finally, assess the deep tissue for holes. Once you use this systematic assessment and confirm that the tissue is fully represented on the slides and the orientation corresponds to your map, you can assess whether tumor is present.

Note the green ink delineating the non-epidermal tissue margin and the intact deep tissue in this section. The ink touches the epidermis and continues in an unbroken line along the complementary edges of this Pac-Man specimen. Meticulous technique such as this permits the unequivocal identification of deep tumor present near the center of the surgical defect in this patient.

In summary, the **entire dermal/fat edge must be marked with dye** so it can be clearly identified as the *true cut edge* and which edge when the slides are reviewed. The only edge that *marks itself* is the epidermis and therefore it does not require inking. If a specimen is left in one piece, dye only needs to be placed in the reference nicks to orient the specimen. Since the epidermis completely encircles such a specimen, it delineates the entire peripheral margin without ink.

If your specimens cannot routinely pass the **specimen integrity assessment** outlined above, you should personally prepare your specimens until your lab consistently produces clearly inked tissue sections without holes. Once you reach that point, you will be at the level of specimen preparation that makes Mohs micrographic surgery the most reliable method of skin cancer excision.
The metric average number of stages to clear tumor (ANSC) was first discussed in the Spring 2017 Quality Corner column. In subsequent columns, high and low ANSC outlier status was reviewed as well as enforcement efforts directed at outliers.

The latest article published on this topic by Albertini et al. examines the behavioral change that occurred when Mohs surgeons were made aware of the outlier status of their ANSC compared to peers. The authors studied the effect on ANSC of a behavioral intervention by analyzing Medicare Part B claims data. The intervention consisted of a written notification to all American College of Mohs Surgery (ACMS) members regarding the members’ ANSC and whether or not they were an outlier relative to peers. The notification delivered in February 2017 was based on the members’ ANSC over a baseline period from January 2016 through January 2017. Quarterly ANSC was then calculated from March 2017 through March 2018. During the study period, 2,329 individuals billed Medicare Part B for Mohs surgery. The intervention group was composed of 1,045 ACMS members and the control group (n=1,284) consisted of all others billing for Mohs surgery during that period. There were 53 outliers in the ACMS intervention group (5%) and 87 in the control group (7%). Albertini et al. found that there was an immediate decrease in ANSC in the first quarter of 2017 (the notification was sent out during the second month of that three-month period) for outliers in the intervention group. This decrease was maintained through the first quarter of 2018. The control group demonstrated a smaller decrease in ANSC, beginning in the second quarter of 2017, which also persisted throughout the study period. The mean decrease in ANSC was 0.26 stages per case for the ACMS intervention group and 0.11 stages per case for the control group. This was statistically significant and thus validated the effectiveness of the intervention at decreasing the ANSC of high outliers.

The decreased ANSC in the control group that consisted of ASMS members and unaffiliated Mohs surgeons was an interesting finding of the study. Albertini et al. referred to this as a “potential latent crossover effect.” The authors proposed that “educational efforts and increased awareness efforts by the [ACMS] at the time of the intervention may have influenced surgeons in the control group ... clinicians in the intervention group may have had an impact on control group participants through personal conversations or a perception of an increased culture of accountability fostered by the initiative.” (I edited for clarity and brevity.) It is highly likely due to these circumstances as well as concurrent educational efforts of the ASMS regarding this issue that the control group also demonstrated a decrease in ANSC.

In the previously discussed Tsai study using 2012 Medicare data, and my own analysis of 2014 Medicare data in collaboration with Howard Steinman, ASMS members account for 60 percent to 70 percent of non-ACMS Mohs surgeons. Both of these analyses indicate significant differences between the practice patterns of ASMS members and Mohs surgeons not affiliated with a Mohs surgical educational association, either the ACMS or ASMS. Tsai et al. showed that ASMS Mohs surgeons performed a significantly higher percentage of Mohs surgeries on the head and neck and had a lower ANSC for both the head and neck and also for all sites combined. The analysis of the 2014 Medicare data was entirely consistent with the analysis of Tsai et al regarding the percentage of Mohs surgery on the head and neck and a lower ANSC. Additionally, the 2014 data analysis revealed that nonaffiliated Mohs surgeons were statistical outliers for ANSC at more than twice the rate of ASMS members (7.38% vs. 3.41%). This represents a significant confounder in the interpretation of Albertini et al. If Albertini et al had separately analyzed the ASMS and unaffiliated Mohs surgeons as Tsai et al had done, would there be a significant overlap between the decreased ANSC seen for ACMS members and ASMS members in contrast to unaffiliated Mohs surgeons?

Could the education and reinforcement of good practice patterns provided by Mohs surgery educational associations be the key to enhanced consistency in Mohs surgery? I believe so.


A New Year - Time to Reflect and Also Look Forward

by Jim Schiro, M.D.

Stuck indoors on a frigid February morning there’s plenty of time to think. Reflecting on what occurred in 2018 brought to mind two major challenges to our profession. The first being approval of a dermatology subspecialty certification in Micrographic Dermatologic Surgery (MDS); the second, proposed policy revisions by the United States Pharmacopeia (USP) to increase regulations on medication compounding, which unfortunately includes buffering lidocaine. Neither of these initiatives will enhance quality for the majority of physicians.

Evidence has been discussed in previous Quality Corner columns indicating that ASMS members compare favorably with national norms for Mohs surgery despite the fact that the vast majority are not fellowship trained1; a fellowship requirement will take effect five years after the first MDS certifying examination is administered. The USP proposal would make buffering lidocaine, which dermatologists have been doing in their offices for decades without any patient safety issues, a burdensome undertaking.

The ASMS has partnered with other dermatology organizations to stay abreast of these situations and will attempt to make any regulations less onerous.

Since both of these issues are out of your control, what can you do personally to ensure the quality of the work you provide your patients? Consider calculating the average number of stages to clear tumor for the cases you did in 2018. My average is 1.53 stages. You may recall that Krishnan et al.2 set the 17311 code series thresholds for high and low outliers at 2.41 and 1.28 stages, respectively.

