ORIGINAL RESEARCH

The comparison of digital microscopy with conventional microscopy in the teaching of oral pathology: A questionnaire-based study

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Abstract

Introduction and Aim: The purpose of this study was to assess undergraduate dental students' perceptions regarding the application of digital microscopy as opposed to conventional microscopy when studying dental histology and ground section slides.

Materials and Methods: A validated questionnaire comprising of 8 questions comparing the clarity of images, overall level of understanding and the more effective teaching technique between conventional microscopy and digital microscopy was prepared and circulated amongst 100 first-year BDS (Bachelor of Dental surgeon) students. The participants were asked to observe the dental histology and ground section slides, following a detailed discussion of the same, focused on the same field, under both conventional and digital microscopes, and then were asked to answer the questionnaire. The results were collected and sent for statistical analysis.

Results: When comparing the level of clarity, understanding, and effectiveness of communication and discussions, 90.9% of students preferred digital microscopy over conventional microscopy in the case of ground section slides and 83.8% for histology slides with frequencies of 90 and 83 respectively. When comparing the level of clarity, understanding, and effectiveness of communication and discussions,90.9% of students preferred digital microscopy over conventional microscopy in the case of ground section slides and 83.8% for histology slides with frequencies of 90 and 83 respectively.

Conclusion: Students largely preferred digital microscopy over conventional microscopy when studying both ground section slides, as well as histopathological sections. The ease of storing the slides and capturing images is also an added advantage.

Keywords: digital microscopy, conventional microscopy, oral pathology, teaching

Introduction

The identification of various histological features in the oral and maxillofacial region is mostly done with the help of conventional microscopes.[1] The dental histology subject of the Bachelor of Dental Surgery curriculum makes it mandatory for the students to learn the identification of different histological features for their practical training.[2] Conventional microscopes are used to view the various histological aspects of a tissue. Students are encouraged to become familiar with the handling and usage of a microscope while studying different tissues, such as sections of teeth that are only a few micrometres thick (ground sections) as well as to ensure every student learns the same features, the focus of each slide is fixed.[3] Only a single student can visualize the slide at a time, which makes it difficult for them to ask their doubts or discuss the structures. The magnification of structures for better clarity and detailed understanding also becomes difficult. [4]

Apart from the difficulty faced by the students, it is also cumbersome for the laboratory to maintain adequate slide collection as well as to ensure that the slides do not fade off. Also, a large reserve of slides is required to create sufficient slides for all the students.[5,6]

Therefore, to overcome these hurdles, there has been a modification of conventional microscopes. The use of digital microscopes has now been put forward in use and

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it represents more of an evolution than a revolution. In the digital microscopic technique, an image is captured and stored in the electronic data file. The captured digital images allow modification of the image quality and contrast such that they can be easily evaluated, duplicated, and manipulated to obtain better images that can be stored thus assisting in retrieval and sharing.[6,7] As there are direct benefits with digital images, they are becoming an essential component of modern practice. The term which is commonly used for the digitalization of the images is Whole slide Imaging (WSI) which includes the digitalized images and slides.[6-8] Slides of higher magnification as digital images of tissue sections are stored in multi-resolution file format. The use of this technology has been successful in the integration of traditional and technology-based methods for the study of histology to train upcoming dental surgeons.[9] However, there are concerns amongst academicians that the student becomes unfamiliar with the maneuvering and maintenance of a microscope which is an integral part of being an oral pathologist. There is also the added disadvantage that students become deprived of studying the entire slide at their leisure and observing cells and other microscopic structures at higher magnifications as per necessity. Therefore, this study was carried out to understand the perception of undergraduate students in viewing the histological slides under both conventional and digital microscopes by analyzing their feedback through a questionnaire.

Methodology

This educational-based research was carried out in the Department of Oral Pathology and Microbiology after approval from the Institutional Ethical Committee. 100 first-year Bachelor of Dental Surgery students studying in our institute were included in this study. The purpose and methodology of the study were explained to all the students and written informed consent was taken from all of them. A validated questionnaire consisting of 8 questions comparing the overall level of understanding, clarity of images, ease of interaction, and the more effective teaching technique between conventional microscopy and digital microscopy was prepared. A thorough discussion on the slides (both ground section as well as dental histology slides) was taken and the participants were asked to observe the same slides, focused on the same field, in both conventional and digital microscopes, and then were asked to answer the questionnaire. The results for both the ground sections as well as the histological slides were separately compiled, based on the responses collected, and were then sent for statistical analysis.

