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The Evaluation of Homegrown Digital Scanner as Learning and Assessment Tool of Hematoxylin and Eosin Stained Slides in Pathology Residency

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Abstract: ***Traditionally, pathology residency education relied mainly on the examination of glass slides. However, this approach has its own set of drawbacks. The arrival of digital pathology and whole slide imaging machines at affordable rates opens up new opportunities in the world of pathology residency training. To assess the utility and significance of low-cost digital slide scanner as learning and assessment tool in pathology residency. 120 digital slides are used in assessment, aided with formative and summative assessment. 28 residents of pathology. The participants were equally divided into 3 groups based on the year of residency. Each session reviewed whole-mount scanned images that were zoomed to high power to demonstrate specific pathological findings in a stress-free, engaging, learning environment with simultaneous group/peer learning. The mean of the post-slide review test collected at the end of each session was calculated for each participant. Summative assessment score was correlated with the mean post-slide review test calculated earlier. Digital pathology education has shown its effectiveness in residency education and is a valuable asset in the hands of a fine mentor. WSI can be an effective tool for training residents in pathology.***

Keywords: Morphle, Digital Pathology, Medical Education, Residency, Mentor

1. Introduction

Since the beginning of pathology residency, it's always been a mentor mentee model of teaching, extensively relied upon face-to-face teaching, handling and reporting of day-to-day cases and laboratory related issues (1) The arrival of digital pathology and whole slide imaging machines at affordable rates opens up new opportunities in the world of teaching particularly in the new era of COVID-19 with its social distancing and remote working capabilities (2). The digital pathology and whole slide scanner come with its unique sets of hurdles including monetary factor, storage and archival issues & learning curve of the mentors (3, 4).

In recent years the affordability of the whole slide scanners has increased substantially due to improvement in technology and the availability of low-cost homegrown whole slide scanners. The Digital Pathology Association (DPA) has been advocating the use of digital slides for a wide range of purposes, including residency training, continuing medical education and interdepartmental lectures (5, 6). Since the pandemic and the nationwide lockdown followed it put an enormous and undue stress on the health care system, doctors and their residents. The medical education took a huge toll in it too, particularly classroom teaching including face to face teaching, to be precise microscope side teachings. This paved the way for the virtual arena where online lectures, social media teaching and webinars take the role of time-tested teaching methods (7).

The aim of this study was to assess the effectiveness of Morphle, a low-budget, cost-effective whole slide scanner that is explored as an ideal tool for continued learning and assessment in pathology residency.

2. Materials and methods

After the Institutional ethical committee approval, the study started with total participants of 28 residents of pathology. The participants were equally divided into 3 groups based on the year of residency, 10 of year-1(Z1-Z10), 8 of year-2(Y1-Y8) and 10 of year-3(X1-X10). The study was a prospective study, Six surgical-pathology glass slides sets (Each 20 slides) were scanned in the home-grown slide scanner - Morphle Optimus 6T (Figure-1). Each whole-mount scanned case-slide was presented as an interactive group discussion. At the end of each session the residents were evaluated based on the performance in the slide discussion (post-slide review test) as formative assessment. Sixty representative screen shots of the scanned images selected by the investigators were used in the evaluation of the residents as final summative assessment. Student feedback questionnaires and self-reflective learning documents were obtained. (Table - 1).

3. Results

The scanning of each twenty-slide-set took 2.5 hrs. Each session reviewed whole-mount scanned images that were zoomed to high power to demonstrate specific pathological findings in a stress-free, engaging, learning environment with simultaneous group/peer learning.

The post-slide review test collected at the end of each session, namely for session "S through R" and mean of all the session was calculated for each individual student as mentioned in Table-1. The final summative assessment was done as per the study methodology and the scores obtained were correlated with the mean post-slide review test calculated earlier.

4. Discussion

Devices for whole slide imaging (WSI) are designed to fulfill the needs of a broad and varied consumer market and come in a variety of styles, functions and capabilities. While some scanners have a small desktop footprint and are only intended to scan a small number of glass slides, other, larger devices can hold hundreds of glass slides. Slides can be placed in trays, racks, or carousels, including tissue microarrays. The Morphle Optimus 6T, a low-cost domestic slide scanner created by Morphle labs, Pvt. Ltd., is the WSI hardware that we used in our study. This WSI scanner is designed to scan whole mount glass slides, 6 slides at a time in a cassette. The average time taken to scan a single slide depends on the size of the tissue in question; in our experience it takes on average 15-20 minutes per slide to scan and stitch the scanned tissue.

The size of the tissue to be scanned might have a significant impact on the file size, which can affect storage size, inevitably expenses. WSI files are substantially bigger than the digital image files those other medical specialties, including radiology, frequently use(8,9). Therefore, to archive virtual slides, "lossy" (like JPEG2000) and "lossless" (like TIFF) types of compression-decompression techniques are used. These are typically kept in several folders as thousands of image files. These files are then assembled into a multilayered "pyramid" to enable instantaneous, optimal real-time viewing at various resolutions. As a result, an equal or greater digital magnification is used as the data source for any given digital magnification. As a result, traversing huge WSI files requires less computational work(10). The field of view and tile size (or number of pixels) are retained in the "pyramid" encoding model. Due to current constraints and monitor display technology, the former is preferred as it more closely mimics the slide viewing method offered by conventional microscopy (i.e., increasing power/magnification increases the resolution).

