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ORIGINAL ARTICLE

DNA Analysis as a Remarkable Tool in Forensic odontology - A Survey

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ABSTRACT
In a number of instances, DNA typing has completely transformed criminal investigations. Nowadays, it is practically impossible to bring a case to trial without identifying the parties involved through the use of our most precise case report, which is now available online. The purpose of this project is to provide dentistry undergraduate students with knowledge about DNA analysis as a tool in forensic odontology. We collected information through the use of self-structured questionnaires. As data gathering software, we made use of a Google form link that was available online. As data gathering software, we made use of a Google form link that was available online. At the time of the study, the level of statistical significance was fixed at 0.005. All of the data was analyzed with the help of SPSS version 21.0. (IBM Inc, Armonk, NY, USA) It was decided to portray the output variables with pie charts and bar diagrams. A total of 200 students participated in this study. Bite mark analysis, Cheiloscopy, Dental imaging techniques, DNA analysis using oral tissue, Rigoscopy, and all of the above were mentioned in the responses. 25.00 percent agreed with bite mark analysis, 18.00 percent agreed with Cheiloscopy, 19.00 percent said Dental imaging techniques, 24.00 percent said DNA analysis using oral tissue, 5.00 percent said Rigoscopy, and 9.00 percent said all of the above. We discovered that the correlation between gender and DNA analysis has a p-value of 8.483, which means that it is not statistically significant. Within the restrictions of the study, we may infer that dental undergraduate students have a decent understanding of DNA analysis as a tool in forensic odontology and are aware of its importance. It may be necessary to organize awareness campaigns such as awareness camps, social media campaigns, workshops, and seminars to raise awareness about DNA analysis, bite mark analysis and lip prints among high school, college, and university students.
KEYWORDS: *DNA analysis, Forensic odontology, Fingerprint, bite Mark analysis , innovative technique , eco friendly*

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INTRODUCTION

In many circumstances, DNA testing has had a major impact on criminal investigations. It is practically impossible to bring a case to trial today without identifying the defendant using the most accurate case report that we have at our disposal. Case by case competency in DNA evidence methodology, concepts, and interpretation has become an increasingly vital part of today's criminal justice system [1]. Short tandem repeat (STR) typing is now the most widely used method of DNA analysis, which uses PCR to amplify a short tandem repeat mostly found in the DNA template and use capillary electrophoresis (CE) to separate the DNA amplicons [2]. The antemortem and postmortem data of a disaster victim must be compared to identify the victim. The use of DNA analysis in the absence of antemortem data becomes increasingly crucial. Human DNA may be extracted from dental pulp and used to identify victims [3]. After this finding was made, DNA analysis in forensics was implemented for the purpose of identifying human remains and resolving questions of parentage. DNA profiling study was aided by the use of DNA analysis [5]. When compared to dentin and cementum, pulp produces the greatest amplification signal [3]. In general, forensic dentistry investigates psychological, physical, chemical and biological phenomena that can easily reach the victim, including human identifications, criminal, civil and administrative forensic

investigation as well as examinations, saliva analysis and other multidisciplinary investigations [6].Criminalistics and forensic medicine have been further evolved and have been applied to DNA fingerprint molecular typing techniques as powerful tools for solving thousands of cases of crime within a short interval of time and easy for human identification [9]. A person's teeth are some of the strongest bones in the body, thus they can be used in forensic odontology to preserve evidence in the event of a fire or other extreme conditions. It is possible to identify the perpetrators of crimes and paternity cases using DNA profiling [7].In the past, studies have been done on forensic dentistry's use of DNA profiling (DNA Profiling in Forensic Dentistry, 2020), STR polymorphism analysis (Okamoto et al., 2003), mitochondrial DNA from archived tissue samples preserved in formalin (Pandey et al., 2014), introduction to forensic odontology (Introduction to Forensic Odontology, 2011), and ethical issues (DNA Profiling in Ethics) (James and Higgins, 2016). The goal is to educate dentistry students about DNA analysis as a forensic odontology technique.

MATERIAL AND METHODS

The study setting is a prospective observational study. The advantages of this study were economical, easy to create, wide reach, and gathering larger data, Quick interpretation. It was approved by the scientific review Board Saveetha Dental College, Chennai. The number of participants involved in this study is 200 college students.

Study design

A self-designed questionnaire was prepared with the guidance of college students which belong to Chennai but we have excluded the teachers. professor etc.

Study population

We have employed self-structured questionnaires to collect data. We utilized a Google Forms link to collect data from the internet. In order to collect data, we used a google form link. The list of output variables includes demographic information on the use of DNA analysis in forensics, as well as information on how well-versed people are in the field. As for the significance, we decided on an alpha cut-off of 0.005. SPSS version 21.0 was used to analyze all of the data (IBM Inc, Armonk, NY, USA) Output variables were depicted using Pie and Bar graphs. Among the participants in this study were 200 undergraduates. We analyzed the data using Pearson Chi-square.

