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***Original article***

# Assessing the Awareness and Attitude of Egyptian Dentists toward Forensic Odontology Practices

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**ABSTRACT**

**Introduction:** Forensic odontology (FO) is crucial in forensic medicine. Aim: This study evaluated the knowledge, attitudes, and practices (KAP) related to FO among Egyptian dentists. **Materials and methods:** This descriptive cross-sectional study was conducted using an online questionnaire via Google Forms. It consisted of thirty-four questions and included responses from 122 dentists. **Results:** 66.9% did not know about FO, and 99.2% thought their knowledge about it was deficient. 70.8% were willing to enroll in postgraduate or diploma programs in FO. 80% of the practitioners thought Egypt had insufficient forensic science education resources. 57.9% maintained dental records in their clinics. The mean knowledge score was 9.31 ± 2.65. The mean attitude score was 3.02 ± 1.14. The mean practice score was 8.34 ± 3.88. Knowledge level was categorized as "low" in 39.3%, "moderate" in 36.1%, and "high" in 24.6% of respondents. Attitude scores were negative in one-third of participating dentists (32.0%) and positive in 40.2%, with the remainder being neutral. 99.2% had a low practice score. No statistically significant correlation was found between participants' demographic data and their knowledge or attitude scores. **Conclusion:** This study highlights the significant challenges facing the field of forensic odontology in Egypt: Low levels of knowledge and practice among Egyptian dentists, the absence of a dedicated FO course in undergraduate dentistry programs, and the reluctance to pursue a career in forensic dentistry. Nevertheless, many participants expressed interest in further FO training, suggesting that educational interventions could enhance knowledge, even if FO remains a less popular career path.

## I. Introduction:

Forensic odontology (FO) is an attractive specialty in forensic science that involves the appropriate examination and demonstration of dental evidence in the interest of justice. FO gathers, examines, evaluates, and presents dental evidence to support legal procedures with objective and scientific proof (Ganeshani et al., 2023). It has a significant role in legal, civil, and criminal conditions (Abdel Naser, 2024). FO focuses mainly on four main domains: forensic identification of either living

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or dead persons, examination of bite marks, study of lip print (cheiloscopy), and analysis of palatal rugae patterns (rugoscopy) (Abdul et al., 2019). By comparing antemortem and postmortem records, FO can play a critical role in the forensic identification of deceased individuals. Therefore, dental records must be kept by dentist (Abdel Naser, 2024). One of the most accurate methods of identification is using teeth.

Teeth are hard tissues that resist putrefaction, burn, immersion, and decomposition. They are unique to everyone and can often be matched to existing dental records. Therefore, FO is of foremost importance in mass disasters, wars, floods, and motor vehicle accidents when the bodies are severely mutilated and hardly recognizable. Teeth can also be a source for DNA identification when other identification methods, such as fingerprinting and facial reconstruction, cannot be established (Salazar et al., 2025; Wang et al., 2020).

FO also assists in estimating the age and gender of living persons, diagnosing suspected victims of child abuse, and presenting dental evidence in the court (expert testimony). In addition, FO plays a crucial role in criminal investigations. Dental physicians can examine bite marks found in assailants and victims (Kundu, 2024; Nagarajappa et al., 2014).

Dentists play a crucial role in identifying and addressing oral injuries, which are common signs of child abuse, while also assessing the child's family environment (Singh & Lehl, 2020). Every practitioner should comprehend the forensic ramifications of their line of work. A greater understanding of forensic discipline could encourage dental professionals to keep legally compliant and readable records and help law enforcement to identify suspects and victims (Agrawal et al., 2022).

In fact, teaching dentists about FO is important not only for those who are interested in becoming forensic odonatologists but also for all dentists to acknowledge their role in keeping records that are readable, complete, and compliant with the law, diagnosing and reporting cases of child abuse, and helping law enforcement identify suspects and victims (Singh & Lehl, 2020).

FO has developed into an essential part of large worldwide forensic educational institutions, such as the American Academy of Forensic Sciences and the International Association of Identification. Since dentists actively participate in the FO, they should possess adequate skills and knowledge when working with dental records, examining bite marks, reading radiographs, analyzing tooth DNA, and evaluating tooth morphology (Cardoza, 2023).

Despite the growing significance of FO worldwide and significant technological advancements, Egypt's field remains significantly underdeveloped. Unfortunately, there are no certified forensic odontologists in the country. Moreover, to our knowledge, very little research has been conducted on this subject in Egypt. This is likely due to a lack of understanding; neither the public nor the government fully acknowledges forensic dentists' role. The current study aimed to evaluate Egyptian dentists' knowledge, attitudes, and practices in the field of forensic dentistry.

## II. Subjects and methods:

### 2.1. Subjects

In this study, 122 Egyptian dentists from various specialties and with diverse years of experience participated.

### 2.2. Study design

This research is a cross-sectional descriptive study. Using Google Forms, an anonymous online structured questionnaire was created based on a review of previous literature on FO (Abdul et al., 2019; Dutta, 2020; Nagarajappa et al., 2014). The link to the online questionnaire was then made accessible on social media dental pages. The authors distributed it to many Egyptian dentists, who were encouraged to participate and share the link with their colleagues. Measures were taken to allow only a single submission per participant.

Before starting the study, a pilot study encompassing 20 Egyptian dentists was performed to recognize possible methodological problems. The following features were appraised: the respondents' reaction to the research procedures, the tools used for data gathering, such as the sequence and precision of the questions, and the time

required to answer the questions. The feedback from the piloting proved that the questionnaire was well-formulated. The pilot study sample was excluded. Cronbach's alpha coefficient confirmed the scale's reliability: 0.76 for the knowledge domain, 0.71 for the attitude domain, and 0.74 for the practice domain, demonstrating adequate internal consistency.

