National Journal of Health Sciences, 2025*, 10*, 26-31

Research Article

Dental Age Estimation on Digital Panoramic Radiographs: A Comparison among Final Year Students, Graduates, and Postgraduate Trainees

Nayab Raza*, Syed Yawar Ali Abidi, Samira Adnan, Maham Muneeb Lone

Department of Operative Dentistry and Endodontics, Sindh Institute of Oral Health Sciences, Jinnah Sindh Medical University, Karachi, Pakistan.

Abstract: Background: Panoramic radiographs aid in holistic treatment planning and dental age estimation based on tooth development stages and eruption sequence. Evaluating dental professionals' proficiency to precisely estimate patient age using orthopantomograms (OPGs) is crucial for identifying existing skill gaps.

Objective: This study aimed to evaluate and compare the knowledge of dental age estimation using digital panoramic radiographs among final-year dental students, recent graduates, and postgraduate trainees.

Materials and Methods: This cross-sectional study was conducted at Sindh Institute of Oral Health Sciences (SIOHS), Jinnah Sindh Medical University (JSMU), over a two-month period from 1st October till 30th November 2022, at the Department of Oral Radiology. Ethical approval was obtained bearing number JSMU/IRB/2022/-639. The calculated sample size was 402, and non-probability convenience sampling was used. An online questionnaire was designed with eight digital OPGs (6–16 years), analyzed by dental specialists using the American Dental Association (ADA) eruption sequence guideline. Each OPG was accompanied by options related to the most likely age to be selected by the study participants. The Google Form link was shared with all potential participants via Facebook and WhatsApp Messenger. Frequency of correct responses was calculated, and chi-square test was applied to determine any significant differences between participants based on their responses (p- value ≤ 0.05).

Result: The response rate was 78.7%, with 493 completed forms analyzed. Most participants were aged 18-23 years (53.3%), and 71.2% were female. Participants comprised final-year students (32.7%), graduates (41%), and postgraduate trainees (26.4%). Postgraduate trainees had the highest percentage (60.4%) of correct responses, followed by graduates (54.7%) and final-year students (48.4%). Radiographic image 8 had the highest correct responses (74.2%), while image 7 had the lowest (25.6%). No statistically significant relationship was found between participants' qualifications and their ability to identify the correct age range on OPGs ($p > 0.05$).

Conclusion: The ability to correctly identify the age range of OPGs seems to improve with progression in clinical training, since more post-graduate dental trainees were able to accurately identify the age range of patients compared to other participants.

Keywords: Tooth eruption, Age determination by teeth, Panoramic radiography, Orthopantomography, Digital, Forensic dentistry.

INTRODUCTION

The arrangement and morphology of human dentition is unique to every individual. Just as finger prints are considered specific to each human and are used to establish one's identity, teeth and human dentition can also be considered analogous in this regard. Because of their durability and resistance to taphonomic processes when compared to bones, teeth serve as an important tool in establishing the definitive identity of a person. Techniques for dental age determination are used in various clinical and scientific fields and are an accepted method for age estimation in medico-legal cases. One of its applications is in forensic odontology, where the chronological age of an unidentified deceased person or a living individual with an unknown birth record can be estimated. Also, some individuals may either not possess accurate information about their date of birth or choose not to disclose it. In such circumstances, age determination techniques serve as a valuable tool.

The routinely used non-invasive methods for dental age estimation are based on the sequence and timing of the eruption of teeth in the oral cavity or by analysis of developmental stage of crown and root mineralization on a panoramic radiograph. Dental age estimation using radiographs has proved advantageous and more reliable than skeletal age estimation as the dentition is less variable and is genetically controlled. The clinical eruption and calcification status of teeth as seen on radiographs are the two main criteria used to predict the dental age of children. This information aids in diagnosis and treatment planning in clinical dentistry [1-8].

