ISSNe 2178-1990

10.35699/2178-1990.2025.59245

ARQUIVOS EM ODONTOLOGIA

Dental Students' Knowledge of the Differential Diagnosis of Developmental Defects of Enamel (DDE): a Comparative Cross-Sectional Study

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Introduction: Developmental Defects of Enamel (DDE) are disturbances in enamel formation that can compromise tooth function and esthetics and increase susceptibility to dental caries. Accurate diagnosis is essential for appropriate clinical management.

Aim: To compare the ability to perform differential diagnosis of DDE among undergraduate dental students in their penultimate (3rd year; G1) and final (4th year; G2) years of study at a private university.

Methods: A total of 121 students participated in this comparative cross-sectional study (G1: n=71; G2: n=50). Data was collected through an online questionnaire comprising ten clinical case scenarios that required differential diagnosis of DDE. One point was awarded for each correct response, and the total scores were analyzed within and between groups. Statistical comparisons were performed using Chi-square, Fisher's Exact test, and Mann-Whitney U test (α=5%).

Results: The mean age of participants was 22.5 ± 4.0 years, with a predominance of females (82.6%). Integrated Dentistry for Children and Adolescents (71.9%) was the most frequently reported discipline addressing DDE. Regarding perceived preparedness, 39.7% of students reported that their coursework provided sufficient knowledge for DDE diagnosis. The overall mean score of correct diagnoses among all participants was 6.2 ± 1.8. Group G2 had a significantly higher mean score (6.6 ± 2.0) compared to G1 (6.0 ± 1.5) ($p < 0.05$).

Conclusion: Dental students demonstrated a moderate level of diagnostic accuracy in identifying DDE. Final-year students demonstrated greater proficiency in the differential diagnosis of DDE than penultimate-year students, suggesting progressive knowledge acquisition throughout the dental curriculum. Nevertheless, diagnostic challenges remain, underscoring the need for ongoing education and reinforcement of this topic.

Uniterms: dental enamel hypoplasia; fluorosis, dental; dental enamel; diagnosis, differential; students, dental.

Data recebimento: 2025-05-21
Data aceite: 2025-09-12

INTRODUCTION

Dental enamel is a highly mineralized tissue derived from the ectoderm, composed predominantly of hydroxyapatite crystals[1-5]. Amelogenesis, the process of enamel formation, occurs in three distinct phases: secretion, calcification, and maturation[6,7]. Ameloblasts – the cells responsible for enamel formation – are particularly sensitive to disturbances during these stages, and disruptions can lead to developmental anomalies in the enamel structure[4,5,7].

Developmental Defects of Enamel (DDE) result from insults occurring at different stages of amelogenesis and present variable severity and etiologies[4,7,8]. These defects may arise due

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to local, systemic, or hereditary/genetic factors, leading to permanent structural alterations in enamel. Clinically, DDE may present variations in form, size, color, or translucency and may affect individual teeth, specific tooth groups, or the entire dentition – either primary or permanent[4,7,9].

The nature of enamel defects depends on the stage of amelogenesis in which the disturbance occurs. Disruptions during the secretion phase typically result in quantitative defects, such as enamel hypoplasia. In contrast, disturbances during the maturation phase led to qualitative defects, such as dental fluorosis and enamel hypomineralization[9,10]. The location and severity of DDE are closely linked to the timing of the insult during amelogenesis, which plays a crucial role in determining the final enamel characteristics[5,11]. Notably, once formed, enamel does not undergo remodeling[6,8,12,13].