Using the Epi Info-7 program (Hayat et al., 2017), the sample size was determined by adjusting the power at 80%, the confidence level at 95.0%, and the proportion of dentists who identified teeth as trustworthy sources for DNA extraction at 94.2% (Zahid et al., 2019). The bare minimum projected sample size was 84 individuals. The sample size was increased to 120 participants to increase the study's power. The following equation was applied: $S= Z2 \times P \times (1-P)/M2$, where S = sample size for an infinite population, Z = Z score (1.96), P = population proportion (0.942), and M = margin of error (0.5).

The questionnaire comprised thirty-four questions divided into four main sections. The first section contained five questions and concerned the demographic and professional information of the participants. The second section, comprising fourteen questions, collected knowledge data about FO. The third section, which encompassed five questions, was assigned to demonstrate the attitude of the participant dentists towards FO. The last section, comprised of ten questions, concerned FO practices among the participating dentists.

The overall knowledge, attitude, and practice scores were calculated separately for each dentist, where each correct answer scored 1, and each wrong or no answer scored 0. Using Bloom's cut-off point, the knowledge, attitude, and practice (KAP) scores were divided into three categories: good if they fell between 80% and 100%, moderate if between 60% and 79%, and poor if below 60% (Akalu et al., 2020).

### 2.3. Ethical considerations

The Alexandria University Faculty of Medicine's Research Ethics Committee provided ethical approval (IRB Number: 00012098, FWA Number: 00018699, Serial Protocol Number: 0306765).

No personally identifiable information was collected from respondents, ensuring anonymity. The authors' comments were not associated with any personal identifiable information. Simultaneously, completing and submitting the questionnaire was interpreted as an implicit consent agreement to take part in the study. This information was provided at the beginning of the questionnaire. The survey introduction informed participants about the study's purpose, and that participation was voluntary. All the collected data was kept private.

### 2.4. Statistical analysis (Cavanaugh, 2007; Kirkpatrick, 2013)

Version 20.0 of the IBM SPSS software suite was utilized to input and analyze data. Numbers and percentages represented categorical data. The Kolmogorov-Smirnov test determined whether continuous data were normally distributed. The range (minimum and maximum), mean, standard deviation, median, and interquartile range expressed quantitative data. Two groups were compared using the student's t-test for normally distributed quantitative variables, while more than two groups were compared using the F-test (one-way ANOVA). Specifically, knowledge, attitude, and practice scores were compared across various demographic categories (e.g., gender, age group, level of education, years of experience). A significance level of 5% ($p < 0.05$) was applied to assess the significance of the results.

## III. Results:

### 3.1. Personal and professional data of the participating dentists (Q1-5)

The current study included the responses of 122 dentists in Egypt concerning their knowledge, attitudes, and practices toward FO from June 2024 to September 2024. **Table (1)** shows that more than half of the respondents (57.6%) were 25–35 years of age, with a mean age of 30.80 ± 7.03 years. Most respondents were females (86%). Among the participants, 62.8% had a bachelor's degree, 25.6% had a master's degree, and the remainder had a doctorate. More than two-thirds (67.3%) had less than ten years of experience, with a mean of 7.88 ± 6.98 years. At

the same time, the percentage of dentists who were specialists was 29.5%, while the percentage of residents was 58.2%.

### 3.2. Knowledge of the participating dentists about forensic odontology. (Table 2) (Q6-19)

Approximately two-thirds of the respondents (66.9%) were unaware that FO is a dental specialty. However, most of them (82.6%) knew that teeth could be a source of DNA. Moreover, 91.7% of the participants were aware that oral cavities can be used in the identification of deceased people.

Concerning establishing the biological profile of the individuals, 94.2%, 54.9%, and 64.8% of the physicians knew that the oral cavity can be used to identify the age, ethnicity, and sex of the deceased person, respectively. Approximately two-thirds of the respondents (63.1%) knew each person has a distinct lip-print. Most of the participants (93.4%) were aware of child abuse, but more than half of them (56.6%) did not know about the role of dentistry in cases of child abuse. A total of 67.8% of them were aware of the significance of the bite mark pattern of their teeth. Additionally, more than half of the participants (59%) were unaware that palatal rugae can be used as a marker in forensic identification. Moreover, approximately half of the participants (47.5%) were unaware that dentists may provide forensic dental evidence in court by testifying as expert witnesses.

A total of 94.2% of the participants knew that dental records can be used to identify criminal suspects and deceased individuals. Moreover, almost all the participants (99.2%) did not believe that their knowledge of FO was sufficient.

### 3.3. Attitudes of the participating dentists toward forensic odontology. (Q20-24)

**Table (3)** shows that more than two-thirds (70.8%) of dental practitioners like to take courses in FO as a certified diploma or postgraduate program. Most practitioners (88.4%) did not take FO as part of their study programs or online courses; so most of them (90%) recommended adding an undergraduate course on forensic odontology. Concerning the resources or equipment available to learn forensic science in Egypt, 80% of practitioners declared that Egypt has limited resources to study forensic science. Furthermore, approximately half of the practitioners were not curious about joining FO professionally. Among them, 90% thought they would not earn enough money in this profession, while approximately half of them (43.5%) did not like this profession.

### 3.4. Practices of the participating dentists in forensic odontology: (Table 4) (Q25-34)

A total of 95.9% of the physicians used eruption patterns and calcification of the teeth to determine the age of children and adults. Approximately 30% and 12.4% of these studies used histological and biochemical methods, respectively. When they were asked how to determine the age and gender of a deceased person in large-scale catastrophes such as fires and accidents, approximately 73% of the participants used dental records. However, 17% did not know how to identify the age and gender of the deceased. Considering the maintenance of the dental records, more than half of the participants (57.9%) kept these records in their clinics.

Thirty-six of the participants identified victims of child abuse by observing behavior changes in the children, whereas 35% identified child abuse by observing physical injuries in the children. When they are asked about the action they would take when they identify a case of child abuse, approximately two-thirds of them report it to the police, 60% of them inform their parents, and approximately one-third do a medical examination of the child. Fewer than three-quarters (72.3%) had not previously met with a case of child abuse. However, most participants (96.7%) had no forensic odontology-related training.

