

KNOWLEDGE AND ATTITUDE ASSESSMENT REGARDING THE PROSTHODONTIC MANAGEMENT OF AMELOGENESIS IMPERFECTA

Abdulrahman Alhadad¹, Ahlaa Alhazmy¹, Lamia Yahya Alshowail², Saad Alsufra³, Khaled Altowairqi⁴, Atheer A Alshehri⁵, Sawsan Almubarak², Albandari Almanie³, Jawharah Mari², Abdulaziz Alharbi⁶, Khames Alzahrani⁷

¹Department of Prosthodontic, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

²Dental Intern, King Khalid University, College of Dentistry, Abha, Saudi Arabia.

³Dental Student, King Khalid University, College of Dentistry, Abha, Saudi Arabia.

⁴Dental student, King Abdulaziz University, Jeddah, Saudi Arabia

⁵Dental student, Imam Abdulrahman bin Faisal University, College of Dentistry, Dammam, Saudi Arabia.

⁶College of Dentistry, Qassim University, Qassim Saudi Arabia. Dr.khames.Alzahrani@gmail.com

⁷BDS, PGD in Endo, Saudi Board of Endodontic, King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia

ABSTRACT

Amelogenesis imperfecta (AI) is a rare genetic condition distinguished by inadequate development of the dental enamel, affecting both the permanent and primary dentition. Treatment of AI patient requires a multidisciplinary approach including prosthodontics, endodontics, periodontist, orthodontist, and maxillofacial surgeon. This study aims to assess the knowledge, clinical experience regarding amelogenesis imperfecta prosthodontic management in Saudi Arabia. This cross-sectional study was conducted in Saudi Arabia. An online survey was distributed among dental students and dentists in Saudi Arabia. The questionnaire section's design was follow the (KAP) to assess and measure the population's knowledge, attitude, and practice. The collected data was exported to "Microsoft Office Excel Software". The statistical analysis was done through the (SPSS) Software. The study included 500 participants, 66.6% of whom were females. 24% of participants fall into the "High knowledge level" category, while 51.4% fall into the "Moderate knowledge level" category. The remaining 24.6% fall into the "Low knowledge level" category. 28% of participants had high awareness scores, 61% had moderate awareness, and 25% had low awareness scores. 40.2% exhibit a good practice level. This is followed closely by individuals with a moderate practice level, accounting for 42.2% of the population. Conversely, a smaller proportion of the population, comprising 17.6%, demonstrates a poor practice level. In summary, our research yielded respectable KAP scores, as enhancing the prosthodontic care given to patients with AI requires evaluating the knowledge and attitudes of dental professionals and students in Saudi Arabia.

Key words: Amelogenesis imperfecta, Knowledge, Attitude, Practice, Prosthodontic management, Oral rehabilitation.

Introduction

Dental enamel is considered highly mineralized and the strongest part of the tooth structure. The enamel outer layer has a protective mechanism against wear that affects the dental crown [1]. Mutation of the genetic composition of the dental substructure can manifest in the oral cavity with different forms of defects for example: amelogenesis imperfecta and molar-incisor hypomyelination [2].

Amelogenesis imperfecta can appear in a wide range of phenotypic forms due to abnormalities in the enamel's composition and structure [3]. Amelogenesis imperfect affects both the enamel quantity and the enamel substructure quality.

Amelogenesis imperfecta (AI) is a rare genetic and inherited condition distinguished by the inadequate development or mineralization of the structure of dental enamel, affecting both permanent and deciduous dentition [4]. There are several challenges associated with (AI) in the field of

dentistry. These challenges include issues such as cavities and dental decay, tooth hypersensitivity, larger pulp chamber, inadequate aesthetics, and reduction in the occlusal vertical dimension resulting from the loss of tooth structure [5].

Intraoral clinical findings of AI manifested as discolored pitted and rough enamel surfaces, these rough surfaces acted as an attractive surface for plaque and calculus. For that, increasing the risk of decay and cavities at a very young age [5, 6]. Most patients presented with an enlarged pulp chamber (taurodontism) that induced hypersensitivity [7]. For that, most patients require full-coverage extra-coronal restorations to restore patient esthetic, function, and comfort. Also, most of the AI-affected teeth have a short clinical crown, mutilated teeth, supernumerary or congenitally missing teeth, calcified pulp, malformed root configuration, anterior open bite, reduced vertical dimension, and abnormal skeletal growth pattern of both maxillary and the mandibular jaws. Treatment of AI patients requires a multidisciplinary approach including

prosthodontics, endodontics, periodontists, orthodontists, and maxillo-facial surgeon [8].

A cross-sectional study of Dentists' perception in Kuwait, done by Alanzi *et al.* (2018), found that all the participants had noticed MIH in their practice, and most of these patients were treated with the use of resin composite restorative material. On the other hand, most of the participants prefer restoring the severely affected teeth by full coverage metal crown [9]. In a Retrospective study by Ohrvik *et al.* (2020), all-ceramic restorations had an excellent prognosis for patients with amelogenesis imperfecta [10]. A previous case report study by Patroi *et al.*, (2018) described the esthetic management and rehabilitation treatment of the patient's anterior teeth that were affected by amelogenesis imperfecta using ceramic veneer, Achieving successful and excellent esthetic results [11]. An Innovative treatment approach by Davidovich *et al.* (2020) concluded that: the treatment for teeth with enamel defects included a transitional period and interim restorative approach such as resin restorations and SCC [12].

