



Survey

Awareness of Digital Imaging/Telepathology Among Dental Post Graduate Students: A Survey

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Abstract

Background: The collection, storage and sharing of pathological data among oral pathologists to this day is done mostly by physical transfer of slides and reports. Telepathology is a form of communication between medical professionals that includes the transmission of pathology images or testing data.

Aim: The aim of the study is to assess the knowledge, attitude and perception of digital pathology/telepathology among dental post graduate students.

Materials and Methods: A cross-sectional study consisting of a self constructed survey was distributed through an online portal to dental post graduate students. The survey focused on the type of respondent, knowledge of microscopic digital photography, current usage, strengths and weaknesses and perceived future direction of digital imaging in the pathology laboratory.

Results: A total of 102 responses were collected. The overall response rate was 100%. 56.9% of dental post graduate students are aware of the term “Digital Pathology” or “Telepathology”. 11.8% of dental post graduate students use digital pathology in their routine practice. 20.6 % of dental post graduate students send specimens once a year. 75.5% of dental post graduate students believe that “Digital Pathology/Telepathology” can be effective for research purposes. 62.7% of dental post graduate students believe that digital pathology imaging provides faster diagnosis. 75.5% of dental post graduate students believe that digital pathology imaging has high equipment cost. Comparison between the age of the respondents and their awareness of the term Digital Imaging/Telepathology and its scope in India stated that dental post graduate students of age group between 21-30 years were aware of the term and believed it has scope in India, but the results were insignificant ($p>0.05$).

Conclusion: Improved knowledge and acceptance of digital pathology and telepathology throughout the dentistry community could facilitate the communication and cooperation necessary to realize the type of initiatives capable of advancing the importance of pathologists in the changing healthcare environment.

Keywords: Digital pathology, telepathology, pathology informatics, academics

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INTRODUCTION

The concept of pathology, like any other specialty of medicine, has undergone the many phases of digitization of the field of medicine. The field, like any other, had to adapt to the fast pace of changes occurring around it[1]. The pathologists have the prime function of diagnosis and documentation of the various diseases identified. Other functions include prompt consultation and educational purposes. Methodical documentation of the macroscopic and microscopic findings of features is necessary[2]. This is done with the help of vocabulary abilities of the pathologist. To overcome the discrepancies that might arise due to inter-observer vocabulary skills, the use of digital photographs came into play. Documentation of digital photographs provides the true appearance of the specimens and thereby eliminates the inaccuracies resulting from inter-observer descriptive ability[3].

The change of pace from physical to digital pathology has opened up numerous uses for gross as well as histopathologies such as telepathology and 3D imaging technology. Telepathology has already been in practice throughout the world. The purpose mostly included diagnostic and consultation services. 3D imaging technology, at the microscopic level can provide simulations and can be possibly used in the future for digital diagnostic pathology practice[4].

Oral and maxillofacial pathologists deal with various lesions in their day to day practice. The collection, storage and sharing of pathological data among oral pathologists to this day is done mostly by physical transfer of slides and reports[5]. This has some significant difficulties. One such thing is obtaining a second opinion of cases from remote places or trans-country consultation. This disadvantage can be overcome by the use of telepathology. Telepathology is a form of communication between medical professionals that includes transmission of pathology images or testing data, associated clinical information for the purpose of various clinical applications, including primary diagnoses, rapid cytology interpretation, intraoperative and second opinion consultations, ancillary study review, archiving and quality activities[6]. Whole slide imaging (WSI) or virtual microscopy involves the scanning (digitization) of glass slides to produce digital slides [7]. This is useful for consultation from remote areas.