The study revealed that 95% of the physicians had not previously participated in research involving FO. Only 38 dental physicians participated in the research. Among them, 42.1% participated in studies concerning age determination from teeth, and 36% contributed to personal identification research.

### 3.5. Scoring system of the knowledge, attitude, and practice (KAP) levels of the participating dentists:

Scoring systems were used to evaluate the level of knowledge, attitudes, and practices of the participating dentists. The knowledge scores ranged from 0 to 14, with a mean of 9.31 + 2.65. The attitude score ranged from 0 to 5, with a mean of 3.02 ± 1.14. The practice score ranged from 0 to 26, with a mean of 8.34 ± 3.88.

According to the Bloom cut-off point, the knowledge percentage score was categorized as "low" for 39.3%, "moderate" for 36.1%, and "high" for 24.6% of the participating dentists **(Figure 2).** The attitude percentage score was categorized as negative for one-third of the participating dentists (32%) and positive for 40.2% of them **(Figure 3). Figure (4)** demonstrates that nearly all the dentists (99.2%) had low practice scores.

### 3.6. Relationships between the scores of knowledge, attitudes, and practices and the personal and professional data of the participating dentists (n = 122) (Tables 5, 6)

In addition, the scores of the participating dentists' knowledge and attitudes and their personal and professional data were related. No statistically significant relationship was observed between the data of the participating dentists and either score. Moreover, no statistical relationship could be created with the practice scores because almost all the participants had low practice scores.

### 3.7. Multivariate linear regression analysis for the parameters affecting knowledge, attitude, and practice of the participating dentists (n=122) (Table 7)

It was found that qualification level of the participating dentists was the only parameter affecting the practice of them (Bachelor degree p 0.021*, B (LL – UL 95 percentage C.I) -4.633 (-8.551 – -0.714); master's degree p 0.042*, B (LL – UL 95 percentage C.I) -3.371 (-6.624 – -0.119). No other parameters affected the knowledge and attitude of the participating dentists.

Table (1): Personal and professional data of the participating dentists.

| Personal and professional data | N | % |
|---|---|---|
| Age (years) | (n = 118) | |
| <25 | 20 | 16.9 |
| 25-<35 | 68 | 57.6 |
| 35-<40 | 25 | 21.2 |
| ≥40 | 5 | 4.2 |
| Min. – Max. | 22.0 – 59.0 | |
| Mean ± SD. | 30.80 ± 7.03 | |
| Gender | (n = 121) | |
| Male | 17 | 14.0 |
| Female | 104 | 86.0 |
| Qualification | (n = 121) | |
| Bachelor | 76 | 62.8 |
| Master | 31 | 25.6 |
| Doctorate | 14 | 11.6 |
| Experience in years | (n = 113) | |
| <10 | 76 | 67.3 |
| 10-<15 | 13 | 11.5 |
| 15-<20 | 13 | 11.5 |
| ≥20 | 11 | 9.7 |
| Min. – Max. | 1.0 – 36.0 | |
| Median (IQR) | 5.0 (2.0 – 12.0) | |
| Job level | (n = 121) | |
| Consultant | 14 | 11.5 |
| Resident | 71 | 58.2 |
| Specialist | 36 | 29.5 |

N: Number of participants IQR: Inter quartile range
Min: Minimum Max: Maximum
SD: Standard deviation

Table (2): Distribution of the participating dentists according to their knowledge of forensic odontology.

| Question | Knowledge | N | Yes | No |
|---|---|---|---|---|

| | | | % | % |
|---|---|---|---|---|
| 6 | Do you know about forensic odontology as a branch in dentistry? | 121 | 33.1 | 66.9 |
| 7 | Can teeth serve as source of DNA? | 121 | 82.6 | 17.4 |
| 8 | Do you know that the oral cavity can be used in identification of deceased people? | 120 | 91.7 | 8.3 |
| 9 | Do you know that the oral cavity can be used in determination of age of deceased people? | 121 | 94.2 | 5.8 |
| 10 | Do you know that the oral cavity can be used in determination of ethnicity of deceased people? | 122 | 54.9 | 45.1 |
| 11 | Do you know that oral cavity can be used in determination of sex of deceased people? | 122 | 64.8 | 35.3 |
| 12 | From your knowledge, could each person have a unique lip-print? | 122 | 63.1 | 36.9 |
| 13 | Do you know what child abuse is? | 122 | 93.4 | 6.5 |
| 14 | Do you know the role of dentistry in cases of child abuse? | 122 | 43.4 | 56.6 |
| 15 | Are you aware of the significance of bite mark pattern of teeth? | 121 | 67.8 | 32.2 |
| 16 | Can palatal rugae serve as a marker in forensic identification? | 122 | 41.0 | 59 |
| 17 | Are you aware that you can testify as an expert witness in court to present forensic dental evidence? | 122 | 52.5 | 47.5 |
| 18 | Are dental records useful in identifying the deceased and crime suspects? | 121 | 94.2 | 5.8 |
| 19 | Do you think your knowledge/awareness about forensic odontology is enough? | 121 | 0.8 | 99.2 |

N:Number of paricipants

Table (3): Distribution of the participating dentists according to their attitude toward forensic odontology.

| Question | Attitude | N | Yes % | No % |
|---|---|---|---|---|
| 20 | Do you have forensic odontology as part of your curriculum or course outline? | 121 | 11.6 | 88.4 |
| 21 | Are you willing to take courses in forensic odontology if introduced as a diploma or postgraduate course? | 120 | 70.8 | 29.2 |
| 22 | Do you recommend adding an undergraduate course on forensic odontology? | 121 | 90.9 | 9.1 |
| 23 | Are you interested in joining as a profession? | 121 | 52.1 | 47.9 |
| 24 | Do you think Egypt has sufficient resources/equipment to study forensic science? | 121 | 19.8 | 80.2 |