An orthopantomogram (OPG) is an extra oral radiograph of the complete dentition, on the basis of which tooth mineralization can also be evaluated [9]. It is considered one of the most

* Address correspondence to this author at the Department of Operative Dentistry and Endodontics, Sindh Institute of Oral Health Sciences, Jinnah Sindh Medical University, Karachi, Pakistan.
Email: nayab.raza@jsmu.edu.pk

commonly used and beneficial imaging tools in dental practice, which has eliminated the need for invasive measures such as extraction or sectioning of teeth in order to visualize the extent of mineralization [10]. Besides the degree of mineralization, knowledge of the timing of primary and permanent tooth eruption is of great importance to both dental students and dental health professionals to accurately estimate the age and skeletal maturity of any patient.

The ability to estimate the age of patients based on OPGs is required in various clinical and scientific disciplines like pediatric dentistry, forensic dentistry, and orthodontics in order to determine appropriate treatment options [11, 12]. This study was therefore designed to assess and compare the ability of final-year dental students, dental graduates, and postgraduate trainees in dentistry to accurately estimate the dental age of the patients through the evaluation of digital oral panoramic radiographs (OPGs). The results of this study will help us identify any shortcomings, if any, in this essential skill and provide evidence to convince regulatory bodies to emphasize it in the curriculum.

MATERIALS AND METHODS

This cross-sectional analytical study was conducted over two months period from 1st October till 30th November 2022, at the Department of Oral Radiology, SIOHS (JSMU). Ethical approval was obtained from the Institutional Review Board bearing number JSMU/IRB/2022/-639, prior to commencing the research. The total number of trainees enrolled in the College of Physicians and Surgeons Pakistan (CPSP) in Karachi for various dental specialties was found to be 203, as communicated via official email correspondence with CPSP. As there was no specific outcome target, we calculated the sample size using OpenEpi v 3.01, assuming a 50% expected maximum frequency of the outcome factor. The required sample size using 95% confidence level was 134 dental postgraduate trainees. As we collected data on three population groups, i.e., dental postgraduates, graduates (HOs), and BDS final-year students, the total sample was 402 (i.e., 134 participants in each group). A total of 50 digital panoramic radiographs (OPGs) taken for clinical purposes were evaluated. OPGs with malocclusion, impactions, or congenitally missing teeth were excluded. Seven high-quality OPGs were shortlisted from a total of 50 digital panoramic radiographs that were evaluated. Each OPG was analyzed by the dental specialists to classify it into the age groups from 6 to 16 years using the American Dental Association (ADA) eruption chart as a guideline [13].

Based on the selected radiographs, a questionnaire was developed on Google Forms. The questionnaire was divided into three sections. In the first section, the consent of the study participants was sought. Only respondents who consented to be part of the study were able to fill out the remainder of the form. The second section included the demographic details of the study participants, i.e., age, gender, qualification, email address, and specialty of postgraduate training. The third section consisted of eight multiple-choice questions each with a radiographic image. Three age range options were given and the participants were asked to choose the age range that, in their opinion, most appropriately correlated with the radiographic image. Radiographic image 1 illustrated the early mixed dentition phase, characterized by the shedding of primary upper incisors and the eruption of permanent incisors, while the primary lateral incisors showed resorbing roots. Images 2 and 5 displayed all deciduous teeth intact, along with the eruption of the first permanent molars, indicating an age range of 5-6 years. Image 3 depicted the early mixed dentition phase, with all primary incisors shed and permanent incisors erupting, corresponding to an age range of 7-8 years. Image 4 featured erupted incisors with intact primary canines and molars, indicating an age range of 8-9 years. Image 6 showed all primary teeth exfoliated except for the primary second molars, with permanent first molars erupted and the maxillary second permanent molar erupting, suggesting an age range of 10–12 years. Image 7 featured fully erupted permanent teeth, excluding the third molars, with immature roots of the second molars, indicating an age range of 13-14 years. Radiographic image 8 depicted nearly complete eruption of all teeth except the maxillary second premolars (Fig. **1**).

