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Evaluation of Use of Digital Method In Studying Histology and Pathology among Undergraduate Students of Dentistry

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Abstract

Context: The technological advances have made it possible to turn microscopic slides into digital images which can be viewed on computer screen known as digital microscopy (DM). Recent studies have shown that DM is gaining popularity in multiple academic fields, including dentistry. There are only few studies evaluating the use of DM compared to light microscopy (LM) with reference to dental students. In addition, there is a lack of literature concerning Indian dental students with the use of DM. *Aims:* To compare the DM with LM and assess the usefulness of DM in learning oral histology and pathology among undergraduate dental students. Setting and analysis used: A total of 363 students participated in the study. DM method was integrated into practical classes in Oral histology and Oral Pathology. The opinions of the students were collected through questionnaire about the usefulness and compliance to DM compared to LM. *Results:* 80% and above students gave opinion that DM is the best way to study the microscopic slides. However, 91.7% of the students were of the opinion that both LM and DM are required to study the slides and were against totally eliminating the conventional LM method (92%). *Conclusion:* These findings support the implementation of DM as the primary teaching methodology in oral histology and Pathology teaching and at the same time, exposing the students to conventional microscopes and glass slides is also essential to appreciate the concepts of histology and digital images.

Keywords: Digital Microscopy; Light Microscopy; Oral Histology; Oral Pathology; Microscopic Slide.

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Introduction

Light microscopy (LM) has been the conventional method of teaching Histology and Pathology in medical education [1]. Recent advancement in technology has made it possible to convert microscopic glass slides into digital images which can be viewed on a computer screen known as "digital microscopy (DM)" or "virtual microscopy". [2] DM is commonly used in research field but recently it is increasingly gaining popularity in many academic fields including dentistry [3-9]. A number of medical teaching institutions have already integrated DM into their curriculum [1,10,11]. In most institutions, the response to the introduction of DM has been immensely positive, due to better image quality, ease of navigation while maintaining orientation and better learning through inclusion of digital annotations and legends with additional informational text [3,11,12].

A few studies have described the experiences in introducing DM in dental education [1,2,4,5,8]. However, there are no detailed comparisons between DM and LM with reference to enhancing learning methods among dental students. In addition, there is a lack of literature concerning the

use of DM among Indian dental students. Hence, the objective of the present study was to compare the DM with LM to assess the usefulness of DM in enhancing knowledge in learning oral histology and pathology among undergraduate dental students.

Materials and Methods

This questionnaire based study was carried out at SDM College of dental Sciences and Hospital, Dharwad after obtaining approval from the Institutional Review Board (IRB.No.2018/S/OP/59). The institution has adapted DM technology as a method of teaching oral histology and pathology to undergraduates since 2010. The undergraduate students are exposed to DM method during their regular practical hours since the 2010–2011 academic year of bachelor of dentistry (BDS) students.

The study group constituted a total of 363 students. Undergraduates from first year bachelor of dentistry to final year participated in the study. The DM method was integrated into practical classes in Oral histology and Oral pathology. Following the completion of the traditional lectures, the microscopic slides were explained with live images using Leica QWin image analyzer software version 2.7 (Leica Microsystems Ltd, Switzerland) in small groups (Fig. 1). The representative images of the microscopic slides were captured and characteristic features were labelled on DM image and saved in JPEG format and stored in CD-ROMs. These images were then compared with the images of the conventional microscopic method. The students were then given an additional task of drawing the images obtained from both the methods of microscopy (Fig. 2 and 3). The DM files were made available in institutional library and copies were given to the students where they could view them using their personal computers at home or hostel.

Fig. 1: Microscopic slides are being explained with live images using Leica QW in image analysis software version 2.7 in small groups of students.

Fig. 2: The images of histological sections are displayed on the computer monitor provided on the working table during practical classes.

Fig. 3: Conventional microscopic method to study the microscopic slides.

At the end of the year, the survey was conducted to collect the students opinion through questionnaire (Table 1 & 2) about the usefulness and compliance to DM compared to LM. Two open-ended questions were also provided with each table to specify if any additional opinions or suggestions. The participation of students in the survey was voluntary and responses to questionnaire were anonymous.

Results

Training students using DM facilitated the involvement and interactions of both the teachers and the students owing to live images. The less time was taken in the teaching using DM as the most time was previously spent on distributing and focusing the slide in microscopes reducing the duration of effective teaching. All students could identify the microscopic structures on the slide which were not appreciated in the conventional LM. Students who had answered both columns in table 1 and 2 were considered and "Not sure" answers or unanswered questions were excluded from the study. As two students had not completed the questionnaire, 351 out of 353 student's answers were considered for the study survey. The results suggested that more than 80% of the students were of the opinion that DM is the best way to study the microscopic slides as there was clarity in images, easy, effective in identifying structures and could study in short time. Although the DM had enhanced the interest in studying slides among many students (65.6%) (Table 1). Students gave a very positive opinion about DM features but more than 90% of the students were of the opinion that both LM and DM is required to study the slides (91.7%) and were against totally eliminating the conventional LM method (92%) (Table 2). All the above findings were statistically highly significant p value <0.05, Z test followed by 't' test.