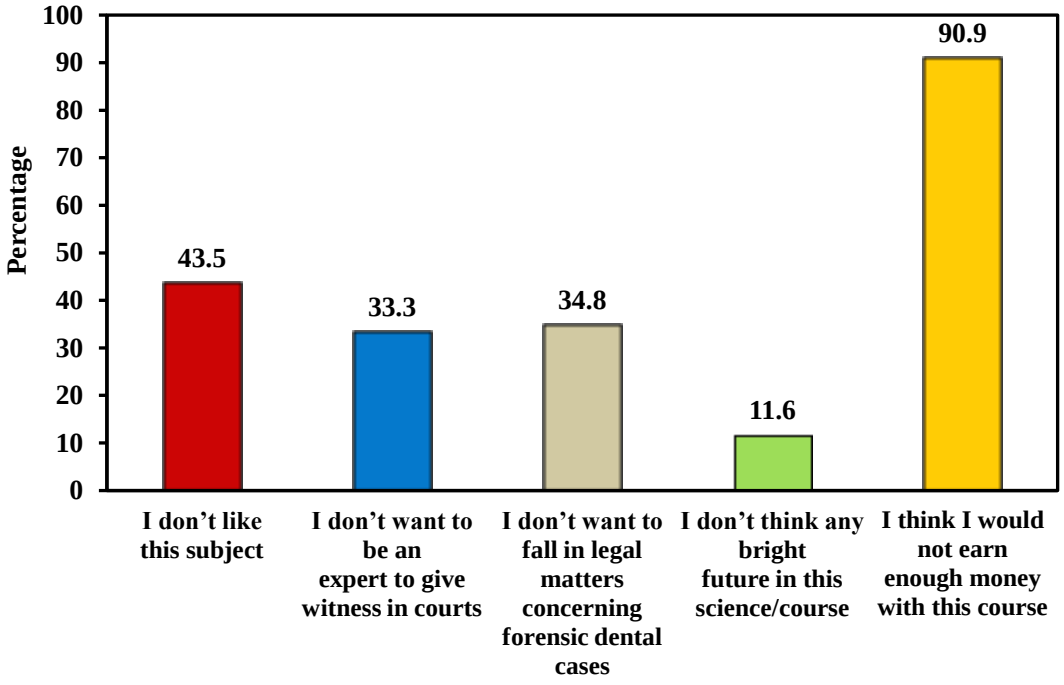


Figure (1): Distribution of the response of participating dentists (n = 69) according to their reasons not to join the forensic odontology as a profession.

Table (4): Distribution of the responses of the participating dentists according to the practice of forensic odontology.

| Question | Practice | N | % |
|---|---|---|---|
| 25 | How do you identify dental age in children and adults? # | (n = 121) | |
| | Eruption patterns and calcification | 116 | 95.9 |
| | Histological methods | 37 | 30.6 |
| | Biochemical methods | 15 | 12.4 |
| | I don't know | 4 | 3.3 |
| 26 | How will you identify a deceased person's age and gender in mass disasters like fires and accidents? # | (n = 122) | |
| | Dental records | 89 | 73.0 |
| | Reconstruct the fragmented deceased body | 48 | 39.3 |
| | Fingerprints | 48 | 39.3 |
| | I don't know | 21 | 17.2 |
| 27 | Do you maintain dental records in your clinic? | (n = 121) | |
| | Yes | 70 | 57.9 |
| | No | 51 | 42.1 |
| 28 | How will you identify physical/neglected/sexual /psychological abuse of a child by # | (n = 122) | |
| | Behavioral changes | 45 | 36.9 |
| | Physical injuries | 43 | 35.2 |
| | Any scars | 39 | 32.0 |
| | Clothing | 32 | 26.2 |
| | All the above | 31 | 25.4 |
| | Don't know | 5 | 4.1 |
| 29 | What action would you take, if you identified a case of child abuse? # | (n = 122) | |
| | Inform police | 81 | 66.4 |
| | Inform parents | 74 | 60.7 |
| | Medical Examination of Child | 40 | 32.8 |
| | Take no action | 5 | 4.1 |
| 30 | Do you have any training related to forensic odontology? | (n = 121) | |
| | Yes | 4 | 3.3 |
| | No | 117 | 96.7 |
| 31 | Did you participate in research work that included forensic odontology before? | (n = 121) | |
| | Yes | 6 | 5.0 |
| | No | 115 | 95.0 |
| 32 | If yes, what was this research work about? # | (n = 38) | |
| | Personal identification | 14 | 36.8 |
| | Determination of age from teeth and related measurements | 16 | 42.1 |
| | Determination of sex from teeth and related measurements. | 12 | 31.6 |
| | Determination of ethnicity from teeth and related measurements | 12 | 31.6 |
| | Others | 12 | 31.6 |
| 33 | If yes, which part of the oral cavity was studied? # | (n = 32) | |
| | Teeth | 32 | 100.0 |
| | Lips | 15 | 46.9 |
| | palatal rugae | 12 | 37.5 |
| | Tongue | 6 | 18.8 |
| 34 | Have you ever met a case of child abuse? | (n = 119) | |
| | Yes | 33 | 27.7 |
| | No | 86 | 72.3 |

N: Number of participants #: responses are not mutually exclusive

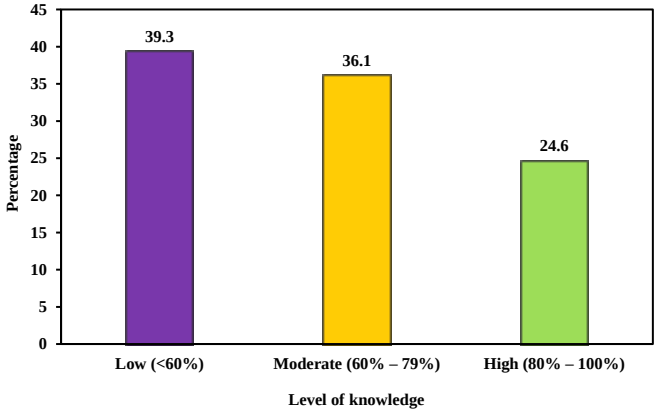


Figure (2): Categories of the scores of knowledge about FO of the participating dentists according to Bloom's cut-off point.