Table 1: Preference ofdigital microscopy over conventional microscopy in ground section slides and histology slides A) Clarity B) Better Understanding C) More effective for communication and discussions D) All of the above

Group			Frequency	Percent	Valid Percent	Cumulative Percent
Ground section slides	Valid	A	2	2.0	2.0	2.0
		B	1	1.0	1.0	3.0
		C	6	6.1	6.1	9.1
		D	90	90.9	90.9	100.0
		Total	99	100.0	100.0	
Histology slides	Valid	A	2	2.0	2.0	2.0
		B	5	5.1	5.1	7.1
		C	9	9.1	9.1	16.2
		D	83	83.8	83.8	100.0
		Total	99	100.0	100.0	

Results

The results were statistically analyzed using SPSS 17.0 version 8. The frequency and percentage of each question for the ground section slides and dental histology slides were calculated separately. Overall, on the basis of all three parameters, 90.9% of students preferred digital microscopy over conventional microscopy (option D), in the case of ground section slides and 83.8% for histology slides with frequencies of 90 and 83 respectively (Table 1).

93.9% of the students preferred digital microscopy with a frequency of 93 for ground section slides and 73.7% of the students preferred digital microscopy for histology slides with a frequency of 73 when assessing the clarity of the images.

81.8% of the students preferred digital microscopic learning for understanding of structures in ground section slides and 70.7% of the students preferred digital microscopy learning for the histology slides as well. 80.8% of the student found digital microscopic learning more interesting with a frequency of 80 for ground section slides and 66.7% of the students preferred digital learning more interesting for histology slides learning with a frequency of 66.

Most of the students (83.8% and 82.8%)found that digital microscopy facilitates more effective interaction when studying ground section slides and histology slides with frequencies of 83 and 82 respectively. More than half the students (70.7% and 71.7%) recommended the usage of digital microscopy for teaching and learning practices for ground section slides as well as for the histology slides. From the examination point of view, 69.7% of the students preferred digital microscopy with a frequency of 69 for ground section slides and 58.6% of the students preferred the same for histology slides as well, with a frequency of 58. All the students (100%)agreed that the circulation of the fixed focus digital images through smart phones and emails for extended learning processes of ground sections and histological slides is preferable.

Discussion

Correlation between the clinical aspects and cellular changes of a lesion in the oral cavity is fundamental to the subject of Oral Pathology. Conceptualisation and proper understanding of normal histologic structures in the first year of BDS, is therefore, fundamental to elicit and differentiate

various pathological changes that may be encountered as the students enter oral pathology in their third year of BDS. Traditionally, the use of conventional microscopes has been utilized not just for the diagnosis of oral pathologies but also in teaching and understanding the same. There are many disadvantages associated with the conventional microscope which can be overcome when digital microscopy is used in its stead, such as fading of stains, breakage of the slides, and section-to-section variability, especially during demonstrations in practical classes.[11]

In this study, the effectiveness of digital microscopy when studying ground section and histology slides for first-year undergraduate students in our institute was evaluated with the help of a questionnaire. This research study compared the preference of the students regarding their learning and an improved understanding of the slides by the conventional microscopic technique and digital microscopic technique. As there are certain limitations in learning practices with the conventional microscopic technique, this research study was designed to understand the effectiveness of the digital microscopic technique and its relevance from the students' perspective.

The educational effectiveness of the two methods was compared according to the responses that were recorded with help of a questionnaire consisting of 8 questions. The statistical analysis clearly showed that in all aspects the students preferred the digital microscopic technique for their educational purpose.

Majority of the students in our study preferred the digital microscopic technique as they felt that clarity was vastly improved with the added advantage to zoom out specific structures for better observation. The same reviews were also seen in the study done by Goldberg HR et al where students widely supported and preferred virtual microscopy technique.[12]

Digital microscopy was also considered much easier for interaction purposes with their batchmates and teachers when it came to clearing of their doubts or location of structures which had always been difficult with the conventional microscope. Similar results were also observed in the survey done by Bloodgood RA et.al in United States Medical School where the faculty involved in teaching with this newer trend where computer based instructional technologies were used and preferred.[13]

In our studies, the students greatly supported the circulation of the images through smartphones and emails for enhanced learning and the results were in accordance with a study done by Harris et al and Heidger et al who assessed the effectiveness of virtual slide use on the web for their medical histology course and found students largely favoring the use of the virtual slides.[14,15]

When it came to teaching and learning purposes, the digital microscopic technique was preferred by all the students in our study and a similar observation was also noted in a trial study by Sahota et.al where whole slide images were circulated amongst individuals and collaborative students who were further categorized as junior and senior academically. The results depicted that the students benefitted from the WSI system and there was great improvement in results of the students who were assessed with online quizzes.[16]

In the analysis done by Fred.R et al, they observed the increasing role of virtual microscopy in continuing education, education of the staff and the advantages of the same in terms of accessibility, efficiency, and pedagogic versatility of the computer and the Internet. Although the initial cost of setting up a virtual microscope in the education system is high and there is no additional replacement cost for the microscopes and maintenance of glass slides which offsets the primary investment. Furthermore, they also suggested that the multiple microscope spaces can be converted into multiuse computer laboratories that could be further used for research purposes.[17]

Conclusion

Digital microscopy is highly advantageous when compared to conventional microscopy and making it a standard practice in institutions should be encouraged. As students largely preferred digital microscopy over conventional microscopy, the incorporation of the same as a mainstay in an oral pathology laboratory is something to be seriously considered in the future.

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