Research

The Technicians´ Role in Digital Pathology Implementation.

Searching Optimization

E. Alcaraz-Mateos¹, I. Tortosa-Martínez¹, C. Alcolea-Guardiola¹, S. Estévez-Ligero¹, Á. Abellán-Palazón¹, A. Kundisova², A. Nieto-Olivares¹, A. Chaves-Benito¹, E. Poblet³.

Affiliation:
1- Pathology Department, Morales Meseguer University Hospital, Murcia, Spain.
2 - Faculty of Medicine, University of Bratislava, Slovakia.
3 - Pathology Department, Reina Sofía University Hospital, Murcia, Spain.

Abstract

Background: Scanning histological or cytological preparations is a crucial element in the process of digitization of Pathology Departments, along with the traceability of tissue samples and the reports management. The scanning time and the high size of the files are still considered suboptimal for full implementation. In order to optimize time and space a comparative study of the workflow performed by histotechnicians in our center has been carried out.

Material and Methods: A total of 25 endoscopic samples were selected with the intention of comparing different parameters (scanning time, error rate during scanning and hard disk storage) between the original histological glass slides (group A: 2 slides per case, 50 preparations) and new sections, with levels grouped into a single slide (group B: 1 slide per case, 25 preparations). They were scanned at 20x magnification in routine way using the Ventana iScan Coreo scanner (Roche diagnostics). The process was repeated 4 times to calculate averages.

Results: The average scanning time was 5 hours 40 minutes (6m 48s / slide) in group A and 5 hours 10 minutes (12m 24s / slide) in group B. The error rate was 6.1% in group A and 3.8% in group B. The space occupied on the hard disk was 11.87 GB in group A and 9.6 GB in group B (475 MB/case vs 385 MB/case, respectively). The average number of tissue sections per case was 7 in group A and 8 in group B.

Conclusion: There is a clear benefit of standardizing and optimizing the number of cuts per slide in terms of storage (saving 19%), biopsy sampling (14% more tissue) and error rate (37% less), including a not negligible decrease in the scanning time (9%) in the study conducted.
Introduction

The digitization of Pathology Departments is an inexorable fact, and it is only a matter of time before implementation becomes more widespread, as happened years ago in Radiology Departments [1-4]. The technical aspects are being examined and approval by the FDA is imminent for clinical use [5-6]. Regardless, there are already many hospitals that have incorporated this technology. Similarly, there are guidelines of sufficient weight so that this natural evolution in our field is not further hindered [7-9].

One of the aspects which slows down this implementation, is that of cost-benefit [10]; however, this also happened with our colleagues in Radiology [11]. On the other hand, the images created require a storage solution that seems to fall short for many hospital IT Departments.

Just as mechanisms for resource optimization for the storage of images are being studied [12], we have considered how to optimize this content in our department.

Here, Histotechnicians (HT) or also Pathologists’ Assistants (PA) come into play as the key to handling the tissue samples. One way to optimize them may be evident - it involves grouping the maximum amount of tissue in a single glass slide instead of several slides. This can only be done with tissue samples of small size such as endoscopic, gynecological, skin and others, representing a large percentage of input in Pathology Services. Thanks to the skills of the histotechnicians, optimization can be achieved while processing biopsies.

Material and Methods

A total of twenty five endoscopic samples (5 esophageal, 5 gastric, 5 duodenal, 5 inflammatory colonic, and 5 neoplastic colonic) were randomly selected with the intention of comparing various parameters including scanning time, error rate during scanning and hard disk drive storage. The original histological slides (group A, where there were two glass slides per case, i.e. 50 glass slides) were compared with new sections where the levels or depth of the cuts would be grouped onto a single slide (group B, one slide per case, i.e., 25 glass slides) <Figure 1>. This does not happen by default, given the differences in sample handling between histotechnicians. A scan from both groups was performed separately, and the process was repeated 4 times to calculate averages. The scanner used was a Ventana iScan Coreo (Roche Diagnostics) and cases were digitized at 20x magnification in routine mode <Figure 2>.
Results

The average time to digitize the preparations for group A was 5 hours and 40 minutes (range 5h18m - 6h25m, $\bar{\sigma} = 26$), which means 6 minutes and 48 seconds per slide and 13 minutes and 36 seconds per case, while for group B it was 5 hours and 10 minutes (range 4h18m - 6h25m, $\bar{\sigma} = 28$), or 12 minutes and 24 seconds per slide and/or case.