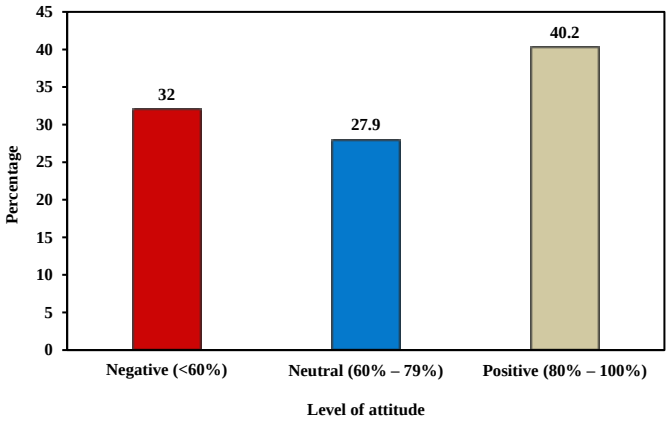


Figure (3): Categories of the scores of attitude toward FO of the participating dentists according to Bloom's cut-off point.

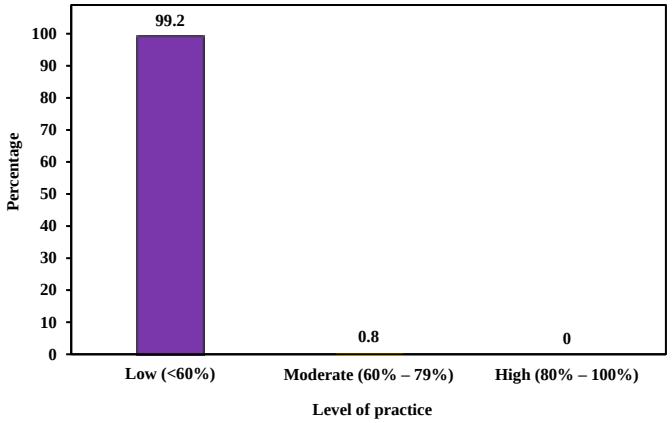


Figure (4): Categories of the scores of practice of FO of the participating dentists according to Bloom's cut-off point.

Table (5): Relation between the score categories of knowledge of the participating dentists and their personal and professional data.

| Personal and professional data | N | Knowledge | | | Test of Sig | P |
|---|---|---|---|---|---|---|
| | | Low | Moderate | High | | |
| | | n = 48 | n = 44 | n = 30 | | |
| Age (years) | | n = 44 | n = 44 | n = 30 | | |
| <25 | 20 | 55.0% | 30.0% | 15.0% | | |
| 25-<35 | 68 | 36.8% | 36.8% | 26.5% | FET= 6.687 | 0.334 |
| 35-<40 | 25 | 24.0% | 40.0% | 36.0% | | |
| ≥40 | 5 | 40.0% | 60.0% | 0.0% | | |
| Gender | | n = 48 | n = 44 | n = 29 | | |
| Male | 17 | 35.3% | 41.2% | 23.5% | $\chi^2$= 0.223 | 0.894 |
| Female | 104 | 40.4% | 35.6% | 24.0% | | |
| Qualification | | n = 48 | n = 43 | n = 30 | | |
| Bachelor | 76 | 42.1% | 32.9% | 25.0% | FET= 1.290 | 0.875 |
| Master | 31 | 38.7% | 38.7% | 22.6% | | |
| Doctorate | 14 | 28.6% | 42.9% | 28.6% | | |
| Experience in years | | n = 44 | n = 42 | n = 27 | | |
| <10 | 76 | 44.7% | 32.9% | 22.4% | | |
| 10-<15 | 13 | 38.5% | 30.8% | 30.8% | FET= 6.199 | 0.399 |
| 15-<20 | 13 | 15.4% | 53.8% | 30.8% | | |
| ≥20 | 11 | 27.3% | 54.5% | 18.2% | | |
| Job level | | n = 48 | n = 44 | n = 29 | | |
| Consultant | 14 | 28.6% | 42.9% | 28.6% | | |
| Resident | 71 | 45.1% | 32.4% | 22.5% | $\chi^2$= 2.270 | 0.686 |
| Specialist | 36 | 33.3% | 41.7% | 25.0% | | |

$\chi^2$: Chi square test FET: Fisher Exact test

p: p value for comparison between the studied categories

*: Statistically significant at $p \leq 0.05$

Table (6): Relation between the score categories of the attitude of the participating dentists and their personal and professional data.

| Demographic data | N | Attitude | | | Test of Sig | P |
|---|---|---|---|---|---|---|
| | | Negative n = 39 | Neutral n = 34 | Positive n = 49 | | |
| Age (years) | | n = 36 | n = 34 | n = 48 | | |
| <25 | 20 | 25.0% | 35.0% | 40.0% | | |
| 25-<35 | 68 | 36.8% | 25.0% | 38.2% | FET= 8.930 | 0.151 |
| 35-<40 | 25 | 16.0% | 28.0% | 56.0% | | |
| ≥40 | 5 | 40.0% | 60.0% | (0.0% | | |
| Gender | | n = 39 | n = 34 | n = 48 | | |
| Male | 17 | 35.3% | 11.8% | 52.9% | $\chi^2$= 2.814 | 0.245 |
| Female | 104 | 31.7% | 30.8% | 37.5% | | |
| Qualification | | n = 39 | n = 34 | n = 48 | | |
| Bachelor | 76 | 35.5% | 23.7% | 40.8% | FET= 3.275 | 0.516 |
| Master | 31 | 22.6% | 35.5% | 41.9% | | |
| Doctorate | 14 | 35.7% | 35.7% | 28.6% | | |
| Experience in years | | n = 37 | n = 31 | n = 45 | | |
| <10 | 76 | 38.2% | 26.3% | 35.5% | | |
| 10-<15 | 13 | 23.1% | 23.1% | 53.8% | FET= 9.932 | 0.115 |
| 15-<20 | 13 | 15.4% | 15.4% | 69.2% | | |
| ≥20 | 11 | 27.3% | 54.5% | 18.2% | | |
| Job level | | n = 39 | n = 34 | n = 48 | | |
| Consultant | 14 | 28.6% | 57.1% | 14.3% | | |
| Resident | 71 | 35.2% | 25.4% | 39.4% | FET= 7.878 | 0.092 |
| Specialist | 36 | 27.8% | 22.2% | 50.0% | | |