Table 1: Students Opinion about the best method of teaching microscopic slides

Sl. No	Questions	Conventional method	Digital microscopy	p value* ('t' test)
1	Which method gives the best clarity of histological images?	63 (17.9%)	288 (82%)	<0.001
2	Which method is useful in identification of structures in histology?	59 (16.8%)	292 (83.1%)	<0.001
3	Which method is easier in studying histology?	65 (18.5%)	286 (81.4%)	<0.001
4	Which method creates interest studying histological slides among students?	121 (34.4%)	230 (65.5%)	<0.001
5	Which method allows studying microscopic slides in short time?	72 (20.5%)	279 (79.4%)	<0.001
6	Which is the best way for studying histology slides?	67 (19%)	284 (80.9%)	<0.001

*p value < 0.001 is significant

Table 2: Students Opinion about the digital microscopy features

Sl. No.	Questions	Yes	No	p value* ('t' test)
1	Is digital microscopy is useful in learning histology?	342 (97.4%)	9 (2.5%)	<0.001
2	Does digital microscopy increases interest in the learning histology?	316 (90%)	35 (10%)	<0.001
3	Does digital microscopy improve the learning of histology?	315 (89.7%)	36 (10.2%)	<0.001
4	Is it necessary to totally eliminate conventional microscope study method?	28 (7.9%)	323 (92%)	<0.001
5	Is it requires to use both conventional microscope and digital microscope?	322 (91.7%)	29 (8.2%)	<0.001

*p value < 0.001 is significant

Only few students answered for open ended questions but comments were supporting the use of DM. Among the 36 students who answered for open ended questions, most commented that DM can be used anytime, anywhere and very useful in revising slides for exams. Some students expressed difficulty in handling, focusing, and eye problem in conventional LM method. Whereas, few students preferred using microscopes and enjoyed using the LM.

Discussion

DM is mainly used to make primary histopathological diagnosis, provide second opinions on histopathological diagnosis, telepathology, quality assurance (e.g. re-review and proficiency testing), archiving and sharing, conferencing, image analysis, research and publications, marketing and business purposes [13]. DM was introduced into the histology and pathology teaching field two decades ago due to few significant limitations of LM. Students tend to dislike LM describing their use as difficult to focus the area in slide, strenuous to eyes and frustrating resulting in student'snon-involvement in the subject. Also the quality and consistency of light microscopes and microscopic slides are often criticized [13]. In addition; it is a new era of digital technology where students need to be exposed to modern advances.

Although several medical and dental institutions have adapted DM into their curriculum for teaching, the reports about its usefulness and influence on academic performance to students is still scarce. There are very few reports about advantages of DM concerning dental students.

In the present study, the dental students strongly agreed that DM is a preferred method of studying oral histology and oral pathology slides which is in consistent with other similar studies [1-5]. Many medical institutions have published similar finding supporting the use of DM in teaching pathology [7,9,10,12].

The observational evidence from staff suggested more enjoyable experience for students with DM. Majority of students (82%) responded that the DM gives the best clarity of histological images and easier to study histology (81.4%) compared to LM, as the high quality images provided to the students were captured at proper condenser position and illumination. Whereas, in LM the students have to adjust the light and condenser which requires time and skill [2]. Most students (83.1%) were of the opinion that DM is effective in studying the structures in histology as the images were labelled and parts were marked with brief description for identification. DM allowed students to study slides in their own time and in a very short time (79.4%) as students could study slides at library, home or hostel without any teacher assistance. LM requires undergraduate laboratory which are open for students at specific hours (practical classes) to study the slides.

In spite of declaring the DM as very effective and best method of learning, over 90% of students were against totally eliminating LM and said both methods are required to study slides. Reasons for the above opinion: (a) Students were not sure about the exam pattern using DM if the conventional method is completely eliminated (b) Some students were scared that they will not be able to identify the tissue on slides after being taught only on DM (c) Students didn't wanted to forget how to use the use of

microscope. However, such issues could be avoided by taking classes with both LM and DM and exam patterns should be set by the institutional bodies.

Most authors have found favourable opinion about their experiences with the transition from LM to DM in medical [6,10,14,15] and dental institutions [2,3,4,13,16,17,18]. Despite numerous evidence of student compliance and improved learning with DM, its influence on academic performance of students yet to be confirmed. Few authors like Weaker F et al. [5], Blake CA et al. [9], Raja S [19] have reported excellent compliance of dental students and teachers with the DM and improvement in examination scores and summative assessments. Some authors have reported transition of LM to DM had no statistically significant influence on academic performance [5,7,20]. In our study, there was no evaluative measures were undertaken to determine student academic performance. The present study was a preliminary analysis to gather information about the usefulness of DM among undergraduate students.

There are many advantages with the use of DM for institutions including elimination of purchase and maintenance of new microscopes and high quality microscopic slides [5]. Digitalization of slides also eliminates the risk of specimen loss, breakage and misplacement [8]. DM can have technological and financial drawbacks depend on how the DM is implemented. For example use of full slide scanners with softwares, [2] wall-size visualisation interactive system [15], high bandwidths, large digital storage space, large back-up modalities and instructors with high levels of training.

Conclusion

The study findings support the implementation of DM as the primary teaching methodology in Oral Histology and Pathology teaching. The student's preference of DM over LM may have a positive effect on student learning. As it is also essential for students to know how to use the light microscope, we recommend briefly exposing the students to conventional microscopes and glass slides during their basic general medical education so that they appreciate the concepts of histology and virtual images.

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(If present, give more details): None

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The authors declare no competing financial interests.

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