Several diagnostic indices have been proposed in the literature to categorize DDE. Most of these indices classify enamel defects into two main categories: hypomineralization (opacities) and enamel hypoplasia. Among the most widely used is the modified Developmental Enamel Defects Index (modified DDE Index) proposed by the Fédération Dentaire Internationale (FDI) World Dental Federation, in 1992[14]. This index evaluates key characteristics of the defect, including its type (e.g., opacity, hypoplasia, discoloration), extent (single or multiple lesions), demarcation (demarcated or diffuse), and location on the tooth surface. Defects are categorized into four groups: demarcated opacities, diffuse opacities, hypoplasia, and combined defects[14]. Another diagnostic tool, the Enamel Defects Index (EDI), was developed in 2001 to provide a more time-efficient assessment method. It classifies enamel defects into three main categories: hypoplasia, opacity, and post-eruptive breakdown, and has been noted for its simplified and faster application in clinical and epidemiological studies[15]. Clinically, the presence of DDE can have significant implications, as affected teeth may exhibit increased susceptibility to dental caries, sensitivity, post-eruptive fractures, and alterations in function and esthetics[9,16-19].

Effective management of DDE requires accurate diagnosis, aimed at preserving function and aesthetics while maintaining overall oral health and preventing future complications[9,19]. DDEs often share overlapping clinical features, which highlight the importance of a comprehensive diagnostic approach, including detailed patient history, thorough clinical examination, and, when indicated, radiographic imaging. Such a multifaceted evaluation supports the development of individualized treatment strategies[7,20].

Research has investigated the perception, knowledge, and clinical management of DDE among dental professionals with varying levels of experience and specialties[21-24]. Additionally, growing attention has been directed toward understanding dental students' knowledge of DDE, as proper education and training are critical for accurate diagnosis and effective preventive and therapeutic management[25-31]. Studies suggest that students in the final years of dental school tend to demonstrate greater proficiency in recognizing certain types of DDE, compared to those in earlier stages of training[26,27,32].

Thus, comparisons considering the academic year of dental students can provide meaningful insights into the effectiveness of the curriculum in developing diagnostic skills related to enamel defects, assessing knowledge progression, identifying potential gaps, and establishing a benchmark for future curricular improvements. Given the complexity involved in differentiating between various forms of DDE, this study aimed to compare dental students´ knowledge and ability to perform a differential diagnosis of DDE. The null hypothesis was that there is no difference in the accuracy of DDE diagnosis between undergraduate dental students in their penultimate and final years of study.

MATERIAL AND METHODS

This comparative cross-sectional study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines. Ethical approval was obtained from the local Research Ethics Committee (CAAE protocol: 36559520.6.0000.8084; approval decision number: 4.251.950).

Population and Sample Size Calculation

All undergraduate dental students enrolled in either the penultimate (3rd year) or final (4th year) year of the Dentistry program at a private institution located in São Paulo, Brazil, were invited to participate. During the first year of the program, students focus primarily on theoretical coursework, supplemented by introductory laboratory sessions. In the second year, laboratory training is expanded, and students begin supervised clinical practice. As

the curriculum progresses, clinical disciplines become increasingly emphasized, culminating in the final year (fourth year), which is predominantly devoted to clinical training with minimal theoretical instruction.

The inclusion criteria comprised students enrolled in the last two years of the dental program, attending either morning or evening classes at the Liberdade Campus (located in the central region of São Paulo) or São Miguel Paulista Campus (located in the eastern zone), aged 18 years or older, and of any gender. All participants must have completed the classes that cover DDE in the institutional curriculum. Before enrollment, all participants were required to sign an informed consent form authorizing the use of their questionnaire data for research purposes.

According to official enrollment records, the total number of eligible students across both academic years was 196. The sample size was calculated based on this population using a 95% confidence interval (CI) and a 5% significance level (α). Due to the lack of comparable prior studies, an assumed knowledge proportion of 50% was applied. The minimum required sample size was calculated to be 131 participants, using the OpenEpi platform (www.openepi.com).

A convenience sampling method was employed, enrolling students who voluntarily consented to participate by signing an informed consent form via the Google Docs/Google Forms platform. Questionnaires that were incomplete or submitted with errors were excluded. The final sample was then stratified by academic year: Group 1 (G1) included students in the penultimate year (3rd year), and Group 2 (G2) included students in the final year (4th year) of the dental program.