Telepathology is currently most useful for providing pathology services to remote locations where the medical and dental facilities are devoid of on-site or easily accessible pathology services[8]. It is often practically easier and affordable to move an image around than it is to move a patient or an oral pathologist. Telepathology can be used to perform rapid consultation of long distant cases where travel is not a practical option. It is also useful as a communication tool between general dentists, general pathologists and oral pathologists[9]. Access to oral pathologists through telepathology provides a tele-consultant remotely reviews the digital images of challenging cases and has the potential to greatly improve patient care. If used in an efficient manner, telepathology is a cost-effective tool that ensures quick turnaround time, can virtually eliminate expensive courier costs, greatly improves resource utilization, and creates added value[10].

Proper use and application of digital pathology and telepathology in India is not well known. Majority of the applications are being underutilized throughout the country. A standardized method for collecting, storing and sharing digital images is necessary and can provide better diagnostic practice for pathology diagnosis[11]. However, these procedures are yet to be standardized. The aim of the study is to assess the knowledge, attitude and perception of digital pathology/telepathology among dentists.

MATERIALS AND METHODS

A self-constructed questionnaire including 20 questions was designed with three specialists from the department of Oral and Maxillofacial Pathology, to improve the design without any ambiguity. The questionnaire was validated and distributed through an online portal to 102 dental post graduate students. This cross-sectional study was designed and focused on the type of respondent, knowledge of microscopic digital photography, current usage, strengths and weaknesses and perceived future direction of digital photography in the pathology laboratory. The participation was purely voluntary. The participants had the choice to quit the survey at any point. The requested answers were in the form of yes/no, multiple choice and free text questions. The results were evaluated using comparison amongst all the groups.

Figure 1:

AWARENESS OF DIGITAL IMAGING/TELEPATHOLOGY AMONG DENTISTS: A SURVEY

Name: _____

Age:

- 20-30 years
- 30-40 years
- 40-50 years
- 50-60 years
- 60-70 years
- Above 70 years

Gender:

- Male
- Female

Designation:

- BDS
- MScD
- PGD
- Others

Affiliated to:

- Institution
- Hospital
- Private practice
- Others

1. Are you aware of the term "Digital Pathology" or "Telepathology"?

- Yes
- No

2. Are you aware of the term "WGL/Work think imaging"?

- Yes
- No

3. Do you use Digital Pathology in your routine practice?

- Yes
- No

4. Do any of your colleagues use Digital Pathology in their routine practice?

- Yes
- No

5. Do you think Digital Pathology/Telepathology should be used in daily practice?

- Yes
- No
- Not sure

6. How often do you send specimens for biopsy?

- Once a week
- Once a month
- Once in 2 months
- Once in 6 months
- Once a year
- Other

7. Do you receive the digital image of the lesion along with the report?

- Yes
- No

8. Which method do you think is best for receiving the report?

- Only the report
- Report along with digital image
- Not sure

9. Which method do you think is the best for requesting a second opinion?

- Digital image
- Sending a glass slide
- Both

10. According to you, what would be the better option for slide storage in your institution?

- Digital image
- Glass slide
- Both

11. Do you think Digital Pathology/Telepathology will be useful in medico-legal cases?

- Yes
- No
- Not sure

12. Do you think Digital Pathology/Telepathology will be useful for diagnosis in rural areas?

- Yes
- No
- Not sure

13. Do you think it would be beneficial to review challenging rare cases on online digital library?

- Yes
- No
- Not sure

14. Do you think Digital Pathology/Telepathology should be included in dental academics?

- Yes
- No
- Not sure

15. According to you, Digital Pathology/Telepathology can be utilized most efficiently in (can choose more than one option)

- Conferences
- Educational purpose
- Research purpose
- Forensic section study
- Routine histopathological diagnosis
- Consultation service
- Other

16. According to you, what is the advantage of Digital Pathology Imaging? (can choose more than one option)

- Easy access
- Faster diagnosis
- Elimination of physical storage space
- Longer storage time
- Cost effective
- Other

17. According to you, what is the disadvantage of Digital Pathology Imaging? (can choose more than one option)

- Image quality is not sufficient enough to make secure diagnosis
- High cost equipment
- Medico-legal issues
- Need to develop an electronic storage system with backup

