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A Cross-sectional Analysis of Dentists' Clinical Decision-making Regarding Laminate Veneers

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Abstract:

Background: Given the growing desire for aesthetic results, the goal of restorative procedures should be to provide a great smile. Laminate veneers are among the most conservative treatment choices available and one of the most aesthetically acceptable methods of producing more pleasing smiles for patients.

Aim of the Study: The study aims to identify clinical decision-making factors that influence dentists' clinical practice for laminate veneers, including dentists' demographics, patients' aesthetic demands, and clinical indications. Additionally, it seeks to compare technique preferences, including preparation designs and material selection, between male and female dentists.

Methods: This study used a cross-sectional design. Data on clinical decision-making and preferred techniques for laminate veneers were gathered using an online survey. The survey targeted Saudi Arabian dentists working in the governmental and private sectors. The Statistical Package for the Social Sciences (SPSS) was used to analyze demographic data and survey responses, examining gender variations in clinical decision-making and procedure preferences. The study design was ethically approved (COD/IRB/2023/2). Participants were informed about the study's goals, confidentiality, and their freedom to discontinue participation at any time.

Results: A total of 200 dentists (50.5% male, 49.5% female) participated, with the majority being early-career practitioners (77% with ≤5 years of experience) and general practitioners (75%). The data revealed that 56% of dentists perform laminate veneers, with men being substantially more likely to conduct the procedure (59.8% *vs*. 40.2%, $p = 0.003$) and handling more patients monthly ($p = 0.036$). Laboratory-fabricated ceramic laminate veneers (25.5%) and CAD-CAM veneers (22%) were the most recommended treatments for peg-shaped lateral incisors, with oral hygiene (23.5%) and residual tooth structure (21%) being major factors affecting treatment decisions. Gender-based differences were observed in impression techniques, with males selecting digital (74.2%) and monophase (70.6%) techniques, while females favored one-step (61.2%) and double-step (52.9%) techniques ($p = 0.003$). Males were considerably more likely to use digital processes (68.8% *vs*. 31.3%, $p = 0.004$). Isolation procedures differed significantly, with females being more likely to utilize rubber dams (59.2% *vs*. 40.8%, $p = 0.032$). Additionally, males underwent more retreatment cases (66.7% *vs*. 33.3%, $p < 0.001$).

Conclusion: The study revealed variations in laminate veneer practice treatment among Saudi Arabian dentists. Dentists' years of experience did not affect the performance of laminate veneers. Male dentists were more likely to perform veneers and adopt modern procedures, while female dentists preferred conventional methods.

Keywords: Laminate veneer, Impression techniques, Decision-making, Esthetics, Aesthetic analysis, Smile design.

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1. INTRODUCTION

The goal of restorative procedures should be to provide a great smile aesthetics, considering the growing patient desire for aesthetic results [1]. Dental function and development, in addition to the restoration of natural dental aesthetics, must be regarded as in today's patients' demand for a smile that is both aesthetically attractive and has a healthy, harmonious tooth structure [2]. As a result, according to reports of previous studies, conservative therapies such as laminate veneers can yield the desired aesthetic benefits for the patient and have been adopted as the initial course of treatment [3, 4]. In this regard, laminate veneers are among the most conservative treatment options available and one of the most aesthetically acceptable methods for producing smiles that meet the patient's satisfaction [5]. Dentists may repair discolored, broken, damaged, and congenitally deformed teeth, diastemas, and cosmetic defects with laminate veneers, changing the tooth's position, shape, size, and color [6, 7].

Laminate veneers (LVs) were first utilized in cosmetic restoration procedures in the mid-1970s [5, 8]. According to the degree of teeth defects, only 3% to 12% of the tooth structure of the anterior teeth needs to be removed to prepare the tooth for LVs, which is less invasive than preparing the tooth for full ceramic crowns [9]. LVs are a legitimate and effective restorative therapeutic approach; however, clinical results can be influenced by several factors [10]. These elements include the design of the tooth preparation, the condition of the abutment tooth, the tooth's vitality, occlusion, adhesive bonding techniques, restorative materials, and adhesive materials [11].

Laminate veneers have been created using both direct and indirect methods, employing various materials for fabrication [5, 11]. Dentists prefer indirect laminate veneers over direct laminate veneers due to their superior resistance to discoloration and fractures [12]. Since the indirect approach offers exceptional abrasion resistance, proximal and occlusal contacts, reduced marginal leakage, and enhanced mechanical properties of the restoration compared to direct procedures, a large portion of the crown needs to be restored [13]. However, indirect laminate veneer restorations are limited by the need for an adhesive cementation technique and increased expenses [14]. As a result, in addition to the mechanical and aesthetic qualities, the cost of chair-side time must be considered when choosing between direct and indirect treatment options [8-14].

