DERMATOPATHOLOGY

Validation of diagnostic accuracy with whole-slide imaging compared with glass slide review in dermatopathology

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Background: Teledermatopathology has evolved from static images to whole slide imaging (WSI), which allows for remote viewing and manipulation of tissue sections. Previous studies of WSI in teledermatopathology predated College of American Pathologists (CAP) telepathology validation guidelines.

Objective: We conducted a comprehensive retrospective WSI validation study of routine dermatopathology cases, adhering to CAP guidelines.

Method: In all, 181 consecutive cases arranged into 3 categories (inflammatory, melanocytic, nonmelanocytic proliferations) were reviewed by 3 board-certified dermatopathologists via traditional microscopy (TM) and WSI. Intraobserver (TM vs WSI), TM intraobserver and interobserver (TM vs TM), and WSI interobserver (WSI vs WSI) concordance was interpreted using a 3-tier system.

Results: TM versus WSI intraobserver concordance (86.9%; 95% confidence interval [CI] 83.7-89.6) did not differ from TM versus TM intraobserver concordance (90.3%; 95% CI 86.7-93.1) or interobserver concordance (WSI: 89.9%; 95% CI 87.0-92.2, and TM: 89.5%; 95% CI 86.5-91.9). Melanocytic proliferations had the lowest TM versus WSI intraobserver concordance (75.6%; 95% CI 68.5-81.5), whereas inflammatory lesions had the highest TM versus WSI intraobserver concordance (96.1%; 95% CI 91.8-98.3). Nonmelanocytic proliferations had an intraobserver concordance of 89.1% (95% CI 83.4-93.0).

Limitations: Efficiency and other logistical WSI parameters were not evaluated.

Conclusion: Intraobserver and interobserver diagnostic concordance between WSI and TM was equivalent. Therefore, WSI appears to be a reliable diagnostic modality for dermatopathology. (J Am Acad Dermatol http://dx.doi.org/10.1016/j.jaad.2016.08.024.)

Key words: concordance; dermatopathology; inflammatory; interobserver; intraobserver variability; melanocytic; nonmelanocytic; validation; variability; whole slide imaging.

Technology has catalyzed the evolution of telepathology from the use of static (store-and-forward) images to real-time video streaming and more recently whole slide imaging (WSI).[1,2] Unlike static photographs and real-time imaging, WSI scans entire slides at various

Abbreviations used:

CAP:	College of American Pathologists
CI:	confidence interval
IHC:	immunohistochemical
TM:	traditional microscopy
WSI:	whole slide imaging

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magnifications allowing the observer the ability to select and zoom to areas of interest via a digital interface. The field of dermatopathology has a novel opportunity to use telepathology, so-called "teledermatopathology," because of its frequent need for subspecialist expert consultation, small specimen sizes, low slide counts, and overall high case volume.[3] WSI has been evaluated in dermatopathology as a tool for routine interpretation, remote consultation, research, education, and collaboration.[3-19] Studies that used WSI reported a 75% to 93.2% concordance with traditional microscopy (TM).[3,10-12,14-16,20] Leinweber and colleagues,[10] evaluating 560 melanocytic lesions by WSI and TM, found a 93.2% concordance when using a binary benign or malignant scoring system.[10] In a smaller but diverse case series by Al-Janabi et al,[16] authors found a lower overall concordance, 73% to 96% per reviewer. These early studies in the field of teledermatopathology illustrate proof of concept, but may not reflect a clinically relevant method of practice that also accounts for interobserver and intraobserver discordance with TM alone, making interpretation difficult.

The College of American Pathologists (CAP) recently published standardized guidelines for validating telepathology systems, with the goals of reducing recall bias, diagnostic errors, and creating awareness among end users of these systems in clinical practice.[2]

Of the multiple studies on teledermatopathology published to date,[3-29] all predated the CAP guidelines for telepathology validation. The primary objective of this study is to validate the use of WSI in the primary diagnosis of routine dermatoses encountered in daily dermatopathology practice, using the recently published CAP consensus guidelines.

CAPSULE SUMMARY

- Whole slide imaging is a digital imaging technology that allows for remote viewing interpretation of slides.
- This study demonstrated high intraobserver and interobserver concordance in the interpretation of whole slide imaging and traditional microscopy for dermatopathology cases.
- Although larger, confirmatory studies are needed, whole slide imaging may offer diagnostic equivalence to traditional microscopy in dermatopathology.

METHODS

Study design

The study was approved by the institutional review board as minimal risk protocol (IRB12-008844) and followed the recommendations outlined by CAP (Table I).[2] Three board-certified practicing dermatopathologists participated as reviewers for this study (L. E. G., J. S. L., C. N. W.) and retrospectively reviewed cases using TM and WSI modalities. Reviewers were blinded to the original diagnosis. The primary outcome measure was degree of diagnostic concordance between modalities (TM vs WSI). Secondary outcome measures included: intraobserver and interobserver concordance of TM versus TM, and interobserver concordance of WSI versus WSI. Fig 1 illustrates the study design. The rationale for intraobserver agreement (TM vs TM) was to document the variability inherent in our current practice and as a comparison with TM versus WSI. Interobserver agreement (TM vs TM and WSI vs WSI) served to highlight any potential error or bias introduced by the diagnostic modality. All participants underwent training before proceeding with digital interpretation. An 8-week washout period was observed between modalities. The washout was increased from the CAP minimum recommendation of 2 weeks to reduce recall bias.[2] Each participant independently reviewed cases and recorded his or her diagnoses. A secure digital database (Access, Microsoft, Redmond, WA) was designed to mimic a laboratory information system. Each case reproduced the patient demographics and clinical information that would be present on the pathology requisition form; however, no clinical images were made available because of variable availability. Intraobserver (TM vs WSI and TM vs TM) and interobserver (TM vs TM and WSI vs WSI) diagnoses were compared and consensus diagnosis derived by the majority TM diagnostic opinion.

Case selection

A total of 181 cases were included for this study. To mirror clinical practice, a consecutive series of completed dermatopathology cases were examined and sorted into 3 categories evenly: inflammatory, melanocytic, and nonmelanocytic proliferations. Inflammatory category included examples such as psoriasiform and interface dermatitis diagnoses. Melanocytic category included various types of nevi, atypical nevi, melanoma in situ, and melanoma. Nonmelanocytic cases included benign and malignant keratinocytic lesions, such as seborrheic keratosis and squamous cell carcinoma. Cases were excluded if received for consultation, re-excision, duplicate diagnoses from a single patient, or did not