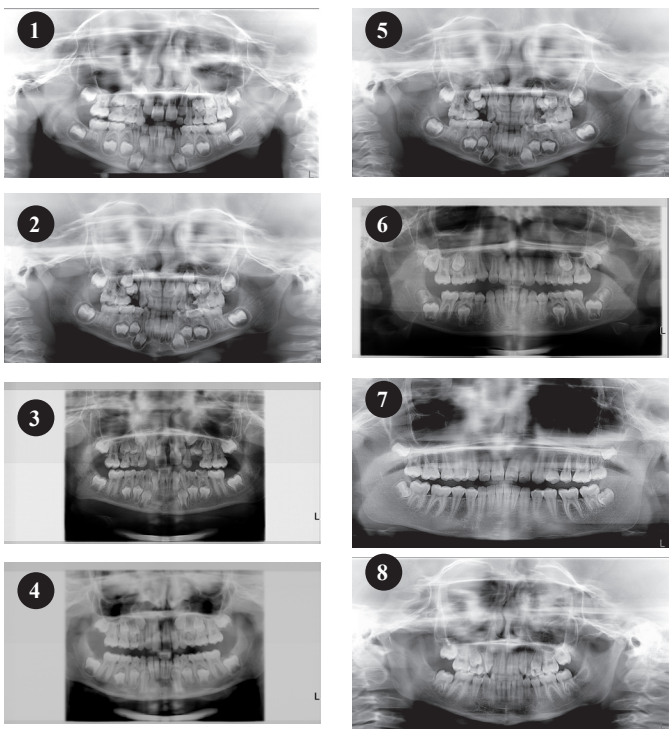

Fig. (1). Radiographic Images 1-8 (OPGs) used for Age Estimation by Participants.

After the key for the items was determined by consensus among the content experts, the questionnaire was piloted on 15 participants who fulfilled the inclusion criteria, to determine any difficulty in understanding the format and language of the questions and the ease of recording the responses. Three groups of participants were included in this study: final-year dental students (G1), dental graduates (HOs) (G2), and dental postgraduate trainees (G3). Any of the potential participants who did not consent to

be part of the study, were not currently pursuing training, or were on long leave were excluded. The final questionnaire, comprising eight radiographic images with options related to the most likely age range depicted by those images, was distributed among the potential participants in Karachi via Google Forms link using social media platforms such as WhatsApp Messenger and Facebook.

STATISTICAL ANALYSIS

Data were analyzed using SPSS v23. Percentages and frequencies for correct and incorrect answers were determined. The chi-square test was applied to determine any significant difference between the three groups based on their responses (p-value ≤ 0.05).

RESULT

The response rate was 78.7%, with 498 of the 632 sent forms returned. We received more responses than our target of 402, likely due to the wide distribution of the questionnaire via social media, which encouraged greater participation. This approach aimed to reach a wider variety of participants, helping ensure our results were representative of the larger dental community. After excluding 5 forms due to being unfilled or partially filled, a total of 493 fully completed responses were analyzed. This significant sample size strengthened our dataset, enhancing the reliability of our findings and enabling better comparisons among the different groups. The frequencies and percentages were computed for categorical variables. The participants had an age range of 18 to 44 years, with the majority 53.3% (263) falling within the 18-23 age group. Females accounted for 71.2% (351) of the participants. In terms of qualifications, 32.7% (161) were final-year dental students, 41% (202) were recent graduates, and 26.4% (130) were postgraduate trainees. Among the postgraduate trainees, 60% (78) specialized in Operative Dentistry & Endodontics, 18.5% (24) in Orthodontics, 11.9% (19) in Oral and Maxillofacial Surgery, and 6.9% (9) in Prosthodontics (Table **1**).

Table 1. Demographic Details of the Study Participants.

Variable		n (%)
Age (in years)	18-23	263 (53.3%)
	24-34	223 (45.2%)
	35-44	7 (1.4%)
Gender	Male	142 (28.8%)
	Female	351 (71.2%)
Qualification	Final Years students	161 (32.7%)
	Graduate/House Officers	202 (41%)
	Postgraduate Trainees (PGs)	130 (26.4%)
Specialty (For PGs only)	Operative Dentistry & Endodontics	78 (60%)
	Oral and Maxillofacial Surgery	19 (11.9%)
	Orthodontics	24 (18.5%)
	Prosthodontics	9 (6.9%)

Table **2** showed the proportion of correct and incorrect responses by the participants in general and stratified on the basis of qualification. Radiographic image number 8 had the highest percentage of overall correct responses 74.2% (366), whereas image number 7 received the lowest percentage of correct age estimations 25.6% (126). A statistically significant difference (p ≤ 0.005) was found in correct responses when stratified on qualification basis, where postgraduate trainees had greater correct responses for images 1, 3, 4 and 7, while graduates demonstrated higher correct age estimation for image 6 (p= 0.002). These findings indicated that the participants' qualifications played a crucial role in their ability to interpret the radiographic images accurately.