The ASMS recently sent out its Peer Review Program packets. If you have not taken advantage of this source of feedback regarding the quality of your Mohs surgery in the past, I recommend that you begin to do so. My technician has randomly pulled a dozen two-stage cases I performed in 2018. I will review each one of them to select the best one for submission to the Peer Review Program. The peer reviewers expect that you have submitted a case that represents your best work. Reviewing several cases without the pressures of performing surgery allows you to concentrate on the quality of the tissue processing, accuracy of tumor mapping, dye placement, and completeness of the epidermis and deep tissue. You will learn something about yourself and your technician by doing this review. I do...every single time. The impressive cure rate achieved by the Mohs technique relies on the fidelity of each step of the technique. Any shortcomings may result in tumor recurrence.

I would like to highlight the common reasons Peer Review cases are reviewed unfavorably. They are:

• Failure to place DYE ON THE ENTIRE NON-EPIDERMAL MARGIN of the excised tissue,
• Failure to OVERLAP ADEQUATELY TOWARD THE CENTER OF THE DEFECT when a layer is positive, and
• Failure to realize that HOLES ARE UNACCEPTABLE in the tissue sections.

These issues have been covered in previous Quality Corner columns, specifically Inking a Specimen in the Winter 2015 issue of The Beveled Edge, Adequate Overlap in the Fall 2016 issue, and Absence of Tissue in the Summer 2016 issue. All of these can be found in the Quality Corner Archive.

These articles contain detailed explanations as to why those tissue harvesting and processing faults are unacceptable Mohs technique. I believe that the primary reason for overlooking those errors is the surgeon’s failure to appreciate that the growth of a tumor and the process to excise it take place in three dimensions. You must develop the ability to generate a three-dimensional representation of the tumor in your mind’s eye by extrapolation from the two-dimensional view through the microscope. If tumor is present some distance from the epidermal edge of a tissue section (i.e., not a focus of superficial basal cell carcinoma), it must be appreciated that the most likely direction for that tumor to be growing is deeper into the area beneath where it was marked on the map of the defect. When you assess the patient for the next tissue layer to be excised, take the distance from the epidermis into account. For reasons detailed in The Deep-only Layer in the Fall 2017 issue, you shouldn’t excise only fat, but should include the beveled dermis around the periphery of the defect. Once the layer has been harvested with at least 2 mm of overlap in each direction around the circumference of the defect as well as beyond the tumor into the center of the defect, it is critical that the tissue is properly inked to delineate the non-epidermal edge of the harvested tissue and processed so that you can assess intact fat and dermis with a distinct ink line demarcating it. Lacking that, you have not proven that you have excised the tumor and are merely guessing.

Since you have read this far, I’ll assume that you are dedicated to providing quality care for your patients. I would like to invite you all to the ASMS 24th Annual Clinical Symposium Dermatologic Surgery: Focus on Skin Cancer in Naples, Fla., on May 23-26, 2019, where I am hosting a breakout session during which I hope to convey that following the tenets of quality that I have reviewed in these columns over the years actually saves you time. Who among us wouldn’t benefit from saving time? I hope to see you there.


The issue of “outlier” physicians with regard to the average number of stages to clear (ANSC) tumor has been discussed in the Quality Corner previously. Outliers and their interaction with enforcement efforts will be discussed herein.

The article by Krishnan et al defined outliers as Mohs surgeons who billed an ANSC that was in the upper or lower 2.5% of the ANSC distribution. Their threshold for a high outlier (HO) is an ANSC more than 2.41 stages. Low outliers (LOs) average less than 1.28 stages per case. This designation has been criticized as being arbitrary. However, any chosen cutoff value is inherently arbitrary since the distribution of ANSC is a continuous function without a clear inflection point to use as a valid discriminator. Of the 2,305 physicians who performed Mohs surgery in the two years reviewed in the article, 137 were outliers in at least one year; of these, 49 were HOs in all three years. There were 92 LOs in at least one year; 20 were persistent LOs. Krishnan et al. opine that “unnecessary surgery financially burdens both insurers and patients.”

A study by Tsai et al published ahead of print in September in Dermatologic Surgery bolsters and refines the findings of Krishnan et al. Tsai and coauthors studied the 2012 Centers for Medicare & Medicaid Services (CMS) billing data and separated surgeons into several demographic groups. Of note are their findings of statistically significant differences in the following:

1) Percentage of cases on the head and neck (H&N): ACMS members - 89%, ASMS members - 94%, and unaffiliated (N) - 92% (p < .001 for ACMS vs. ASMS or N).

2) Variance of ANSC for H&N cases: ACMS members - 1.76 layers, ASMS members - 1.66 layers, and N - 1.68 layers (p < .001 for ACMS vs. ASMS or N).

3) Proportion of cases repaired with flap or graft: ACMS members - 0.30, ASMS members - 0.23, and N - 0.26 (p<.001 ACMS to ASMS, p<.006 N to ACMS).

Tsai et al concluded that “there is a lot of variability in practice patterns of Mohs surgeons across the country.” While the presence of variability in the practice of medicine is not unexpected, drawing attention to it when the myriad factors that lead to such variability are unknown for a particular case may be considered unwise. Alas, the era of Big Data is upon us and the presence of outliers is already known to the federal government. Wolfson et al wrote about the federal government’s enforcement activities in a recent issue of JAMA Dermatology. They state that the U.S. Department of Justice and CMS are “increasingly investigating dermatologists for alleged Medicare fraud and abuse related to Mohs surgery as part of the ramped-up provisions” of the Affordable Care Act. They indicate that the clinical practices and billing behaviors of Mohs surgeons are routinely scrutinized. Despite the absence of summary data from the government, their opinion is based on communications with U.S. attorneys and personal experience in Medicare fraud and abuse cases. Prosecutors will look to outliers as fertile ground in which to find those possibly engaging in fraudulent activity. This may relieve insurers and patients of the unnecessary financial burden mentioned by Krishnan et al.