QUESTIONNAIRES:

S.NO	Questions	OPTIONS								
1	Gender	Male			Female					
2	Age	17 years	18 years	19 years	20 years	21 years	22 years	23 years	24 years	25 years
3	Do you have knowledge about DNA analysis	Yes			No					
4	Do you think that DNA analysis is needed for forensic odontology?	Yes			No					
5	Do you know tools are used by forensic odontologist?	Dental imaging techniques		Bite mark analysis	Cheiloscopy			Rigoscopy	DNA analysis using oral tissue	All of these
6	Do you think that DNA analysis can give accurate evidence of criminal cases?	Yes			No					
7	What are the types of DNA analysis you know	Polymerase chain reaction	Short tandem repeat (STR)		Y-chromosomes		Mitochondria DNA		Next-generation sequencing	

8	Do you know why DNA analysis is used for forensic odontology?	Criminal investigations	Comparing criminal suspects profile	Parentage testing	Genealogical and medical research
9	Do you think that DNA analysis will give an accurate result?	Yes		No	Maybe
10	Do you know about DNA fingerprinting	Yes		No	Maybe
11	What percentage you think that DNA will give accurate results	20% - 30 %	30% - 50 %	50 % - 70 %	70 % - 90 %
12	Do you know that every child has the same mtDNA as its mother?	Yes		No	
13	Do you think that DNA analysis can give accurate results of sex identification?	Yes		No	
14	Do you think that a single tooth can identify the sex of the person?	Yes		No	

RESULTS

The questionnaires were developed and sent to 100 college students via the Google Forms link in this current study. Figure 1 depicts the gender breakdown of the students, with 76.50 percent men and 23.50 percent women. The following diagram is an illustration of what I mean: 1.50 percent of students are between the ages of 18 and 19, 8.00 percent are between the ages of 19 and 20, 14.50 percent are between the ages of 20 and 21, 19.50 percent are between the ages of 22 and 23, and 4.00 percent are between the ages of 24 and 25.

In [Fig 3] According to the graph, 93.5 percent of people are aware of DNA analysis, whereas 6.50 percent aren't. [Figure 4] The graph indicates the requirement for DNA analysis in forensic odontology, with 26.50% saying Yes and 73.50% saying No. There is a [Fig 5] More than two-thirds of the respondents agreed that forensic odontologists use bite mark analysis, 18.00 percent agreed Cheiloscopy, 19.00 percent agreed Dental imaging techniques, 24.00 percent agreed DNA analysis using oral tissue, 5.00 percent agreed Rigoscopy, and 9.00 percent agreed with all of these. 87.50 percent of those polled agreed that DNA analysis can provide accurate proof, while 12.50 percent were still unsure. Mitochondrial DNA, next-generation sequencing, polymerase chain reaction (PCR), and short tandem repeats (STR) were the most popular methods of DNA analysis, with 26.00 percent of respondents agreeing (STR).

[Fig 8] It depicted the DNA analysis used for forensic odontology, 58.50 % said comparing criminal suspects profile and 26.50 % said criminal investigations. [Fig 9] The graph depicting the awareness of knowledge on DNA fingerprinting, 73.00 % said Yes and 8.00 % are still not aware.

[Fig 10] Graph depicting that DNA will give accurate results, 38.00 % said Yes and 21.00 % still not aware. [Fig 11] It shows the percentage of DNA analysis will give accurate results , 14.50 % agreed 20% - 30 % , 32.00 % agreed 30 % - 50 % , 40.00 % agreed 50 % -70 % and 13.50 % said 70 % - 90 % . [Fig 12] The graph showing awareness of children has the same mtDNA from its mother, 74.50 % said yes,

14.00 % said No and 11.50 % are still not aware. [Fig 13] Graph showing the single tooth can identify the sex of the person, 57.00 % said Yes and 43.00 % said No.
We have seen the association between gender and tools used in forensic odontology (Fig 14), type of DNA analysis (Fig 15), DNA analysis use (Fig 16).

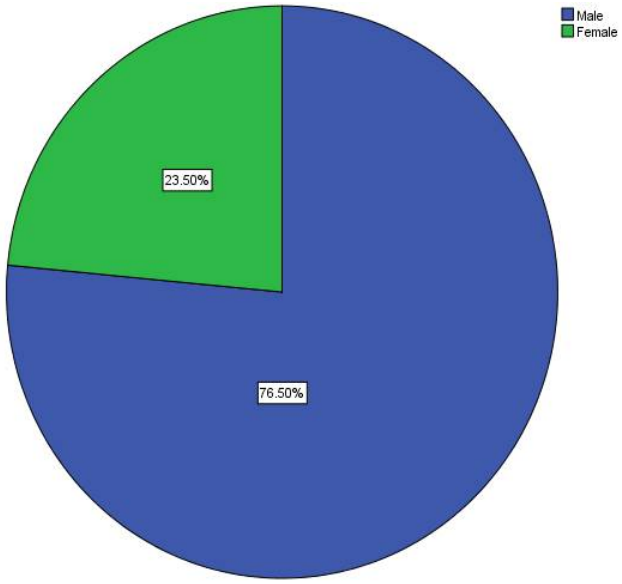

FIGURE 1 : Pie chart representing percentage distribution of gender of the participants 76.50 % - male (blue) , 23.50 % - female (green)