18. Do you think there is scope for Digital Pathology/Telepathology?

- Yes
- No
- Not sure

19. Do you think there is scope for Digital Pathology/Telepathology in India?

- Yes
- No
- Not sure

20. Where do you see Digital Pathology in 10 years?

- Used only for special cases
- Used for regular histopathological diagnosis

21. Any other suggestions, please specify:

Figure1: Figure shows the questionnaire for the survey

Figure2:

1. Are you aware of the term "Digital Pathology" or "Telepathology"?

102 responses

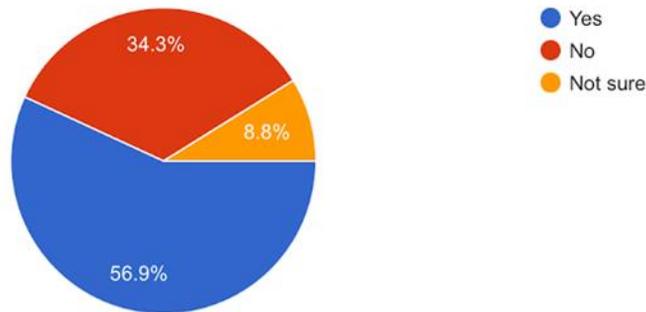


Figure2: Pie chart representing the awareness of dental post graduate students of the term "Digital Pathology" or "Telepathology". Significant no. of dentists(blue) are aware of the term "Digital Pathology" or "Telepathology".

Figure.3:

3. Do you use Digital Pathology in your routine practice?

102 responses

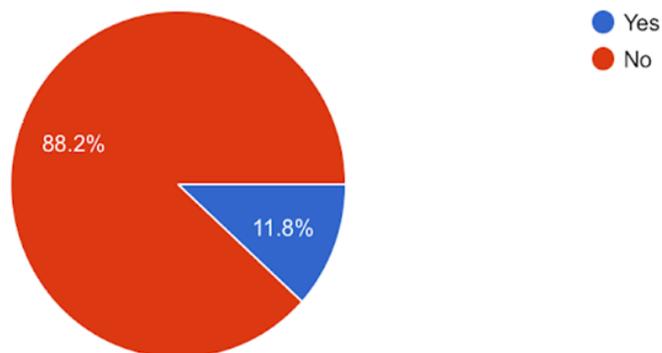


Figure.3: Pie chart representing the use of digital pathology among dental post graduate students in their routine practice. Significant no. of dentists(red) do not use digital pathology in their routine practice.

Figure.4:

5. Do you think Digital Pathology/Telepathology should be used in daily practice?

102 responses

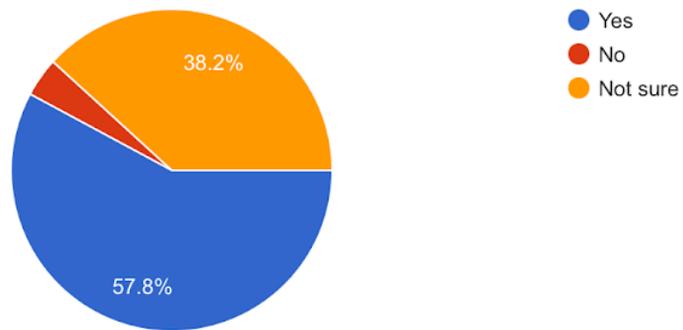


Figure.4: Pie chart representing the awareness of dental post graduate students in the use of digital pathology/telepathology in daily practice. Significant no. of dentists(blue) believe that digital pathology/telepathology should be used in daily practice.