Consideration of the statistical data cited above reveals that the average member of our Society is well within the norms for Mohs surgery. As a group, we have the highest proportion of H&N cases, the lowest ANSC for H&N cases, and the lowest proportion of cases closed with a flap or graft. Nonetheless, being an ASMS member means nothing to a prosecutor if your billing indicates an outlier status. I believe our Society does an admirable job of educating our members and reinforcing an honest work ethic in order to achieve those commendable statistical results. Wolfson et al outline measures to reduce the likelihood of an investigation which include understanding and using the Mohs Surgery Appropriate Use Criteria and any Medicare Local Coverage Determinations, documenting thoroughly, and performing quality assurance and compliance audits annually. If investigated, do not ignore any information requests, but rather hire an attorney experienced in health care.

In closing, I would like to share the motto that appears on a statue just outside the venue where our Fundamentals of Mohs Surgery Annual Training Course for Physicians and Technicians is held each year.

“Be Just and Fear Not”

R. E. Hazard, Sr. 1880-1975

How true.

References


Quality Corner:

The Components of a Robust Quality Assurance Program

by Jim Schiro, M.D.

There have been 10 Quality Corner articles published in The Beveled Edge over the past few years. All are being made available on the member section of the ASMS website to facilitate periodic review. Our Peer Review physicians continue to see technique shortfalls in submitted cases despite Quality Corner articles addressing such issues as Inking a Specimen and How Much Overlap is Enough? It may be time to reread these articles now that they are conveniently located in one place and you may have missed a few. In this issue, I would like to discuss the implementation of a robust Quality Assurance (QA) program for your practice. Compliance with a robust QA program will take some time as well as some mindfulness of what you are doing during a Mohs surgery session. However, the dividends to your patients will be significant.

The federal Clinical Laboratory Improvement Amendments (CLIA) require a written QA or Proficiency Testing program for all practices rendering high complexity testing. Mohs falls under this category as a subset of dermatopathology. I practice in Maryland, which may be one of the most highly regulated states in the country, where the federal government has delegated the CLIA inspection function to the state. Maryland inspectors have required my technician to attend Mohs meetings every three years and two different methods to verify the accuracy of my readings. Since there isn’t a national Mohs review slide set where one reads unknowns, as there is for general pathology, you need to come up with your own QA system satisfactory to the inspector.

The first method I employ is to take a randomly selected sample of 10 percent of my two- or three-stage cases (usually 10 to 14 cases) to review with a dermatopathologist annually. A random sample also ensures that you get an honest sample of your work. Dermatopathologists tend to be more discriminating about slide quality than Mohs surgeons. I view this as a valuable source of feedback regarding my technician’s performance as well as my own. To avoid the possibility that the review could be viewed as a kickback, the pathologist is compensated for the service.

My second verification method is the ASMS Peer Review Program. I believe that the anonymous review afforded by the Peer Review Program is an excellent means of getting unbiased feedback on your case quality. When you are reviewing cases face to face with colleagues, there are always interpersonal dynamics that play into the frankness of the review. If you get back an unsatisfactory Peer Review, do not assume the reviewer “has it in for you.” The reviewers don’t know who you are and their task is to uphold the highest standards of Mohs surgery for our members through education. The Peer Review physicians work very hard, dedicating time outside their practice responsibilities to this important function of the ASMS. Be honest with yourself about the review. Realize that there is not just one person performing the review. An unsatisfactory review is independently reviewed by a second physician. Thus, two of your colleagues have agreed on the assessment of the submitted case which is supposed to represent your best work. If you elect to utilize this verification method, do not use it as your sole QA method because there can be many reasons for delays in providing reviews in time for scheduled CLIA inspections.

Fulfilling the minimum requirements shouldn’t be your goal, so here are a few other things you should consider implementing to improve your Mohs surgery QA activities:

• In the case of a Mohs recurrence, and there will be some, pull out the old case when you are not pressed for time to review it very carefully. You may find tumor you missed or tissue holes you felt weren’t significant at the time (see the previous Quality Corner entitled Absence of Tissue Does Not Prove Absence of Tumor). In fact, if I diagnose a new tumor in reasonable proximity to a previous Mohs case I performed, I pull the old slides to review the quality of tissue preparation and interpretation, even if I don’t believe it was a recurrence. A chance to review your work without time pressure opens your eyes to things you may have overlooked before. To document this QA activity, I dictate a QA note for inclusion in my lab manual. You must set aside your ego to learn from this activity. It will make you a better physician.

• Periodically review tissue sections with your technician. The gap between what you need to render quality readings and the tissue sections you are getting from the technician should be clearly communicated so you both understand your roles in this process. If the technician is having trouble processing the tissue you provide, discuss what the problem is and how you can provide him with tissue that fulfills his needs to produce quality tissue sections. The tissue you are harvesting for a Mohs layer may be inconsistent in thickness and have ragged rather than smooth epidermal edges or frank holes. Any of these harvest problems creates significant difficulties for your technician who should not be blamed for them.

Set your ego aside, go back to review your previous work, and learn how to help the members of your team; great patient care will result.
The issue of “outlier” physicians with regard to the average number of stages billed to clear tumor (ANSC) has been discussed in the Quality Corner previously. Possible reasons for being a “high outlier” (HO) in ANSC will be addressed in this issue.

The previously cited article by Krishnan et al1 defined outliers as Mohs surgeons who billed an ANSC that was in the upper or lower 2.5% of the ANSC distribution. This distribution is not a symmetrical bell curve. There is a steep upslope on the low end of the ANSC distribution curve and a broad shoulder with an elongated tail on the high side. The middle 50% of Mohs surgeons billed between 1.51 and 1.89 stages per CPT 17311 case.1 The threshold for being an HO is 2.41 ANSC. Thus, the “average case” for an HO is either two or three stages rather than one or two stages for the middle 50% of Mohs surgeons.

There can be a few reasons that may explain the HO status of a particular Mohs surgeon.

