Evaluation of Medical and Dental Professionals' Expertise in Digital Forensics-A Survey

Aswani E
Post Graduate student
Department of Oral Pathology,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University,
Chennai- 600077
Email Id: aswaniuma029@gmail.com

Dr. Abirami Arthanari BDS, MSc, PhD(On Going)
Lecturer
Department of Forensic Odontology,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University,
Chennai- 600077
Email Id: abiramia.sdc@saveetha.com

Dr. Pratibha Ramani
Professor and Head of the Department
Department of oral and maxillofacial pathology
Saveetha Dental College and Hospital
Saveetha Institute of Medical and Technical Sciences,
Saveetha University,
Chennai, India
Email Id: hod.omfp@saveetha.com

ABSTRACT:

BACKGROUND: Digital forensics is a vital part of almost every criminal investigation given the amount of information available and the opportunities offered by electronic data to investigate and evidence a crime. In order to practice digital forensic and effectively in different disciplines of specialists , it is essential to have a good knowledge. The aim of the study was to assess the awareness, knowledge and practice about digital forensics among doctors.

MATERIAL AND METHODS: A cross sectional questionnaire survey was conducted among doctors. In this study, 150 participants were evaluated. The questionnaire consists of 21 questions which mainly focus on knowledge, awareness about digital forensics among doctors. The obtained data was entered and analyzed statistically with SPSS statistical software 20.0.

RESULT: 72% of respondents did not have digital forensic related software in curriculum. About 86% and 63.3% of the students were aware about the different types of process and cases where digital forensics is used in dentistry. In comparison among study participants, BDS and medical students showed less knowledge and awareness.72.7% did not get proper digital forensics training Most of the MDS (68.67%)and BDS (14%) students think that better scope for digital forensics.

CONCLUSION: Results of this survey clearly stipulated that dental and medical students have moderate knowledge and awareness of digital forensics and its implementation in forensics investigations but are interested in using software in digital forensics. Furthermore, accomplishment of digital forensics in undergraduate curriculum might provide better gain in knowledge and practice at early stage

Keywords: Digital forensic, Dental students,Medical students,Forensic odontology,Criminal investigation

INTRODUCTION:

Approach of digital technologies and communications evacuated many of the traditional barriers associated with conventional forms of media. With the rising presence of digital devices, information repositories, and network traffic, cyber forensics (a.k.a. digital forensics) faces an increasing number of cases having ever growing complexity(1).

Forensic odontology has been defined by Keiser Neilson in 1970 as that branch of dentistry which in the interest of justice, deals with the proper handling and examination of dental evidence, and with the proper evaluation and presentation of dental findings.It primarily concerned with identification based on dental characteristics that are unique to every individual(2). The enamel being the hardest tissue in

the human body withstands peri and postmortem (PM) changes and environmental challenges, thereby ensuring the reliability of dental evidence(3).

The importance of victim identification, in the face of mass disasters,post- mortem decomposition, violent deaths such as road traffic accidents or brutal murders was valued worldwide(3). It helps in resolving serious legal and social predicaments as well as provides closure to grieving families.The accuracy of forensic sciences has always been a cause for concern, and still; it is under debate.The newer techniques such as matching of DNA, bite marks, fingerprints, firearm marks and footprint matching are evolved in forensic(3).

Nortje (1986) stated that "radiographic appearance of teeth and bone of the face is a permanent record of these tissues even when teeth and sections of the bone are removed for histopathologic examination."(3) The uniqueness of each dentition and the ability of teeth to sustain harsh conditions make dental characteristics reliable and often the only source of identification available.Technology has grown by leaps and bounds and has become an integral part of our daily lives(4).

Hence, it comes as no surprise that technology has crept into the field of forensics, thus leading to a separate branch called digital forensics(5). Digital forensics is the scientific acquisition, analysis, and preservation of data contained in electronic media whose information can be used as evidence in a court of law(6). Comparing dental radiographs of antemortem (AM) and PM data obtained manually gives positive identification was a tedious task and time-consuming(5). Therefore, to improve the efficiency, accuracy, and lower the costs, the computer-aided software was developed to help cope with the increasing demand to obtain faster means of identification(7).

Despite a tremendous increase in digital forensics in dentistry, hardly few surveys have been conducted in India. Hence, the main aim of this survey is to create awareness, assess the educational level and knowledge about digital forensics application among doctors.

MATERIALS AND METHODS:

The present study was carried out in the month of december 2020 among doctors.Approval of the study was obtained from the Institutional Review board..

In this study, 150 participants were evaluated. 134 of them were dental students (25 UG and 109 PG),13 were medicine students (8 UG and 5 PG) and 3 were M.Sc forensic odontology. The questionnaire was collected after answering for evaluating the result.The close-ended questionnaire consists of 20 items assessing the awareness and understanding the applications of digital forensics regarding different specialties of doctors.The obtained data responses were transformed to excel sheets

and transferred to SPSS statistical software 20.0 Chi-square test was done for the association between dental students and practitioners on their knowledge and awareness of lasers. The results were tabulated and formulated with bar graphs. P value less than 0.05 was considered statistically significant. Confidence level was set at 90%.

RESULT:

Questionnaire responses were tabulated and percent distributions for each response to each item were computed.There were 150 responses to each questionnaire yielding a response rate of 100%. Demographics of the study participants revealed that out of 150,16.66% were BDS dental students and 72.6% were MDS dental students and 5.33% were MBBS students and
3.33% were MD, forensic medicine and remaining 2% were M.Sc,Forensic Odontology.(Figure-1).