Figure 5:

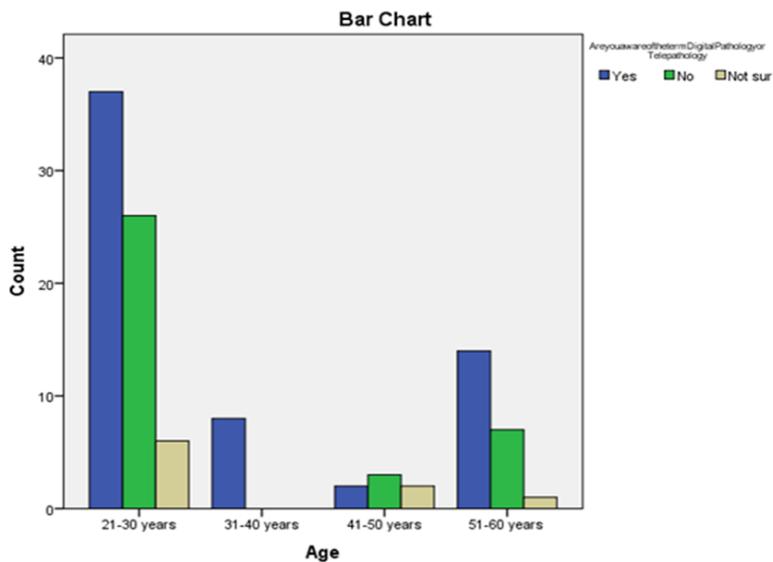


Figure5: Bar graph representing the relationship between the age of the respondents and their awareness of the term digital pathology/telepathology. Respondents between the age group of 21-30 years were aware of the term digital pathology/telepathology.

Figure6:

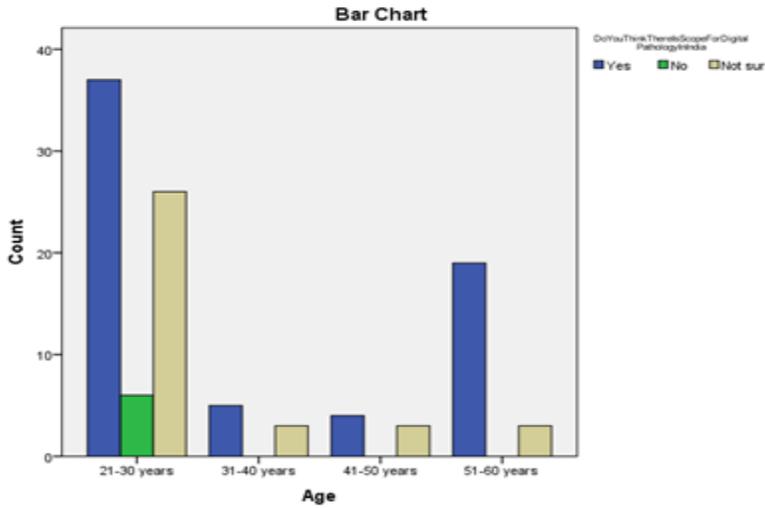


Figure6: Bar graph representing the relationship between the age of the respondents and their awareness to the scope of Digital Pathology in India. Respondents between the age group of 21-30 years (blue) believe that there is scope for Digital Pathology in India.

Figure 7:

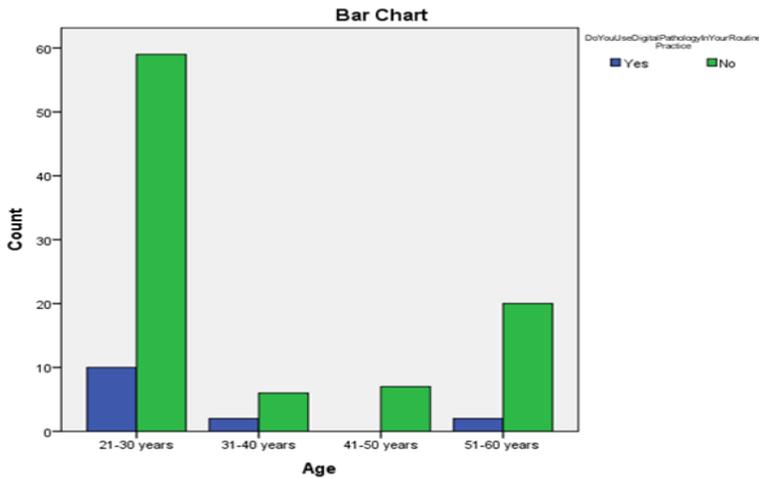


Figure 7: Bar graph representing the relationship between the age of the respondent and their usage of Digital Pathology in their routine practice. Majority of respondents from all age groups (green) do not use Digital Pathology in their routine practice. Only a few respondents of age group 21-30 years (blue) use Digital Pathology in their routine practice.

RESULTS

A total of 102 responses were received. Majority of the results (66.7%) were received from respondents of age group 21-30 years of age. Females’ respondents were more (67.6%) than males. Figure 1 depicts the questionnaire prepared for the survey. Results show that 56.9% of dentists are aware of the term “Digital

Pathology” or “Telepathology” (Figure 2). A mere 33.3% of dental post graduate students are aware of the term WSI (Whole Slide Imaging). 11.8% of dental post graduate students use digital pathology in their routine practice (Figure 3). 19.6% of dental post graduate students colleagues use digital pathology in their routine practice. 57.8% of dental post graduate students believe that digital pathology/telepathology should be used in daily practice (Figure 3). 20.6 % of dental post graduate students send specimens once a year. 31.4% of dental post graduate students receive digital images along with the report. 87.3% of dentists believe that it is best to receive the report along with the digital image. 70.6% of dental post graduate students believe that it is best to send both the digital image and glass slide for requesting a second opinion. 56.9% of dental post graduate students believe that it is better to store both digital images and glass slides. 71.6% of dental post graduate students believe that “Digital pathology/Telepathology” is useful in medico-legal cases. 52.9% dental post graduate students believe that “Digital pathology/Telepathology” is useful for diagnosis in rural areas. 82.4% of dental post graduate students believe that “Digital pathology/Telepathology” is useful in reviewing challenging/rare cases on online libraries. 81.4% of dental post graduate students believe that “Digital pathology/Telepathology” should be included in dental academia. 75.5% of dental post graduate students believe that “Digital Pathology/Telepathology” can be effectively for research purpose. 62.7% of dental post graduate students believe that digital pathology imaging provides faster diagnosis. 75.5% of dental post graduate students believe that digital pathology imaging has high equipment cost. 72.5% of dental post graduate students believe that there is scope for “Digital pathology/Telepathology”. 60.8% of dental post graduate students believe that there is scope for “Digital pathology/Telepathology” in India. 57.8% of dental post graduate students believe that Digital “pathology/Telepathology” in 10 years will be used for regular histopathological diagnosis.

Statistical analysis (Chi-square) was performed comparing the respondents age and their awareness to the term digital pathology/ telepathology (Table 1). Respondents between the age group of 21-30 years were aware of the term digital pathology/telepathology (Figure 5) but results were not significant ($p=0.75$). Chi - square test when performed comparing the respondents age and their awareness of scope of Digital Pathology in India, insignificant results ($p=0.154$) were obtained (Table 2). Respondents between the age group of 21-30 years (blue) believe that there is scope for Digital Pathology in India (Figure 6). Chi - square test when performed comparing the age of the respondents age and their use of Digital Pathology in routine practice, obtained insignificant results ($p=0.482$) (Table 3). Majority of respondents from all age groups (green) do not use Digital Pathology in their routine practice. Only a few respondents of age group 21-30 years (blue) use Digital Pathology in their routine practice (Figure 7).

Table 1

Chi- Square Test			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.454	6	.075
Likelihood Ratio	13.407	6	.037
Linear-by-linear Association	.215	1	.643
N of Valid Cases	106		
A. 7 cells(58.3%) have expected count less than 5. The minimum expected count is 0.59.			