Coding incorrectly by counting the debulking of tumor as the first stage of Mohs and the scalpel excision of the first tissue layer as the second stage will raise the surgeon’s baseline ANSC to two. Tumor debulking is included in the first stage work for the Mohs surgery CPT codes. Even if you examine the curettings as a separate tissue block, that work is included in the first Mohs stage. In certain circumstances, performance of a biopsy is permitted on the same day as Mohs, but it should be coded as a biopsy and a frozen section tissue examination, not as a stage of Mohs.

With regard to delineating tumor margins, some Mohs surgeons do not curette to delineate the tumor. Some rely exclusively on alternate methods, such as visual estimation or dermoscopy, to delineate tumor borders. This can be valid if your ANSC is within the 1.51 to 1.89 middle ground. However, if you are an HO, you are underestimating tumor size too frequently and should use the curette to further delineate tumor margins prior to excising the first Mohs layer. The combination of two methods of tumor margin estimation is optimal since visual inspection or dermoscopy may allow you to identify sclerotic areas that may not be identified by curetting and curetting may alert you to deep dermal undermining by tumor not visible from the surface. If you significantly underestimate tumor margins, taking the standard 2 mm of additional tissue will require more stages than average to clear the margin.

The third possible reason for an HO status is too small a margin being taken for the subsequent Mohs stages. We have all run into the seemingly small papular recurrent carcinoma on the scalp without evidence for tumor on the surface that runs for several centimeters horizontally within the galea. Thankfully, these do not comprise the majority of cases in most practices. If that were the case for a particular practice, that would easily justify an HO status. Good tumor margin estimation will remove the bulk of any tumor regardless of its size. Subsequent stages are used to clean up residual tumor identified at the margin. If you remove less than the standard 2 mm of additional margin with each stage, it will require more stages to clear the margin.

Lastly, some Mohs surgeons always excise the first tissue layer as a partial thickness layer rather than full thickness to the subcutaneous fat. The removal of a partial thickness layer preserves the possibility of allowing second intention healing of the defect if the margins are clear. Unless you are performing Mohs on a high proportion of thin, small tumors, there will be a positive deep margin in the majority of cases, resulting in a second stage. The lowest possible ANSC for that surgeon will be close to two stages rather than one stage leading to a higher ANSC value. If you rarely allow the clear one-stage wounds to heal by second intention and instead close all wounds primarily, the virtue of the partial thickness first layer is negated.

Thus, HO status could be justifiably attributable to a high proportion of aggressive histology or recurrent tumors or could be due to errors related to improper coding, consistent underestimation of initial tumor dimensions, consistent removal of partial thickness first layers for tumors that are of significant size, or removal of extremely small subsequent stages for areas of positive margins. Your conformance to the standard ANSC is a measure of the quality of your Mohs technique. If you are an HO, you should examine each step of your technique with a critical eye to identify which factor accounts for that HO status.

Reference
The issue of “outlier” physicians with regard to the average number of stages billed to clear tumor (ANSC) was mentioned in a previous Quality Corner. Possible reasons for being a “low outlier” (LO) in ANSC will be addressed in this issue.

The concept of the outlier in Mohs surgery bears further examination. The article by Krishnan et al. defined outliers as Mohs surgeons who billed an ANSC that was in the upper or lower 2.5% of the ANSC distribution. This distribution is not a symmetrical bell curve. The curve has a steep upslope on the low end of ANSC and a broad shoulder with an elongated tail on the high side. This is due to the fact that the lower limit of stages is 1 and the upper limit is unbounded. ANSC is a utilization measure that is used as a proxy for quality because it measures the performance of an individual relative to the peer group practicing Mohs micrographic surgery. There are no easily measurable characteristics that can quantify quality; recurrence rate being the most important. The prospective study to quantify surgeon recurrence rate would be prohibitive due to the enormous sample size and monitoring over a 10-year period needed to discern small statistical differences. Thus, using ANSC as a quality proxy, Krishnan et al determined the LO threshold as the number of times that surgeon took a second stage, a second stage was taken in less than one of every 10 Mohs surgery cases.

ANSC reported by Krishnan et al was 1.07 stages. When viewed as the number of times that surgeon took a second stage, a second stage was taken in less than one of every 10 Mohs surgery cases. The Beveled Edge.References

There can be a number of reasons for an LO status. The lowest ANSC reported by Krishnan et al was 1.07 stages. When viewed as the number of times that surgeon took a second stage, a second stage was taken in less than one of every 10 Mohs surgery cases.

Being an LO could be the result of consistently taking too large a margin beyond the tumor borders defined by either curettage or visually. This is counter to the philosophy of Mohs surgery. Mohs is a meticulous margin control procedure that results in extremely high cure rates due to the thoroughness of the margin examination regardless of the size of the margin removed by the surgeon. Since cure rate does not decrease with narrower margins, Mohs is a tissue sparing procedure allowing removal of smaller amounts of normal tissue to achieve tumor cure. Taking larger than necessary margins will lead to larger defects, potentially requiring advanced wound closure procedures in a larger fraction of patients. The majority of closures should be accomplished with the less sexy, but practical, linear closures: simple, intermediate, or complex repairs. If a particular Mohs surgeon is billing for a much higher than average number of flaps and grafts, that surgeon will be flagged as a repair outlier. The combination of a low ANSC and high utilization of advanced wound closures will surely attract the attention of payers.

A second possibility is that Mohs surgery is being used for tumors that could be treated effectively with an alternate method without sacrificing cure rate. Many tumors in the Appropriate Use Criteria (AUC) H and M anatomic areas, tumors for which the AUC almost uniformly indicates a score ≥7, can be treated effectively with standard excision or electrodessication and curettage. Using Mohs surgery to treat all tumors diagnosed in H and M locations, including those that are well defined clinically and/or small and uncomplicated, can result in a very low ANSC for the Mohs surgeon. Thus, reserve Mohs surgery for those tumors you would not realistically expect to be curable by another method. Having an AUC score of 7 or higher alone is not adequate justification for the use of Mohs surgery.