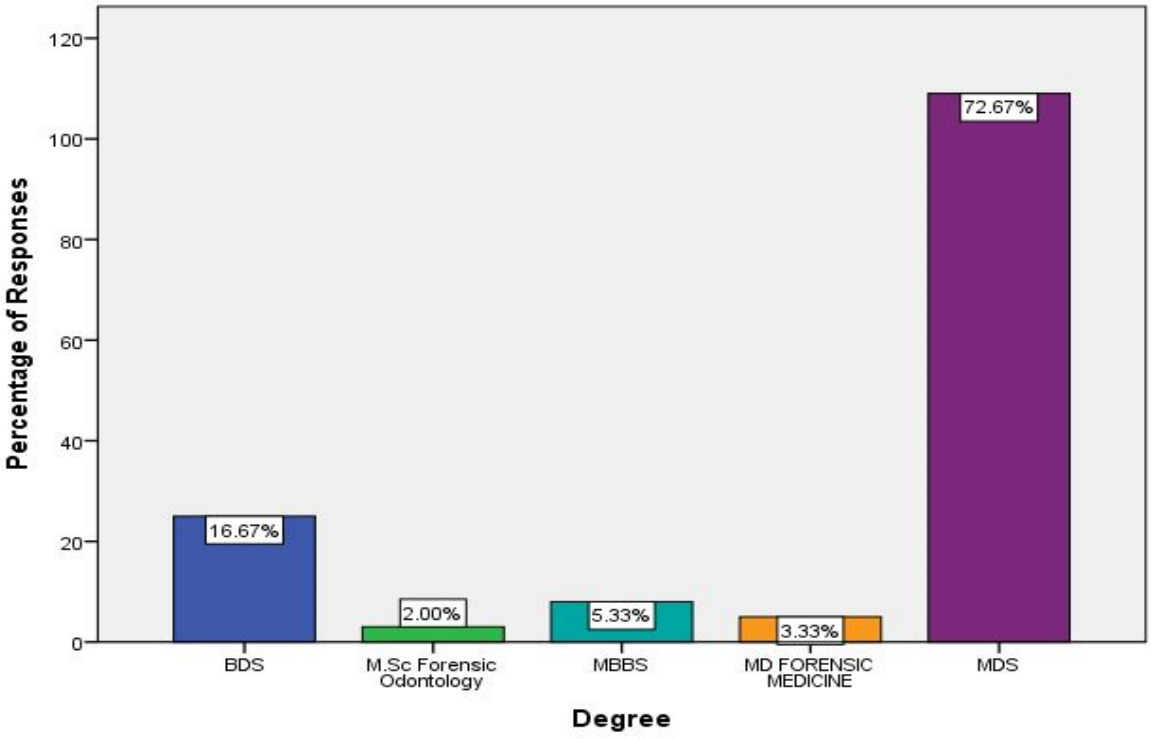

Figure-1: Graph depicting distribution of participants.. 16.66% were BDS dental students(Blue) and 72.6% were MDS dental students(violet) and 5.33% were MBBS students(Light blue) and 3.33% were MD, forensic medicine(yellow) and remaining 2% were M.Sc,Forensic Odontology(Green).

54.7% of respondents were aware about digital forensics in dentistry and 45.3% were unaware about digital forensics. Out of 16.67%of the BDS students ,9.33% were not aware about digital forensics. Chi-square test p= 0.09 (p<0.05 indicating not statistically significant).(Figure-2).

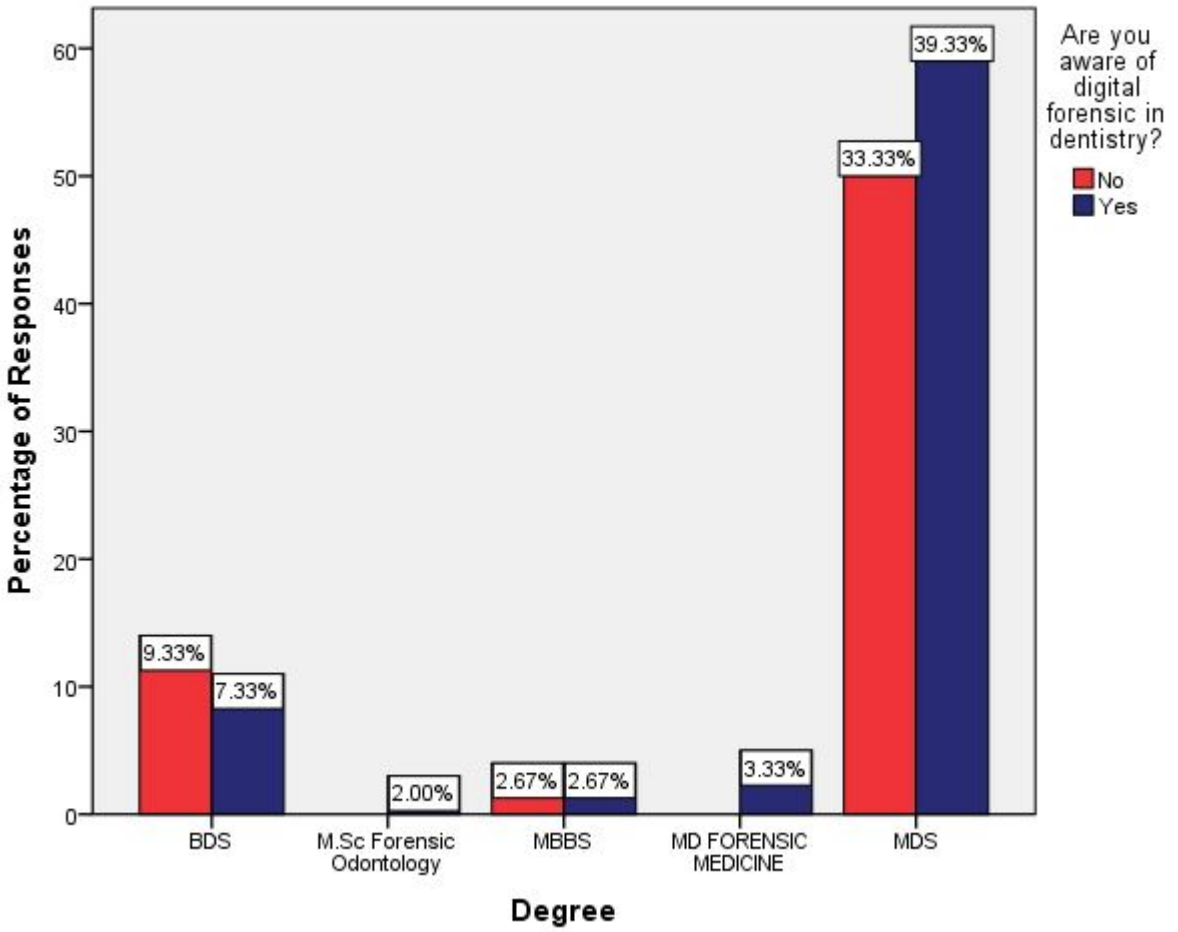

Figure-2: Bar Graph showing comparison of responses between doctors on awareness of digital forensics in dentistry. Most of the MDS students (39.33%) were aware about digital forensics in dentistry (Blue). About 9.33% out of 16.67% were not aware about digital forensics(Red). Chi-square test p= 0.09 (p<0.05 indicating not statistically significant).

72% of respondents did not have digital forensic related software in curriculum and only 28% were having software related digital forensics courses in their curriculum. Most of the MDS (50%) and BDS (15.33%) students did not use digital forensics software in their curriculum.Chi-square test p= 0.02 (p<0.05 indicating statistically significant).(Figure-3).