Composite resins and ceramics are two examples of the aesthetic restoration materials available to dentists [15]. Traditionally, composite resin is preferred for conservative and cosmetic operations [16]. Because composite laminate veneers use less invasive and more conservative treatment methods to cover discolored teeth, repair broken teeth, and fix unsightly tooth shapes, they are the preferred option [2]. Nevertheless, wear, marginal fracture, and marginal discoloration are frequent issues with composite veneers, which, over time, reduce the aesthetic results [17]. Indirect laminate veneer treatments have a significantly higher success rate than composite resin bonding methods, and their physical characteristics have substantially improved [18]. Because ceramic is aesthetically accepted and long-lasting, dentists also commonly utilize it in laminate veneers. Ceramic veneers have drawbacks, including marginal flaws, tooth sensitivity, debonding, and delicate construction [19]. Composites also exhibit outstanding mechanical and aesthetic properties, even though ceramics were often chosen for their desirable qualities, including color stability and strong fracture resistance [20]. In terms of clinical performance, randomized clinical research comparing the short-term survival rates of ceramic laminate veneers with indirect resin composite veneers found no statistically significant differences between the two materials. However, changes in surface quality were more frequent in the composite veneers, which were noted as a condition that may require further maintenance in the future [21].

Successful restorations now depend on preserving the tooth structure using minimally invasive techniques. It is emphasized that the load failure of laminate veneers is significantly influenced by the design of preparation and the quantity of surviving dental structure [22]. A reversible treatment method, the no-prep procedure, preserves the soft tissue's architecture by keeping all the original tooth structure [23]. On the other hand, no-prep laminate veneers do not necessitate anesthesia or intermediate provisional restorations. In addition, they are not associated with wear or postoperative sensitivity. Their advantages include minimal flexing stress, long-term margin integrity, longer-lasting restorations, and higher patient acceptance of treatment [13, 24-26]. This type of treatment is recommended when the tooth structure is sound enough to

permit the addition of material. One common indication for no-prep laminate veneers includes diastema closure, abfractions, reshaping, and incisal edge and labial volume augmentation [27]. This method's primary contraindication is that it cannot be applied in cases of extreme discoloration, deformity, and malposition, as simply applying restorative material without first preparing the tooth would not provide the required shape and discoloration masking. The necessity for preparation should be carefully considered in these situations. The technique should be considered in terms of some potential limitations, such as periodontal complications and aesthetic outcomes, including gum inflammation resulting from over-contoured restorations, even though no-prep veneers were thought to be the best option because they preserve the most tooth structure [13, 16]. Therefore, a treatment plan with or without tooth preparation may be chosen based on the patient's clinical state and needs to give them the best appearance, functionality, and lifespan.

Veneer replacement in anterior teeth has gained popularity due to the rising desire for attractive smiles with a more conservative treatment approach [19]. The current study is based on a proposed hypothesis that the dental practitioner's clinical experience and gender will affect the clinical decision-making regarding the laminate's clinical workflow. The study aimed to address research gaps in cosmetic dentistry, explicitly focusing on laminate veneers. It explored practitioners' years of experience, gender variations in dental practice, including case selection, material choice, and preparation practices. It also examined variables that influence dentists' decisions to offer laminate veneers, enabling the customization of training programs and standards. The study will provide a platform for dentists to discuss their experiences and preferences, indicating areas for improvement in training, resources, and support. The purpose is to contribute to a more thorough understanding of cosmetic dental procedures and enhance patient outcomes.

Aim of the study: In addition to analyzing technique preferences, such as preparation designs, bonding methods, and material selection, the study compares male and female dentists to identify the frequency of performance of laminate veneers and clinical decision-making factors that influence dentists' practice for laminate veneers, such as dentists’ demographics, patients’ aesthetic demands, and clinical indications.

2. METHODS

This study used a cross-sectional design. The survey was directed at Saudi Arabian dentists working in the governmental and private sectors. A cross-sectional online survey was conducted between November 20, 2024, and February 20, 2025. The survey assessed the data on clinical decision-making and preferred techniques for laminate veneers. The Institutional Review Board (IRB) granted the study ethical approval # COD/IRB/2023/2. The participants were informed of the study's goal, the confidentiality of their answers, and their freedom to discontinue participation at any time. Anonymity for participants was guaranteed, as no personally identifiable information was collected.

Saudi Arabian dentists holding professional licenses from the Saudi Commission for Health Specialties were included in the study. Dentists from both the governmental and private healthcare sectors were selected to provide comprehensive representation. Invitations to participate in the survey were distributed *via* Google Forms (Google LLC, United States) and disseminated through the social media platform WhatsApp (Meta Platforms Inc., United States). Consequently, the study sample comprised dentists with diverse educational backgrounds and skills, effectively reflecting the broader dental community in Saudi Arabia. The online survey was created, and responses were received anonymously, without any identifying data, and only the principal investigator had access to the data. Participation was voluntary, and participants received a bi-weekly reminder throughout the survey's duration to encourage completion of the online survey. Their electronic consent to participate was obtained before respondents' responses to the survey questions.