Table 2. Frequency and Percentages of Correct and Incorrect Responses of the Participants Based on their Qualification.

Qualification	Correct n (%)	Incorrect n (%)	p-value
Radiographic Image 1			
Final year student	77 (47.8%)	84 (52.2%)	0.020*
Graduate/house officer	78 (38.6%)	124 (61.4%)	
Postgraduate trainee	70 (53.8%)	60 (46.2%)	
Radiographic Image 2			
Final year student	86 (53.4%)	75 (46.6%)	0.111
Graduate/house officer	122 (60.4%)	80 (39.6%)	
Postgraduate trainee	85 (65.4%)	45 (34.6%)	
Radiographic Image 3			
Final year student	65 (40.4%)	96 (59.6%)	0.050*
Graduate/house officer	98 (48.5%)	104 (51.5%)	
Postgraduate trainee	71 (54.6%)	59 (45.4%)	

Radiographic Image 4			
Final year student	72 (44.7%)	89 (55.3%)	0.008*
Graduate/house officer	117 (57.9%)	85 (42.1%)	
Postgraduate trainee	80 (61.5%)	50 (38.5%)	
Radiographic Image 5			
Final year student	86 (53.4%)	75 (46.6%)	0.111
Graduate/house officer	122 (60.4%)	80 (39.6%)	
Postgraduate trainee	85 (65.4%)	45 (34.6%)	
Radiographic Image 6			
Final year student	98 (60.9%)	63 (39.1%)	0.002*
Graduate/house officer	153 (75.7%)	49 (24.3%)	
Postgraduate trainee	79 (60.8%)	51 (39.2%)	
Radiographic Image 7			
Final year student	23 (14.3%)	138 (85.7%)	<0.001
Graduate/house officer	48 (23.8%)	154 (76.2%)	
Postgraduate trainee	55 (42.3%)	75 (57.7%)	
Radiographic Image 8			
Final year student	117 (72.7%)	44 (27.3%)	0.315
Graduate/house officer	146 (72.3%)	56 (27.7%)	

*Chi-square test was applied. p-value ≤ 0.05 was considered statistically significant.

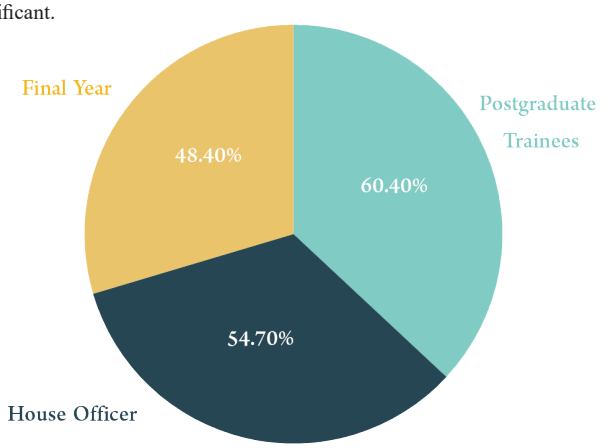

Fig. (2). Total Correct Responses of the Participants Based on their Qualification.

As indicated in Fig. (**2**), postgraduate trainees (628, 60.4%) had the highest percentage of total correct responses, followed by house officers (884, 54.7%) and final-year students (624, 48.4%).