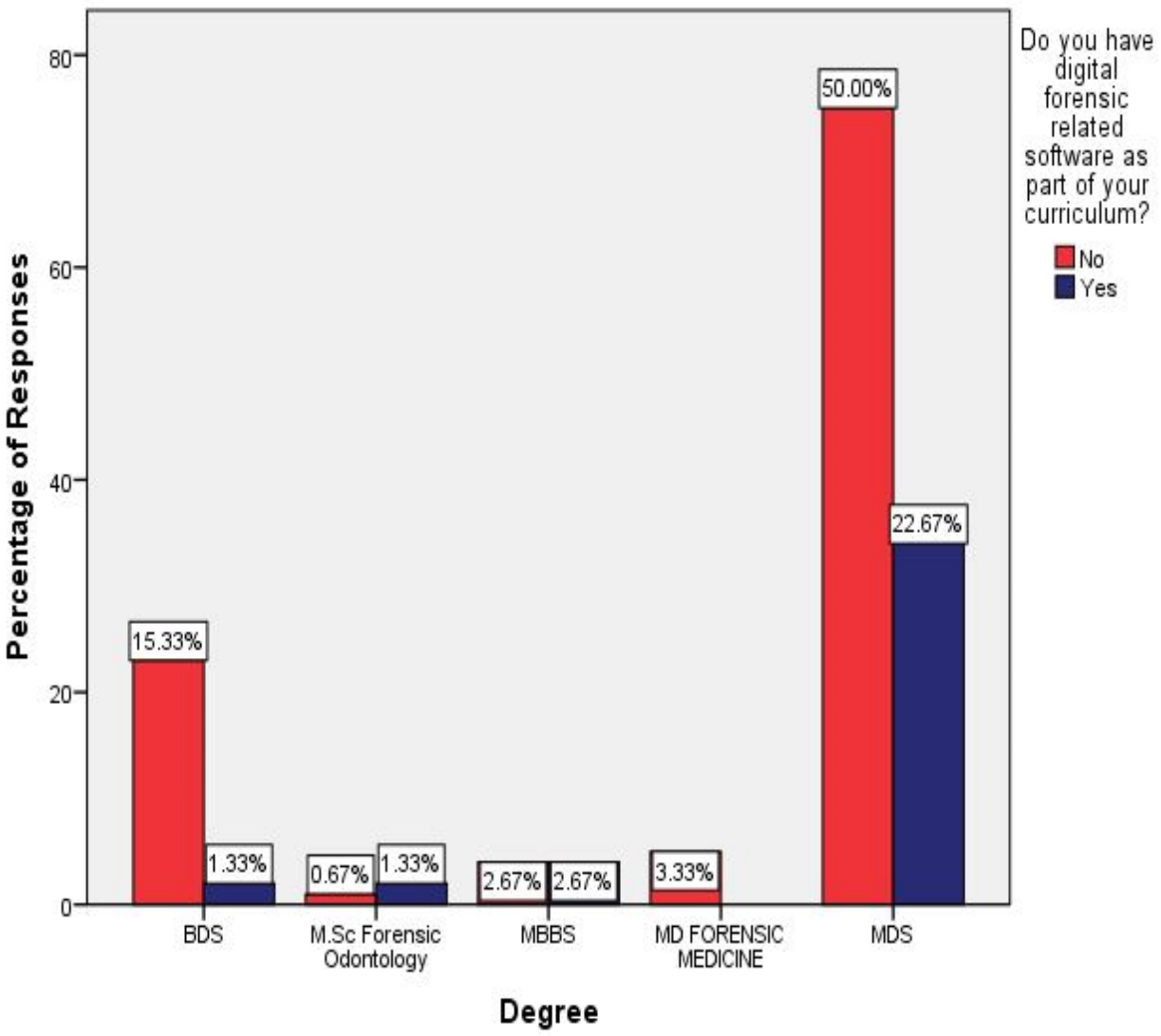

Figure-3: Bar Graph showing comparison of responses between doctors on use of digital forensics software in curriculum.Only 28% were having software related digital forensics courses in their curriculum(Blue). Most of the MDS (50%) and BDS (15.33%) students did not use digital forensics software in their curriculum(Red).Chi-square test p= 0.02 ($p<0.05$ indicating statistically significant).

48.7% and 46.7% respondents get sources of knowledge about digital forensics mainly by media and lectures respectively. Out of which 30%(MDS) and 10.67% (BDS) students got knowledge by lectures.39.33% MDS students get source of knowledge by internet,and television respectively.Chi-square test p= 0.66 ($p<0.05$ indicating not statistically significant).(Figure-4).