A thorough literature review and expert interaction were the foundation for developing the survey questionnaire. This study was conducted following the World Medical Association's Code of Ethics (Declaration of Helsinki). The survey had two main parts; the first part included demographic data such as age, gender, years of experience, practice sector (government or private), and educational background. The second part comprises clinical decision-making related questions, evaluating patient preferences, aesthetic requirements, and clinical indications related to the selection of laminate veneers. In addition to technique preferences, there are inquiries concerning the best methods for choosing materials, bonding, and preparation for laminate veneers.

2.1. Sample Size Calculation

The required sample size was determined using Raosoft software to calculate the sample size for the survey. A margin of error of 5% was chosen; the confidence level was set at 95%, which is the standard for obtaining high reliability in statistical analysis, indicating there is only a 5% possibility that the findings differ considerably from the actual population values. The population size was estimated to be 200,000, with an anticipated response distribution of 15%. The minimum acceptable sample size was calculated to be 196 respondents. This sample size ensures that the survey results accurately represent the larger population with a 95% confidence level and a 5% margin of error. The number increased to 200 to account for the dropout rate. Twenty dentists were randomly selected to participate in a questionnaire pilot study to verify its validity, reliability, and clarity. Based on the input from the pilot study, the survey was improved.

The Statistical Package for Social Sciences (SPSS) program was used to analyze the data. Demographic data and survey answers were summarized using descriptive statistics (frequencies, percentages). Gender variations in clinical decision-making and procedure preferences were examined using inferential statistics, including the chi-square test. Statistical significance was defined as a p-value of less than 0.05.

3. RESULTS

3.1. Characteristics of the Study Participants

The demographic and professional characteristics of the study participants (n = 200) are shown in Table 1. Most participants (70%) were aged 20-30, with only 5.5% being over 50 years old. The gender distribution was roughly equal, with 50.5% males and 49.5% females. Most participants (77%) have been practicing dentistry for less than 5 years, indicating they are in their early careers. A small percentage (9%) had been practicing for over 20 years, whereas none indicated 10-20 years of experience. The workplace distribution revealed a preference for private-sector employment, with 55.5% working in private academic institutions and 27.5% in private non-academic settings. In contrast, academic and non-academic governmental workplaces constituted 12% and 5%, respectively. Regarding specialty, the majority (75%) are general practitioners (GPs), with the remaining 25% being specialists or consultants. This distribution is consistent with that of most early-career dentists, as specialization typically requires more years of study.

3.2. Dentists' Clinical Practices Regarding Laminate Veneers

Details of dentists' clinical practices regarding laminate veneers are presented in Table 2a-n. The technique is moderately frequent but not widely used, as evidenced by 56% of the 200 participants stating they conduct laminate veneers in their clinic, and 44% do not practice laminate veneers.

3.3. Frequency of Performing Laminate Veneers

A considerable sector of dentists who perform laminate veneers (39%) only do one to three cases monthly. In comparison, fewer dentists handle a greater number of cases (11% for four to six cases, 5.5% for seven to ten cases, and only 3.5% for more than ten instances). Remarkably, 41% of respondents indicated that they never performed laminate veneers, showing variations in practice patterns that may be impacted by patient demand, training, or resource availability, as shown in Table 2a.

Table 1. General characteristics of the study participants.

Characteristics	Frequency (n=200)	Percentage
Age (years)	-	-
20 30	140	70.0
31-40	34	17.0
41-50	15	7.5
>50	11	5.5
Gender	-	-
Male	101	50.5
Female	99	49.5
Duration of practicing dentistry (years)	-	-
≤ 5	154	77.0
>5 to 10	28	14.0
>10 to 20	0	0
>20	18	9.0
Place of work	-	-
Governmental (academic)	24	12.0
Governmental (non-academic)	10	5.0
Private (academic)	111	55.5
Private (non-academic)	55	27.5
Specialty	-	-
GP	150	75.0
Specialist or consultant	50	25.0

Table 2. Relationship between frequency of dentists' practice preferences and case selection for laminate veneers.

Characteristics	Frequency (n=200)	Percentage
a. Frequency of performing laminate veneer/month	-	-
1-3 cases	78	39.0
4-6 cases	22	11.0
7-10 cases	11	5.5
>10 cases	7	3.5
Not performing	82	41.0
b. The best treatment for peg-shaped lateral is:	-	-
Laboratory-fabricated ceramic laminate veneers	51	25.5
CAD-CAM veneers	44	22.0
Direct composite veneer restorations	40	20.0
Composite resin restorations	17	8.5
Indirect composite veneer restorations	13	6.5
Indirect composite veneer restorations, CAD-CAM veneers	4	2.0
Composite resin restorations, indirect composite veneer restorations	3	1.5
Combinations of the options	28	14.0
c. The factor that affects the treatment option for peg-shaped lateral	-	-
Oral hygiene	47	23.5
Remaining tooth structure	42	21.0
Occlusion	32	16.0

(Table 2) contd.....