Data Collection

Data collection was conducted between September and October 2020, using a virtual questionnaire specifically developed for this study, administered via the Google Forms platform. To ensure participant anonymity, the questionnaire link was distributed to eligible students through the institutional Blackboard Learn platform by the dental school administration. The methodology employed in the study was developed and adapted from previous research that utilized questionnaires to assess students' knowledge and confidence in the diagnosis of enamel defects[26,31,33].

The questionnaire was initially applied in a pilot sample of undergraduate dental students (n=10) to assess the clarity, relevance, internal consistency, and overall quality of the questionnaire, and it was subsequently refined based on the feedback received. The students who participated in this pilot study were not included in the final study sample.

The first section of the questionnaire comprised five sociodemographic questions and three teaching-learning related questions, presented in a variety of formats, including dichotomous, multiple-choice, and Likert-scale responses. Information was collected regarding participants' age, gender, academic year (3rd or 4th year), campus location (Liberdade or São Miguel Paulista), and class schedule (morning or evening). Teaching-learning questions assessed whether students believed the knowledge acquired during their undergraduate dental training was sufficient for making accurate diagnostic decisions regarding various types of DDE. Additionally, participants were asked to indicate which dental classes they had completed or were currently enrolled in that addressed the topic of DDE.

The second section of the questionnaire focused on students' foundational knowledge of DDE and their ability to perform differential diagnoses. This section presented ten clinical case scenarios, each accompanied by intraoral photographs (frontal, lateral, or occlusal views of the defect when appropriate) selected from the University´s pediatric and adolescent dental patient records, illustrating a range of DDE types. Each question asked: "What is the most likely diagnosis for the case shown below?", with four multiple-choice options:

(A) Dental Fluorosis
(B) Amelogenesis Imperfecta
(C) Enamel Hypoplasia
(D) Enamel Hypomineralization.

The photographs of the clinical cases used in the present study were obtained from the archives maintained by the faculty team, comprising records of patients treated at the University's Pediatric Dentistry Clinic. Two experienced pediatric dentistry professionals and professors with expertise in subject matter (M.B.D. and R.O.G.) independently evaluated each clinical case image. Consensus discussions were held to establish the most accurate diagnosis for each case, ensuring consistency in the reference answers used for scoring. The two professors were previously calibrated by a senior researcher for the modified Developmental Defects of Enamel (DDE) Index, as proposed by the FDI World Dental Federation[14], for studies on this topic. The Kappa values for intra- and inter-examiner reproducibility were greater than 0.8.

Statistical Analysis

Responses were automatically recorded via the Google Forms platform and subsequently compiled for statistical analysis. All analyses were performed using MedCalc software for Windows, version 15.2.2 (Mariakerke, Belgium), with a significance level set at 5% (α = 0,05).

Descriptive statistics were used to summarize the data. Absolute frequencies and percentages were calculated for categorical variables, while means, standard deviations, and ranges were used for quantitative variables. The normality of quantitative data was assessed using the Kolmogorov-Smirnov test, which indicated a non-normal distribution ($p > 0.05$).

Each participant received one point for every correct diagnosis across the ten clinical case scenarios, and total scores were calculated for each respondent. Comparisons between the two groups – Group 1 (G1: penultimate year) and Group 2 (G2: final year) – were performed using the Chi-square test or Fisher's Exact test for categorical variables, and the Mann-Whitney U test for quantitative variables, due to the non-parametric distribution of the data.

RESULTS

A total of 121 dental students completed the questionnaire, yielding a response rate of 62.2%. Participants' ages ranged from 19 to 43 years, with a mean age of 22.5 ± 4.0 years and a median age of 21. Approximately 77.5% of respondents were between 19 and 23 years of age.