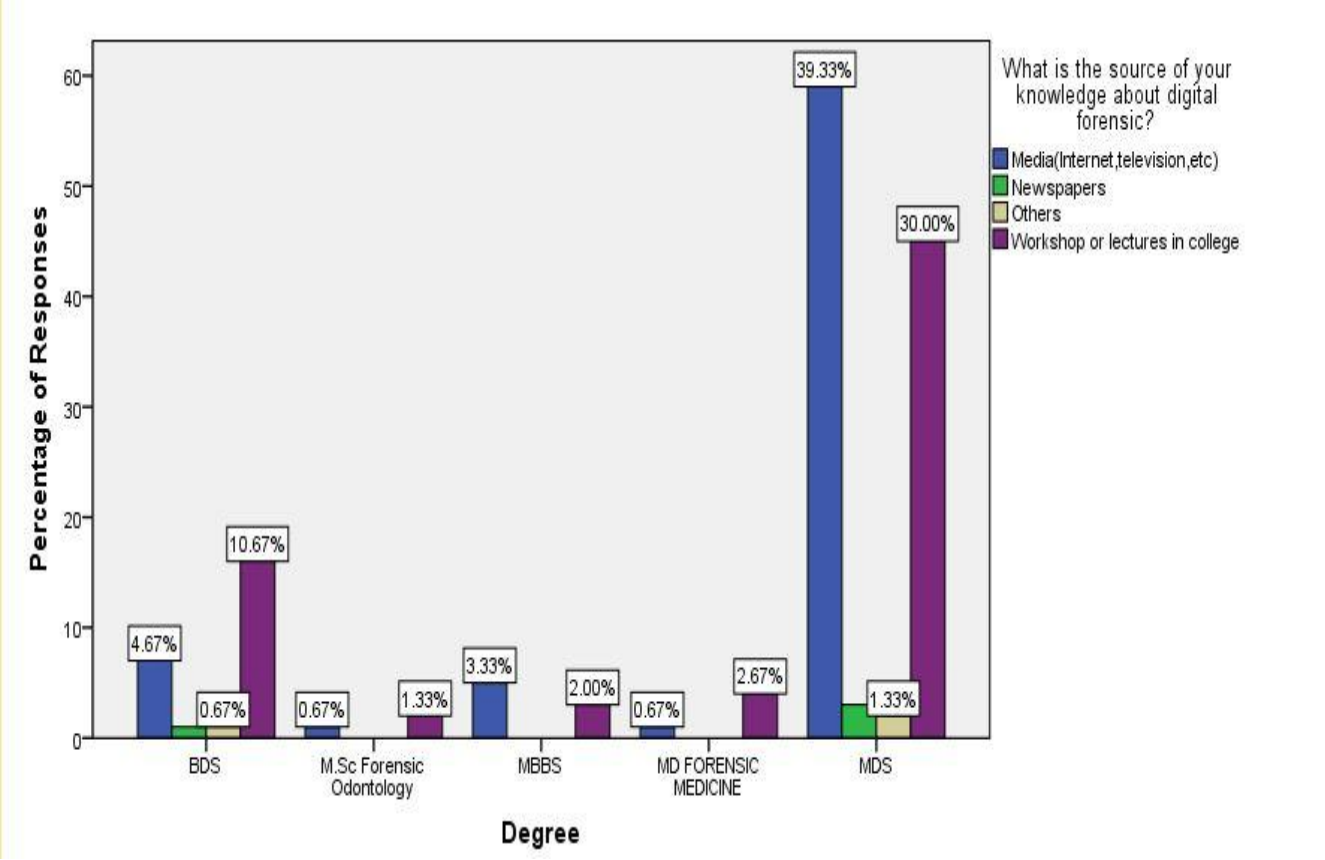

Figure-4: Bar Graph showing comparison of responses between doctors on source of knowledge about digital forensics. Out of which 30%(MDS) and 10.67% (BDS) students got knowledge by lectures(Violet).39.33% of the MDS students get source of knowledge by internet,and television respectively(Blue).Chi-square test p= 0.66 (p<0.05 indicating not statistically significant).

86% of the respondents are known about the process of digital forensics.Most of the MDS (63.33%) and BDS (14%)students are well knowledgeable about the process of digital forensics.Chi-square test p= 0.88 (p<0.05 indicating not statistically significant).

63.3% of the respondents are known about the cases where digital forensics is useful.Out of that 28% of the doctors are thinking that digital forensics is useful in fraud investigation.Most of the MDS (48%) and BDS (6.67%)students are agree that digital forensics will used all types of criminal cases.But about 19.33% (MDS) and 7.33%(BDS) students thought that forensics mainly used for fraud investigation.Chi-square test p= 0.11 (p<0.05 indicating not statistically significant).(Figure-5)

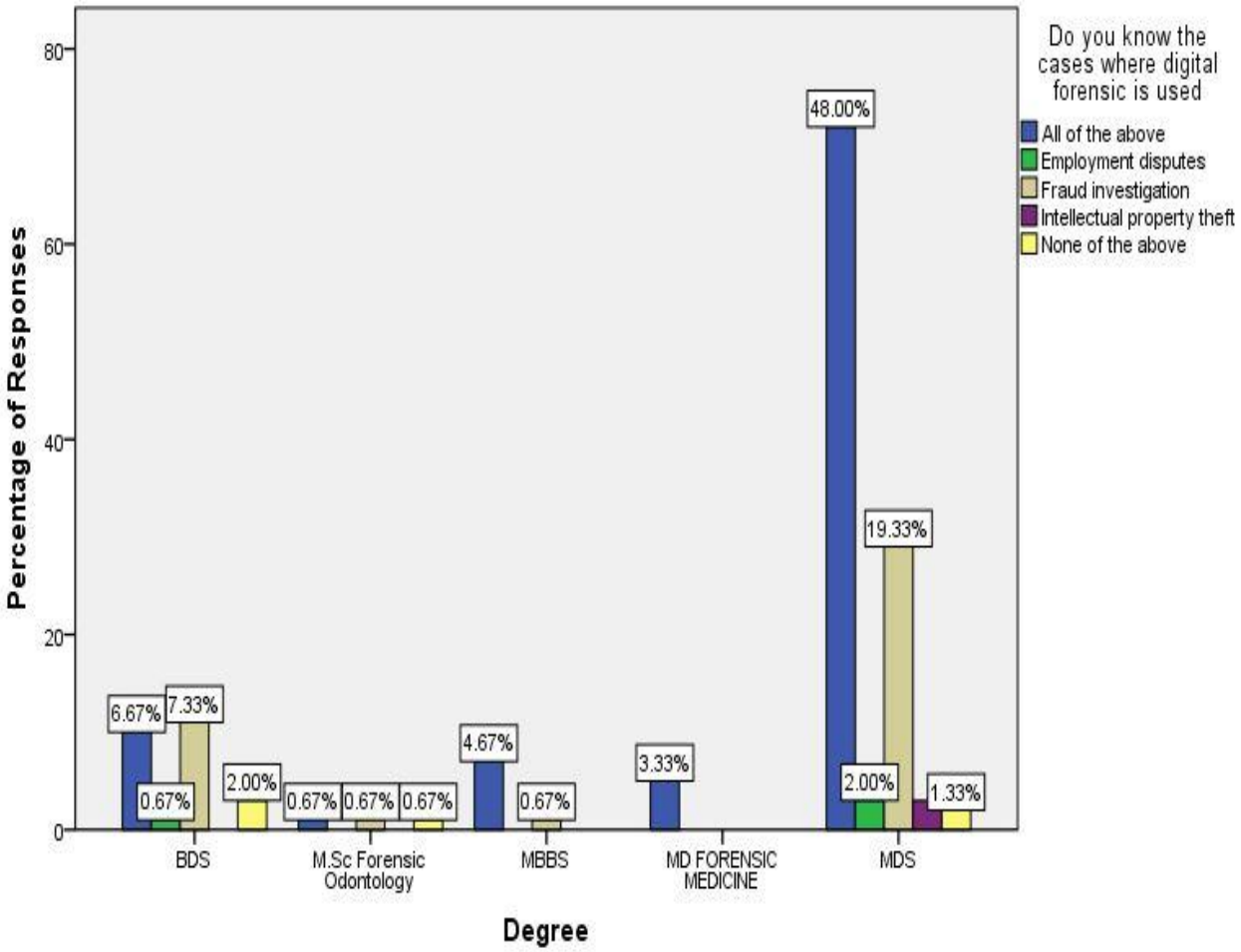

Figure-5: Bar Graph showing comparison of responses between doctors aware about recent prints in forensics. Most of the MDS (48%) and BDS (6.67%)students are agree that digital forensics will used all types of criminal cases(Blue).But about 19.33% (MDS) and 7.33%(BDS) students thought that forensics mainly used for fraud investigation(olive green).Chi-square test p= 0.11 ($p<0.05$ indicating not statistically significant).