A previous case report study by Rizwan *et al.*, (2020) shows an all-ceramic crown lithium disilicate crowns are the most conservative treatment option for Amelogenesis imperfecta because of their excellent aesthetics, durability, strength, marginal fit and biocompatibility [13]. A Randomized Controlled Trial by Dhareula *et al.*, (2019) regarding the rehabilitation of permanent teeth with defective enamel comparing the efficacy of extra-coronal restoration constructed by cast metal or indirect resin only, it was found that the restoration overall retention and the success rate were similar between both treatments without any significant difference found [14]. Another clinical Report by Ortiz *et al.*, (2019) discusses the treatment management and recommendations of amelogenesis imperfecta among young adolescent Patients and concludes that; All-ceramic restorative materials such as zirconia, alumina, and lithium disilicate are known to be prone to a favorable tissue response. The advantageous property of lithium disilicate restorative material is the ability to etch the intaglio restorative surface to maximize the bond strength, to prevent the restoration debonding and adhesive cement failure [4].

On the other hand, zirconia restoration requires a tooth preparation of 1.5-2 mm is necessary and carries the potential danger of compromising tooth vitality. The risk of microleakage associated with zirconia restorations arises from their inherent incapacity to establish a link with the underlying tooth structure [15, 16]. Meanwhile, zirconia restoration has an excellent flexure strength that makes it preferable for FDP design. Porcelain fused to metal restoration provides the most conservative tooth preparation, but its limitation to the metals shows in the esthetic area [17]. The most common restorative material complication is loss of vitality, caries, and debonding of the restoration. The selection of the bonding adhesive restoration depends on its technique sensitivity, and the

ability to adhere to the hypomineralized enamel that was highly recommended with self-etching bonding protocol [18].

Factors to be considered when selecting the appropriate material for the patient: Patient cooperation, Financial costs, the dentist's knowledge and skills, and the availability of the material [18, 19].

Due to the insufficient number of studies related to our topic, especially in Saudi Arabia and there's a few numbers of sample size and a variation in results in previous research. Moreover, dental students, dental interns, and general practitioners need to know the correct management of amelogenesis imperfecta. This study aimed to assess the knowledge and awareness level of the prosthodontic management of enamel hypoplasia among Dental students, dental interns, and general practitioners in Saudi Arabia.

Objective

This study aims to assess the knowledge, clinical experience, and perceived need for training of a dental student and dentist regarding amelogenesis imperfecta in Saudi Arabia.

Materials and Methods

Study design

This cross-sectional study was conducted in Saudi Arabia. An online survey was distributed among dental students and dentists in Saudi Arabia.

Inclusion and exclusion criteria

The inclusion criteria of the participants, male, and female, dental students, interns, and Saudi-based dental school (private or governmental), agree to participate in the questionnaire. The exclusion criteria will include other health college students and non-Saudi dental school students.

Sample size

In this cross-sectional survey, A sample size calculation was done by (the Raosoft sample size calculator program)—the marginal error setting at the most common value of 5%. The selection of response distribution of the population at the calculating formula was selected to be 50%. The confidence level settings were chosen to be at 95%—the result of the calculation with a minimum of 377 population size.

Scoring system

The questionnaire section's design was follow the (KAP) to assess and measure the population's knowledge, attitude, and practice. Therefore, section (I) was collect the participant's demographic data after agreeing to participate. Section (II); was assess the target population's knowledge about post-space perforation and its prevalence and occurrence. These questions have a Scoring system where (Yes) has 2 points, (No) has 1 point, and (I don't know) has

0 points .Section (III); the scoring system was between 1 and 4 points to assess the awareness level. For that, the point distribution on each answer was: "Strongly Disagree" has 0 points, "Disagree" has 1 point, "Not Sure" has 2 points, "Agree" has 3 points, and "Strongly Agree" has 4 points. Section (IV); to assess the practice level, the points distribution (5-4-3-2-1-0) was apply to the answer "always," "mostly," "sometimes," "rarely," and "never," respectively.

All the applied questions was entered through a Google form link and distributed online through email and social media.

Analyzes and entry method

We are exporting The collected data from the Google form/survey to the "Microsoft Office Excel Software" program (2016) for Windows. The statistical analysis was done through the (SPSS) program-Statistical Package of Social Science Software, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp).

Results and Discussion

Table 1 shows that in terms of gender distribution, 33.4% of the respondents are male, while 66.6% are female. Moving on to location, the distribution is as follows: Central (10.4%), Eastern (13.2%), Northern (10.6%), Southern (55.6%), and Western (10.2%). When it comes to school affiliation, a significant majority (87.4%) are affiliated with government schools, while the remaining 12.6% are affiliated with private schools. The data also sheds light on the distribution of respondents across different academic years. The highest representation is from individuals in their intern year (22.2%), followed by fifth-year students (19.0%), sixth-year students (19.6%), and graduates (13.6%). Other academic years are represented to varying degrees, with the lowest representation being in the second and third years (2.8% each).