N: Number of participants $\chi^2$: Chi square test FET: Fisher Exact test

p: p value for comparison between the studied categories

Table (7): Multivariate Linear regression analysis for the parameters affecting Knowledge, Attitude, and Practice

| | Knowledge | | Attitude | | Practice | |
|---|---|---|---|---|---|---|
| | p | B (LL – UL 95%C.I) | p | B (LL – UL 95%C.I) | p | B (LL – UL 95%C.I) |
| Age (years) | | | | | | |
| <25 | 0.315 | 2.197 (-2.120 –6.514) | 0.257 | 1.061 (-0.786 –2.907) | 0.580 | 1.812 (-4.666 –8.289) |
| 25-<35 | 0.179 | 2.793 (-1.298 –6.883) | 0.374 | 0.787 (-0.962 –2.537) | 0.684 | 1.262 (-4.875 –7.400) |
| 35-<40 | 0.084 | 2.977 (-0.410 –6.363) | 0.301 | 0.759 (-0.690 –2.207) | 0.757 | 0.795 (-4.286 –5.876) |
| ≥40 | | 0.000 | | 0.000 | | 0.000 |
| Gender | | | | | | |
| Male | 0.719 | 0.267 (-1.201 –1.735) | 0.354 | 0.294 (-0.334 –0.923) | 0.744 | 0.363 (-1.840 –2.566) |
| Female | | 0.000 | | 0.000 | | 0.000 |
| Qualification | | | | | | |
| Bechor | 0.435 | 1.032 (-1.580 –3.643) | 0.317 | 0.567 (-0.550 –1.684) | 0.021* | -4.633 (-8.551 –-0.714) |
| Master | 0.545 | 0.664 (-1.504 –2.831) | 0.675 | 0.197 (-0.731 –1.124) | 0.042* | -3.371 (-6.624 –-0.119) |
| Doctorate | | 0.000 | | 0.000 | | 0.000 |
| Experience in years | | | | | | |
| <10 | 0.607 | -0.882 (-4.280 –2.515) | 0.194 | -0.957 (-2.410 –0.496) | 0.715 | 0.939 (-4.158 –6.036) |
| 10-<15 | 0.685 | -0.609 (-3.585 –2.366) | 0.751 | -0.204 (-1.476 –1.069) | 0.573 | -1.272 (-5.736 –3.192) |
| 15-<20 | 0.932 | -0.115 (-2.798 –2.567) | 0.976 | -0.017 (-1.165 –1.130) | 0.927 | -0.185 (-4.211 –3.840) |
| ≥20 | | 0.000 | | 0.000 | | 0.000 |
| Job level | | | | | | |
| Consultant | 0.427 | 1.005 (-1.495 –3.506) | 0.398 | -0.458 (-1.527 –0.612) | 0.314 | -1.913 (-5.665 –1.838) |
| Resident | 0.450 | -0.706 (-2.553 –1.141) | 0.418 | -0.324 (-1.114 –0.466) | 0.878 | 0.215 (-2.557 –2.986) |
| Specialist | | 0.000 | | 0.000 | | 0.000 |

p: p value for comparison between the studied categories

B: Unstandardized Coefficients C.I: Confidence interval LL: Lower limit UL: Upper Limit

## IV. Discussion:

The field of dentistry identified as FO is concerned with properly managing, analyzing, and presenting dental discoveries in the service of justice. Dentists are called upon to assist in the event of major disasters. They are also called upon to estimate the age of people, whether they are alive or deceased. They help in the field of civil litigation and the assessment of dental evidence (Cardoza, 2023).

Teeth are considered the most reliable and constant identification tool. They are resilient to changes in the environment or the body. Understanding teeth and their supporting tissues is essential to FO. Dental tissues are special in that they yield precise results. Therefore, it is crucial for identifying people who cannot be recognized visually or by other methods (Menon & Kumar, 2021).

Unfortunately, several dentistry schools, including those in Egypt, do not recognize specified courses on FO in their undergraduate students' curricula. Due to this longstanding and global under evaluation of FO in academic institutions, practicing dentists will also be less knowledgeable about this field. To help administer justice, graduating dentists should recognize their ethical role and responsibilities. This can be as easy as giving all needed information, such as correct dental records and high-quality dental radiographs. Moreover, FO is concerned with ethical dental practice. The present work is designed to evaluate Egyptian dentists' knowledge, attitude, and practice in the field of FO (Soon et al., 2019; Wadhwan et al., 2014).

In the current study, 66.9% of the respondents declared ignorance about FO as a subdivision of dentistry. This result coincided with many previous studies (Alamoudi & Alghamdi, 2024; Hashim et al., 2020; Khalifa et al., 2024). This could be explained by the absence of FO courses in Egypt's undergraduate dentistry curricula. Similarly, Abdul et al. (2022) concluded the same finding due to the non-inclusion of FO in Saudi Arabia's undergraduate curriculum (Abdul et al., 2022). However, this result contradicts the findings of a study performed by Hannah et al. (2017) in India, who reported that all the participants were attentive to FO as a subdivision of dentistry (Hannah et al. , 2017) . This could be due to the inclusion of FO as a part of the undergraduate curriculum by the Dental Council of India. Moreover, in the study performed by Shetty and Raviprakash (2011), almost all the subjects were acquainted with the subspecialty of FO (Shetty & Raviprakash, 2011). In their study in the European University of Cyprus, Giannakopoulos et al. (2023) reported that 87% of faculty members and 65% of students were aware of FO (Giannakopoulos et al., 2023). This may be due to including a Legal and Forensic Dentistry course in undergraduate courses.