Virtual tracking and tutoring, performance improvement programs, transdisciplinary graduate and professional education, and medical examinations are just a few of the educational activities that regularly use WSI(11-18). Virtual slides have a number of advantages over traditional glass slides in these circumstances. The use of digital slides encourages the standardization of training materials since they are more interactive, instantly accessible to numerous remote users, easily annotatable, and make the same slide sets readily available to all learners. For proficiency testing, it is logistically simpler to transfer digital slides to several locations than glass slides. On the other hand, glass slides require pricey light microscopes, physically deteriorate over time (such as loss of staining), and cannot be viewed instantly or shared with numerous remote users. Additionally, with glass slides, some cases are frequently excluded from teaching sets, such as rare or exotic specimens, cytology slides, small biopsies with insufficient amounts of material for recuts, and consult slides that must be returned. With WSI platforms, it is simple to archive the best slides from the most representative sections for instructional uses in a virtual slide format that won't fade, break, and can withstand the test of time

The COVID-19 pandemic is an unpredicted and overwhelming period for the entire world with no exception of the medical field, those particularly involved in medical education. The pandemic followed by the lockdown devastated the way how society and medical educators have worked for decades. Putting unprecedented strain on mentor-mentee relationships existing among the pathology teachings. Our study reveals that digital pathology when used for educational purposes among postgraduates received a significant boost in scores when pre and post-test were evaluated. With the test scores found to be significantly and consistently high in almost all residents participated in the study.

The study we did on digital pathology using whole slide scanners can be used in the future and may be used in remote teachings as well while travel ban and social distancing norms have to be followed to restrict the spread and also needless time waste during transit or travel can be avoided(19). Medical teachings need to be conducted as vigorously as ever to train the residents of pathology so that they can be better in their field. For the educators, this new digital platform and sudden shift to digital media can lead to a lag time to adjust to the new normal and to learn the digital platforms(20). The advantages as per the participants were Faster, easier, interactive, more time was available for discussion, and architecture of the lesion can be appreciated better and easy accessibility. The liabilities as per the participants were Steep learning curve, not exam friendly; calculation of field size is cumbersome.

Digital pathology when optimally used can dramatically increase the abilities of the training facilitators to train the residents to practice pathology in their respective careers.

Limitations of the study were limited study participants and the evaluations were done immediately after the peer-group discussion which may have a confounding effect on the study.

5. Conclusion

Digital scanning of pathology slides using Morphle is user-friendly and cost-effective. The real-time zooming of the whole mount scanned images is easy and of great clarity with high resolution that allows for assessment with just-in-time learning suitable for group/peer or individual self-learning. This low cost, time-sensitive scanner also provides a permanent digital resource for continued deep learning with the ongoing potential of real-time portability and knowledge sharing across digital divides which can traverse the borders physically and others which can hinder the education. The digital medium of histopathology teaching has shown its effectiveness in the field of pathology residency training and can be a valuable asset in the hands of a fine mentor and can elevate the mentor-mentee relationship to the next level in the near future.

The scanned images were also available digitally for individual/self-learning. The final summative review test scores demonstrated increased knowledge gain. All students liked this digital format of teaching as an exam preparatory tool in comparison to microscopic sessions and self-reported improved personal knowledge.

However, current limitations of WSI also hold true in the educational setting. Indeed, many users are dissatisfied with current viewing speeds and find viewing software counterintuitive to use. Also, there may be an annoying lag when viewing images, especially when working with massive file sizes over slow networks.

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Figures

Figure 1: (WSI – Morphle Optimus 6T) [21]

Tables

Table 1: Students Test Scores along with final summative test result

S. No	Participant	Session S	Session U	Session T	Session Q	Session P	Session R	Mean (S to R)	Final session
1	X1	56	58	78	58	61	60	62	98
2	X2	53	54	74	81	54	65	64	93
3	X3	A	A	58	56	53	55	56	93
4	X4	62	63	64	72	55	65	64	89
5	X5	45	44	58	67	55	62	55	94
6	X6	A	A	A	58	54	55	42	99
7	X7	62	64	88	58	66	62	67	94
8	X8	39	42	74	76	58	65	59	95
9	X9	45	44	60	A	A	A	50	94
10	X10	56	56	64	71	55	60	60	73
11	Y1	A	A	A	36	33	35	35	86
12	Y2	50	53	61	A	A	A	55	85
13	Y3	45	44	43	A	A	A	44	91
14	Y4	A	A	A	75	63	67	68	88
15	Y5	50	53	75	50	53	54	56	90
16	Y6	39	40	42	63	55	60	50	75
17	Y7	A	0	0	78	55	65	40	88
18	Y8	42	43	63	76	47	55	54	89
19	Z1	37	36	50	56	43	55	46	48
20	Z2	42	42	32	49	41	45	42	57
21	Z3	41	40	25	69	53	65	49	51
22	Z4	A	A	A	24	21	25	23	20
23	Z5	44	43	47	39	47	45	44	66
24	Z6	32	32	24	44	21	45	33	69
25	Z7	A	A	A	67	55	65	62	61
26	Z8	46	46	32	58	38	55	46	83
27	Z9	A	A	A	42	26	43	37	49
28	Z10	38	38	40	47	36	45	41	59