64% of the respondents agree that digital imaging techniques will give accurate analysis of ante-mortem and post-mortem data. Most of the MDS students about 48% agree that digital imaging techniques give accurate analysis of data.Chi-square test p= 0.06 ($p<0.05$ indicating not statistically significant).(Figure-6)

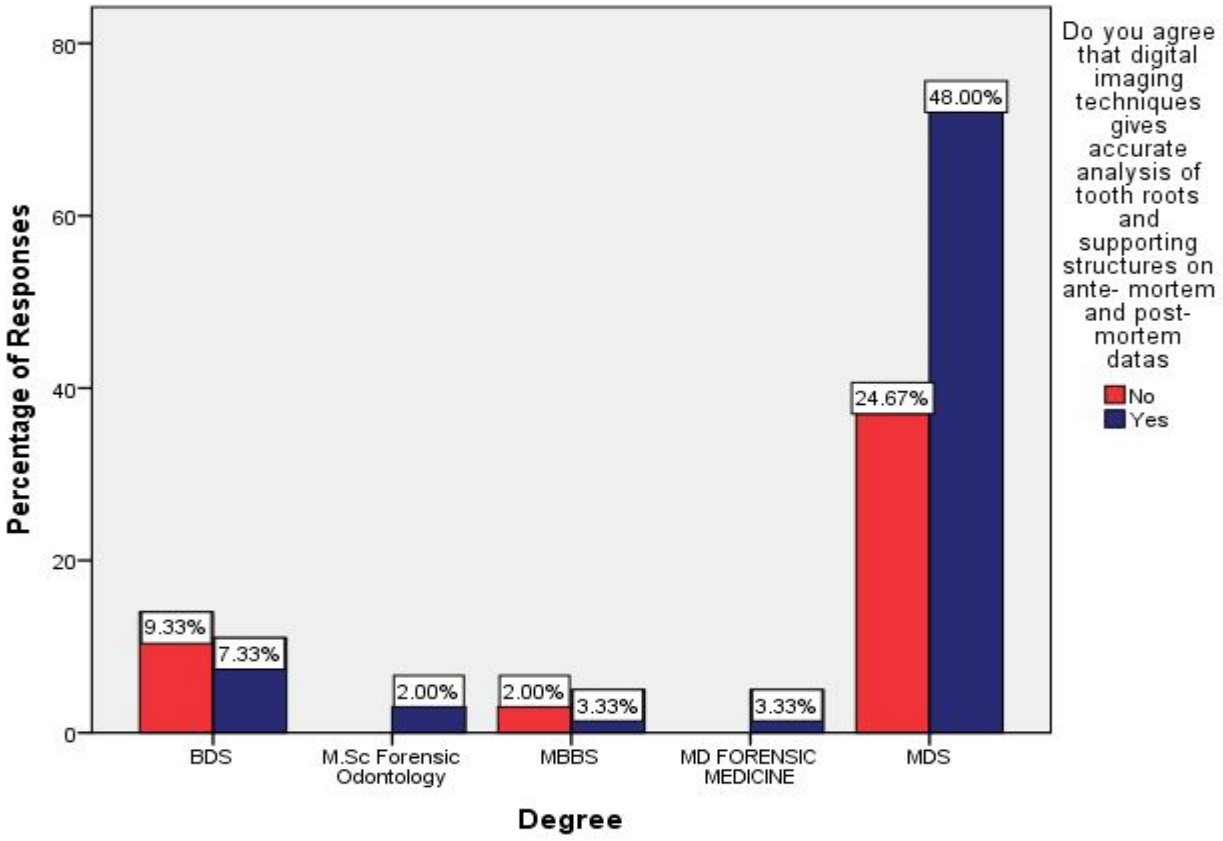

Figure-6: Bar Graph showing comparison of responses between doctors on digital imaging techniques gives accurate analysis of ante-mortem and post-mortem data. Most of the MDS students about 48% agree that digital imaging techniques give accurate analysis of data(Blue).Chi-square test p= 0.06 ($p<0.05$ indicating not statistically significant).

53.3% of the respondents agree computer -generated dental records are usually in routine professional or forensics related cases.About 34.97%(MDS)and 10%(BDS) students did not agree with the computer -generated dental records are used in routine dentistry. Chi-square test p= 0.11 ($p<0.05$ indicating not statistically significant).

53.3% of the respondents were not aware of 3D/CT images used in digital forensic for facial reconstruction.Most of the MDS (39.33%)and BDS (10%) students were not aware of 3D/CT imaging techniques used in facial reconstruction.Chi-square test p= 0.13 ($p<0.05$ indicating not statistically significant).

59.3% of the respondents were not aware of Nano chips and bar coding in denture identification.Most of the MDS (40%)and BDS (12%) students were not aware of nanochip and bar coding are used in denture identification.Chi-square test p= 0.48 (p<0.05 indicating not statistically significant).

70% of the respondents were not aware of bullet trax- 3D system in digital forensicsMost of the MDS (49.33%)and BDS (13.33%) students were not aware of the bullet trax- 3D system used in digital forensics.Chi-square test p= 0.53 (p<0.05 indicating not statistically significant).

80% of the respondents are known about the different prints used in digital forensics.Out of that 32.7% of the doctors are thinking that digital forensics is used in fingerprint identification.Most of the MDS (39.33%) and BDS (7.33%)students were aware about all recent prints used in forensics.But about 26% (MDS) and 4.67%(BDS) students thought that mainly used prints in forensics identification was fingerprints.Chi-square test p= 0.12 (p<0.05 indicating not statistically significant).(Figure-7)