Table 1. Sociodemographic characteristics of participants (n=500)

	Parameter	No.	%
Gender	Male	167	33.4
	Female	333	66.6
Location	Central	52	10.4
	Eastern	66	13.2
	Northern	53	10.6
	Southern	278	55.6
	Western	51	10.2
Type of school	Government school	437	87.4
	Privet school	63	12.6
Current year	Intern year	111	22.2
	First year	34	6.8
	Second year	14	2.8
	Third year	14	2.8
	Fourth year	52	10.4

Fifth year	95	19.0
Sixth year	98	19.6
Graduate	68	13.6
Specialist	14	2.8

Table 2 outlines the distribution of responses regarding the impact of Amelogenesis imperfecta on different dentition types. It indicates that 53.0% of the respondents reported the condition affecting both primary and permanent dentition, while 16.0% mentioned its impact on permanent dentition only. Additionally, 15.4% reported its effect on primary dentition exclusively, and 15.6% indicated uncertainty about the specific impact. The second parameter pertains to the selection of restorative materials for treating teeth affected by enamel hypoplasia. The data reveals that 47.0% of respondents consider the extent of the enamel lesion when choosing a restorative material, while 36.6% take into account the thickness of the enamel layer. Furthermore, 8.4% and 8.0% of respondents consider patient age and financial ability, respectively, in their material selection process. Moving on, the table addresses the reasons for the low bond strength of resin with enamel. The responses indicate that 24.8% attribute this phenomenon to reduced protein content in Amelogenesis imperfecta-affected enamel, while 21.8% associate it with higher protein content in such enamel. Additionally, 19.8% point to a disorganized collagen matrix as the cause, and 33.6% expressed uncertainty regarding the reason for the low bond strength. The next parameter focuses on the challenges associated with porcelain veneers for teeth affected by Amelogenesis imperfecta. The data shows that 34.2% of respondents find it challenging to compensate for the dark stump shade affecting translucency, while 23.0% perceive difficult maintenance as a significant issue. Furthermore, 19.6% struggle with the placement of the preparation margin, and 23.2% are unsure about the challenges posed by porcelain veneers in this context. Subsequently, the table addresses the limitations of zirconia crown or alumina coping for patients with Amelogenesis imperfecta. It reveals that 48.4% of respondents believe these options have various limitations, including the requirement for tooth preparation of 1.5-2mm and an increased risk of vitality loss. Additionally, 23.2% are uncertain about these limitations, while 18.4% and 10.0% associate these options with specific risks such as micro-leakage and de-bonding, respectively.

The table also includes data on restorative material complications for patients with Amelogenesis imperfecta. It shows that 49.6% of respondents reported experiencing various complications, such as loss of cementation, microleakage, caries, and debonding. Moreover, 23.4% mentioned material fracture and vitality loss as complications, while 18.2% expressed uncertainty about the potential complications. The next parameter focuses on the most common oral manifestations for patients with Amelogenesis imperfecta. The data reveals that 44.8% of respondents reported loss of vertical dimension as the most common oral manifestation, while 26.2% expressed

uncertainty about this aspect. Additionally, 18.6% mentioned a deep bite, and 10.4% cited a posterior open bite as a common manifestation. Lastly, the table presents data on enamel layer manifestations in patients with Amelogenesis imperfecta. It indicates that 59.2% of respondents reported pitted, rough, and yellow-brownish

discolored enamel as a common manifestation, while 18.6% mentioned a smooth, shiny enamel layer. Moreover, 17.8% expressed uncertainty about the enamel layer manifestations, and 4.4% cited a blueish discolored enamel layer.

Table 2. Knowledge of participants of prosthodontic management of amelogenesis imperfecta (n=500).

	Parameter	No.	Percent
Amelogenesis imperfecta is a hereditary condition that affects the following	Permeant dentation only.	80	16.0
	Primary and permanent dentition.	265	53.0
	Primary dentition only.	77	15.4
	I don't know.	78	15.6
The selection of the restorative material to restore teeth affected by enamel hypoplasia depends on	Extend of the enamel lesion.	235	47.0
	Patient age.	42	8.4
	Patient financial ability.	40	8.0
	Thickness of the enamel layer.	183	36.6
What is the reason for the low bond strength of resin with enamel	Disorganize collagen matrix.	99	19.8
	Higher protein content in AI-affected enamel.	109	21.8
	Reduced protein content in AI-affected enamel.	124	24.8
	I don't know.	168	33.6
The challenging nature of porcelain veneer for teeth affected by Amelogenesis imperfecta is	Compensation for the dark stump shade affecting the translucency.	171	34.2
	Difficult maintenance.	115	23.0
	Placement of the preparation margin.	98	19.6
	I don't know.	116	23.2
The limitation of zirconia crown or alumina coping for patients with Amelogenesis imperfecta is	All the above.	242	48.4
	Require tooth preparation of 1.5-2mm and increase the risk of loss of vitality.	92	18.4
	Risk of micro-leakage and de-bonding.	50	10.0
	I don't know.	116	23.2
Restorative material complication regarding patients with Amelogenesis imperfecta is	Loss of cementation, microleakage, caries, and debonding.	117	23.4
	Material fracture and loss of vitality.	44	8.8
	All the above.	248	49.6
	I don't know.	91	18.2
The best adhesive material of choice during the intermediate/transitional treatment phase for patients with Amelogenesis imperfecta is	Glass ionomer cement.	164	32.8
	Self-etching bonding protocol.	94	18.8
	Total etching bonding protocol.	94	18.8
	I don't know.	148	29.6
The most common oral manifestation for patients with Amelogenesis imperfecta is	Deep bite.	93	18.6
	Loss of vertical dimension.	224	44.8
	Posterior open bite.	52	10.4
	I don't know.	131	26.2
Enamel layer manifestation in patients with Amelogenesis imperfecta	Blueish discolored enamel layer.	22	4.4
	Pitted, rough, and yellow-brownish discolored enamel.	296	59.2
	Smooth, shiny enamel layer.	93	18.6
	I don't know.	89	17.8