Table 1 presents the frequency distribution of the demographic and academic characteristics of the participants. The majority of respondents were female (82.6%), enrolled at the São Miguel Paulista campus (55.7%), and attending morning classes (64.2%). Of the total participants, 71 students (58.7%) were in the penultimate year of the undergraduate dental program (Group 1 – G1), while 50 students (41.3%) were in the final year (Group 2 – G2). Regarding coursework related to the differential diagnosis of developmental defects of enamel (DDE), the most frequently reported disciplines were 'Integrated Dentistry for Children and Adolescents' (71.9%), 'Oral Histology and Embryology' (60.3%), 'Cariology' (54.5%), 'Integrated Diagnosis I and II' (48.8%), 'Oral Pathology' (45.5%), and 'Restorative Dentistry' (38.8%). When asked whether the knowledge acquired during their undergraduate training was sufficient to support the accurate diagnosis of DDE, the majority of students either agreed (39.7%) or responded neutrally (31.4%). Similarly, in response to the statement 'I feel confident in conducting the differential diagnosis of DDE,' most participants indicated a neutral position (46.3%) or agreed (29.8%).

Table 1. Frequency distribution of the demographic and academic variables of the participants.

(continues)

Variables	n (%)
Gender	
Male	21(17.4%)
Female	100 (82.6%)
Campus location	
Liberdade	54 (44.6%)
São Miguel Paulista	67 (55.7%)
Class schedule	
Morning	77 (64.2%)
Evening	44 (35.8%)
Academic year	
Third year	71 (58.7%)
Fourth year	50 (41.3%)

(conclusion)

Dental classes addressing DDE	
Integrated Dentistry for Children and Adolescents	87 (71.9%)
Oral Histology and Embryology	73 (60.3%)
Cariology	66 (54.5%)
Integrated Diagnosis I and II	59 (48.8%)
Oral Pathology	55 (45.5%)
Restorative Dentistry	47 (38.8%)
Supervised Curricular Internship I-IV	43 (35.5%)
Integrated Clinic I and II	36 (29.8%)
Human Physiology	29 (24.0%)
Integrated Dentistry	23 (19.0%)
Patients with Special Needs	18 (14.9%)
Applied Microbiology	16 (13.2%)
Prosthetic Rehabilitation	13 (10.7%)
Integrated Dentistry for Adults and the Elderly	11 (9.1%)
Endodontics	11 (9.1%)
Human Anatomy	9 (7.4%)
Orthodontics and Orthopedics	7 (5.8%)
Oral Surgery	7 (5.8%)
Dental Biomaterials	6 (5.0%)
Pharmacology	6 (5.0%)
Periodontics	6 (5.0%)
Knowledge acquired for the accurate diagnosis of DDE	
Strongly agreed	20 (16.5%)
Agreed	48 (39.7%)
Neutral	38 (31.4%)
Disagreed	14 (11.6%)
Strongly disagreed	1 (0.8%)
"I feel confident in conducting the differential diagnosis of DDE"	
Strongly agreed	17 (14.0%)
Agreed	36 (29.8%)
Neutral	56 (46.3%)
Disagreed	12 (9.9%)
Strongly disagreed	0 (0.0%)

Based on a scoring system awarding one point per correct response across ten clinical cases, Table 2 presents the distribution of total scores for all participants and compares the performance of dental students in groups G1 and G2. The overall mean score of correct diagnoses among all participants was 6.2 ± 1.8. When analyzed by group, the mean score was 6.0 ± 1.5 for students in G1 and 6.6 ± 2.0 for those in G2. A statistically significant difference was found between the groups (p = 0.0187), indicating a higher average diagnostic accuracy among final-year students.

Table 2. Analysis of the total correct scores for the differential diagnosis of DDE among all participants and comparison between dental students divided into group G1 (3rd/penultimate year) and G2 (4th/final year).

Dental students	TOTAL CORRECT SCORES						
	Mean	SD	Median	Minimum	Maximum	IQR	
						P25	P75
All participants	6.2	1.8	7.0	1.0	9.0	5.0	8.0
G1 - 3rd year	6.0	1.5	6.0	1.0	9.0	5.0	7.0
G2 - 4th year	6.6	2.0	7.0	1.0	9.0	5.0	8.0
p-value(1)	0.0187						

Note: SD = standard deviation; IQR = interquartile range (P25 - 25th percentile; P75 - 75th percentile); (1) Mann-Whitney U test

Table 3 presents the distribution of dental students in groups G1 and G2, based on the accuracy of their responses in diagnosing DDE in clinical cases. Overall, diagnostic accuracy was comparable between the groups for most cases, with no statistically significant differences observed in individual case comparisons (p > 0.05). However, when considering the total accuracy across all participants, statistically significant differences were observed in favor of correct diagnoses, except for clinical cases #4 and #10. No significant differences were found between correct and incorrect responses for clinical cases #5, #6, and #9.