DISCUSSION

Estimating age is of paramount importance in medico-legal issues [14, 15]. An individual may be unaware of their exact date of birth for multiple reasons, or may choose not to disclose it [16]. Under such circumstances, it may be necessary to employ an age determination technique to accurately determine the age of such an individual. The expanding horizons of the field of dentistry have enabled dental professionals to become proficient experts in legal proceedings and forensic investigations [17]. The timing of the eruption of teeth can serve as a valuable aid in determining the type and extent of treatment that can be offered to the patient. It can be used for the holistic determination of patient treatment needs [18, 19]. It usually gives a more precise indication of the child's early or late growth [3]. Therefore, this study helped to determine if individuals in different phases of their dental studies and experience are able to correctly assess the age of any patient that comes to their practice, or if subsequently their expertise in age estimation based on the status of the dentition of a subject is required in medico-legal cases.

In determining the age of humans, radiology and radiography play an indispensable role [20]. Orthopantomograms, also known as OPGs, are considered one of the most useful tools for age estimation in children [21, 22]. Due to its easy accessibility and relatively common use, we used a panoramic radiograph for dental age estimation based on the tooth eruption sequence in this study. Unlike previous studies that used methods such as Nolla, Demirjian, Williams, etc., We used the American Dental Association eruption sequence guideline for age estimation. These guidelines are straightforward, less time-consuming in terms of interpretation, easy to comprehend, require fewer data sets, and hence were anticipated to be less complex for all the participants in the study to comprehend. This eruption sequence is taught to them in their curriculum in the undergraduate dental program. To the best of our knowledge, our study was the first to examine the eruption sequence on panoramic radiographs of patients by final-year BDS students, fresh graduates, and postgraduate trainees for age estimation. Prior to this study, age estimation in various studies used only field experts who utilized complex methods [23-26]. However, since students, either at undergraduate or postgraduate levels, will eventually be practicing in the community where their ability to accurately estimate age will be applied, it is essential to determine the age estimation ability of this strata so in addition to gaining this skill through experience, their theoretical knowledge and application is evaluated at an early stage.

According to our study results, the ability to predict age was better among postgraduate trainees in comparison to house officers and final-year students. This could be due to the improved clinical exposure and academic level of the postgraduate trainees. However, the findings from the three groups were not statis-

tically significant, indicating an overall lack of proficiency and skills in interpreting radiographs. This could potentially hinder future dentists and consultants from formulating an effective treatment strategy for their patients. Given its significance as an essential skill for all dental graduates, efforts should be made to improve the clinical training of dental students in this domain. Educational strategies could be devised and recommended to ensure enhanced understanding and competence in dental age estimation using non- invasive, easily available and effective methods like the OPG.

Radiographic image no. 08 elicited the highest level of accuracy, with 79.2% of postgraduate trainees providing the correct response. This was followed by final-year students and house officers, with 72.7% and 72.3% correct responses, respectively. The reason for the ease of age estimation could potentially be attributed to the fact that almost all teeth were erupted, with the exception of maxillary second premolars. This tooth typically erupts within a specific range of 10 to 12 years, making it simpler for participants to estimate the age from the age range options provided.

The maximum number of incorrect responses were for radiograph no. 07, in which all the permanent teeth had erupted except for the third molar, which erupts at age 17 years (or later). Majority of the participants selected the option with an age range of 15 to 17 years. The correct response to this radiographic image was 13 to 14 years as the third molars were not erupted or had completely formed tooth buds. Additionally, the roots of the 2nd molars were not completely formed, predicting its recent eruption. In the author's opinion, the presence of all 28 erupted teeth might have confused the participants and made them overlook the other features that would have helped in correct age estimation. Also, they may have chosen the option with the maximum age range because all the other radiographs included in the questionnaire had mixed dentition period.

With regard to the specialty, postgraduate trainees in Operative Dentistry and Endodontics demonstrated superior ability to accurately estimate the age of patients on the radiographic images in comparison to trainees in Orthodontics, Oral and Maxillofacial Surgery, and Prosthodontics. However, the results were not statistically significant. The comparatively better results obtained by Operative Dentistry and Endodontic trainees could be a result of their exposure to more paediatric patients in their practice and frequent utilization of radiographs depicting mixed dentition, both of which were included in our study.