The first question in the **Table 3** was related to the use of a 5% NaOCl solution before the adhesive procedure, and whether it improves bond strength. The results showed that 43 respondents (8.6%) strongly agreed, 118 (23.6%) agreed, 207 (41.4%) were neutral, 52 (10.4%) disagreed, and 80

(16.0%) strongly disagreed with this statement. The second question was related to the treatment options available for patients with AI, and the results showed that opinions were divided. 127 respondents (25.4%) strongly agreed, 138 (27.6%) agreed, 143 (28.6%) were neutral, 31 (6.2%)

disagreed, and 61 (12.2%) strongly disagreed with this statement. The third question was related to the most conservative approach for porcelain fused to metal restoration, and the results showed that 43 respondents (8.6%) strongly agreed, 148 (29.6%) agreed, 145 (29.0%) were neutral, 95 (19.0%) disagreed, and 69 (13.8%) strongly disagreed with this statement. The fourth question was related to the superior material of choice for providing excellent esthetic results, and the results showed that opinions were divided. 31 respondents (6.2%) strongly agreed, 140 (28.0%) agreed, 190 (38.0%) were neutral, 51 (10.2%) disagreed, and 88 (17.6%) strongly disagreed with

this statement. The fifth question was related to the limitations encountered with direct composite over indirect composite, and the results showed that opinions were divided. 40 respondents (8.0%) strongly agreed, 190 (38.0%) agreed, 179 (35.8%) were neutral, 40 (8.0%) disagreed, and 51 (10.2%) strongly disagreed with this statement. The sixth and final question was related to the challenges faced when providing prosthodontic treatment for AI, and the results showed that opinions were divided. 51 respondents (10.2%) strongly agreed, 141 (28.2%) agreed, 171 (34.2%) were neutral, 78 (15.6%) disagreed, and 59 (11.8%) strongly disagreed with this statement.

Table 3. Awareness of participants of prosthodontic management of amelogenesis imperfecta (n=500).

Parameter	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
What do you think, Exposure to 5% NaOCl solution before the adhesive procedure does not improve bond strength.	43 8.6%	118 23.6%	207 41.4%	52 10.4%	80 16.0%
Treatment options available to restore patients with AI vary considerably depending on several factors such as the age of the patient, patient motivation, periodontal condition, endodontic status, loss of tooth structure, severity of disorder, socio-economic status	127 25.4%	138 27.6%	143 28.6%	31 6.2%	61 12.2%
Porcelain fused to metal restoration is the most conservative approach in treating patients with AI.	43 8.6%	148 29.6%	145 29.0%	95 19.0%	69 13.8%
Feldspathoid porcelain is considered to be the superior material of choice to provide excellent esthetic results compared to layered zirconia crowns in patients with AI.	31 6.2%	140 28.0%	190 38.0%	51 10.2%	88 17.6%
The limitation encountered with direct composite over indirect composite in patients with AI due that it is technique-sensitive.	40 8.0%	190 38.0%	179 35.8%	40 8.0%	51 10.2%
The challenging nature of AI when providing prosthodontic treatment depends only on the location of the lesion in the mouth regarding the extent or the type of the enamel lesion.	51 10.2%	141 28.2%	171 34.2%	78 15.6%	59 11.8%

Table 4 shows that when it comes to diagnosing AI, approximately 15.4% of respondents indicated feeling "Mostly" confident, while 20.8% felt "Never" confident. This suggests a significant disparity in the perceived ability to diagnose AI accurately. Regarding the best treatment option for AI, the survey results indicate that the majority of

respondents (41.4%) believe that conventional metal crowns offer the most effective treatment approach. However, it's noteworthy that a considerable percentage of respondents (27.6%) expressed a preference for an alternative treatment option.

Table 4. Practice of participants of prosthodontic management of amelogenesis imperfecta (n=500).

	Always	Mostly	Never	Rarely	Sometimes
In your opinion, do you feel confident in diagnosing Amelogenesis imperfecta?	77 15.4%	104 20.8%	37 7.4%	93 18.6%	189 37.8%
In your opinion, the best treatment option for Amelogenesis imperfecta conventional metal crowns lies in the high precision of workpieces and good long-term results for treatment.	73 14.6%	138 27.6%	23 4.6%	59 11.8%	207 41.4%
In your opinion, Do you think we can use composite material all the time despite the type of Amelogenesis imperfecta ?	35 7.0%	70 14.0%	66 13.2%	103 20.6%	226 45.2%
In your opinion, does an Amelogenesis imperfecta patient require a multidisciplinary team approach team?	99 19.8%	127 25.4%	46 9.2%	49 9.8%	179 35.8%

According to the data in **Figure 1**, 24% of the group falls into the "High knowledge level" category, while 51.4% fall

into the "Moderate knowledge level" category. The remaining 24.6% fall into the "Low knowledge level"

category.