Table 3. Distribution (%) of students according to correct diagnostic responses for the differential diagnosis of DDE in cases #1 to #10, as reported by the dental students from groups G1 (3rd/penultimate year) and G2 (4th/final year), and all participants.

(continues)

Clinical Cases	Groups				p-value	All participants		p-value
	G1 (n = 71)		G2 (n = 50)			(N = 121)		
	n	%	n	%		N	%	
CLINICAL CASE #1								
Correct diagnosis					0.9255(1)			<0.0001(1)
Dental Fluorosis	52	73.2	37	74.0		89	73.6	
Other responses	19	26.7	13	26.0		32	26.4	
CLINICAL CASE #2								
Correct diagnosis					0.4718(1)			0.0011(1)
Enamel Hypomineralization	44	62.0	35	70.0		79	65.3	
Other responses	27	38.0	15	30.0		42	34.7	
CLINICAL CASE #3								
Correct diagnosis					0.8693(2)			<0.0001(1)
Amelogenesis Imperfecta	62	87.3	45	90.0		107	88.4	
Other responses	9	12.7	5	10.0		14	11.6	

(conclusion)

CLINICAL CASE #4								
Correct diagnosis					*0.2213*(1)			*0.0455*(1)
Enamel Hypomineralization	25	35.2	24	48.0		49	40.5	
Other responses	46	64.8	26	52.0		72	59.5	
CLINICAL CASE #5								
Correct diagnosis					0.2874(1)			0.4263(1)
Enamel Hypoplasia	33	46.5	29	58.0		62	51.2	
Other responses	38	53.5	21	42.0		59	48.8	
CLINICAL CASE #6								
Correct diagnosis					*0.8236*(1)			*0.2031*(1)
Enamel Hypomineralization	30	42.2	23	46.0		53	43.8	
Other responses	41	57.8	27	54.0		68	56.2	
CLINICAL CASE #7								
Correct diagnosis					*0.6032*(2)			*<0.0001*(1)
Amelogenesis Imperfecta	62	87.3	46	92.0		108	89.2	
Other responses	9	12.7	4	8.0		13	10.8	
CLINICAL CASE #8								
Correct diagnosis					*0.7769*(2)			*<0.0001*(1)
Dental Fluorosis	63	88.7	46	92.0		109	90.1	
Other responses	8	11.3	4	8.0		12	9.9	
CLINICAL CASE #9								
Correct diagnosis					*0.0715*(1)			*0.8557*(1)
Enamel Hypoplasia	31	43.7	31	62.0		62	51.2	
Other responses	40	56.3	19	38.0		59	48.8	

Note: (1) Chi-Square test; (2) Fisher's Exact test.

Table 4 presents the distribution of dental students' responses to the differential diagnosis of DDE for each of the clinical cases presented. Overall, responses between penultimate-year (G1) and final-year (G2) students were consistent, with no statistically significant differences observed ($p > 0.05$). However, an exception was found in clinical case #9, where a significant difference was detected between the groups: 52.0% of G1 students selected "Enamel Hypomineralization", while 62.0% of G2 students selected "Enamel Hypoplasia" ($p < 0.05$).

Table 4. Percentage frequency of responses regarding the differential diagnosis of DDE in clinical cases #1 to #10, as reported by participants from group G1 (3rd/penultimate year) and group G2 (4th/final year).