Characteristics	Frequency (n=200)	Percentage
Oral hygiene, remaining tooth structure	22	11.0
Oral hygiene, remaining tooth structure, occlusion	17	8.5
Age, Oral hygiene, remaining tooth structure, occlusion	11	5.5
Remaining tooth structure, occlusion	7	3.5
Age	5	2.5
Age, oral hygiene	4	2.0
Other	13	6.5
d. If the patient is insisting on performing laminate veneer	-	-
Explain the risks to the patient, and if the patient insists, perform a laminate veneer	107	53.5
Refuse to perform laminate veneer	73	36.5
Obey the patient's request	18	9.0
Explain and refer	1	0.5
Refer to another dentist	1	0.0
e. Reasons for refusing laminate veneer conduct	-	-
Oral hygiene	58	29.0
Two of the mentioned options	47	23.5
Three or more options	38	19.0
Remaining tooth structure	31	15.5
Occlusion	16	8.0
Age	10	5.0
f. Types of aesthetic analysis performed.	-	-
Study casts	31	15.5
Mock-ups	27	13.5
Digital smile analysis	24	12.0
Photographs	16	8.0
Videos	1	0.5
More than one option	76	38.0
No	25	12.5
g. Using a retraction cord or another type of retraction before the impression	-	-
Yes	177	88.5
No	23	11.5
h. Preferred impression technique	-	-
Double-step technique	85	42.5
One-step technique	67	33.5
Digital impression	31	15.5
Mono-phase	17	8.5
i. Practice of digital impression	-	-
Take the digital impression and design the final restoration	32	16.0
Send the digital photo as an e-file to the lab	26	13.0
Send the cast to the lab technician to scan and design the final restoration	24	12.0
Don’t use	118	59.0
j. Practice during try-in	-	-
Try different try-in shades until the patient becomes satisfied	128	64.0
Depending on clinical judgment for the shades of the cement to be used	46	23.0
Rarely try different shades in try-in pastes	26	13.0
k. The isolation technique used during laminate veneer cementation	-	-
Cotton roll isolation	124	62.0
Rubber dam isolation	76	38.0
l. Reasons for using cotton roll isolation (n=124)	-	-
Rubber dams interfere with the cementation procedure	46	37.1
Rubber dam is time-consuming	30	24.2
Rubber dams are a different technique	23	18.5
Patient discomfort with the rubber dam	25	20.2
m. Dentists performing retreatment cases of laminate veneers.	-	-
Yes	93	46.5
No	107	53.5

(Table 2) contd.....

Characteristics	Frequency (n=200)	Percentage
n. Reasons for retreatment of laminate veneers	-	-
Deboning	17	8.5
Gingival inflammation	16	8.0
Recurrent caries	11	5.5
Fracture	10	5.0
Recurrent caries, fractures	8	4.0
Shade mismatch	8	4.0
Anatomical defect	8	4.0
More than one reason	15	16.0

3.4. Preferred Management for Peg-shaped Lateral Incisors

Direct composite veneer restorations (20%) are the third preferred treatment, after laboratory-fabricated ceramic laminate veneers (25.5%) and CAD-CAM veneers (22%). A lower percentage of participants chose indirect composite veneers (6.5%), composite resin restorations (8.5%), or combinations of treatment techniques (14%). This variety demonstrates the practitioners' varied treatment approaches and preferred technologies, as shown in Table **2b**. Oral hygiene of the selected patients was recorded (23.5%) to be a deciding factor regarding the case selection for treatment of peg-shaped laterals with laminate veneers, followed by the amount of remaining tooth structure, which showed a considerable percentage as well for laminate veneers treatment to be selected by the respondent dentists, as shown in Table **2c**.

3.5. Handling Laminate Veneer Requests from Patients

Approximately 37% of respondents stated they would refuse treatment, while more than half (53.5%) indicated that they would explain the risks but continue if the patient insisted. Only 0.5% of the dentists said they would explain and refer the patient to another dentist, while 9% said they would comply with patient demands without hesitation. These answers highlight the moral and professional challenges in cosmetic dentistry that necessitate striking a balance between clinical judgment and patient autonomy, as shown in Table **2d**.

3.6. Reasons Against Laminate Veneers Selection as an Aesthetic Treatment

Poor dental hygiene was the most frequent cause of rejection (29%), followed by occlusion-related problems (8%), inadequate residual tooth structure (15.5%), and various concerns (23.5%). The least common explanation was age (5%), as shown in Table **2e**. These results show that dentists consider biological and functional factors to be significant when evaluating the viability of laminate veneers.