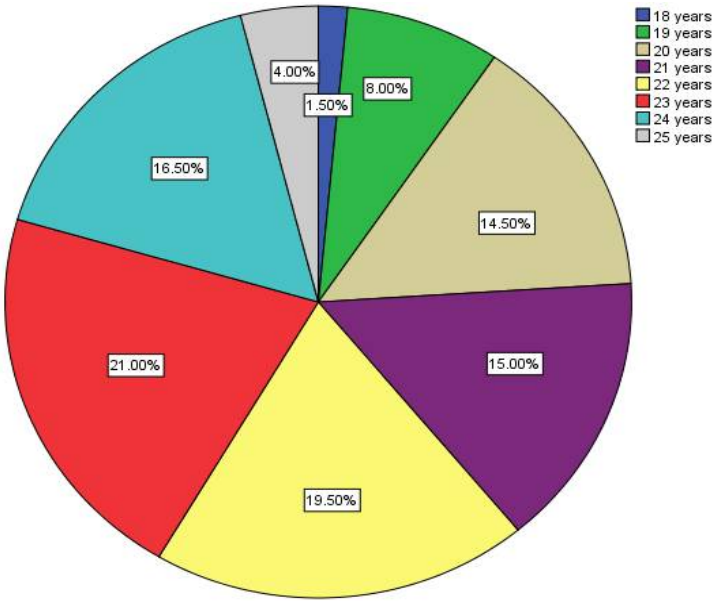

FIGURE 2 : Pie chart representing distribution of age group of participants . 1.50 % - belong to age group 18 years (blue) , 8.00 % - belong to age group 19 years (green) , 14.50 % - belong to age 20 (brown) , 15.00 % - belong to age 21 (violet) , 19.50 % - belong to age 22 (yellow) , 21.00 % - belong to age 23 (red) , 16.50 % - belong to age group 24 (blue) , 4.00 % - belong to age 25 (grey) .

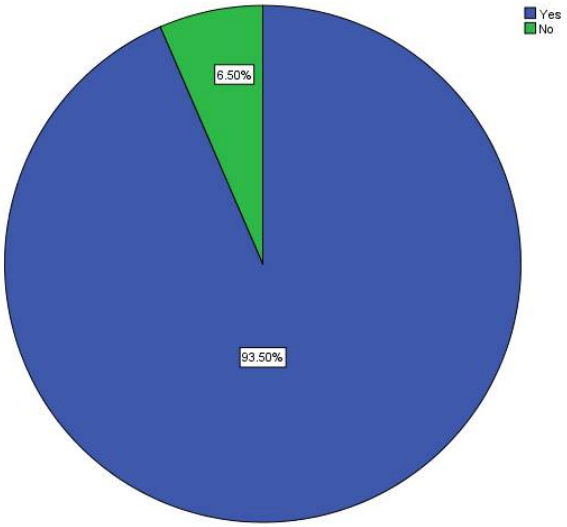

FIGURE 3: Pie chart representing a distribution of responses about knowledge on DNA analysis, 93.50 % - Yes (blue), 6.50 % - No (Green).

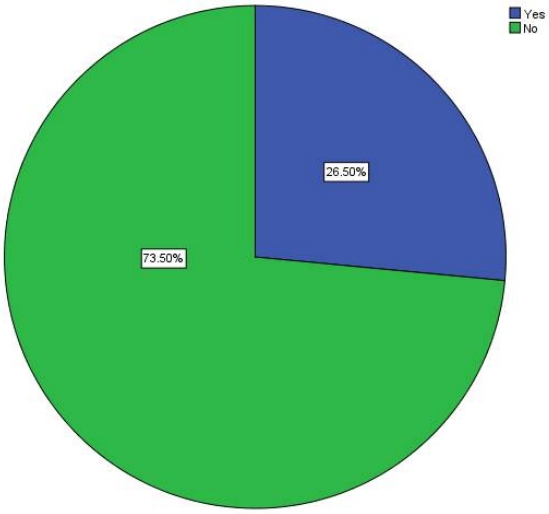

FIGURE 4: Pie chart representing a distribution of responses about the need of DNA analysis on forensic odontology, 26.50 % - Yes (blue), 73.50 % - No (green).