(contninues)

Clinical Cases #	Dental Fluorosis		Amelogenesis Imperfecta		Enamel Hypoplasia		Enamel Hypomineralization		p-value
	G1	G2	G1	G2	G1	G2	G1	G2	
1	73.5%	74.0%	7.0%	4.0%	14.0%	12.0%	5.5%	10.0%	0.7244
2	4.5%	2.0%	9.5%	8.0%	24.0%	20.0%	62.0%	70.0%	0.7903
3	0.0%	0.0%	87.5%	90.0%	5.5%	6.0%	7.0%	4.0%	0.7788
4	5.5%	2.0%	18.5%	6.0%	41.0%	44.0%	35.0%	48.0%	0.1355
5	27.0%	16.0%	4.5%	6.0%	46.5%	58.0%	22.0%	10.0%	0.4652
6	32.5%	26.0%	5.0%	6.0%	20.0%	22.0%	42.5%	46.0%	0.9015

(conclusion)

7	0.0%	2.0%	87.5%	92.0%	5.5%	2.0%	7.0%	4.0%	0.4075
8	89.0%	92.0%	1.0%	0.0%	10.0%	4.0%	0.0%	4.0%	0.1768
9	3.0%	0.0%	1.5%	8.0%	43.5%	62.0%	52.0%	30.0%	0.0207*
10	4.5%	6.0%	14.0%	8.0%	33.5%	24.0%	48.0%	62.0%	0.3675

Note: *Statistically significant differences between groups (Chi-Square test, $p < 0.05$).

DISCUSSION

In the present study, the overall diagnostic accuracy of students in identifying clinical images of DDE was considered good, highlighting the effectiveness of academic training in this area and aligning with previous findings in the literature[26]. The teaching and learning experiences provided during the final two years of undergraduate education appear to play a critical role in enhancing students' confidence in diagnostic accuracy and procedural competence. Nevertheless, statistically significant differences were observed between the groups, with final-year students outperforming those in the penultimate year. This finding supports the notion that increased clinical experience contributes to greater knowledge retention and improved diagnostic skills. It also underscores the importance of clinical exposure in consolidating theoretical learning, in contrast to previous reports[26,27].

The undergraduate curriculum of the participating students addresses DDE across multiple disciplines, underscoring its fundamental role in dental education. The most frequently cited classes included "Integrated Dentistry for Children and Adolescents", "Oral Histology and Embryology", "Cariology", "Integrated Diagnosis I and II", and "Oral Pathology," all of which are offered during the first three years of the program. This interdisciplinary approach is consistent with findings from a study conducted in New Zealand, where DDE was incorporated into Oral Biology, Pediatric Dentistry, and clinical sessions[25]. Notably, however, there are no specific dental classes dedicated exclusively to this topic. It is important to emphasize that the theoretical component of the course "Integrated Dentistry for Children and Adolescents" includes content specifically focused on the differential diagnosis of DDEs. Furthermore, the better performance of final-year students on this topic may be attributed to the progressive consolidation of knowledge, which begins with classes addressing theoretical foundations in the early years of the dental curriculum and is subsequently reinforced through clinical training. This clinical experience, which entails a heavier workload in the final year - particularly involving the treatment of pediatric and adolescent patients - enhances the application of theoretical knowledge in clinical practice.

The teaching-learning component of this study explored whether students perceived their undergraduate dental education as adequate for supporting accurate diagnostic decisions concerning various types of DDE. The findings revealed that while a significant proportion of students agreed that their training provided sufficient guidance, a substantial number expressed neutrality, suggesting uncertainty or a lack of confidence in their diagnostic capabilities. This reflects a possible gap between theoretical instruction and clinical application, particularly given the complex and often overlapping clinical presentations of DDE. The predominance of neutral responses regarding confidence in conducting differential diagnoses indicates that although students may have been exposed to the topic, the depth and practical reinforcement of this knowledge might be insufficient. These findings highlight the need for curricular improvement, such as the incorporation of more case-based learning, the integration of DDE diagnosis into clinical assessments, and the enhancement of interdepartmental coordination to ensure consistent and comprehensive coverage of enamel defects throughout the dental curriculum. Addressing these educational gaps may enhance students' diagnostic confidence and competence, ultimately contributing to more accurate clinical decision-making in professional practice[33].