3.7. Aesthetic Analysis Before Laminate Veneers

Before proposing laminate veneers, a substantial percentage of dentists (87.5%) do an aesthetic investigation, demonstrating their dedication to treatment planning. Mock-ups (13.5%), digital smile analysis (12%), and study casts (15.5%) are the most often utilized techniques. Nonetheless, (38%), as shown in Table **2f**, of respondents use a variety of methods, indicating an integrated approach to smile design. Contrary to 12.5% not performing aesthetic analysis before Laminate Veneers

3.8. The Use of Impression Preferences and Retraction Techniques

Soft tissue control is critical for achieving reliable outcomes, as indicated by most responders (88.5%) who use a retraction cord or a similar tissue management technique before obtaining an impression, as shown in Table **2g**. Double-step (42.5%) is the most common impression technique, followed by one-step (33.5%), digital impression (15.5%), and mono-phase (8.5%), as shown in Table **2h**. Patient characteristics, digital technology availability, and clinical training may all impact these choices.

3.9. Utilizing Digital Impression Technology

Despite their increasing use, 59% of the included dentists do not utilize digital impressions. Taking a digital impression and designing the final restoration is the most favored procedure among those who do it (16%), followed by submitting digital data to the lab (13%) or scanning castings for lab processing (12%), as shown in Table **2i**. These findings demonstrate that classic impression processes are still widely employed, despite the expansion of digital workflows.

3.10. Practices for Try-In and Shade Selection

While 23% of dentists use visual clinical judgment when choosing cement shades, 64% try several shades until the patient is pleased during the try-in phase. Most practitioners value exact shade matching to improve aesthetic results, as evidenced by the lower percentage (13%) in Table **2j**, who rarely experiment with try-in pastes.

3.11. Methods of Isolation for Laminate Veneer Cementation

Rubber dam isolation (38%) is less used than cotton roll isolation (62%). The participants reported that the primary reasons for using cotton rolls were rubber dam interference with cementation (37.1%), time constraints (24.2%), technique difficulties (18.5%), and patient discomfort (20.2%). These results showed that, despite rubber dams' superior moisture management capabilities, practical considerations often may lead to the use of alternative isolation methods.

Table 3. Relationship between dentists' gender and practice preferences for laminate veneers.

-	Male	Female	Test of Significance (*p*-value)
-	-	-	-
a. Performing laminate veneers in practice			
Yes	67 (59.8)	45 (40.2)	X^2= 8.8 (0.003*)
No	34 (38.6)	54 (61.4)	
b. Frequency of performing laminate veneer/month			
1-3 cases	47 (60.3)	31 (39.7)	X^2= 10.2 (0.036*)
4-6 cases	11 (50)	11(50)	
7-10 cases	7 (63.3)	4 (36.4)	
>10 cases	5 (71.4)	2 (28.6)	
Not performing	31 (37.8)	51 (62.2)	
c. Preferred impression technique	-	-	-
Double-step technique	40 (47.1)	45 (52.9)	X^2= 13.8 (0.003*)
One-step technique	26 (38.8)	41 (61.2)	
Digital impression	23 (74.2)	8 (25.8)	
Mono-phase	12 (70.6)	5 (29.4)	
d. Practice of digital impression			
Take the digital impression and design the final restoration	22 (68.8)	10 (31.3)	X^2= 13.2 (0.004*)
Send the digital photo as an e-file to the lab	17 (65.4)	9 (34.6)	
Send the cast to the lab technician to scan and design the final restoration	6 (25.0)	18 (75.0)	
Don’t use	56 (47.5)	62 (52.5)	
e. The isolation technique used during laminate veneer cementation			
Cotton roll isolation	70 (56.5)	54 (43.5)	X^2= 4.6 (0.032*)
Rubber dam isolation	31 (40.8)	45 (59.2)	
f. Dentists performing retreatment cases of laminate veneers.			
Yes	62 (66.7)	31 (33.3)	X^2= 18.2 (<0.001*)
No	39 (36.4)	68 (63.6)	

Note: X^2: Chi Square test * <0.05: statistically significant.

3.12. Laminate Veneer Retreatment

Retreatment cases for laminate veneers were performed by almost half (46.5%) of the dentists, with the most frequent causes being debonding (8.5%), gingival inflammation (8%), recurrent caries (5.5%), and fractures (5%). The multifaceted character of veneer failure was shown by the substantial number (16%), as shown in Table **2k**, who indicated various causes for retreatment.

3.13. The Dentists' Gender and Laminate Veneers

The relationship between dentists' gender and practice preferences for laminate veneers is shown in Table **3a-f**. The findings of the chi-square test showed statistically significant differences between male and female dentists in a considerable number of practice patterns (*p*-values < 0.05).

3.14. The Practice of Laminate Veneers

With a *p*-value of 0.003, a significantly higher percentage of male dentists (59.8%) than female dentists (40.2%) reported doing laminate veneers, as shown in Table **3a**. The difference raises the possibility that male dentists perform more cosmetic restoration procedures; this may be due to variations in training, confidence, or professional emphasis.