A third possibility is that the Mohs surgeon is overlooking tumor when examining stage I slides. This is highly improbable since dermatologists receive adequate pathology training during residency to diagnose basal and squamous skin cancers in Mohs pathology sections. In addition, failure to diagnose a significant number of positive margins would result in an excessive recurrence rate for a particular surgeon. This is a circumstance not likely to be overlooked by the surgeon or the local community.

Lastly, two types of incorrect coding could result in an unusually low ANSC. The surgeon or billing staff could mistakenly code only the first stage of Mohs surgery. Failing to code for subsequent Mohs layers after a multi-stage Mohs surgery was performed is questionable. A different scenario could be envisioned in which the surgeon excises a tumor with a margin deemed to be more than adequate and closes the defect prior to examining the frozen section slides. The surgeon then examines the slides confirming clear margins and subsequently bills for Mohs surgery. However, that was not Mohs surgery and should not be coded as such. It was an excision of the skin cancer, closure of the defect, and frozen section examination of the margins and should be coded appropriately. Mohs is chosen as the appropriate treatment for a given tumor when clear margins cannot reasonably be predicted by using other treatment methods. If you have closed the defect before examining the microscopic sections, you are acting in a manner that indicates you are confident the margins are going to be negative and therefore cannot justify using Mohs surgery.

Reference

I would like to dispel the idea that peer review is just another task you need to perform for some bureaucrat. The ASMS Peer Review Program, which was created to provide feedback to practicing Mohs surgeons about how their Mohs technique compares to accepted norms, can be a crucial part of a comprehensive quality improvement program as it assesses the integrity of your Mohs technique. You can use it to improve the quality of your Mohs surgery by objective, honest self-assessment during peer review case selection.

The peer review instructions state that the surgeon should “personally select one case...representative of his/her best Mohs work.” Selecting the case is the most valuable part of the process. You should scrutinize each case as if you were a peer reviewer.

The following is my system for selecting cases:

- Pull 10 random 2- or 3-stage cases performed throughout the previous calendar year. My lab technician does this for me.
- Place slides in slide trays with a copy of the Mohs map for review when you’re not tired or rushed. Taking your time when reviewing for quality is imperative. If you take several minutes per case, reviewing 10 cases to choose the best one takes approximately an hour from start to finish.
- Assess the staining and sectioning of all the cases without using the microscope. Is the section quality good? Slide quality shouldn’t just be good enough for a peer review case. This case is supposed to represent your best work! After a few minutes of inspection, you should be able to rank your cases for microscopic review.
- Starting with the lowest ranking case based on its gross appearance, use the microscope to note any technique errors present. Don’t look for tumor at this point; you are only assessing section quality.
  - Perform a tissue integrity check for each wafer (see the Quality Corner entitled Inking a Specimen in the Winter 2015 issue) by assessing for intact epidermis, torn or folded tissue, holes, etc.
  - Eliminate cases that have technical problems based on the gross and microscopic review. For example, if orientation ink is not clearly visible on the entire non-epidermal edge, then the case cannot be deemed satisfactory. You should personally ink your specimens until your technique has been perfected and practiced enough to produce consistent results.
- Review the technically satisfactory cases for tumor.
  - Redraw the Mohs map without referring to the original map. Viewing the case without using the original map allows you to assess it without being biased by your original reading. After reviewing these cases for tumor, compare the new maps with the original maps. If they are consistent, you have identified cases you can submit.
- Review these cases once more to choose the most straightforward case to submit.
- Draw the submission map while looking through the microscope. Don’t use your original map drawn on the day of surgery. The reviewer will be looking at your slides, not your original map. The case is assessed based on what is seen through the microscope, not what was drawn on the day of surgery.

Hopefully, all of your cases passed the initial quality screens and you had a hard time deciding which case would be the easiest one for the reviewer. If the gross and microscopic quality checks eliminated a number of your cases, catalog the problems and formulate a remedial plan. Above all, be honest with yourself when reviewing slides without the time pressure of a surgery day.

10th Anniversary of Don’t Fry Day

This year marks the 10th anniversary of Don’t Fry Day (DFD) on Friday, May 25. The theme is “10” as in 10th anniversary. It’s not too soon to start thinking about how you can incorporate this theme into Facebook posts and Twitter tweets. For example, “Top 10 Skin Cancer Myths Busted” or “It only takes 10 minutes to get a sunburn!” Start collecting and/or creating these messages for your use in May, and kindly send them along to us.

The DFD Committee would like to partner with organizations focused on children, families, sports, and/or spring outdoor events. If you, or your organization, are working with such partners, please connect with them. Consider joining the DFD Committee; we especially need media, social media, or communication folks. It doesn’t require a lot of time or effort. If you can help, please contact John Antonishak (antonishak@skincancerprevention.org) or Carolyn Heckman (Carolyn.Heckman@fccc.edu). Thank you from the DFD Committee.
Two years ago, the members of the ASMS Peer Review Committee identified a Mohs micrographic surgery technique error in cases submitted to the Annual Peer Review Program. In order to draw attention to this particular error, the committee members formulated a case submission checklist to draw attention to what they judged to be an adequate Mohs stage following a “deep only” positive Mohs layer.

The requirement for dermis around the periphery of the stage subsequent to a “deep only” positive layer is based on principles reviewed in previous *Quality Corner* columns as well as good Mohs lab tissue preparation concepts and proper surgical practice as follows:

- Skin is a deformable material. The further a tumor focus is located from the epidermal orientation nicks, the ability to accurately locate the tumor in the defect decreases. This is especially true in the subcutaneous fat compartment where deformability is extreme.

- Layers must be excised to ensure adequate overlap of tumor identified in a tissue section. A good rule of thumb is a distance of 2 mm in all directions for an accurately identifiable site of tumor. The amount of overlap must be more generous in situations where there is less precision in locating residual tumor in the defect.

- Tumor may intersect the surgical margin in such a way that it may be extending vertically into the defect, but it may actually be extending horizontally at the same anatomic depth within the dermis around the periphery of the defect.