When assessing the correct diagnostic responses for the differential diagnosis of DDE using clinical images, it is noteworthy that the overall diagnostic performance of the dental students was considered good, indicating a moderate level of knowledge and training acquired during the final two years of undergraduate education. However, when responses were analyzed separately by academic year, a statistically significant difference was observed, with final-year students demonstrating higher

accuracy—likely reflecting the positive impact of increased clinical experience. Notably, among all participants, the greatest diagnostic challenge was associated with cases of enamel hypoplasia, which was frequently misdiagnosed as other types of DDE, as previously reported in the literature[31,33]. Specifically, in clinical cases #5, #9, and #10 – depicting enamel hypoplasia affecting the maxillary central incisor – a wide variation in incorrect diagnoses was observed, reflecting a significant degree of diagnostic inconsistency[34].

Concerning the diagnostic challenges associated with hypomineralization and hypoplasia, it is important to emphasize that these enamel defects can exhibit similar clinical features, such as white, yellowish, or brown opacities/spots, as well as surface irregularities characterized by structure loss. Additionally, hypomineralized enamel may change over time due to its increased porosity and susceptibility to post-eruptive fractures. In contrast, dental fluorosis and amelogenesis imperfecta were more accurately identified by all students, likely due to their characteristic bilateral and symmetrical presentation[8]. Amelogenesis imperfecta, a hereditary condition, typically affects all primary and permanent dentition[8]. Among the ten cases presented in the study, two involved amelogenesis imperfecta and two were diagnosed with dental fluorosis, each exhibiting distinct phenotypic characteristics.

These results underscore notable deficiencies in students' foundational knowledge of the clinical manifestations of various DDE types, indicating that current understanding remains insufficient. The observed variation in diagnostic accuracy for specific types of DDE indicates that conventional teaching approaches may be insufficient for comprehensive knowledge acquisition in this area. Consequently, it is recommended that DDE be more thoroughly integrated into the dental curriculum through dedicated clinical sessions, hands-on workshops, seminars, expanded lecture content, and the promotion of self-directed learning[26,35].

One of the limitations of the present study lies in the use of clinical case photographs that depicted only the teeth affected by DDE. These two-dimensional images may have included overlapping or rotated surfaces due to tooth positioning within the arch, which restricted the full clinical assessment and were not supplemented with patient anamnesis. Additionally, it should be considered that diagnostic accuracy may have been influenced by using magnified intraoral photographs captured with a digital camera and macro lens. Another limitation was the lack of evaluation of differential diagnoses between DDE and white spot lesions caused by dental caries, as well as the omission of associated etiological factors. Furthermore, the study's response rate of 62.2% reflects communication challenges with students during the data collection phase, which was conducted via an online form during the COVID-19 pandemic.

Pandemic-related restrictions limited in-person interactions, which may have affected participants' recruitment and the ability to conduct clinical evaluations. Additionally, the use of an online questionnaire may have introduced response bias, as participants could have searched for information about the clinical features before responding, potentially influencing the accuracy and authenticity of their answers. Future research in this field should aim to minimize potential sources of bias by incorporating in-person data collection methods whenever feasible, allowing for direct clinical assessment and standardized diagnostic criteria. Additionally, the use of validated instruments and structured interviews could improve the reliability of the responses. Studies with larger and more diverse samples would also help to strengthen the generalizability and accuracy of the findings.

This study highlights the importance of evaluating dental students' knowledge of DDE and their ability to perform accurate differential diagnoses. The findings address a notable gap in existing literature. Given the complexity of DDE diagnosis, dental students must develop a thorough understanding of the condition. Accurate differential diagnosis, along with proper assessment of the severity of defects, enables appropriate preventive and/or therapeutic interventions tailored to each case.

Dental students frequently encounter various types of DDE during clinical training[33]. These defects often exhibit overlapping clinical characteristics, underscoring the importance of a thorough patient history and detailed clinical examination for an accurate diagnosis[4,7,36-38]. Accordingly, a strong foundational understanding of DDE is essential for formulating appropriate and effective treatment plans[26,31]. Comparative analyses based on students' academic years can offer valuable insights into the effectiveness of the dental curriculum in fostering diagnostic competencies related to enamel defects. Such comparison enables the assessment of knowledge progression, the identification of potential educational gaps, and the establishment of benchmarks for future curricular enhancements.