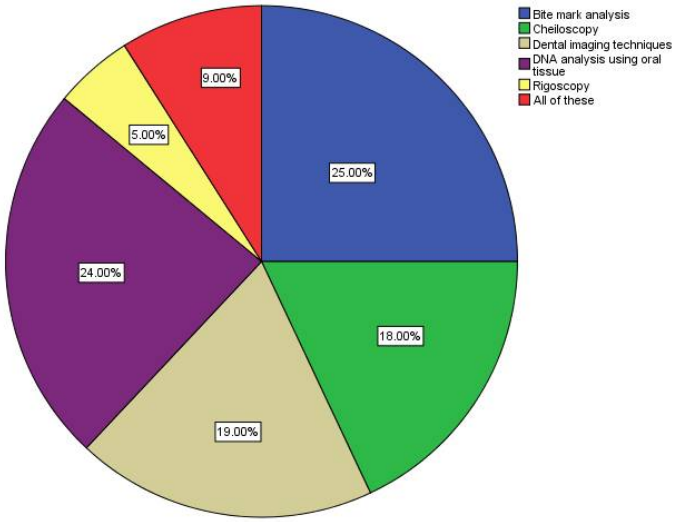

FIGURE 5 : Pie chart representing percentage of responses about tools used in forensic odontologist , 25.00 % - bite mark analysis (blue) ,18.00 % - Cheiloscopy (green) , 19.00 % - Dental imaging techniques (brown) , 24.00 % - DNA analysis using oral tissue (Violet) , 5.00 % - Rigoscopy (yellow) , 9.00 % - all the these (red) .

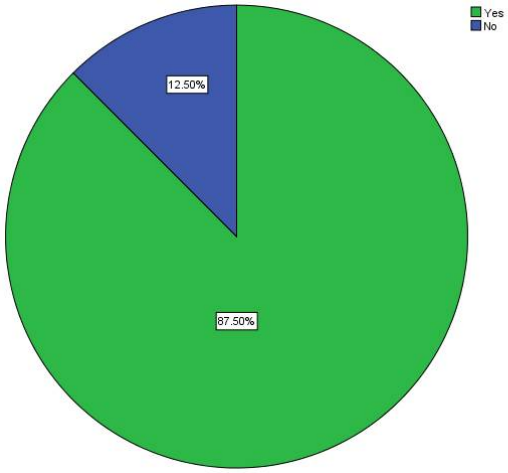

FIGURE 6: Pie chart representing a distribution of responses about DNA analysis can give accurate evidence, 87.50 % - Yes (Green), 12.50 % - No (Blue).

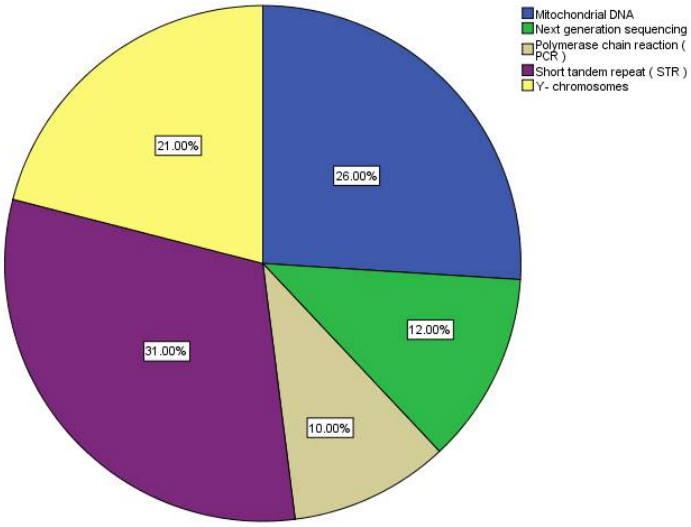

FIGURE 7 : Pie chart representing distribution of response about types of DNA analysis , 26.00 % - Mitochondria DNA (blue) , 12.00 % - next generation sequencing (green) , 10.00 % - polymerase chain reaction (PCR) (brown) , 31.00 % - short tandem repeats (STR) , 21.00 % - Y chromosomes (yellow) .