LIMITATIONS

Some of the limitations of our study were that we used digital radiographs and the OPGs were not given physically to the participants but they were asked to analyze the radiographs in a digital format, which could have interfered with accurate assessment. Also, the teeth were assessed by eruption sequence only and not developmental stage, which could lead to variability due to local and environmental factors. So, considerations can be put forward for developing age estimation classification specifically for Pakistani population. Also, the OPGs that were included were from the age range of 6 to 16 years only. Despite these limitations, this study identifies deficiencies observed with radiographic age prediction and will help us to recommend strategies to improve their understanding of this essential skill during their academics and clinical training. In addition, this topic should be covered and emphasized in dental school, as this is the final checkpoint before they are licensed to practice.

CONCLUSION

The ability to correctly identify age range on OPGs seems to improve with progression in clinical training, as more post-graduate dental trainees were able to accurately determine patient age compared to other participants. This highlights the impact of advanced training. However, since it is an essential skill for all dental graduates, high percentage of incorrect responses warrant efforts to improve clinical training of dental students, graduates and postgraduates in this aspect.

AUTHORS' CONTRIBUTION

- **Nayab Raza**: Conceptualization, Study Design, Methodology, Data analysis and interpretation, Writing draft, Critical review and revision the manuscript.
- **Syed Yawar Ali Abidi**: Writing draft, Critical review and revision the manuscript, Final approval, final proof to be published.
- **Samira Adnan**: Methodology, Data analysis and interpretation, Critical review and revision the manuscript, Final approval, final proof to be published.
- **Maham Muneeb Lone**: Methodology, Data analysis and interpretation, Critical review and revision the manuscript, Final approval, final proof to be published.

FUNDING DISCLOSURE

Declared None.

CONFLICT OF INTEREST

Declared None.

ACKNOWLEDGMENTS

Declared None.

REFERENCES

[1] Kaul B, Vaid V, Gupta S, Kaul S. Forensic odontological parameters as biometric tool: A review. Int J Clin Pediatr Dent 2021; 14(3): 416. DOI: 10.5005/jp-journals-10005-1967

[2] Viciano J, López-Lázaro S, Tanga C. Post-mortem dental profile as a powerful tool in animal forensic investigations: A review. Animals 2022; 12(16): 2038. DOI: 10.3390/ani12162038

[3] Nassif N, Sfeir E. Age and sequence of permanent teeth eruption in Lebanese children. Sci World J 2020; 2020(54): 1-5.

[4] Jayakrishnan JM, Reddy J, Kumar RV. Role of forensic odontology and anthropology in the identification of human remains. J Oral Maxillofac Pathol 2021; 25(3): 543-7. DOI: 10.4103/jomfp.jomfp_81_21

[5] Voors A. Can dental development be used for assessing age in underdeveloped communities? J Trop Pediatr Environ Child Health 1973; 19: 242.

[6] Peretz B, Gotler M, Kaffe I. Common errors in digital panoramic radiographs of patients with mixed dentition and patients with permanent dentition. Int J Dent 2012; 2012: 584138.

[7] Gupta E, Pannar D, Naimatullah MN, Zainab SN, Yadav AK, Chacko PK. Assessment of skeletal maturity indicators and their correlation with dental calcification stages in pediatric patients: A comparative analysis. J Adv Med Dent Sci Res 2023;11(10):75-8. DOI: 10.21276/jamdsr

[8] Maber M, Liversidge H, Hector M. Accuracy of age estimation of radiographic methods using developing teeth. Forensic Sci Int 2006; 159(Suppl 1): S68-S73.

[9] Kumari S, Sahu AK, Rajguru J, Bishnoi P, Garg AJ, Thakur R, *et al*. Age estimation by dental calcification stages and hand-wrist radiograph. Cureus 2022; 14(9): e29045. DOI: 10.7759/cureus.29045

[10] Jain V, Chowdhry A, Sircar K, Kapoor P. Application of comprehensive chart for dental age estimation (DAEcc) based on demirjian method using orthopantograms: A pilot study. Forensic Sci Int 2019; 1: 100017.

