



DIGITAL SCANNING OF HISTOLOGICAL MICROSCOPIC SAMPLES FOR THE PATHOLOGY TRAINING NEEDS OF THE STUDENTS OF MEDICAL UNIVERSITY OF PLOVDIV

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Abstract:

With the advent of digital scanners for whole microscopic slides, tissue histopathology images can now be digitized and stored in digital image form. In this way, we can give new life to the archived and collected tissue samples with such diligence and care by generations of pathologists from MU-Plovdiv for the production of microscopic study slides for the education of students of medicine, dentistry and pharmacy. Once digitized, the images will provide many additional possibilities for archiving, for transfer, for consultations, for additional processing, including by artificial intelligence, for more accessible education for students. Digital pathology provides an opportunity to create a new model of training and demonstration of training materials.

The aim of the project is to transform the standard microscopic preparations into digital images and store them in high quality and resolution in the Data Center of the Medical University of Plovdiv. There is still no routine use of high-quality scanned materials in mass teaching work in universities in Bulgaria, while they have been used in daily clinical practice in a number of European countries for decades.

Innovative digital methods of imaging and analysis enhance opportunities to raise student interest in learning morphological disciplines such as pathology in an interactive environment. Digital pathology also provides an opportunity to prepare a rich array of databases for demonstration and development of new teaching aids, exam tests and conducting training seminars with other departments and universities. The current project provides an opportunity to prepare a methodology by which digital pathology can be introduced widely into teaching practice, something that is lacking nationally.

1. INTRODUCTION

Anatomy and pathohistology are core educational disciplines in the curriculum of medical universities around the world. A good knowledge of mic-

roscopic images in anatomy and histology is essential for medical education and knowledge.

Since the middle of the 19th century, light microscope preparations have been used and each student

works with an individual microscope in practical exercises. At the beginning of the 20th century, projectors were introduced on the market, with the help of which microscopic images can be projected onto a screen. This method has been used in practice for quite a long time.

The Covid-19 pandemic led to the cancellation of face-to-face learning and changed our idea of learning in a classroom and in front of a microscope and on a blackboard. We teachers were challenged to create an environment in which students could continue their studies without the use of microscopes and preparations in the microscope rooms and without the presence of a teacher. Online platforms were introduced, where exercises were conducted using presentations and comments, with remote presentation and testing.

2. DIGITAL TRANSFORMATION

Virtual microscopy is an emerging technology that provides a physically remote learning opportunity for histology and pathoanatomy. It involves digitally photographing tissue sections on slides using one or more microscope objectives in one or more focal planes. The software reproduces high-quality images with precise clarity and added features that allow students and educators to highlight, annotate, and zoom in on the image.

Using computer software these images can be viewed on a monitor. Magnification and focus can be adjusted by clicking the mouse buttons. With the advent of digital scanners for whole microscopic slides, tissue histopathological images can now be digitized and stored in digital image form.

In this way, we can give a new life to the tissue samples archived and collected with such diligence and care by generations of pathologists in the Department of General and Clinical Pathology of the Medical University of Plovdiv for the production of macroscopic and microscopic teaching preparations for teaching medical and dental students and Pharmacy, as well as to the students of the College of Medicine.

We may eliminate the need for physical transport of materials and preparations between different laboratories and units, which in a number of surveys is reported as a problem in our health system and leads to delays in making the final diagnosis in patients at risk and in starting therapy.

2. 1. INNOVATION AND APPLICATIONS

Digital scanning in pathology represents the transformation of hundreds of glassy and difficult-to-store archival preparations into a digital image with high image resolution. The biggest advantages of this method of image transformation and storage are the ability to view, analyze, and share images electronically, which allows pathologists to work more efficiently and collaborate with their colleagues. One significant positive of digital scanning is the ability to improve diagnostic accuracy. Still challenges to digitization are the price range, the availability of servers for storing a large volume of information, the introduction of cloud technologies, and last but not least – the training of personnel to work with new technologies and their application in real practice.