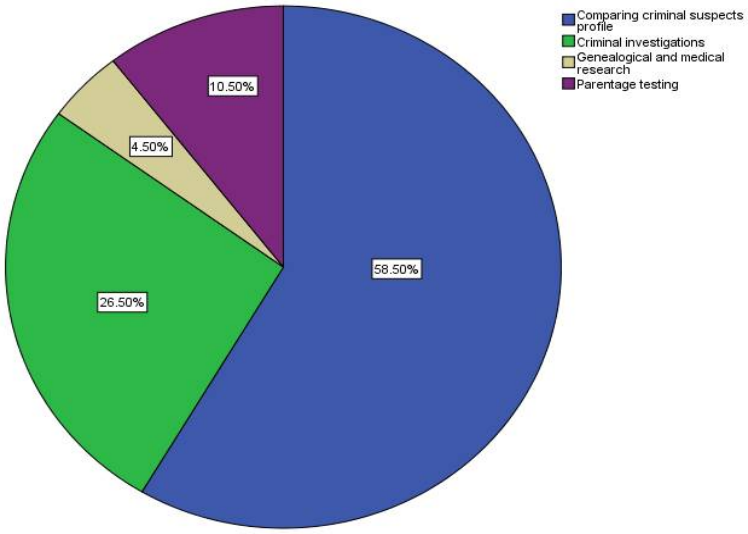

FIGURE 8 : Pie chart representing distribution of responses about DNA analysis used for forensic odontology , 58.50 % - comparing criminal suspects profile (blue) , 26.50 % - criminal investigations (green) , 4.50 % - genealogical and medical research (brown) , 10.50 % - parentage testing (Violet) .

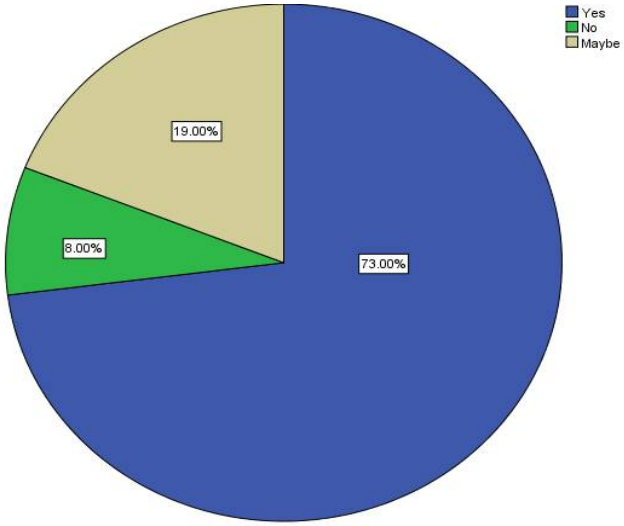

FIGURE 9: Pie chart representing percentage distribution of responses about awareness of knowledge on DNA fingerprinting, 73.00 % - Yes (blue), 8.00 % - No (green),19.00 % - maybe (brown).

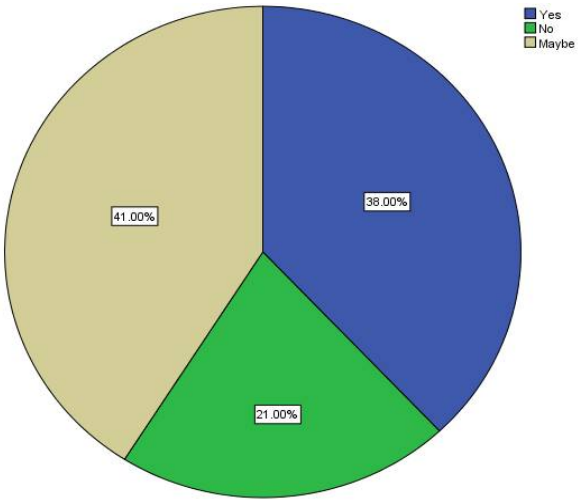

FIGURE 10 : Pie chart representing percentage distribution of responses about percentage of DNA will give accurate results , 38.00 % - Yes (blue) , 21.00 % - No (green) , 41.00 % - maybe (brown) .

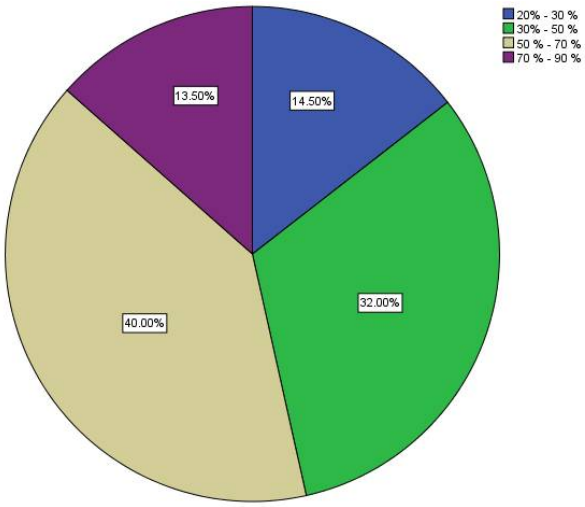

FIGURE 11 : Pie chart representing percentage distribution of responses about percentage of DNA will give accurate results , 14.50 % - 20% - 30 % (blue) , 32.00 %- 30 % - 50 % (green) , 40.00 % - 50 % -70 % (brown) , 13.50 % - 70 % - 90 % (violet) .