The last principle is one that is underappreciated by those who omit dermis from layers subsequent to certain “deep only” positive layers. A Mohs layer may have tumor at the level of the reticular dermis quite a distance from the epidermal edge of the specimen. When marked on the two-dimensional map corresponding to the layer, it may map a third or even half way to the center of the defect. However, when you perform the subsequent layer, you must keep in mind that the elastic recoil of the skin has caused the cut edge of the dermis to retract toward the outer edge of the defect. This two-dimensional to three-dimensional incongruity may make a site of residual tumor in the dermis reside on the sloped dermal wall of the defect despite the fact that you have mapped it much closer to the center of the defect on your map. If you include the sloped dermal wall of your defect in the next layer, you will not miss tumors that favor horizontal over vertical growth. Many tumors demonstrate a propensity to find a dermal depth at which they will grow horizontally very rapidly, especially in the deep dermis or at the subcutaneous interface.

In the case of a positive “deep only” layer, in which tumor is present only in fat, you should still excise the layer in contiguity with the sloped dermal wall of the defect. The inclusion of the sloped wall is necessary for several reasons. It provides your fatty tissue layer with integrity so it may be nicked and handled more easily during surgery. It precisely defines the edge of your excised fat which can then be inked for orientation in the lab. Nicking and inking the edge of a formless blob of fat is ridiculous. In this situation, the dermis serves the same purpose as the epidermis does in a more superficial Mohs layer – it definitively delineates the margin of the resected tissue with an instantly recognizable border. Its presence proves that you have excised all of the fat from the base of the defect and flattened it so the dermis is present around the circumference of the fat and the entire surgical margin is represented on the slide. Thinking in three-dimension, for a specimen composed of only fat that is not properly flattened and correctly processed, you will miss tumor that enters the fat, finds a nerve or blood vessel, and follows it out through the vertical wall of your fatty layer unseen because you don’t have any unequivocal marker to define the true margin of the specimen without that rim of dermis!

The ultimate reason to include the sloped dermal edge on a “deep only” case is that that tissue is not going to be used in the closure of the defect anyway. You should excise the sloped edge of this type of layer with your scalpel held at 90° (yes, I know the mantra is 45°, but in this particular case 90° is correct) to the surface of the skin just grazing the epidermis. This doesn’t make the defect any larger and de-bevels the epidermis. This saves you time at closure while not making the closure any larger. In the lab, the presence of the fat deep to the dermis easily permits flattening of the surgical margin for the very reason we need to include the dermis in such layers - the fat is extremely deformable.
After having reviewed several of the factors involved in achieving quality Mohs surgery—proper subdivision of a tissue layer, inking of the tissue layer, and how many clear tissue sections must be reviewed to declare a layer clear—we should next consider the metric that synthesizes all of these factors into a measurable quantity that you can use to determine whether or not your practice falls within accepted norms.

There are always going to be arguments that the difficulty of a case falls outside the “average.” I have heard these arguments numerous times as the quality officer for a health plan whenever metrics were used to compare physician performance. The only advice I can offer is that if your practice deviates significantly from the norm, you should have data to back up your opinion about the complexity of the cases you encounter should any questions arise. Hard data resolves any disputes, personal opinion does not.

The metric that has been employed with respect to Mohs surgery is “stages to clear tumor.” Stages to clear tumor is a value easily calculated from the year-end financial reports of your claims data. Even the most rudimentary practice management system can provide you with the number of times you billed for codes 17311, 17312, 17313, and 17314. If you cannot obtain these values internally, you can access the publicly available Centers for Medicare & Medicaid Services claims database to see how many times you charged Medicare for these codes in any given year. Once you have tabulated these values for the past few years, you can use the following calculations to determine trends for your practice:

\[
\begin{align*}
17311 + 17312 & = \text{Stages to Clear Tumor in High and Moderate Risk Locations} \\
17313 + 17314 & = \text{Stages to Clear Tumor in Low Risk Locations}
\end{align*}
\]

In an article by Alam et al.\(^1\), 20 early- and mid-career fellowship-trained Mohs surgeons were surveyed and the stages to clear tumor was determined for a number of surgeon-, patient-, and tumor-specific factors. The investigators found that the number of stages to clear tumor did not differ among the surveyed fellowship-trained surgeons based on the number of years in practice, number of cases performed per year, geographic region of the country, or sex of the surgeon. Anatomic location did influence the number of stages to clear tumor such that tumors of the ears, nose, and periorbital/temple area required an average of 2.06, 2.01, and 1.95 stages, respectively. The forehead and lip required 1.9 stages to clear tumor. The scalp, cheeks, and chin had values between 1.76 and 1.80 stages. Tumors in low risk anatomic locations and the neck required approximately 1.5 stages to clear. Interestingly, the data showed that fewer stages were required to clear squamous cell carcinoma (SCC) than basal cell carcinoma (BCC). Two explanations were proposed: either the surgeons were more cautious when treating SCCs and removed a larger margin of normal appearing tissue in each stage or SCCs are better defined on clinical examination than BCCs, permitting a more accurate estimation of their clinical extent.

In this sample of 2,000 tumors, 42% required only one stage to clear. An additional 41% were cleared on the second stage and 12% more were cleared on the third stage, which is a cumulative 94% tumor clearance rate after three Mohs surgery stages.

You should consider examining how many stages it takes you to clear tumor in an introspective analysis of your practice. If you find that you deviate significantly from the aforementioned values, you should evaluate your technique and especially your criteria for declaring a section clear as discussed in a previous Quality Corner. Further issues that may account for discrepancies will be discussed in future installments of the Quality Corner.

In theory, only one intact tissue section free of visible tumor is required to confirm tumor clearance during Mohs micrographic surgery. In practice, however, you cannot be that dogmatic. The confounding factors of tissue retraction, section tears, inflammation, difficulty in evaluating fat, and the presence of myriad adnexal structures can cause uncertainty in the evaluation of Mohs surgery tissue sections. We compensate for these uncertainties by evaluating multiple tissue levels of the surgical margin to ensure that a margin is truly free of tumor.