It is recommended that this methodological approach be applied across diverse educational contexts, extending beyond diagnostic accuracy to include discussions on etiological factors and treatment planning. Emphasis should be placed on the need to restructure academic curricula to ensure the development of these critical competencies. Furthermore, continuing education programs are essential to support lifelong learning and to improve the quality of care provided by future dental professionals to patients affected by DDE[39].

CONCLUSION

Overall, dental students demonstrated a moderate level of diagnostic accuracy in identifying developmental defects of enamel (DDE) using clinical images, reflecting the general effectiveness of undergraduate training. However, final-year dental students showed greater proficiency in the differential diagnosis of DDE compared to penultimate-year students, suggesting that increased clinical experience positively influences diagnostic performance. Nonetheless, diagnostic challenges were evident in both groups, particularly in cases where different types of DDE presented overlapping clinical features.

FINANCIAL SUPPORT

This study was supported by the Institutional Scientific Initiation Scholarship Program (PIBIC) of the University.

ACKNOWLEDGMENTS

The authors would like to thank the dental students from the University for their valuable participation in this study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHOR'S CONTRIBUTIONS

Cortegozo GAL: methodology, investigation, data curation, writing – original draft
Ribeiro CS: methodology, investigation, data curation, writing – original draft
Rangel M: methodology, investigation, data curation, writing – original draft
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Conhecimento de estudantes de odontologia sobre o diagnóstico diferencial de Defeitos de Desenvolvimento do Esmalte (DDE): um estudo transversal comparativo

Introdução: Defeitos de Desenvolvimento do Esmalte (DDE) são distúrbios na formação do esmalte que podem comprometer a função e a estética dos dentes e aumentar a suscetibilidade à cárie dentária. O diagnóstico preciso é essencial para o manejo clínico adequado.

Objetivo: Comparar a capacidade de realizar diagnóstico diferencial de DDE entre estudantes de graduação em Odontologia nos penúltimo (3º ano; G1) e último (4º ano; G2) anos de estudo em uma universidade privada.

Métodos: Um total de 121 estudantes participaram deste estudo transversal comparativo (G1: n = 71; G2: n = 50). Os dados foram coletados por meio de um questionário online contendo dez cenários de casos clínicos que exigiam diagnóstico diferencial de DDE. Um ponto foi concedido para cada resposta correta, e as pontuações totais foram analisadas dentro e entre os grupos. As comparações estatísticas foram realizadas usando o teste Qui-quadrado, o teste Exato de Fisher e o teste U de Mann-Whitney (α = 5%).

Resultados: A média de idade dos participantes foi de 22,5 ± 4,0 anos, com predomínio do sexo feminino (82,6%). Odontologia Integrada para Crianças e Adolescentes (71,9%) foi a disciplina mais frequentemente relatada em abordar DDE. Em relação à preparação percebida, 39,7% dos alunos relataram que suas disciplinas forneceram conhecimento suficiente para o diagnóstico de DDE. A média geral de diagnósticos corretos entre todos os participantes foi de 6,2 ± 1,8. O Grupo G2 apresentou uma média significativamente maior (6,6 ± 2,0) em comparação ao G1 (6,0 ± 1,5) ($p < 0,05$).

Conclusão: Os alunos de Odontologia demonstraram um nível moderado de acurácia diagnóstica na identificação de DDE. Os alunos do último ano demonstraram maior proficiência no diagnóstico diferencial de DDE do que os alunos do penúltimo ano, sugerindo aquisição progressiva de conhecimento ao longo do currículo odontológico. No entanto, os desafios diagnósticos permanecem, ressaltando a necessidade de educação continuada e reforço deste tópico.

Descritores: hipoplasia do esmalte dentário; fluorose dentária; esmalte dentário; diagnóstico diferencial; estudantes de odontologia.