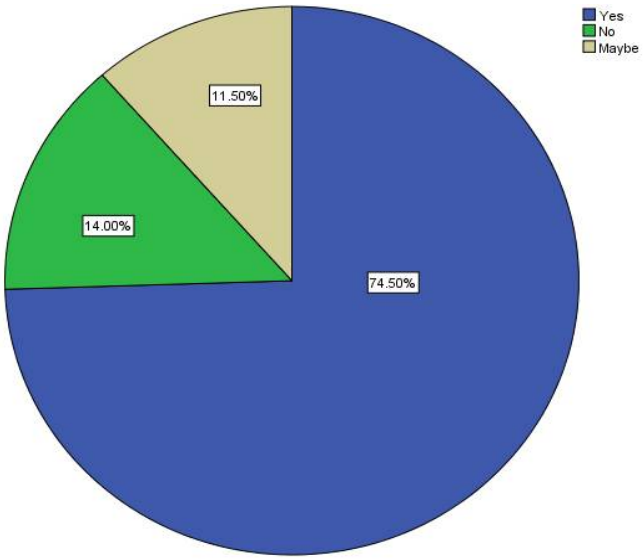

FIGURE 12: Pie chart representing percentage distribution of responses about awareness on children has the same mtDNA from its mother, 74.50 % - yes (blue), 14.00 % - No (green), 11.50 % - maybe (brown).

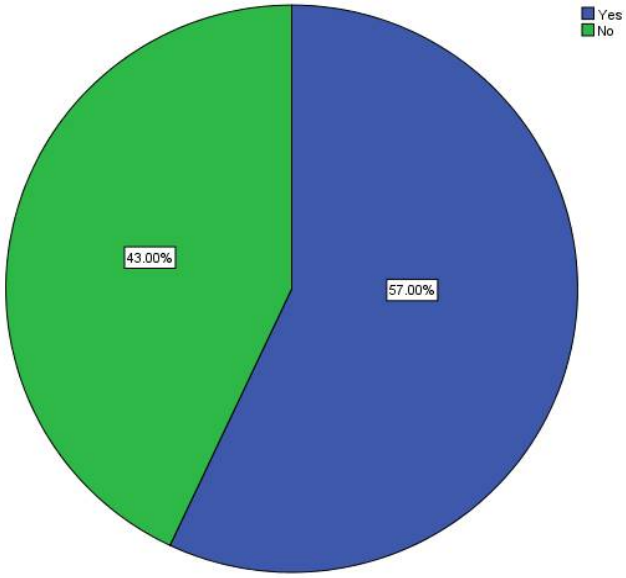

FIGURE 13: Pie chart representing percentage distribution of responses about a single tooth can identify the sex of the person, 57.00 % - Yes (blue), 43.00 % (green)

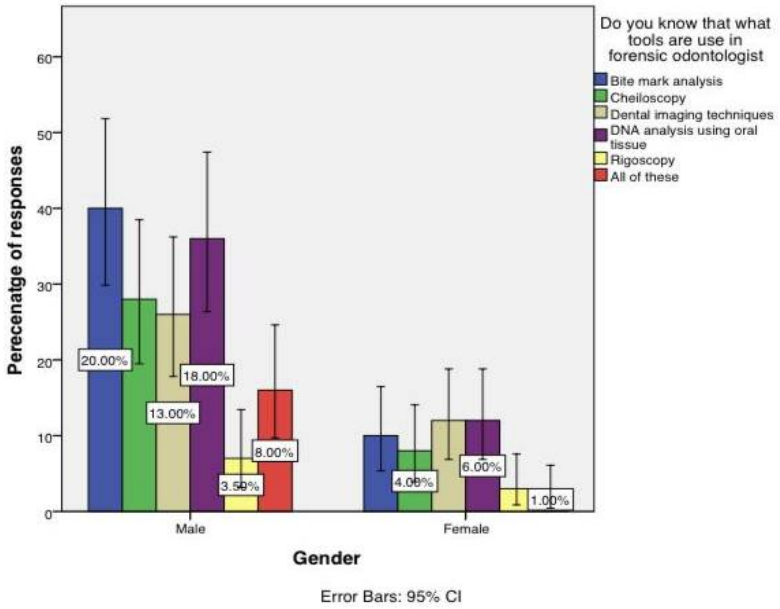

FIGURE 14: An X-axis bar graph shows the relationship between gender and the forensic odontologist's tools (Y-axis). 20.00 percent of the males and 6.00 percent of the females reported bite mark analysis and oral DNA analysis, respectively. Bite mark analysis is denoted by blue, green cheiloscopy is denoted by brown dental imaging techniques are denoted by brown violet DNA analysis of oral tissue is denoted by yellow rigoscopy is denoted by red all of these are denoted by red. There was no statistically significant difference in the results of the Chi-square test (Pearson Chi-square value: 3.585) when the sample size was small.