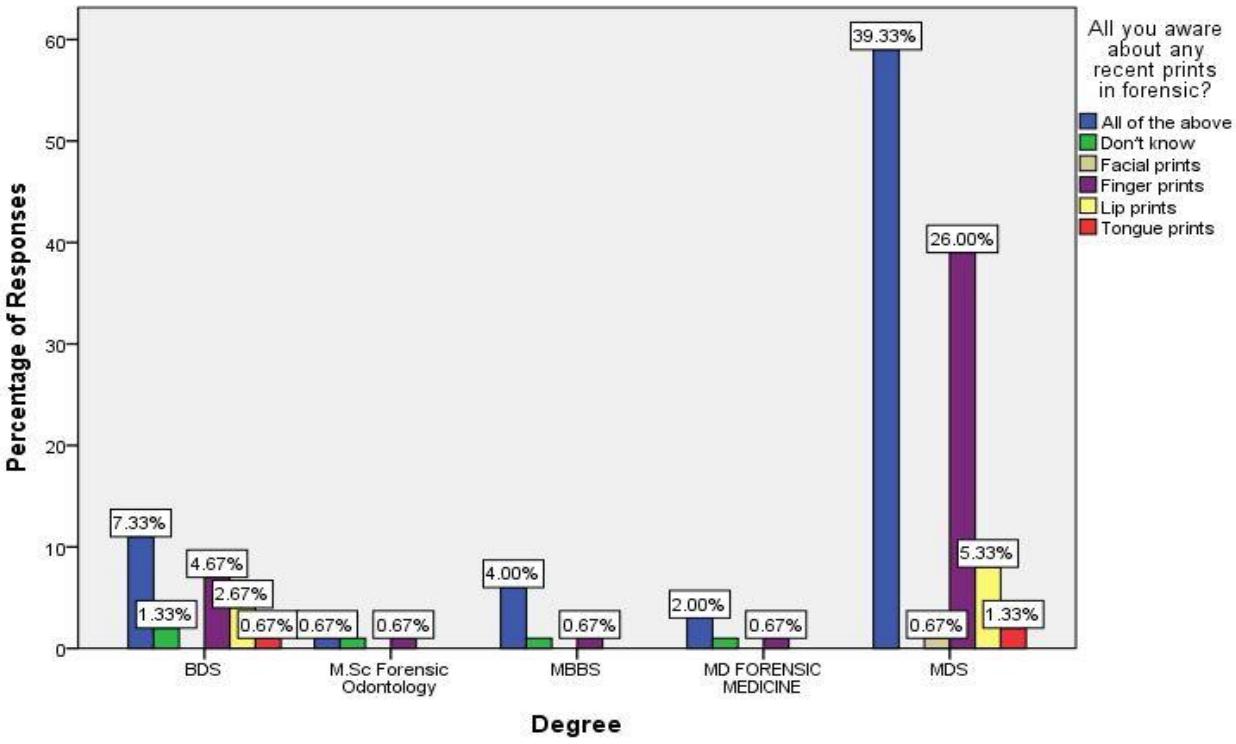

Figure-7: Bar Graph showing comparison of responses between doctors aware about recent prints in forensics. Most of the MDS (39.33%) and BDS (7.33%)students were aware about all recent prints used in forensics(Blue).But about 26% (MDS) and 4.67%(BDS) students thought that mainly used

prints in forensics identification was fingerprints(Violet).Chi-square test p= 0.12 (p<0.05 indicating not statistically significant).

70% of the respondents were not aware about Win-ID3 software in digital forensics.Most of the MDS (50%)and BDS (13.33%) students were not aware of Win-ID3 software used in digital forensics.Chi-square test p= 0.55 (p<0.05 indicating not statistically significant).

56% of the respondents were not aware about superimposition procedures in facial reconstruction. Most of the MDS (46.67%)and BDS (11.33%) students were not aware of this recent procedure in forensics identification.Chi-square test p= 0.01 (p<0.05 indicating statistically significant).(Figure-8)

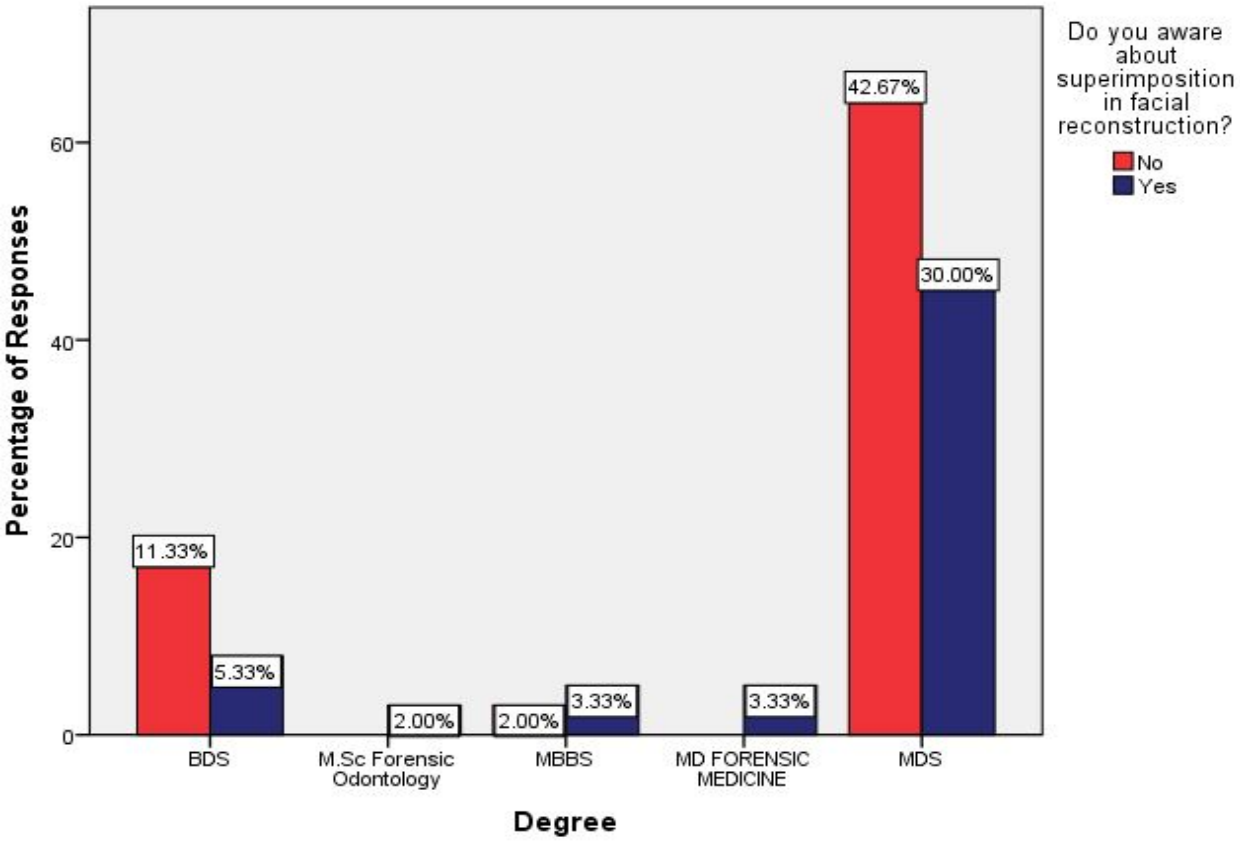

Figure-8: Bar Graph showing comparison of responses between doctors on aware about superimposition in facial reconstructions.Most of the MDS (42.67%)and BDS (11.33%) students were not aware of superimposition techniques(Red).Chi-square test p= 0.01 (p<0.05 indicating statistically significant).

70% of the respondents were not aware about GIMP -2.10.18 version software in forensics identification. Most of the MDS (49.33%)and BDS (14%) students were not aware of this recent software in forensics identification.Chi-square test p= 0.36 (p<0.05 indicating not statistically significant).

50% of the respondents were not agree for forensics is important in mass disaster identification and remaining 50% were agree with that.Most of the MDS (37.33%)and BDS (9.33%) students were not agree that forensics play important role in mass disaster..Chi-square test p= 0.38(p<0.05 indicating not statistically significant).