Table1: Table represents the chi-square test comparing the age of the respondents and their

awareness towards the term digital pathology/telepathology. Insignificant results ($p>0.05$) were obtained.

Table 2

Chi- Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.367	6	.154
Likelihood Ratio	11.775	6	.068
Linear-by-linear Association	5.234	1	.022
N of Valid Cases	106		
A. 8 cells(66.7%) have expected count less than 5. The minimum expected count is 0.40.			

Table 2: Table represents the chi-square test comparing the age of the respondents and their awareness towards scope of Digital Pathology in India. Insignificant results ($p>0.05$) were obtained.

Table 3

Chi- Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.460	3	.482
Likelihood Ratio	3.239	3	.359
Linear-by-linear Association	.705	1	.401
N of Valid Cases	106		
A. cells(37.5%) have expected count less than 5. The minimum expected count is 0.92.			

Table 3: Table represents the chi-square test comparing the age of the respondents and their use of Digital Pathology in their routine practice. Insignificant results ($p>0.05$) were obtained.

DISCUSSION

Telepathology has been used to help a large number of laboratories around the world to provide pathology services by allowing them to connect with experts with ease. Telepathology has also been used to improve the efficiency of pathology services between hospitals in short distances. With increasing super specialization in pathology, the use of telepathology to access these has been extremely useful. The practice of telepathology, however, is not only limited to diagnostic work but can be used in education, research, medico-legal cases, remote access areas and obtaining consultation for rare cases.

Telepathology is a branch of broader telehealth[12].

Overall, pathology informatics and specifically digital photomicrography has become a common place in pathology laboratories across India. In this study, the noteworthy feedback was that a majority of dental post graduate students (56.9%) are familiar with the terms Digital pathology/Telepathology. On the downside, a majority of the dental post graduate students (88.2%) do not use digital pathology in their routine practice. This could be due to the high cost of software[9]. Only a few dental post graduate students (33.3%) are aware of the term Whole Slide Imaging. Whole slide imaging (WSI) or virtual microscopy involves the scanning (digitization) of glass slides to produce digital slides. With the use of WSI, the entire slide can be digitally scanned and saved. This provides a digital record. This record can be used to obtain a second opinion, provide diagnosis through telepathology in remote areas, use as evidence in medico-legal cases and provide a valuable tool in research and educational purposes[1,9].

A little more than half of the dental post graduate students (57.8%) believe that digital pathology/telepathology should be used in daily practice. This bipartition view among dentists might be due to the lack of awareness on the various applications of digital pathology and telepathology[13]. There was an array of feedback received on the “duration of biopsies” done by the dentists. A majority of dentists (20.6%) send their biopsy once a year, while other results vary from once a month to referring the patient to an oral surgeon to never. The difference in the feedbacks may be due to the procedure “biopsy” itself is technique sensitive. Hence many may not attempt it[14].

One third of dentists (31.4%) receive digital images along with the report. This when compared with the use of digital pathology among dentists shows that the result is an appreciable level. Though the overall percentage of dentists who receive digital images along with their report is less, the number is still high compared to the number of dentists who actually use digital pathology in their routine practice. But then again, three fourth of dental post graduate students (87.3%) believe that it is best to receive a digital image along with the report. This contradicts with the number of dentists who practice this method. This difference in answers could be due to lack of available software needed to apply this in practice, cost of the software and most importantly, number of available oral pathologists who practice digital pathology and telepathology[15]. In India, although the practice of digital pathology is not new, only few developments have been made since the start of the digital imaging era. The use of telepathology is still restricted to urban and semi-urban areas. Its application is still confined to diagnosing rare lesions. Hence, increase in the use of digital pathology and telepathology among oral pathologists can directly influence its application among dentists[16].