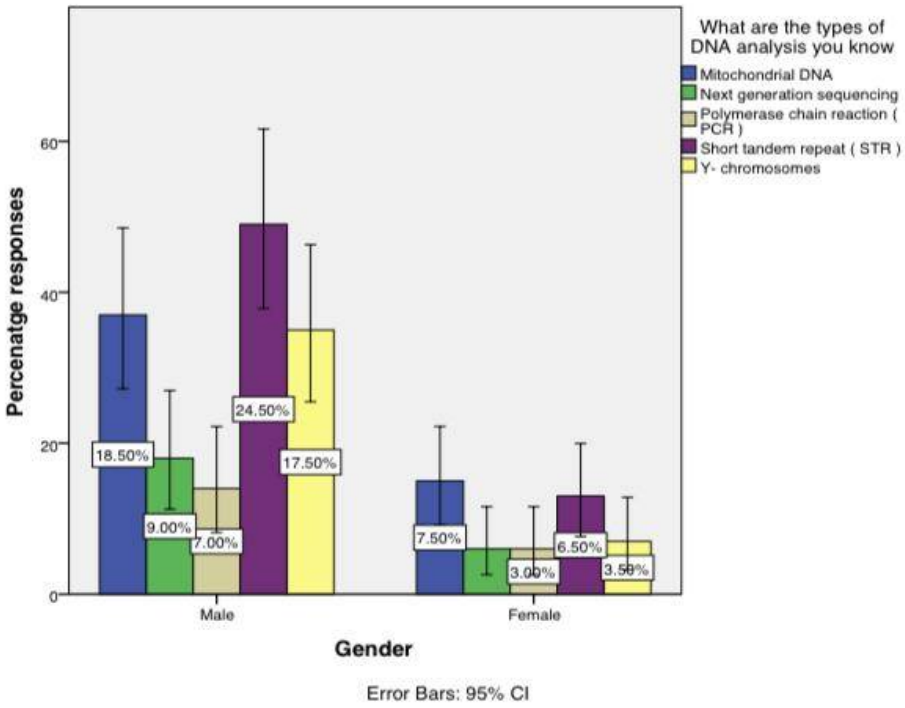

FIGURE 15: Bar graph showing the association between the gender (X-axis) and type of DNA analysis (Y-axis). 24.50 % of the male reported short tandem repeat (STR) and 18.50 % of the male reported mitochondrial DNA. Blue denotes mitochondrial DNA, green denotes next-generation sequencing, brown denotes polymerase chain reaction (PCR), violet denotes short tandem repeat (STR), yellow denotes Y- chromosomes. Chi-square test (Pearson Chi-square value = 2.639) p = 4 (p > 0.05 statistically not significant) .