[11] Espinoza-Silva PV, López-Lázaro S, Fonseca GM. Forensic odontology and dental age estimation research: A scoping review a decade after the NAS report on strengthening forensic science. Forensic Sci Med Pathol 2023; 19(2): 224-35. DOI: 10.1007/s12024-022-00499-w

[12] Kohli RK, Mishra A, Haque I. Significance of dental age assessment in forensic science: A review. Int J Med Toxicol Legal Med 2022; 25(1-2): 96-9. DOI: 10.5958/0974-4614.2022.00021.3

[13] Teeth P. Tooth eruption. J Am Dent Assoc 2006; 137(1): 127.

[14] Kuhnen B, Fernandes CM, Barros FD, Scarso Filho J, Gonçalves M, Serra MD. Chronology of permanent teeth mineralization in Brazilian individuals: Age estimation tables. BMC Oral Health 2023; 23(1): 165. DOI: 10.1186/s12903-023-02837-y

[15] Pandey H, Chaudhary SK, Pathak H, Nuzzolese EJM-LU. Forensic odontology: An aid in identification of unknown human remains. Medico-Legal Update 2021; 21(4): 37-42. DOI: 10.37506/mlu.v21i4.3099

[16] Lorkiewicz-Muszyńska D, Przystańska A, Kulczyk T, Hyrchała A, Bartecki B, Kociemba W, *et al*. Application of X-rays to dental age estimation in medico-legal practice. Arch Med Sadowej Kryminol 2015; 65(1): 1-16.

[17] Kaur S. Forensic dentistry need to expand the horizon. Medicon Dent Sci 2023; 3: 1-2.

[18] Saputri RIJS. Dental age estimation of Indonesian population: A literature review. SONDE 2020; 5(1): 13-21. DOI: 10.28932/sod.v5i1.2380

[19] Pan J, Shen C, Yang Z, Fan L, Wang M, Shen S, *et al*. A modified dental age assessment method for 5-to 16-year-old eastern Chinese children. Clin Oral Investig 2021; 25: 3463-74. DOI: 10.1007/s00784-020-03668-9

[20] Yazdanian M, Karami S, Tahmasebi E, Alam M, Abbasi K, Rahbar M, *et al*. Dental radiographic/digital radiography technology along with biological agents in human identification. Scanning 2022; 2022(1): 5265912. DOI: https://doi.org/10.1155/2022/5265912

[21] Mohammed F, Fairozekhan AT, Siddiqui IA, AlMoumen S, Ali AlShehri T, AlRssasi MH, *et al*. Assessment to determine the accuracy of Chaillet and Demirjian method of dental age estimation using Orthopantomographs, Eastern Province, Saudi Arabia. F1000Research 2024; 13: 1554. DOI:https://doi.org/10.12688/f1000research.157275.1

[22] Dalessandri D, Tonni I, Laffranchi L, Migliorati M, Isola G, Visconti L, *et al*. 2D vs. 3D radiological methods for dental age determination around 18 Years: A systematic review. Appl Sci 2020; 10(9): 3094. DOI: https://doi.org/10.3390/app10093094

[23] Mohammed RB, Sanghvi P, Perumalla KK, Srinivasaraju D, Srinivas J, Kalyan US, *et al*. Accuracy of four dental age estimation methods in southern Indian children. J Clin Diagn Res 2015; 9(1): HC01-8.

[24] Kurniawan A, Chusida An, Atika N, Gianosa TK, Solikhin MD, Margaretha MS, *et al*. The applicable dental age estimation methods for children and adolescents in Indonesia. Int J Dent 2022; 2022: 6761476.

[25] Alharbi Sr HS, Alharbi AM, Alenazi AO, Kolarkodi SH, Elmoazen R, Alharbi Sr A, *et al*. Age estimation by Kvaal's method using digital panoramic radiographs in the Saudi population. Cureus 2022; 14(4): e23768.

[26] Shi L, Zhou Y, Lu T, Fan F, Zhu L, Suo Y, *et al*. Dental age estimation of Tibetan children and adolescents: Comparison of Demirjian, Willems methods and a newly modified Demirjian method. Legal Med (Tokyo) 2022; 55: 102013. DOI: 10.1016/j.legalmed.2022.102013.

Received: June 29, 2024 Revised: February 12, 2025 Accepted: February 12, 2025