Teeth are known to be resilient to tough conditions. Consequently, their morphology is conserved, and the enamel safeguards the pulp chamber's contents from outside influences. Hydroxyapatite crystals, which make up enamel, attach to DNA and stabilize it. Therefore, the teeth might yield a large amount of DNA (Menon & Kumar, 2021). In the present study, most participating dentists (82.6%) identified the teeth as a source from which DNA could be extracted. These results agree with previous studies (Giannakopoulos et al., 2023; Hannah et al., 2017). Furthermore, this percentage was higher than that obtained by Abdul et al. (2019).

In the current work, 91.7% of the participants confirmed the possibility of using the oral cavity to identify deceased people. A total of 94.2%, 54.9%, and 64.8% of the participating dentists affirmed the use of the oral cavity in determining the age, ethnicity, and sex of the deceased, respectively. This result was in agreement with those of Hannah et al. (2017) and Giannakopoulos et al. (2023) Every person has a unique lip print. Lip prints can be used as biometric records for personal identification (Samudhrasri et al., 2022). In the present study, fewer than two-thirds of the respondents (63.1%) recognized the uniqueness of the lip-print. This result contradicts with that of Abdul et al. (2019), who revealed that 55% of their participants were ignorant that lip prints are distinctive and vary among individuals (Abdul et al., 2019).

Child abuse is a severe public problem with worldwide consequences. It is significantly increasing in all ethnic groups and different socioeconomic levels (Bhargava et al., 2023). In the current work, most of the participants (93.4%) were attentive to child abuse, but more than half of them (56.6%) did not know about the role of dentistry in cases of child abuse. This percentage is higher than that obtained by Preethi et al. (2011), who concluded that 40% of dental physicians did not have the proficiency to recognize child abuse cases (Preethi et al., 2011).

In the current study, thirty-six of the participants identified cases of child abuse by observing behavior changes in their children, and 35% of them identified child abuse by observing physical injuries in their children. Giannakopoulos et al. (2023) reported that a major percentage of faculty participants (95.7%) and most students (84.5%) declared that cases of child abuse can be recognized by examination of clothing, scars, physical injuries, and behavioral changes (Giannakopoulos et al., 2023).

When asked about the action they would take when they recognize a case of child abuse, approximately two-thirds of the participating dentists declared reporting it to the police, 60% of them would inform their parents, and approximately one-third would examine their child. This result was different from that attained by Bhargava et al. (2023), who reported that all the participating dentists would inform the police and that 40% of them would inform parents in case of child abuse (Bhargava et al., 2023). However, in a former study performed in Egypt, Ahmed et al. (2023) reported that 52.8% of the participating dental students thought that dentists would report cases of child abuse to the family protection department (Ahmed et al., 2023).

In Egypt, the family protection department works as a specific department dealing with cases of domestic violence. The National Council of Childhood and Motherhood (NCCM) plays a substantial role in child protection and prevention of child abuse through the child helpline 16000, which is a way to receive and record the complaints of children. The NCCM defends against violence, abuse, and neglect throughout the nation within the outline of an actual corporation with the concerned ministries and the societal community working in this field (NCCM,UNICEF 2018).

In the study conducted by Preethi et al. (2011), 60% of the participants were diagnosed the child abuse by clothing, scars, physical injuries and behavior. Concerning the reporting of these cases, 60% of the dental physicians approved parental/child therapy and reported these cases to the childcare authorities (Preethi et al., 2011).

A total of 72.3% of the participating dental physicians in the present work denied having previously experienced child abuse. In their day-to-day work, dentists are more likely to experience child abuse. However, because of inadequate understanding, such cases typically go undetected. Moreover, for a variety of reasons, practitioners are reluctant to report them, which creates a vicious circle that traps the victim and has serious long-term effects (Singh & Lehl, 2020).

In the present study, 67.8% of the contributing dentist were attentive to the importance of the bite mark pattern of their teeth. This result was similar to that of Giannakopoulos et al. (2023). Abdul et al. (2019) reported that approximately 87.5% of postgraduates, 27.3% of undergraduate students, and 50% of graduate dentists knew the importance of bite marks in forensic dentistry (Abdul et al., 2019). Moreover, other studies from India and Pakistan reported 32% and 48% unawareness levels, respectively, about the significance of bite marks in FO (Dineshkumar & Rekha, 2022; Kashif et al., 2020).

More than half of the participants (59%) in the present work were ignorant about the role of palatal rugae as an indicator in forensic identification. This percentage is greater than that reported by Hashim et al. (2020), who reported a shortage in dental students' knowledge about palatal rugae as a sign of forensic identification (36.2%) (Hashim et al., 2020).

Approximately half of the participants (47.5%) were unaware that dental practitioners could be testified as court-appointed expert witnesses to provide forensic dental evidence. This result contrasts with that of Giannakopoulos et al. (2023) who reported that a remarkable percentage of

faculty members (63.8%) and students (56.9%) were aware that a dentist can provide forensic dental evidence as an expert witness in a court of law (Giannakopoulos et al., 2023). Moreover, 61.6% of the participants in previous study did not know that they could present dental evidence in front of the court by testifying as a qualified experience (Khan et al., 2024).

Almost all the participants (99.2%) thought their awareness of FO was deficient. This result coincided with that of Hashim et al. (2020), who concluded that the majority (93.1%) of their participants thought that they did not have sufficient knowledge in FO (Hashim et al., 2020).

Like previous research Shetty and Raviprakash (2011); Hannah et al. (2017); Khan et al. (2024), most of the participants (96.7%) in the present work denied receiving any formal FO training. Shetty and Raviprakash (2011) revealed that only 7% of study participants were exposed to formal training in FO (Shetty & Raviprakash, 2011). (Hannah et al., 2017) reported that eighty-three percent of the contributors were concerned to go through a formal training in FO (Hannah et al., 2017). Khan et al. (2024) reported that 90.4% of respondents never received formal training in FO (Khan et al., 2024).