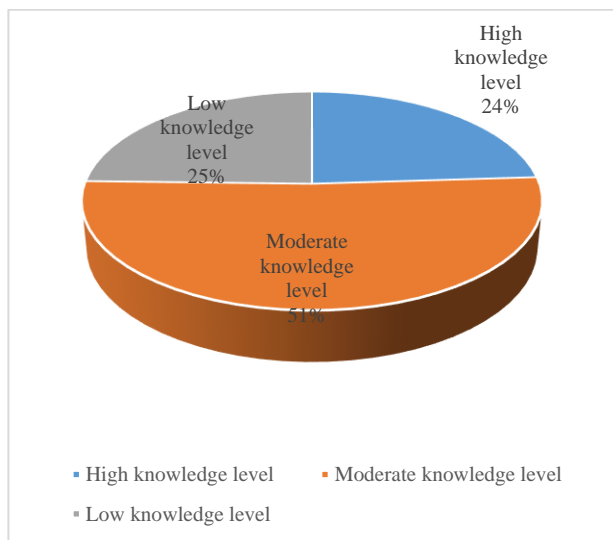


Figure 1. Knowledge score of participants of prosthodontic management of amelogenesis imperfecta

Figure 2 shows that the category with the highest frequency is "Moderate awareness level," which accounts for 60.8% of the total sample. The "High awareness level" category, (28.0%), also represents a considerable portion of the population. Conversely, the "Low awareness level" category, with 56 individuals (11.2%), represents the smallest proportion of the population.

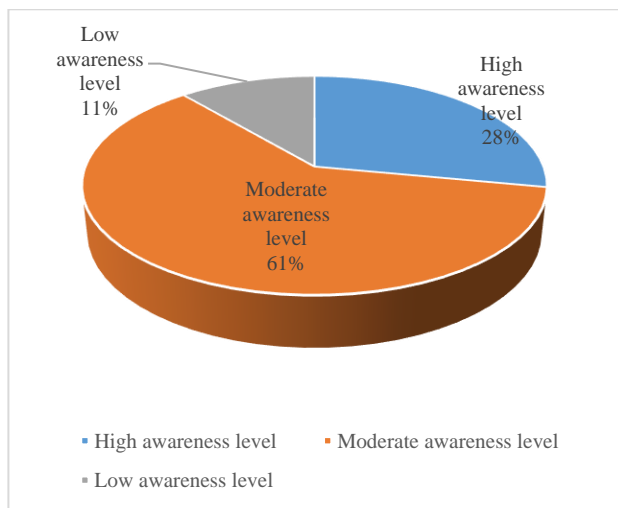


Figure 2. Awareness score of participants of prosthodontic management of amelogenesis imperfecta

Figure 3 revealed that the majority of the population, constituting 40.2%, exhibit a good practice level. This is followed closely by individuals with a moderate practice level, accounting for 42.2% of the population. Conversely, a smaller proportion of the population, comprising 17.6%, demonstrates a poor practice level.

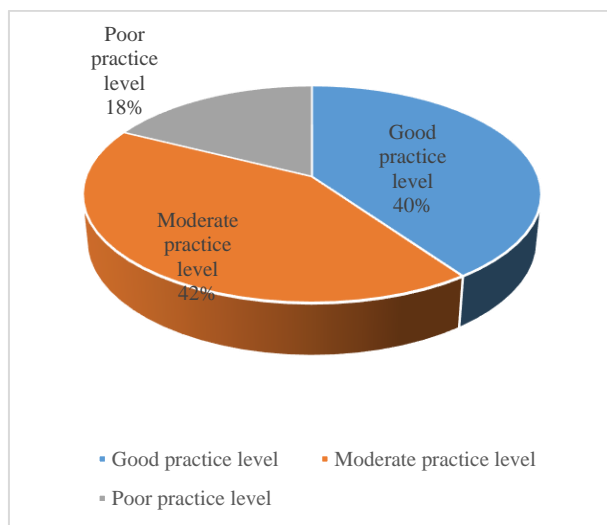


Figure 3. Practice score of participants of prosthodontic management of amelogenesis imperfecta

When examining the gender parameter in the **Table 5**, it is observed that a higher percentage of females (18.0%) exhibit high knowledge scores compared to males (6.0%), with p-value= 0.060. Similarly, the data suggests that individuals affiliated with government schools have a significantly higher proportion of high knowledge scores (22.8%) compared to those affiliated with private schools (1.2%). Having significant association with p-value= 0.001. The location parameter also reveals interesting insights. For instance, individuals from the Southern region exhibit a higher percentage of high knowledge scores (15.4%) compared to other regions. Additionally, the current year of study appears to have an impact on knowledge scores, with graduates and intern year students showing the highest percentage of high knowledge scores (6.8%) and (6.4%), respectively. The statistical significance of these findings is indicated by the P values of 0.001.

Table 5. Association between sociodemographic characteristics and knowledge score of participants of prosthodontic management of amelogenesis imperfecta (n=500).

Parameter	Knowledge score			Total (N=500)	P value
	High knowledge	Moderate knowledge	Low knowledge		
Gender	Male	30	96	41	167
		6.0%	19.2%	8.2%	33.4%

Gender	Female	90	161	82	333	
		18.0%	32.2%	16.4%	66.6%	
Location	Central	18	20	14	52	0.001
		3.6%	4.0%	2.8%	10.4%	
	Eastern	12	38	16	66	
		2.4%	7.6%	3.2%	13.2%	
	Northern	2	28	23	53	
		0.4%	5.6%	4.6%	10.6%	
	Southern	77	147	54	278	
15.4%		29.4%	10.8%	55.6%		
Western	11	24	16	51		
	2.2%	4.8%	3.2%	10.2%		
Type of school	Government school	114	238	85	437	0.001
		22.8%	47.6%	17.0%	87.4%	
	Privet school	6	19	38	63	
		1.2%	3.8%	7.6%	12.6%	
Current year	Intern year	32	63	16	111	0.001
		6.4%	12.6%	3.2%	22.2%	
	First year	0	22	12	34	
		0.0%	4.4%	2.4%	6.8%	
	Second year	0	3	11	14	
		0.0%	0.6%	2.2%	2.8%	
	Third year	0	6	8	14	
		0.0%	1.2%	1.6%	2.8%	
	Fourth year	1	26	25	52	
		0.2%	5.2%	5.0%	10.4%	
Fifth year	23	57	15	95		
	4.6%	11.4%	3.0%	19.0%		
Sixth year	24	54	20	98		
	4.8%	10.8%	4.0%	19.6%		
Graduate	34	26	8	68		
	6.8%	5.2%	1.6%	13.6%		
Specialist	6	0	8	14		
	1.2%	0.0%	1.6%	2.8%		