Assuming competent slide preparation, presence of tumor in the first section examined or absence of tumor in any of the tissue sections leaves no question as to whether or not the margin is clear. Cases in which tumor is seen after a number of tissue sections are free of tumor requires a decision as to how many clear sections are necessary to deem the margin to be clear. Unfortunately, there is no absolutely correct answer. In many institutions, Mohs surgery is taught with variations based on how the surgeons who are teaching it were trained. Conducting a prospective trial employing varying parameters to clarify the miniscule differences in cure rates after five years would be prohibitive. The best we can do in such a situation is to rely on survey data to establish the norms of performance for the procedure.

The question of when to declare a margin clear is complex. We all rely on our own training and experience to arrive at a criterion with which we feel comfortable. If you commit to the single clear section standard, you must closely monitor your technician’s quality and tumor recurrence rate. Minimal changes in section quality can invalidate the single clear section standard. The adoption of a standard that requires a very high number of clear sections could result in you becoming a statistical outlier with respect to number of stages to clear tumor. The average number of stages to clear tumor is an accepted quality standard that is easily generated from claims data. The latter issue will be discussed in the next Quality Corner.

The first question to address is how many tissue sections should be examined? Survey data on this question has been fairly consistent over time. A recent survey that included this question was published by Cartee and Monheit in 2013. Eighty percent of Mohs surgeons viewed between four and nine sections per tissue block. The weighted average was six tissue sections.

The number of clear sections required to declare a tumor clear varied significantly. One-quarter of the survey respondents were comfortable declaring a tumor clear with one clear section. However, nearly as many (19%) would perform an additional Mohs layer despite viewing eight clear sections before seeing tumor. Sixty percent of respondents declared a clear margin with four tumor-free sections. A trend for requiring more clear sections was evident for more aggressive tumor types such as morpheaform or recurrent basal cell carcinoma, T2 squamous cell carcinoma, sebaceous carcinoma, ordermatofibrosarcoma protuberans. A very small percentage of respondents (16%) would compromise their accepted standard and not perform an additional Mohs layer if doing so would make the resulting repair more difficult. This is congruent with the duty of the Mohs surgeon to, first and foremost, achieve cure.

Mohs Micrographic surgery is the skin cancer surgery with the highest cure rate based on meticulous tissue excision and processing methods, and the principle of contiguous tumor growth.

Although a primary non-melanoma skin cancer grows in a contiguous fashion from the point of origin, the growth direction of tumor identified on a tissue section is uncertain. The tumor may be growing radially (approximately 90° to the surgical margin) or it may be growing tangentially (close to 0°) as it crosses the surgical margin. (These principles do not apply to recurrent tumors, which will be addressed in a future Quality Corner).

The uncertainty of the direction of growth, as well as the fact that skin is a deformable material, requires the Mohs surgeon to excise a subsequent tissue layer such that it adequately overlaps tumor identified at the surgical margin to ensure that all tumor has been removed.

In her lecture on quality assurance, Sharon Tiefenbrunn, M.D., former chair of ASMS’ Peer Review Program, quantified the excision overlap necessary for Mohs layers using a mathematical proof that I will not reiterate here. Generally, the minimum overlap should be 2 mm in all directions, in both directions around the circumference of the defect as well as toward the center of the defect.

The specified 2 mm overlap assumes that you can accurately locate the area of positive tumor in the wound bed. Accuracy is dependent on the number of reference points (orientation nicks) and the deformability of the tissue.

If you only use a single orientation nick, the accuracy with which you can locate a tumor focus decreases as the tumor focus gets further from your reference mark. Using four orientation nicks (two nicks at 12 o’clock and one nick at 3, 6, and 9 o’clock) enables equal accuracy around the entire circumference of the defect and preserves orientation asymmetry for inking as discussed in the Quality Corner entitled Inking a Specimen. Orientation nicks heal without scarring if they are incised into the superficial papillary dermis so there is no disadvantage to using four nicks, or more if the layer is large or involves complex anatomic structures.

If the tumor focus is in subcutaneous fat or the wound bed consists of fat at the location deep to an identified tumor focus, the overlap must be considerably larger. Since fat is extremely deformable, the accuracy of locating a residual tumor focus is poor.

This is especially true for a “deep only” positive Mohs layer. In the case of a “deep only” layer, prudent excision of the next layer would dictate excising the entire expanse of subcutaneous fat in the defect in contiguity with the beveled dermis around the circumference of the defect up to the epidermis. This dermal tissue is sacrificed in the process of de-beveling the defect for repair. Its excision and examination unequivocally demonstrates that all of the subcutaneous fat in the defect was excised and examined.

An instant quality check of overlap adequacy can be performed by placing a second stage slide on top of a first stage slide superimposing corresponding orientation nicks and locating the epidermis of the second stage slightly outside that of the first. By focusing up and down through the sections, you can determine whether you have indeed overlapped by the recommended 2 mm or more.
Absence of Tissue Does Not Prove Absence of Tumor

The guiding principle of Mohs surgery is microscopic examination of 100% of the surgical margin. As mentioned in a previous Quality Corner column, the Mohs surgeon must remain ever vigilant for lapses in technique that may lead to a recurrence. Only by examining 100% of the surgical margin can the integrity of the Mohs technique be guarded.

The Mohs surgeon’s duty is to ensure that the entire surgical margin is examined.

- The technician’s responsibility is to ensure that the tissue block is not faced excessively, the tissue sections are not shredded, and there are no tissue holes.

- It is the responsibility of the surgeon to note absent epidermis, holes in the dermis, or shredded fat on the slides provided. If any of these are present, the surgeon should request recuts.

- If the defect does not “fill in” on the recuts, then another layer must be excised and examined.

An analysis of 33 tumors that had recurred after 2,414 cases of Mohs surgery at an academic center during a 4-year period emphasizes the importance of examining 100% of the surgical margin. In this study1, the time to recurrence was between 5.5 and 104 months with a mean of 38 months. Notably, 20% of the recurrences occurred more than 5 years after Mohs surgery.