Moreover, 88.4% of the participating dentists in the current study disproved taking FO as part of their undergraduate dentistry program, so most of them (90%) recommended adding an undergraduate course on forensic odontology. This result agrees with that of Hashim et al. (2020).

Moreover, 70.8% of the practitioners in the present work were willing to join special courses in FO such as diplomas or postgraduate courses. At the same time, 80% declared insufficient resources to learn FO in Egypt. In Egypt, a course on FO is available at many universities as an obligatory course on the master's degree in forensic medicine in medical schools. At the same time, an elective course on FO is available as an elective course for doctorate degrees in many faculties of dentistry.

On the other hand, approximately half of the practitioners in the current work were not concerned with joining FO professionally. Ninety percent of them believed that this line of work would pay them inadequately, whereas 43.5% of the participants disliked this subject. This finding contrasts with that of Hannah et al. (2017), who reported that 89.6% of participants thought that there is a worthy opportunity for FO as a profession (Hannah et al., 2017). Furthermore, Khan et al. (2024) reported that 95.6% of their research participants thought that FO ought to be as well acknowledged as other professions (Khan et al., 2024).

A total of 95.9% of the physicians in the current work used eruption patterns and calcification of the teeth to determine the age of children and adults. On the other hand, approximately 30% and 12.4% of them used histological and biochemical methods, respectively. This result disagrees with Abdul et al. (2019), who stated that 25% of dental students did not know how to estimate dental age (Abdul et al., 2019). Giannakopoulos et al. (2023) reported that 15% of undergraduates and 13% of faculty members were ignorant of how to assess dental age (Giannakopoulos et al., 2023).

In the present study, 94.2% of the participants confirmed the usefulness of the dental records in identifying deceased and crime suspects. Moreover, 57.9% of the participants maintained dental records in their clinics. This percentage is less than that obtained by Ali et al. (2016), Al Khalaf et al. (2017), Abdul et al. (2019) and Giannakopoulos et al. (2023) where 87.5%, 87%, 88.5%, and 78.7%, respectively, of the contributors kept dental records (Abdul et al., 2019; Al Khalaf et al., 2017; Giannakopoulos et al., 2023); (Ali et al., 2016). Additionally, Khan et al. (2024) reported that more than 85% of participants understood how essential it was to keep their dental records (Khan et al., 2024).

In their study, Preethi et al. (2011) reported that only twenty-one percent of the participating dentists did not keep dental records in their clinic or workplace, with only 12% of them preserving complete records (Preethi et al., 2011). On the other hand, in a study by Hannah et al. (2017), forty-eight percent of participants preserved the patient's case record (Hannah et al., 2017). This result highlights the community duty of every dental physician to keep comprehensive dental records of their patients, which

can aid as a significant source of data in case of any accident or mass disaster.

From a legal point of view, all dental records must be signed and dated by the one who wrote them. Any modifications in the record had to be struck off with one line to be clear and to escape doubt of deception. Furthermore, dentists are legally responsible for keeping a correctly understandable dental record of their patients in good condition for a minimum period of seven to ten years (Devadiga, 2014).

Electronic digital medical records have recently represented a significant advancement in document management. Moreover, accurate dental records largely characterize a person's identity. Recording dental data is mandatory in several European countries. The laws of the state must be approved before a patient's record can be deleted (Chugh et al., 2022; Shanbhag, 2016).

Our study revealed that 95% of physicians denied previous participation in FO research. 42.1% of those who contributed to research participated in age determination from teeth, while 36% were involved in personal identification research. This result reflects the lack of interest among most participating dentists in this branch of odontology.

A scoring system was employed to evaluate the degree of KAP among the participating dentists. According to Bloom's cut-off point, these scores were categorized as low, moderate, and high. In this study, the highest percentage of the participating dentists (39.3%) demonstrated a low level of knowledge regarding FO. However, 40.2% of them exhibited a positive attitude towards FO. In terms of practice levels, nearly all the participating dentists (99.2%) received low scores in practice. This result reflects the positive attitudes toward FO despite the participants' poor knowledge and practice levels. It offers hope for enhancing this field in Egypt by including mandatory courses on FO in undergraduate and postgraduate curricula at Egyptian universities and implementing various formal training programs and workshops for interested dentists.

## Conclusion

The present study highlights the significant challenges facing the field of forensic odontology in Egypt. Notable issues include the low levels of knowledge and practice among participating dentists in the field, the absence of a dedicated forensic odontology course in undergraduate dentistry programs, and the reluctance of approximately half of the participants to join the forensic odontology profession. On the other hand, the highest percentage of participating dentists demonstrated a positive attitude towards learning and training in forensic odontology.

## Recommendation

From the perspective of the current study, it is essential to integrate a specific course on FO into undergraduate educational programs at Egyptian faculties of dentistry. Additionally, formal programs should be offered to interested dentists in postgraduate training, enabling them to become experts in this field. They should also be encouraged to join forensic teams to identify unknown individuals and investigate crimes and mass disasters. Postgraduate dentists should engage in mandatory FO coursework and workshops. Dentistry faculties should collaborate with forensic medicine departments and the Forensic Medicine Authority to provide hands-on training for dental professionals. Furthermore, the Egyptian Dental Syndicate could facilitate workshops and continuous professional development programs to improve practitioners' knowledge in forensic odontology.

## Limitations

The relatively small sample size of the study may affect the generalization of the findings and needs to be confirmed in further research using a larger number of samples. Moreover, the sample was obtained through a convenience sampling method (online voluntary participation), which may not represent all Egyptian dentists and thus limits the generalizability of the findings.

## Consent for publication

Not applicable

## Availability of data and materials

Not applicable

## Competing interests

All the authors declare no competing interests

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