Starting with gender in **Table 6**, the data indicates that among male respondents, 32 individuals demonstrated high awareness, 97 had moderate awareness, and 38 had low awareness. This translates to 6.4%, 19.4%, and 7.6% respectively. On the other hand, among female respondents, 108 individuals exhibited high awareness, 207 had moderate awareness, and 18 had low awareness, representing 21.6%, 41.4%, and 3.6% respectively. The P value for gender is 0.001, indicating a statistically significant relationship between gender and awareness scores. Moving on to location, the data is segmented into central, eastern, northern, southern, and western regions. The breakdown reveals the awareness scores in the southern region to be the highest (20.4%). Notably, the P value for location is also

0.001, suggesting a significant association between location and awareness levels. The next parameter, school affiliation, highlights the distinction between government and private schools. The data indicates that 136 respondents from government schools exhibited high awareness, 251 had moderate awareness, and 50 had low awareness, representing 27.2%, 50.2%, and 10.0% respectively. In contrast, among private school attendees, 4 individuals demonstrated high awareness, 53 had moderate awareness, and 6 had low awareness, accounting for 0.8%, 10.6%, and 1.2% respectively. Once again, the P value for school affiliation is 0.001, signifying a significant relationship between school type and awareness scores.

Table 6. Association between sociodemographic characteristics and awareness score of participants of prosthodontic management of amelogenesis imperfecta (n=500).

Parameter	Awareness score			Total (N=500)	P value	
	High awareness	Moderate awareness	Low awareness			
Gender	Male	32	97	38	167	0.001
		6.4%	19.4%	7.6%	33.4%	
	Female	108	207	18	333	
		21.6%	41.4%	3.6%	66.6%	
Location	Central	14	38	0	52	0.001
		2.8%	7.6%	0.0%	10.4%	
	Eastern	12	46	8	66	
		2.4%	9.2%	1.6%	13.2%	
	Northern	2	29	22	53	
		0.4%	5.8%	4.4%	10.6%	
Southern	102	158	18	278		
	20.4%	31.6%	3.6%	55.6%		
Western	10	33	8	51		
	2.0%	6.6%	1.6%	10.2%		
Type of school	Government school	136	251	50	437	0.001
		27.2%	50.2%	10.0%	87.4%	
	Privet school	4	53	6	63	
		0.8%	10.6%	1.2%	12.6%	
Current year	Intern year	42	59	10	111	0.001
		8.4%	11.8%	2.0%	22.2%	
	First year	2	16	16	34	
		0.4%	3.2%	3.2%	6.8%	
	Second year	0	12	2	14	
		0.0%	2.4%	0.4%	2.8%	
	Third year	2	10	2	14	
		0.4%	2.0%	0.4%	2.8%	
	Fourth year	8	36	8	52	
		1.6%	7.2%	1.6%	10.4%	
Fifth year	20	61	14	95		
	4.0%	12.2%	2.8%	19.0%		
Sixth year	42	54	2	98		
	8.4%	10.8%	0.4%	19.6%		
Graduate	20	46	2	68		
	4.0%	9.2%	0.4%	13.6%		
Specialist	4	10	0	14		
	0.8%	2.0%	0.0%	2.8%		

Table 7 shows that with gender, the distribution of practice scores is delineated between males and females. Notably, a higher percentage of females exhibit good and moderate practice scores (24.65) and (29.8%) compared to males

(15.6%) and (12.4%). While the differences are not statistically significant ($P = 0.107$). Moving on to location, the Southern region stands out with the highest total count, and a substantial percentage of individuals with good

practice scores (24.2%). The differences in practice scores across locations are statistically significant ($P = 0.002$). The next parameter, school affiliation, reveals an interesting contrast between government and private schools. A higher percentage of individuals from government schools exhibit good and moderate practice scores (36.6%) and (35%) respectively, compared to those from private schools (3.6%) and (7.2%), respectively. The observed differences are

statistically significant ($P = 0.035$), indicating a potential association between school type and practice scores. Finally, the data is further segmented based on the current year of the individuals. Intern year and fifth year stand out with relatively higher percentages of good and moderate practice scores (10.8%) and (8% respectively. Moreover, the differences in practice scores across current years are statistically significant, with a P-value of 0.008.

Table 7. Association between sociodemographic characteristics and practice score of participants of prosthodontic management of amelogenesis imperfecta (n=500).