3.15. Monthly based Frequency of Performing Laminate Veneer

Male dentists are more likely than female dentists to perform laminate veneers and handle a higher number of cases each month. Males represented 60.3% of those who conduct one to three instances each month, and this percentage increases as the frequency rises (63.3%) for 7 to 10 cases and (71.4% for more than 10 cases, as shown in Table **3b**. Conversely, females are less likely to use laminate veneers at all or use them infrequently. This gender-based disparity (p = 0.036) can indicate variations in specialized choices, workload, or patient preferences.

3.16. Favorite Method of Impression

Preferences for impression techniques varied significantly by gender (p = 0.003). Digital impressions are preferred by male dentists more often than by female dentists (74.2% *vs*. 25.8%). Additionally, they favor the

mono-phase approach more (70.6% *vs*. 29.4%). However, female dentists use the one-step technique (61.2% *vs*. 38.8%) and the double-step technique (52.9% *vs*. 47.1%) more frequently, as shown in Table **3c**. These results showed that while female dentists tend to favor conventional methods, male dentists are more likely to adopt recent digital technology. As demonstrated in Table sections **3d** and **e**, (68.8%) of male dentists prefer to take the digital impression and design the final restoration. In comparison, 47.5% of males and 52.5% of females do not advocate using digital impressions. Regarding isolation techniques, the highest percentage was among females (59%), using cotton roll isolation.

3.17. Relationship Between Years of Experience and Dentists' Practice Preferences for Laminate Veneers

The study's results revealed that the association between dentists' years of experience and their laminate veneer practice is analyzed in Table **4**. Laminate veneer performance was most common among dentists with ≤5 years of experience (70.5%), followed by those with 5 to 20 years of experience (16.1%), and those with >20 years of experience (13.4%), as shown in Table **4a**. The statistical significance of this association (X^2 = 7.6, p = 0.022) reveals that the level of expertise influences the probability of performing laminate veneers. Most dentists with less than five years of experience (76.9%) reported handling one to three cases per month, as shown in Table **4b**. Experience has a significant impact on the number of cases treated, as indicated by the statistically significant frequency distribution across experience groups (MCT, p = 0.011). The most common impression technique was the one-step approach (75.3% among those with less than five years of experience). However, there was no significant association between experience and preferred impression (MCT, p = 0.65) as shown in Table **4c**. The results show that years of expertise do not influence one's choice of impression technique.

3.18. Utilizing Digital Impression Methods

There are notable variations in how digital impressions are used (p = 0.004). Males are more likely to send the digital file to the lab (65.4% *vs*. 34.6%) or take the digital impression themselves and design the final restoration (68.8% *vs*. 31.3%). However, 75.0% of female and 25.0% of male dentists submit casts to the lab for scanning and design. Furthermore, a higher percentage of female dentists (52.5%) than male dentists (47.5%) reported not using digital impressions, as shown in Table **4d**. Males were found to have a greater preference for personally performing digital design, revealing a gender-related variation in the adoption of digital processes.

Table 4. Relationship between years of experience and dentists' practice preferences for laminate veneers.

-	≤20 Years	>5 to 20 Years	>20 Years	Test of Significance (*p*-value)
-	-	-	-	-
a. Performing laminate veneers in practice				
Yes	78 (70.5)	18 (16.1)	15 (13.4)	X^2= 7.6 (0.022*)
No	75 (85.2)	10 (11.4)	3 (3.4)	
b. Frequency of performing laminate veneer/month				
1-3 cases	60 (76.9)	10 (12.8)	8 (10.3)	*MCT* (0.011*)
4-6 cases	11 (50.0)	7 (31.8)	4(18.2)	
7-10 cases	7 (63.6)	3 (27.3)	1 (9.1)	
>10 cases	4 (57.1)	1 (14.3)	2 (28.6)	
Not performing	72 (87.8)	7 (8.5)	3 (3.7)	
c. Preferred impression technique				
Double-step technique	22 (71.0)	4 (12.9)	5 (16.1)	*MCT* (0.65)
One-step technique	64 (75.3)	15 (17.6)	6 (7.1)	
Digital impression	13 (76.5)	2 (11.8)	2 (11.8)	
Mono-phase	55 (82.1)	7 (10.4)	5 (7.5)	
d. Practice of digital impression				
Take the digital impression and design the final restoration	20 (83.3)	2 (8.3)	2 (8.3)	*MCT* (0.182)
Send the digital photo as an e-file to the lab	16 (61.5)	4 (15.4)	6 (23.1)	
Send the cast to the lab technician to scan and design the final restoration	24 (75.0)	6 (18.8)	2 (6.3)	
Don’t use	24 (75.0)	16 (13.6)	8 (6.8)	
e. The isolation technique used during laminate veneer cementation				
Cotton roll isolation	97 (78.2)	18 (14.5)	9 (7.3)	X^2= 1.22 (0.54)
Rubber dam isolation	57 (75.0)	10 (13.2)	9 (11.8)	
f. Dentists performing retreatment cases of laminate veneers.				
Yes	61 (65.6)	18 (19.4)	14 (15.1)	X^2= 13.58 (<0.001*)
No	93 (86.9)	10 (9.3)	4 (3.7)	

Note: X^2: Chi Square test * <0.05: statistically significant MCT: Monte Carlo test.