In 77% of the cases, an error was identified on slide review:

- 30% - Epidermis was missing in the final margin
- 20% - Tumor cells were identified in the final margin
- 10% - A defect in the dermis/fat in the final margin
- 10% - Overlap was inadequate
- 7% - 2 squamous cell carcinoma cases had inflammation in the final margin

In 23% of the cases, an error in the interpretation of the case slides could not be identified. In these cases, Mohs surgery had been used to treat a tumor that had recurred after a non-Mohs treatment. Tumor presumably recurred from a non-contiguous tumor focus within the original treatment scar. Thus, if a scar is present in the surgical margin, another layer should be excised to encompass the scar. In summary, 40% of the time absent tissue is responsible for tumor recurrence.

Your surgical technique must ensure that the layer has no dermal/fat holes and has encompassed the epidermal curettage defect. The layer thickness must permit proper processing. Excise too thin a layer and tumor-containing tissue can be faced off the block; too thick a layer causes tissue retraction and difficulty sectioning the margin. In any case where tissue is absent after thorough review of the slides, the surgeon must order recuts or excise an additional Mohs layer.

If you are not seeing complete tissue layers on your first stage slides on every case, take a critical look at each step in the processing: preoperative marking of the site, debulking, excised layer integrity and thickness, tissue inking/subdivision, embedding, and facing the block through to the number of sections discarded between sections placed on the slides. If you find a systematic error, correct it and you will be rewarded with better quality sections requiring less microscope time to fully examine.

Never rely on an absence of tissue to assume an absence of tumor. Prove the absence of tumor by visualizing tumor-free tissue in 100% of the surgical margin.

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Properly inking a micrographic surgical specimen was reviewed in the Quality Corner published in the Winter 2015 issue of The Beveled Edge. The figures accompanying that column demonstrated that inking becomes more complex, and thus more likely to introduce error, as the number of tissue blocks increases. Tissue embedding, processing, and microscopic review also are more difficult with multiple tissue blocks. In the intricate series of steps that constitutes Mohs micrographic surgery, any one of which can introduce error, how can we reduce potential sources of error? First and foremost, Leonard Dzubow, M.D., suggests “to the physician using the Mohs technique ... to never relax, to be on guard, to be suspicious. If any component of the Mohs technique is flawed, the chain breaks and the procedure becomes invalid and unreliable.”(1)

In practice, error can be minimized by dividing each tissue layer into the minimum number of tissue blocks that will fit on a microscope slide. A brief, well illustrated article entitled Mohs math—where the error hides (2) clearly demonstrates this principle. The free open access article may be found at: http://bmcdermatol.biomedcentral.com/articles/10.1186/1471-5945-6-10.

The authors use a mathematical model to analyze errors introduced by dividing a specimen into multiple blocks. The errors addressed include compression or squash errors, tip or edge lift errors, and the edge roll error. These errors should be readily detected by meticulously inking the edges of a divided specimen such that dye does not migrate onto the surgical margin of the specimen. When reviewing sections under the microscope, the absence of marking dye on the edge or tip of a tissue section would indicate lift errors and tissue “outside” the ink would reveal a squash or edge roll error. Nonetheless, you should be wary of introducing error when you process a Mohs layer.

Ellis et al. make a strong argument for dividing Mohs layers into the minimum possible number of pieces. This minimizes the creation of edge and tip tissue that could be displaced when embedding and sectioning the tissue. In fact, leaving a specimen in one piece almost completely eliminates these errors by not creating any problematic edges. By extension, if a specimen is left in one piece, the incision in the “Pac-man” should only be made long enough, accompanied by any necessary relaxing incisions in the top of the specimen, to allow the surgical margin to be flattened into a single plane for sectioning. If the specimen cannot be properly flattened, or if it is too large to be placed on a slide as a single piece, divide it into appropriately sized pieces and follow the tenets of proper inking technique to ensure you can identify any errors that can be introduced by the non-epidermal edges you created.

Investing time to ensure that a specimen is properly flattened will save time at the microscope because your sections will have a complete epidermis and no holes in fewer levels. Remember to perform an edge integrity assessment and insist on intact tissue layers to achieve the incomparable reliability of the Mohs technique.

In order to accomplish the second objective, you must place ink on the entire non-epidermal edge of the specimen. To adequately delineate a non-epidermal tissue edge, whether it is the deep notch used in a “Pac-man” specimen or the incisions dividing a layer into two or more pieces, carefully place the dye along the entire non-epidermal edge of the tissue, not just on a small area adjacent to the epidermis. Care should be taken to prevent ink from migrating onto the deep surface of the specimen. This is accomplished by placing the specimen on filter paper, rather than gauze; the moist tissue adheres to the absorbent paper creating a seal that prevents the dye from wicking under the edge. It creates a sharp line of dye outlining the non-epidermal edge. You can apply the ink freehand or while the specimen is sitting on the gauze, but it is significantly more difficult to prevent dye spread onto the deep surface.

Meticulous inking enables you to conduct a specimen edge integrity assessment for each block as follows: First, scan the epidermal edge for completeness. Next, confirm that the non-epidermal marking dyes touch the epidermis at both ends. Finally, assess whether the non-epidermal edge marking dye is continuous from one epidermal contact point to the other. Once you use this systematic edge assessment to confirm that the edges are intact, and in an orientation corresponding to the map, you can assess the completeness of the tissue layer and whether tumor is present.

In summary, the entire dermal/fat edge must be marked with dye so that it can be clearly identified as “the edge” and “which edge” when slides are reviewed. The only edge that “marks itself” is the epidermis and therefore it does not require inking. If a specimen is left in one piece, dye only needs to be placed in the reference nicks to orient the specimen. Since the epidermis completely encircles such a specimen, it delineates the entire peripheral margin without ink.

If your specimens cannot routinely pass the specimen edge integrity assessment outlined above, you should personally ink specimens until your system achieves a high level of consistency. Once you reach that point, you will have achieved the level of specimen preparation that makes Mohs micrographic surgery the most reliable method of skin cancer excision.