Majority of dental post graduate students (70.6%) believe that it is best to send both the glass slide and digital image for a second opinion. Sufficient awareness about WSI and digital imaging would be enough to conclude that use of digital image alone is sufficient to obtain a second opinion. Lack of proper awareness tends to make dentists believe that it would be safe to send both the digital image and glass slide for a second opinion. It is also safe to consider the fact that there are some downfalls to solely rely on WSI[17]. Technical and manual errors during digital pathology imaging can lead to misinterpretation. Although the margin of error is less, most dentists believe it is best to send both the digital imaging and slide for a second opinion. One other thing that supports the view of dentists is that, as mentioned earlier, only few oral pathologists practice digital imaging and telepathology in their routine. This sets back the overall application of digital imaging among dentists and therefore reduces its use in routine practice[18].

A few limitations of this survey are worth discussion. The sample size of the survey is relatively less compared to the overall dentist’s population. Despite this drawback, the response rate collected was 90%

which is well over what was expected for a cross-sectional questionnaire survey. In addition, as with any voluntary study, not all individuals are inclined to participate. In general, only those with strong opinions tend to respond.

Majority of the dentists believe that there is scope for digital imaging and telepathology in India. This is a highly positive response which can be obtained through such a survey. This gives a more positive outlook towards the field of digital pathology and telepathology.

Telepathology is currently most effective in providing oral pathology services to remote locations where the medical facilities do not have easily accessible pathology services. It is often practically easier and less expensive to move an image around than it is to move an oral pathologist or patient[19]. Telepathology can be used to do rapid consultation of cases from remote areas where travel is not a practical option. It is also useful as a communication tool between general and oral pathologists. Access to experts through telepathology, in which a teleconsultant remotely reviews digital images of challenging cases, has the potential to greatly improve patient prognosis. In an appropriate setting, telepathology can be viewed as a cost-effective method that can ensure quick turnaround time, virtually eliminates expensive postal costs, improves resource utilization, permits load balancing, and creates added value[20].

According to the Office for the Advancement of Telehealth, telehealth is the use of telecommunications technologies and electronic information to support long-distance clinical health care, health education, public health, and health administration[21]. Telemedicine is another branch of telehealth that allows remote transfer of clinical information through electronic communications. Technologies used in telemedicine include the Internet, videoconferencing, storage and dispatch of images, streaming media, and wireless communications[22]. Telemedicine can be further subdivided by specialty like telepathology, teleradiology, teledermatology, telesurgery, telepsychiatry etc[6].

Telepathology has been applied to all subspecialties of pathology, including surgical pathology, cytopathology, autopsy, and clinical pathology. Telecytology is the practice of cytology at a distance which has been successful with both gynecologic specimens (eg, Pap tests) and non gynecological cases (e.g., fine needle aspirations). Today, telecytology is mostly used for rapid on-site evaluation. Diagnostic accuracy with telecytology is imperfect, and in early published studies ranged from 80% to 100%. With improved technology, diagnostic accuracy has improved. However, the interpretation of telecytology digital images is still hindered by the inability of images to accurately display cellular detail and to change focus along the z axis, especially in thick areas with overlapping cell groups. Telepathology has been widely used for intraoperative consultation at a remote location without a pathologist on-site and/or when traveling and/or when shipment of a specimen may be impracticable.

CONCLUSION

With various advances being witnessed in the field of dentistry, the up and coming sub-specialty of digital imaging and telepathology are ever expanding and continue to excel in academic dental centers. With the survey conducted with over a hundred participants, the study has its limitations. Perception of pathology informatics by dentists could yield more insight. The emerging relationship and investment of its environment underscores the need for stronger efforts in teaching pathology informatics to all oral pathologists, both at the undergraduate and postgraduate level. Improved knowledge and acceptance of digital pathology and telepathology throughout the dentistry community could facilitate the communication and cooperation necessary to realize the type of initiatives capable of advancing the importance of pathologists in the changing healthcare environment.

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Nil

CONFLICT OF INTEREST

The authors do not have any conflict of interest.

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