With the availability of a large array of variables, combined with sophisticated imaging and analysis techniques, it will be possible to review digitized tissue sections. Once digitized, the images will provide many additional possibilities, for archiving, for transfer, for consultations, for additional processing, including by artificial intelligence, for more accessible training for students.

The goal of the project is to transform standard microscopic preparations into digital images and store them in high quality and resolution in the Data Center of MU-Plovdiv.

There is still no routine use of high-quality scanned materials in mass scientific work at universities in Bulgaria, while such materials have been used in daily clinical practice in a number of European countries for a decade.

The daily application of this software, in turn, will provoke ideas and proposals from the assistants and postdoctoral fellows in the department related to its expansion and improvement. This will increase the qualification of both the teaching, research and treatment-diagnostic activities of the staff of the Department of General and Clinical Pathology.

Preparations will be prepared with strictly defined dimensions of the slide, with the absence of artifacts or air bubbles.

They will be scanned using a digital scanner. Then they will be compressed into images and uploaded to a common virtual platform. Thus, a digital collection of histological and pathohistological preparations will be created.



Scanned images will be sorted and grouped by type. They will be accompanied by a description with the most important characteristics of the given tissue and keywords, in which hyperlinks are incorporated. They will take the student to the corresponding structure.

2. 2. BENEFITS OF VIRTUAL MICROSCOPY

Advantages of virtual microscopy are the ability to enlarge the image and visualize details of the studied tissue, with the possibility of learning and checking the acquired knowledge through test questions.

The possibility of creating databases and developing a new approach to training and diagnosis in pathology creates enormous opportunities for a renewed model of training for specialists, specialists and students.

The development and implementation of this project will provide new perspectives for training, research projects, publications and presentations of study preparations to students, at conferences and seminars. Virtual microscopy represents a modern tool with increased quality and advantages in pathology training.

This project is the first of its kind in Bulgaria and will greatly contribute to the implementation of virtual microscopy and the digitization of pathology training.

Digital scanning in pathology represents the transformation of hundreds of glass and difficult-to-store archival slides into a digital image with high image resolution. The biggest positives of this image transformation and storage method is the ability to review, analyze and share electronically, allowing pathologists to work more efficiently and collaborate with their colleagues.

The construction of a new platform on the MU-Plovdiv website with microscope slides will arouse their interest and allow remote access to these images and their description. Even the students themselves can propose new ideas for their integration in the development of research topics in pathology based on digital imaging and analysis.

The presence of a biopsy slide scanner and image analysis software will allow for multidisciplinary meetings and discussion of interesting and difficult cases with fellow pathologists from other university

units and from various hospitals in the country and abroad.

Conditions will be created for teamwork between pathologists and specialists from different teams for multidisciplinary scientific developments.

The project will also enable students to become familiar with the nature of scientific work and the presentation of microscopic preparations, and this will increase their opportunities for future professional realization.

As a result of this project, conditions are being created for future cooperation with scientific research organizations at the international level for discussion, consultations and cooperation and inclusion in scientific digital networks, with the expansion of the scope of scientific research.

3. CONCLUSIONS

A review of the literature on digital scanning in pathology found a growing body of evidence supporting precision in diagnostic accuracy, workflow efficiency, and educational application. Studies note the potential of scanning to enhance material preservation, distance consultation, and interdisciplinary collaboration and discussion. The integration of increasingly sophisticated artificial intelligence aims for automated analysis, faster diagnosis, and prognostic predictions. The challenges are around product cost, regulatory norms, standardization and validation, and wider use.

Studies have shown that digital pathology can reduce the chance of errors related to fatigue or other factors that reduce quality of work and increase time to diagnosis. Digital images can be magnified and analyzed, allowing for the visualization of small details that may be missed in daily practice. This method of archiving biopsy images significantly reduces the time required to cover, store, and archive conventional microscope slides.

Pathologists can access these digital images from anywhere with just an internet connection, eliminating the need to physically transport materials and preparations between different laboratories and units, which has been reported in a number of surveys as a problem in our healthcare system and leads to delays in placing the final diagnosis in patients at risk and to initiate therapy. This enables difficult cases to be discussed, shared in diagnostic groups, and the patient pointed in the right direction expeditiously.

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