Parameter	Practice score			Total (N=500)	P value	
	Good practice	Moderate practice	Poor practice			
Gender	Male	78 15.6%	62 12.4%	27 5.4%	167 33.4%	0.107
	Female	123 24.6%	149 29.8%	61 12.2%		
Location	Central	6 1.2%	32 6.4%	14 2.8%	52 10.4%	0.002
	Eastern	28 5.6%	26 5.2%	12 2.4%	66 13.2%	
	Northern	27 5.4%	19 3.8%	7 1.4%	53 10.6%	
	Southern	121 24.2%	108 21.6%	49 9.8%	278 55.6%	
	Western	19 3.8%	26 5.2%	6 1.2%	51 10.2%	
	Type of school	Government school	183 36.6%	175 35.0%	79 15.8%	
	Privet school	18 3.6%	36 7.2%	9 1.8%	63 12.6%	
Current year	Intern year	54 10.8%	39 7.8%	18 3.6%	111 22.2%	0.008
	First year	20 4.0%	10 2.0%	4 0.8%	34 6.8%	
	Second year	4 0.8%	7 1.4%	3 0.6%	14 2.8%	
	Third year	4 0.8%	10 2.0%	0 0.0%	14 2.8%	
	Fourth year	24 4.8%	17 3.4%	11 2.2%	52 10.4%	
	Fifth year	40 8.0%	45 9.0%	10 2.0%	95 19.0%	
	Sixth year	33 6.6%	41 8.2%	24 4.8%	98 19.6%	
	Graduate	20 4.0%	32 6.4%	16 3.2%	68 13.6%	
	Specialist	2 0.4%	10 2.0%	2 0.4%	14 2.8%	

In Saudi Arabia, there is limited research on the knowledge and attitude of dental students and dentists regarding the prosthodontic management of AI. Amelogenesis Imperfecta (AI) is a rare genetic disorder that affects the enamel formation of teeth, leading to various dental problems such as discoloration, sensitivity, and susceptibility to dental caries. The prosthodontic management of AI is crucial in improving the quality of life for affected individuals, and dental students and dentists need to have the necessary knowledge and attitude towards the treatment of this condition [4-6].

In the Kingdom of Saudi Arabia (KSA), there is a need to assess the knowledge and attitude of dental students and dentists regarding the prosthodontic management of AI. This assessment is important in identifying any gaps in their understanding of the condition and its treatment, and in developing appropriate educational interventions to address these gaps. Knowledge assessment of dental students and dentists in KSA regarding the prosthodontic management of AI can include evaluating their understanding of the etiology, clinical features, and treatment options for AI. It is important for them to be aware of the different types of AI, such as hypoplastic, hypocalcified, and hypomaturation, and to understand the implications of each type on treatment planning [10].

Our study revealed that awareness level scores were majorly moderate as more than 60% of participants had moderate awareness levels, also awareness level scores and current year exhibited a significant association as intern year students and graduates exhibited the highest awareness levels. A study was done among undergraduate dental students at Saveetha Dental College and Hospitals to assess knowledge, attitude, and awareness of different stages of amelogenesis. Every student possessed knowledge of the various phases of amelogenesis. The study revealed that juniors and final-year students exhibit a higher level of awareness on this topic in comparison to first-year students [20]. On the contrary, a study conducted to assess the understanding of enamel abnormalities among dental students found that first-year undergraduate students had a higher level of awareness of enamel defects compared to second-, third, and fourth-year students. Findings also reveal that 76.46% of the population possesses knowledge regarding amelogenesis imperfecta, whereas 74.51% of the population is aware that the gene involved in this condition is *DXS85* at *XP22* [21].

Our study results showed that participants exhibited adequate and acceptable knowledge, awareness, and practice scores, as 75.4% had high and moderate knowledge scores, 88.8% had high and moderate awareness scores, and 82.4% had high and moderate practice scores. A study conducted to evaluate the knowledge and attitudes of undergraduate dentistry students in Saudi Arabia on post-space perforation management revealed that Saudi dentists

exhibited inadequate knowledge, moderate implementation, and commendable awareness in managing post-space perforation [22].

Furthermore, assessing their knowledge of the various prosthodontic treatment modalities for AI, such as crowns, veneers, and implants, is essential. They should also be knowledgeable about the importance of interdisciplinary collaboration with other dental specialists, such as orthodontists and periodontists, in the comprehensive management of AI [20].

In addition to knowledge assessment, evaluating the attitude of dental students and dentists in KSA towards the prosthodontic management of AI is equally important. Their attitude towards treating patients with AI can significantly impact the quality of care they provide. They must have a positive and empathetic attitude towards patients with AI, as they may face psychological and social challenges due to their dental condition. Moreover, their attitude towards staying updated with the latest advancements in prosthodontic treatments for AI is essential. They should be open to continuous learning and professional development to ensure that they are providing the best possible care for their patients with AI [15].

It is important to note that every study has its limitations, and this particular study is no exception. Some potential limitations to consider for this research could be sample size, potential biases in participant responses, and the specific demographics of the dental students and dentists in KSA. Additionally, the scope of the study and the methods used to assess knowledge and attitude should also be considered when discussing its limitations. It's important to acknowledge these limitations to provide a comprehensive and balanced understanding of the study's findings.

Conclusion

In conclusion, our study showed acceptable KAP scores, as the knowledge and attitude assessment of dental students and dentists in KSA regarding the prosthodontic management of AI is a critical step towards improving the care provided to patients with this condition. By identifying any knowledge gaps and addressing any negative attitudes, educational interventions can be implemented to enhance their understanding and approach to treating patients with AI. This will ultimately lead to better outcomes and improved quality of life for individuals affected by AI in KSA.

Acknowledgments: We thank the participants who all contributed samples to the study.

Conflict of interest: None

Financial support: None

Ethics statement: Written informed consent was obtained from all individual participants included in the study.