72.7% of the respondents agreed that knowledge level and awareness about digital forensics was inadequate.Out of that 37.33%(MDS) and 9.33%(BDS) students were agree that knowledge and awareness level is inadequate..Chi-square test p= 0.36 (p<0.05 indicating not statistically significant).(Figure-9)

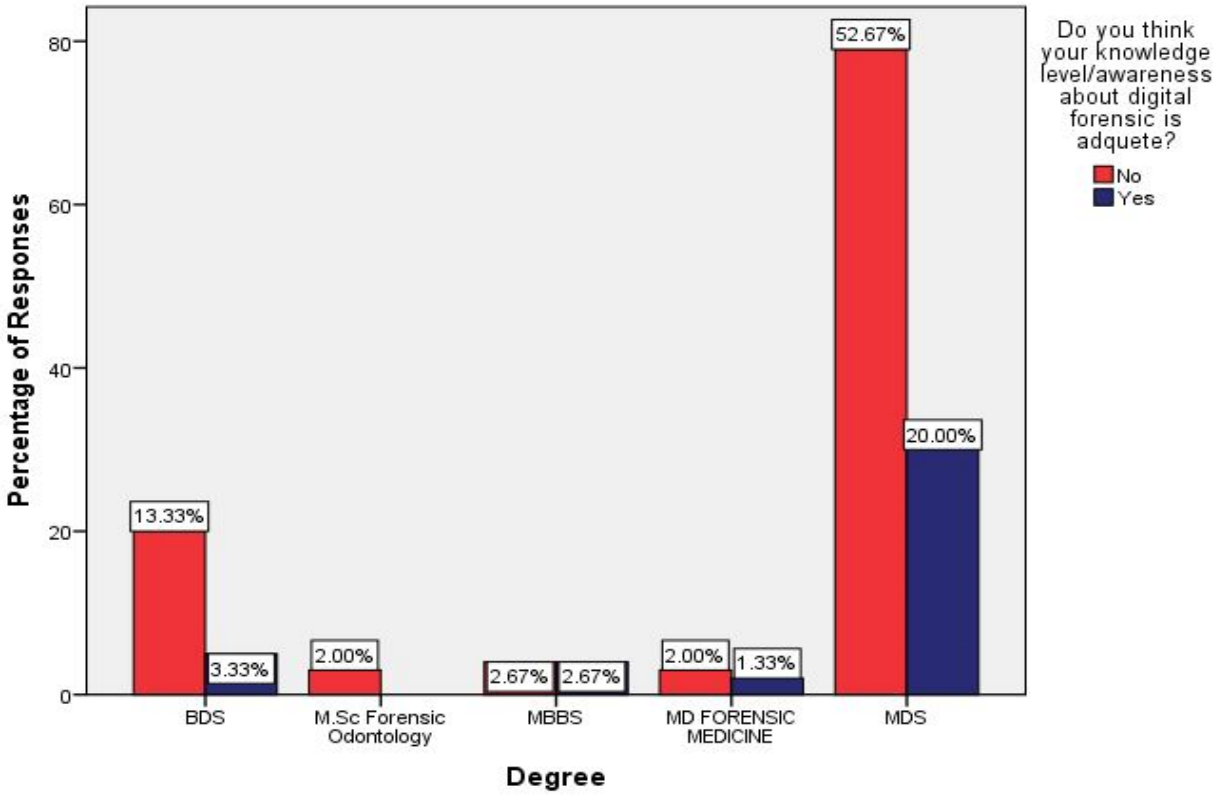

Figure-9: Bar Graph showing comparison of responses between doctors on knowledge level and awareness about digital forensics was adequate.Most of the MDS (37.33%)and BDS (9.33%) students

were agree that knowledge and awareness level is inadequate(Red).Chi-square test p= 0.36 (p<0.05 indicating not statistically significant).

91.3% of the respondents agreed that they were interested in digital forensics courses.Most of the MDS (68%)and BDS (13.33%) students were interested in forensics related courses.Chi-square test p= 0.22 (p<0.05 indicating not statistically significant).

92% of the respondents agreed that there was better scope for digital forensics.Most of the MDS (68.67%)and BDS (14%) students were think that better scope for digital forensics.Chi-square test p= 0.33 (p<0.05 indicating not statistically significant).(Figure-10)