3.19. The Method of Isolation Used in Cementation

There was a statistically significant difference in the selection of isolation techniques ($p = 0.032$). Rubber dam isolation is more common among female dentists (59.2% *vs*. 40.8%), while cotton roll isolation is used by more male dentists (56.5%) than female dentists (43.5%), as shown in Table **4e**. Given the better isolation that rubber dams provide during veneer cementation, this data showed that female dentists might prioritize controlling moisture more.

3.20. Laminate Veneer Retreatment

The incidence of instances of retreatment showed a significant gender difference ($p < 0.001$). A higher proportion of male dentists (66.7%) perform retreatment of laminate veneers compared to female dentists (33.3%). On the other hand, (63.6%) of female dentists report not doing retreatment, compared to (36.4%) of male dentists, as shown in Table **3f**. Regarding the relationship to the years of experience, as shown in Table **4f**, the highest percentage (86.9%) of dentists do not perform retreatment cases in the age group ≤ 20 years of clinical experience.

4. DISCUSSION

The study demonstrated that laminate veneers are a popular procedure among dentists. 56% of participants conduct this procedure in their clinics, whereas 44% do not. This shows that most dentists perform this procedure and prefer it as a cosmetic treatment option. Factors such as variances in training, patient demographics, or preferences for other cosmetic dental operations might contribute to these results. Previous studies have demonstrated comparable results, such as those by Komine *et al*. (2024), which illustrate the variability in adoption depending on regional practices and clinical preferences [28]. Compared with prior studies, the findings demonstrate that direct laminate veneers benefit cosmetic dentistry [29, 30]. Clinical studies evaluating the longevity of porcelain veneers have found that patients are generally satisfied with the treatment, with a satisfaction rate ranging from 80% to 100% [31-33]. This finding aligns with most dentists who frequently practice indirect laminates, as confirmed by a randomized clinical trial that assessed the technique preference, patient acceptance, and clinical performance of ceramic laminate veneers made with Celtra Press and IPS e.max Press ceramic. They found that after one year of follow-up, dentists used both Celtra press laminate veneers and IPS e.max press laminate veneers, which showed successful clinical performance in anterior teeth requiring conservative labial laminate veneers with incisal wrap design in terms of color matching and color stability, fracture, sensitivity, and patient satisfaction [34, 35].

The study reveals that poor dental hygiene is the primary reason for rejecting laminate veneers, underscoring the importance of maintaining an effective oral care routine. Occlusion-related difficulties and inadequate remaining tooth structure are also essential concerns, limiting the durability and benefit of the veneers. Other considerations include patient expectations, expense, and possible consequences. Previous research has also identified comparable factors for veneer rejection, emphasizing the importance of maintaining adequate oral hygiene and addressing occlusal concerns [28]. The study stresses that careful patient evaluation and preparation are crucial for the success of laminate veneers, as addressing these issues can enhance patient outcomes and satisfaction with the procedure.

The study reveals a significant gender difference in the practice of laminate veneers, with male dentists reporting a higher frequency of performing these procedures than female dentists (59.8% *vs*. 40.2%). This showed that male dentists may be more engaged in cosmetic restoration operations, possibly due to characteristics such as training, confidence, or professional emphasis. Factors contributing to this higher engagement include increased training and education, a greater focus on cosmetic dentistry in professional contexts, and more hands-on experience. Previous research has also demonstrated gender variations in dental practice patterns, with female dentists more likely to work part-time and in metropolitan regions. In contrast, male dentists are more likely to work full-time and in rural areas. Female dentists are also more likely to work in pediatric and public health dentistry, which may explain their lower involvement in cosmetic treatments, such as laminate veneers [36]. Identifying these distinctions can help tailor training programs and professional development opportunities to ensure that all dentists are prepared to perform a range of treatments.

The study demonstrates gender variations in dental impression procedures. Male dentists tend to favor digital impressions and monophase procedures more than female dentists, whereas female dentists prefer conventional one-step and double-step techniques. This demonstrates that male dentists are more receptive to embracing contemporary technologies and simplified processes, likely due to variables such as training, familiarity with technology, or professional focus. Female dentists may prefer conventional procedures, as they might find them more reliable or easier to manage. Previous studies have also revealed gender variations in the utilization of digital technology in dentistry. Research by Yuzbasioglu *et al*. (2014) indicated that patients frequently preferred digital impressions due to their comfort and efficiency [37]. Another study by Terres Bustos & Tapia Ornelas (2023) highlighted the advantages of digital impressions, while also acknowledging the increased initial cost and learning curve associated with these technologies [38, 38]. Understanding these preferences can assist in customizing training programs and professional development to ensure that dentists are ready to employ both traditional and modern procedures efficiently.

