Slow Mohs Micrographic Surgery and the Role of the Pathologist
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In 1941, Frederick Mohs described an innovative surgical technique for the treatment of various cutaneous neoplasms that combined staged excisions with intraoperative histologic assessment of margins on frozen section. Known as Mohs micrographic surgery (MMS), this technique is the only procedure for skin cancer that assesses 100% of the surgical margins and integrates the roles of surgeon and pathologist under one physician specifically trained in MMS, which commonly include dermatologists, ophthalmologists, and otolaryngologists. This procedure yields cure rates that exceed those of other modalities and allows for maximal conservation of the surrounding healthy tissue. A modified variant of MMS, known as “slow MMS,” incorporates the expertise of a dermatopathologist rather than the MMS surgeon to assess margin status on formalin-fixed, paraffin-embedded (FFPE) tissue. Slow MMS is essential for the evaluation of margin status in skin tumors that are difficult to assess histologically on frozen section, such as melanoma, dermatofibrosarcoma protuberans (DFSP), and sebaceous carcinoma.

Indications for MMS and slow MMS are well established and include tumors of the central face, nose, lip, and periorbital region; tumors larger than 2 cm in diameter; tumors with aggressive histology; tumors in immunosuppressed patients; and those tumors arising in irradiated skin. Prior to excision, the MMS surgeon marks clinical margins varying from 1 to 3 mm around the cutaneous lesion. After local anesthesia is applied and the tumor is debulked, the first staged excision is performed with the scalpel blade beveled at a 45° angle to allow for flattening of the peripheral margins so that the deep margin and peripheral margins can be assessed in one continuous plane upon horizontal sectioning. Alternatively, a 90° angle excision can be performed with the peripheral margins assessed as separate tissue specimens. In MMS, the excised tissue specimens are mapped by photographs or hand drawings and inked for anatomic reference prior to being frozen (Figure 1). The frozen tissue is then cut into thin histologic sections, placed onto slides and stained with hematoxylin and eosin (H&E), and microscopically assessed for tumor presence at the margins by the surgeon. If a margin is positive, the anatomic location is determined by comparing the inked area and specimen map, and additional tissue is taken from the corresponding anatomic area on the patient. If margins are negative, subsequent reconstructive closure of the postexcision defect is performed. The entire MMS procedure is usually performed within one day.

Slow MMS requires the expertise of a dermatopathologist in order to accurately assess the margins of tumors that are difficult to identify on frozen section, including malignant melanoma, DFSP, and sebaceous carcinoma. Due to inherent artifacts present on frozen section, these lesions can be challenging to identify in the following ways: differentiating melanoma from atypical melanocytic hyperplasia found on sun-damaged skin, identifying thin strands of DFSP that are characterized by bland spindle cells infiltrating subcutaneous fibrous septa in a storiform pattern, and assessing the presence...
of pagetoid spread in the epidermis in cases of sebaceous gland carcinoma. Clear histopathologic morphology provided by FFPE tissue, as opposed to frozen tissue, is necessary for adequate margin assessment in these types of lesions (Figure 2). Clear and accurate communication among the pathologist, histotechnician, and surgeon is essential in order to determine which specific anatomic location requires additional re-excision for adequate tumor clearance. Unlike traditional MMS, which can be completed within one day, slow MMS may take several days to complete due to the need for processing of FFPE tissue and margin assessment by the dermatopathologist. Nevertheless, the diagnostic accuracy provided by slow MMS is vital when managing patients with difficult lesions.

In summary, MMS is an invaluable surgical technique for the treatment of skin cancer. By combining staged excisions with histopathologic assessment of frozen section margins, MMS maximizes conservation of the surrounding tissue and provides superior cure rates. Slow MMS is a modified variant of MMS that requires the expertise of a dermatopathologist in order to assess margin status on FFPE tissue for cutaneous malignancies, which are difficult to identify on frozen section. Collaboration among the dermatopathologist, histotechnician, and surgeon is of paramount importance in the successful management of the patient undergoing slow MMS.

**Figure 1.** Mohs mapping of clinical margins and anatomic location in situ. Photograph courtesy of Deborah L. Cook, MD, Department of Pathology, Fletcher Allen Health Care, University of Vermont, Burlington, Vermont.
Figure 2. Slow MMS section of melanoma in situ present at a peripheral margin. Photograph courtesy of Deborah L. Cook, MD, Department of Pathology, Fletcher Allen Health Care, University of Vermont, Burlington, Vermont.

References