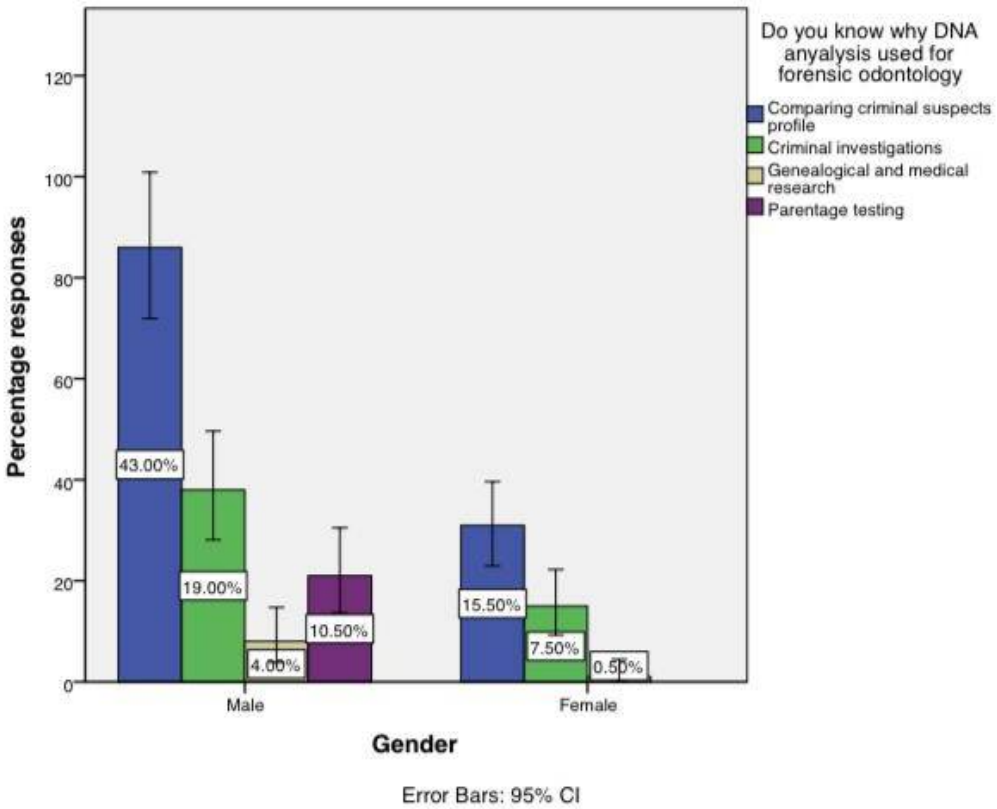

FIGURE 16: Bar graph showing the association between the gender (X-axis) and DNA analysis use (Y-axis). 43.00 % of the male reported comparing criminal suspects' profiles and 19.00 % of the males reported comparing criminal investigations. Blue denotes comparing criminal suspects' profiles, green denotes criminal investigations, brown denotes genealogical and medical research, violet denotes parentage testing. Chi-square test (Pearson Chi-square value = 8.483) p = 3 ($p > 0.05$ statistically not significant) .

DISCUSSION

When it comes to investigating crimes, DNA analysis is a strong tool that has become the standard by which other forensic disciplines are judged. In our publications, we primarily focus on the most recent technological developments and the most likely future developments. This discipline is clearly moving toward increasing automation and the usage of primarily deteriorated biological materials that are left behind when we compare it to other studies looking at potential advances in genotyping techniques. When it comes to researching violent crimes, fraud, and conservative laws [11], non-human DNA analysis has become the most powerful routine.

Polymerase chain reactions, according to S. Leena et al [10], are the most widely known method of DNA analysis. For DNA analysis, short tandem repeats are preferred since they reveal the repeated tandem repeats, making it easier to identify suspects than the long tandem repeats found in our study.

Jeffreys et al [4] claims that fingerprints are the best way to identify a person's family, but our study indicated that just 41 percent of people are aware of DNA fingerprinting. We can conclude that fingerprints are the best method for identifying a person's family in the future.

However, there are a couple of limitations to the study. Firstly, the study had a smaller sample size. We couldn't identify the potential confounding factors. Secondly, college students' practice behaviors were self-reported consistent with the willingness to perform the activities; thus, they might not reflect the particular practice patterns. Thirdly, overall KAP surveys have inherent limitations: for instance, respondents could also be primed to supply certain responses, and therefore the multiple-choice format of the questionnaire may direct them to socially desirable answers.

CONCLUSION

According to the findings, dental undergraduate students have a decent understanding of DNA analysis as a forensic odontology method within the study's constraints. Students in high school, college, and

university can be educated about DNA analysis, bite mark analysis, and lip print analysis through awareness campaigns on social media, workshops, and seminars.

ACKNOWLEDGMENT
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CONFLICT OF INTEREST:
NO

REFERENCES

1. Dodd, B.E. (1985). DNA fingerprinting in matters of family and crime', *Nature*, 318(6046), pp. 506–507.
2. Downs, J.C.U., Upshaw Downs, J.C. and Barsley, R.E. (2018). Ethical Issues in Forensic Science & Forensic Odontology', *Forensic Odontology*, pp. 241–273. doi:10.1016/b978-0-12-805198-6.00013-x.
3. James, H. and Higgins, D. (2016). Forensic odontology management', *Forensic Odontology*, pp. 402–418. doi:10.1002/9781118864418.ch13.
4. Jeffreys, A.J., Wilson, V. and Thein, S.L. (1985). Individual-specific "fingerprints" of human DNA', *Nature*, pp. 76–79. doi:10.1038/316076a0.
5. Malaver, P.C. and Yunis, J.J. (2003) . Different dental tissues as source of DNA for human identification in forensic cases', *Croatian medical journal*, 44(3), pp. 306–309.
6. Manjunath, B.C. *et al.* (2011). DNA Profiling and forensic dentistry – A review of the recent concepts and trends', *Journal of Forensic and Legal Medicine*, pp. 191–197. doi:10.1016/j.jflm.2011.02.005.
7. Okamoto, O. *et al.* (2003) 'Analysis of short tandem repeat (STR) polymorphisms by the powerplex 16 system and capillary electrophoresis: application to forensic practice', *Acta medicinae Okayama*, 57(2), pp. 59–71.
8. Pandey, R. *et al.* (2014) 'Mitochondrial DNA from archived tissue samples kept in formalin for forensic odontology studies', *Journal of oral biology and craniofacial research*, 4(2), pp. 109–113.
9. P, S. and Shambulingappa, P. (2012) 'Use of DNA Technology in Forensic Dentistry', *Journal of Forensic Research*. doi:10.4172/2157-7145.1000155.
10. Sakari, S.L. *et al.* (2015) 'Role of DNA profiling in forensic odontology', *Journal of pharmacy & bioallied sciences*, 7(Suppl 1), pp. S138–41.
11. Thomas McClintock, J. (2008). Forensic DNA Analysis: A Laboratory Manual. CRC Press.
12. Trengrove, H.G. (2016). Forensic odontology in disaster victim identification', *Forensic Odontology*, pp. 286–335. doi:10.1002/9781118864418.ch9.