The study reveals a significant gender difference in the choice of isolation procedures during cementation, with female dentists opting for rubber dam isolation (59.2%) and male dentists selecting cotton roll isolation (56.5%). This preference is related to rubber dams' superior moisture management, which is necessary for restorative treatments such as veneer cementation. Cotton roll isolation, more commonly employed by male dentists, is chosen due to its simplicity and convenience of use, but it

is less successful in preventing moisture. Previous studies have also revealed the benefits of rubber dam isolation over cotton roll isolation, such as a decreased failure rate of restorations and more effective management of a dry field [39, 40]. Understanding these preferences can help in designing effective training programs and professional development to ensure that dentists can employ the most suitable approaches for their procedures.

The current study showed an insignificant correlation between years of experience and the clinical performance of laminate veneers. The results were supported by a 2009 study by Burque and Luccarotti, which found that the years that dentists utilized their skills after graduation exhibited no noticeable effect on the endurance of porcelain veneers. This clarifies that factors other than experience—such as implementing therapeutic standards —may be crucial for veneer treatments to be successful [41].

In the same regard, a prospective clinical research study was conducted in 2020 to assess the outcomes of minimally invasive ceramic restorations performed by dentists with varying degrees of proficiency. The study concluded that the professional experience of the dentist had no significant influence on either patient happiness or the success of the restorations. Instead, early failures have been attributed to noncompliance with clinical protocols [42]. Another opposing opinion was presented in an *in vitro* study, where the operator's expertise was found to affect dentin exposure after tooth preparation for laminate veneers. Excessive dentin preparation may reduce the lifespan of the veneer, suggesting that experienced practitioners may achieve superior outcomes [43]. This may be attributed to the individual variations in preparation limitations from the former study.

While this study provides valuable insights into the practice of laminate veneers among dentists in Saudi Arabia, it has certain limitations that should be addressed. Self-reported data may be subject to response bias, and convenience sampling may not accurately represent the broader community. Additionally, the cross-sectional design provides a snapshot of practices at a particular moment, and most participants were early-career dentists. Another limitation of the current study was related to the participating dentists' background, their prosthodontics educational degrees, and clinical experience regarding dental prosthodontics and esthetic restorative dentistry. This limitation should be carefully examined, as it may impact clinical decision-making and treatment preferences. The study's geographical focus may limit its relevance to other areas or countries with differing cultural, educational, or healthcare systems.

CONCLUSION

This study demonstrated significant variations in the practice of laminate veneers among dentists in Saudi Arabia. Among those variations, as shown in the results, 44% do not practice laminate veneers, which is considered a vast gap in the reported clinical experience of the dentists who responded to the survey. However, in correlation with the age distribution, it was also an impressive finding that 77% of individuals with less than 5 years of experience had a professional interest in the clinical practice of laminate veneers. The years of experience had a less substantial impact on treatment decision-making. However, further research is needed to correlate years of experience with the clinical protocols and materials used in clinical trials, as well as treatment preferences. Overall, the survey response was nearly equal from both male and female dentists, while gender-based conclusions were found related to the technique of executing laminate veneers. Male dentists were more likely to perform laminate veneers, manage a larger number of patients, and adopt modern procedures, such as digital impressions and CAD-CAM processes. In contrast, female dentists preferred conventional approaches, such as one-step and two-step impression techniques. In addition, cotton roll isolation and sending physical impressions to the lab are preferred over rubber dam isolation and digital impressions. Regarding laminate veneers retreatment, it was found that nearly half of the respondents perform these clinically, but concerning gender, it was more practiced by male dentists. These variations showed that although both males and females had the initiative of responding to the questionnaire, gender may influence clinical decision-making, method preferences, and the adoption of innovative technologies in the fabrication of laminate veneers.

AUTHORS' CONTRIBUTIONS

The authors confirm their contribution to the paper as follows: H.E.: Study conception and design; A.S., N.A.: Data collection; G.A.: Analysis, and interpretation of results; L.A., H.E., F.B., S.H.: Draft manuscript; H.E., Y.A.: All authors reviewed the results and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

SPSS = Statistical Package for the Social Sciences

LVs = Laminate Veneers

IRB = Institutional Review Board

GPs = General Practitioners

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Institutional Review Board (IRB) at College of Dentistry/Dar Aluloom University granted the study ethical approval # COD/IRB/2023/2.

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

The electronic consent to participate was obtained before respondents' responses to the survey questions.

STANDARDS OF REPORTING

STROBE guidelines were followed

AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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