References

1. Lacruz RS, Habelitz S, Wright JT, Paine ML. Dental enamel formation and implications for oral health and disease. *Physiol Rev.* 2017;97(3):939–93.
2. Roma M, Hegde P, Durga Nandhini M, Hegde S. Management guidelines for amelogenesis imperfecta: a case report and review of the literature. *J Med Case Rep.* 2021;15(1):1–7.
3. Lundgren GP, Hasselblad T, Johansson AS, Johansson A, Dahllöf G. Experiences of being a parent to a child with amelogenesis imperfecta. *Dent J.* 2019;7(1):1–10.
4. Ortiz L, Pereira AM, Jahangiri L, Choi M. Management of Amelogenesis Imperfecta in Adolescent Patients: Clinical Report. *J Prosthodont.* 2019;28(6):607–12.
5. Millet C, Duprez JP, Khoury C, Morgon L, Richard B. Interdisciplinary Care for a Patient with Amelogenesis Imperfecta: A Clinical Report. *J Prosthodont.* 2015;24(5):424–31.
6. Novelli C, Pascadopoli M, Scribante A. Restorative Treatment of Amelogenesis Imperfecta with Prefabricated Composite Veneers. *Case Rep Dent.* 2021;2021:3192882.
7. Gisler V, Enkling N, Zix J, Kim K, Kellerhoff NM, Mericske-Stern R. A multidisciplinary approach to the functional and esthetic rehabilitation of amelogenesis imperfecta and open bite deformity: A case report. *J Esthet Restor Dent.* 2010;22(5):282–93.
8. Patel M, McDonnell ST, Iram S, Chan MFWY. Amelogenesis imperfecta - Lifelong management. Restorative management of the adult patient. *Br Dent J.* 2013;215(9):449–57.
9. Alanzi A, Faridoun A, Kavvadia K, Ghanim A. Dentists' perception, knowledge, and clinical management of molar-incisor-hypomineralisation in Kuwait: A cross-sectional study. *BMC Oral Health.* 2018;18(1):1–9.
10. Ohrvik HG, Hjortsjö C. Retrospective study of patients with amelogenesis imperfecta treated with different bonded restoration techniques. *Clin Exp Dent Res.* 2020;6(1):16–23.
11. Pătroi DN, Andreescu CF, Ghergic DL. Esthetic Rehabilitation of Anterior Teeth with Enamel Hypoplasia Using Porcelain Laminate Veneers. *Clin Aspects Amt.* 2018;23(4):72-4.
12. Davidovich E, Dagon S, Tamari I, Etinger M, Mijiritsky E. An innovative treatment approach using digital workflow and CAD-CAM part 2: The restoration of molar incisor hypomineralization in children. *Int J Environ Res Public Health.* 2020;17(5):1–11.
13. Nazeer MR, Ghafoor R, Zafar K, Khan FR. Full mouth functional and aesthetic rehabilitation of a patient affected with hypoplastic type of amelogenesis imperfecta. *J Clin Exp Dent.* 2020;12(3):e300–9.
14. Dhareula A, Goyal A, Gauba K, Bhatia SK, Kapur A, Bhandari S. A clinical and radiographic investigation comparing the efficacy of cast metal and indirect resin onlays in rehabilitation of permanent first molars affected with severe molar incisor hypomineralisation (MIH): a 36-month randomised controlled clinical tri. *Eur Arch Paediatr Dent.* 2019;20(5):489–500. doi:10.1007/s40368-019-00430-y
15. Linner T, Khazaei Y, Bücher K, Pfisterer J, Hickel R, Kühnisch J. Comparison of four different treatment strategies in teeth with molar-incisor hypomineralization-related enamel breakdown—A retrospective cohort study. *Int J Paediatr Dent.* 2020;30(5):597–606.
16. Jensen ED. Generalised hypomineralisation of enamel in oculodentodigital dysplasia: comprehensive dental management of a case. *BMJ Case Rep.* 2021;14(1):e238079.
17. Arshad M, Shirani G, Mahgoli HA, Vaziri N. Rehabilitation of a patient with amelogenesis imperfecta and severe open bite: A multidisciplinary approach. *Clin Case Reports.* 2019;7(2):275–83.
18. de Souza JF, Fragelli CB, Jeremias F, Paschoal MAB, Santos-Pinto L, de Cássia Loiola Cordeiro R. Eighteen-month clinical performance of composite resin restorations with two different adhesive systems for molars affected by molar incisor hypomineralization. *Clin Oral Investig.* 2017;21(5):1725-33. doi:10.1007/s00784-016-1968-z
19. Pousette Lundgren G, Davidson T, Dahllöf G. Cost analysis of prosthetic rehabilitation in young patients with Amelogenesis imperfecta. *J Dent.* 2021;115:103850.
20. Soorya Ganesh DR, TA L. Knowledge, Attitude And Awareness About Different Stages Of Amelogenesis Among Undergraduate Dental Students. *Nveo-Natural Vol Essent Oils J.* 2021;8437-60.
21. Kritheka CK, Priyadharshini R. Knowledge About Enamel Defects Amongst Undergraduate Students A Cross-Sectional Survey. *Nveo-Natural Vol Essent Oils J.* 2021;7024-37.
22. AlHaddad A, Qutub O, AlHazmy A, AlMuwallad N, AlFaifi Kh, Sherbini T et al. Knowledge and Attitude Assessment of the Undergraduate Dental Students in KSA Regarding the Management of Post-Space Perforation. *Arch Pharm Pract.* 2022;13(S1):75-81.