Figure 1 – Histotechnicians’ workflow: a) Microtome tissue sectioning. b) Placement of the tissue sections on a glass slide. c) Slides from the group A (left) and B (right).

Figure 2 – iScan Coreo scanning system.

The error rate for the study, which was slightly higher than that which was found in previous tests (2-3%), was 6.1% in group A (range 1.9 to 12.3%, $\bar{\sigma} = 3.9$) and 3.8% in group B (range 0 to 10.7%, $\bar{\sigma} = 3.6$). Those preparations which were not digitized (failure to take the slide) or which after scanning were not possible to view or diagnosis due to blurred or fragmented
images were included in the error rate. On some occasions, these errors required a simple rescan or needed opening and checking the slide (label and cover glass) once or more per round, resulting in a longer time, which was recorded.

The space occupied on the hard drive was 11.87 gigabytes in group A (475 megabytes / case) and 9.6 gigabytes in group B (385 megabytes / case), without identifying variations between scans (fields detected automatically were the same as the scanned area).

Additionally, a count of the number of sections included on each slide was carried out to objectify the sampled tissue for study under the microscope. There were 7 sections of tissue in group A and 8 in group B.

The results obtained with this simple study demonstrate a clear benefit to standardizing the work of histotechnicians in the sense of optimization, with improvement in all aspects studied. Through the implementation of such standardization in the process of creating the slide we achieved the following results: hard disk storage, with a percentage improvement of 19%; the volume of the tissue sample to be studied, with a 14% increase; a reduction of 37% in the error rate; and a reduction in scan time of 9%.

The impressions of histotechnicians who participated in this study to standardize the elaboration of slides were those of a necessity of experience and skills, as well as greater concentration, while the reduction in the number of slides by half was a perceived benefit from the perspective of the physical effort required for processing and storage.

Figure 3 – Percentage improvements.
In the same way, a similar methodology was used to improve slide efficiency in the field of dermatopathology, which affected not only the Histotechnicians when preparing paraffin blocks, but also during the process of manipulating skin samples doing the gross (carried out by pathologists, pathologist assistants or technicians).

Overall, the workload generated in our department during 2015 was estimated. By grouping endoscopic and cutaneous samples together using the new methodology, a potential reduction in the number of slides by up to 14%, from 66.701 to 57.529 hematoxylin-eosin slides was objectified.

**Discussion**

Years ago, radiologists had to face a similar change that pathologists are now confronting: the evolution of imaging to the digital format. For them, Digital Radiology or “Filmless Radiology” represented a definite improvement. We have the opportunity to participate in this implementation, trying to provide a benefit for all parties: for the patient, but also for professionals and managers. In this sense, we can carry out at the personnel level in our centers, optimization strategies that can lead to significant savings. We have learned from this single study, in which measures of standardization in the preparation of slides by the histotechnician lead to an improvement in all aspects analyzed, including the physical space saving due to the reduction in the number of slides. Further, at the level of sample handling during the gross examination, the pathologist or pathologist assistant also have the ability to optimize embedded tissue cassettes, thus, creating a circuit in which, without prejudice to the patient and to the study of their tissue sample, the health system is benefited. All this despite the automation of slide processing systems recently developed (i.e. SmartSection Tissue Tek, Sakura), since the human factor will continue to have a major role in pathology services.

Although digitizing an entire department is not necessary to undertake these standardization and efficiency measures described in this paper, in our particular case, where time and space saving and optimization measures had never been seriously considered, it has served to modify the workflow in this regards and achieve resource optimization.

**References**