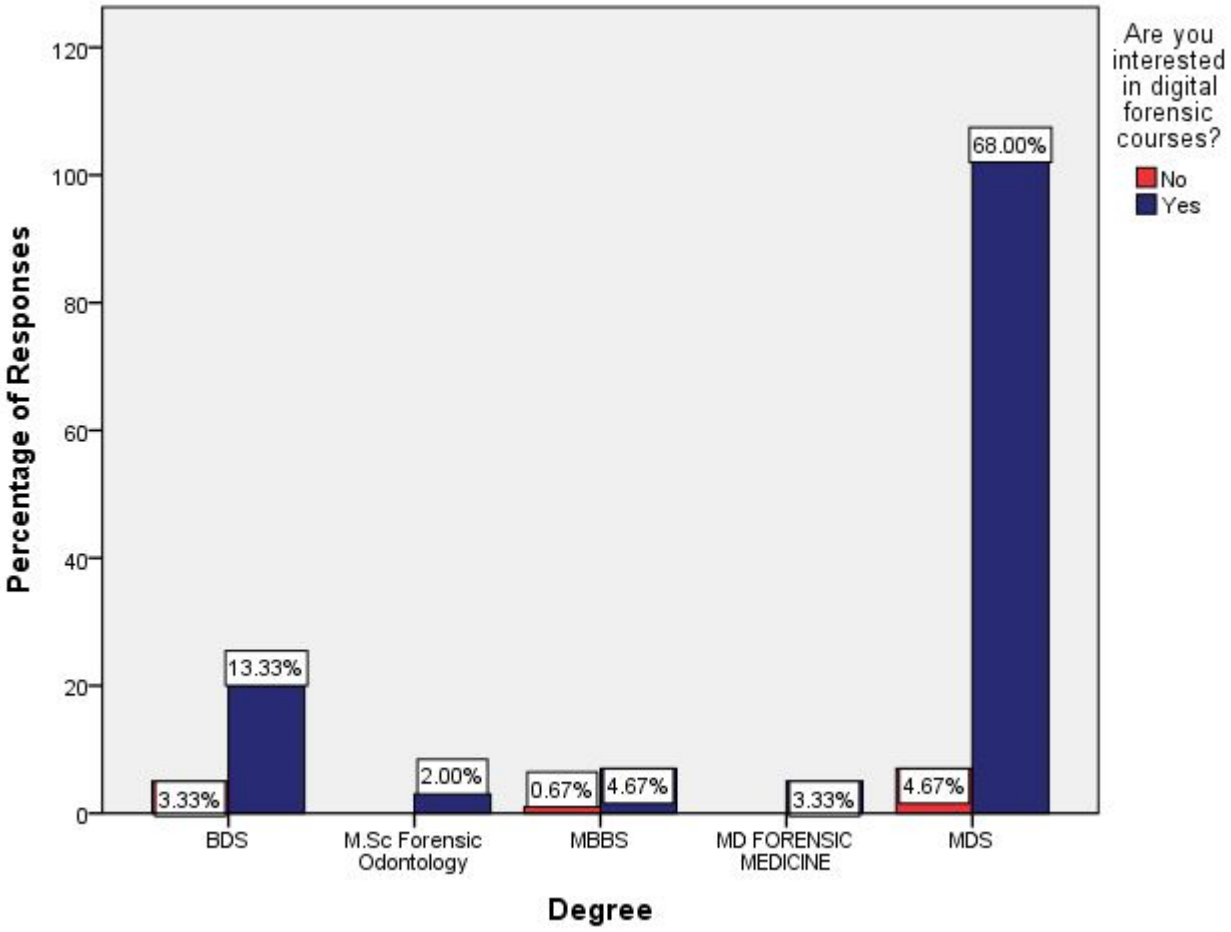

Figure-10: Bar Graph showing comparison of responses between doctors on digital forensics courses.Most of the MDS (68%)and BDS (13.33%) students were interested in forensics related courses(Blue).Chi-square test p= 0.22 (p<0.05 indicating not statistically significant).

61.3% of the respondents are interested in reading digital forensics related journals and 38.7% respondents do not know about the digital forensics related journals.

100% of the respondents agreed they recorded their patients dental history regularly.58.9% 0f the respondents agree that they record the dental history in digital methods and remaining 41.1% respondents were recorded by manual methods.

DISCUSSION:

In the present study, dental students are confronted with a exceptional level of knowledge and awareness about digital forensics than medical students.Association between doctors on use of digital forensics software in curriculum shows most of the MDS (50%) and BDS (15.33%) students did not use digital forensics software in their curriculum which show statistically significant p=0.02.

Association between doctors aware about superimposition in facial reconstructions shows most of the MDS (42.67%)and BDS (11.33%) students were not aware of superimposition techniques which shows statistically significant results(p= 0.01).

Ante-mortem data organized as dental records may be utilized as an invaluable tool for substantiating or denying identity. Relevant professional bodies, including the Indian Dental Association and the Indian Association of Forensic Odontology have been promoting patient record maintenance for the period of time prescribed by the law(8),(9).

Although the many more comparison of studies conducted in different country and even states in India showed that there was adequate exposure to forensic odontology during undergraduate education and exposure may not be sufficient regarding digital forensics related software for easy identification in criminal cases(8).Furthermore, lively nature of dental practices is the biggest challenge associated with accurate and complete dental record keeping.

With various and stubborn environmental challenges, teeth are sophisticated to be excellent post-mortem material for identification with enough concordant points to make a significant comparison(10).

Scope of forensic odontology and digital forensics play an wide arrange in identification of suspects in criminal investigations, suspected child or adult abuse, bite marks or physical injuries, determination of age and gender of the living or decedent person, providing forensic dental evidence as an expert witness in the court and human identification through human remains that are decomposed and distorted in mass disasters(8).

In the present study, M.D.S dental students presented a better level of knowledge and awareness about digital forensics than B.D.S and medical students. Reason could be justified as the majority of B.D.S and medical students upgrade their knowledge related to forensic dentistry mainly by media and Internet while M.D.S dental practitioners upgrade their knowledge through Journals,lectures and Workshops which are more updated sources which was in concordance with result of Preethi et al in 2011 and Rahman et al 2017 (11),(8).

Dentists played a powerful role in identifying deceased in case of mass disaster as they can aid in issuing death certificates which can be very helpful in claiming the insurance, settlement of property, facilitating remarriage of a surviving spouse and allowing the last ritual of the body. Identifying the feature will include displaced / rotated teeth, permanent amalgam and composite restorations, carious tooth, missing teeth, occupational or habit created wear facets, fractured teeth, diastema, prosthodontic appliances, extent of shovelling of the maxillary incisors and angulation of impacted teeth similarly dental anomalies, intrinsic staining and bone level present with digital radiograph(8).

Sex of a person would be identified by Barr bodies and Y-chromosomes in dental pulp in molecular level.Despite that, present study only 9.33% of B.D.S and 37.33% of M.D.S knew the role of digital forensics in the event of mass disaster which was in concordance with Preethi et al in 2011 (11). There is a need for maintaining the records legally and professionally to protect against any commercial, legal, and medico-legal litigation(12).Law states that the doctors has the legal duty, to maintain and preserve medical, medico-legal, and legal documents in the best interests of social and professional justice by Under Article 51 A(h) of the Constitution of India(13).

In the present study suggested that 100% of the respondents agreed they recorded their patients dental history regularly.58.9% and the remaining 41.1% respondents were recorded by digital and manual methods, respectively.These findings were similar when compared with findings of the study conducted by Preeti S (2011)and Rahman et al 2017 (11),(8).

Recent advances in different types prints other than finger prints for individual identification in any murder and crinimal cases.Even superimpsition and 3D/CT images for facial reconstriction were in case of terriost attack.Futhmore in the computer generated nanochips,bar codings for denture for in case of deceased decomposed edentulous person and even WIN -ID3 software recording both ante-mortem and post-mortem records of the patients for future references.In the present study states that 70% of the overall study participants did not aware of the recent advances of forensic in the computer era.

72.7% of the study participants agreed that knowledge in the case of forensics was very limited and inadequate which was in concordance with those of a study by Preethi et al in 2011(11).

This study is the first of its kind to be conducted on chennai in digital forensics. Based on this study , MDS students show the highest level of knowledge regarding digital forensics, but the difference between the groups was not significant. A significant group difference was observed in the level of awareness of the dental record maintenance regularly.

The study has several limitations as per the sample size, answer bias, etc. Despite this, regarding the potential quality of being generalizable of the results, caution was exercised by ensuring that the survey respondents closely matched the demographic characteristics of the underlying population.

CONCLUSION:

This study shows that most participants of the dental and medicine field had only moderate knowledge on digital forensics and its implementation in forensics investigations but are interested in using software in digital forensics.Even Though digital forensics has many advantages in the field of dentistry to identification of living and deceased persons, its practice is less due to the lack of knowledge and it being not given legal accuracy to conduct the autopsy and even criminal cases in the institutional level. Hence education should be given during their college study programs on digital forensics software to increase its implementation in the field of dentistry.

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CONFLICT OF INTEREST:

The author declares that there was no conflict of interest in the present study.

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