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# Questionnaire for the Evaluation of Knowledge and Attitudes of Undergraduate Dentistry Students Regarding the Use of CAD-CAM in Class 2 Inlay Restoration Applications

## *Diş Hekimliği Fakültesi Lisans Öğrencilerinin Sınıf 2 İnley Restorasyon Uygulamalarında CAD-CAM Kullanımına İlişkin Bilgi ve Tutumlarının Değerlendirilmesi Anketi*

### ABSTRACT

**Objective:** This study aims to assess the knowledge and practices of undergraduate dental students regarding the use of CAD-CAM technology in inlay restorations for maxillary premolars affected by Class 2 caries.

**Methods:** The questions asked in this study were adapted from a previous survey and were translated into Turkish. The questionnaire, which consists of 17 questions related to CAD-CAM knowledge, preferences, and group characteristics, was distributed to 1<sup>st</sup>-, 2<sup>nd</sup>-, 3<sup>rd</sup>-, 4<sup>th</sup>-, and 5<sup>th</sup>-year dental students. Participants who volunteered and completed the entire questionnaire were included in this study, resulting in a total of 365 participants (272 preclinical and 93 clinical students). The Chi-square independence test was employed to test the independence between two categorical variables.

**Results:** In this study, 75% of the participants were preclinical students, and 25% were clinical students. The analysis of the number and percentage of responses to the questions in the questionnaire, grouped by preclinical and clinical years as well as the total number of students, indicated significant differences between the groups in all questions, except for S1 (Do you consider occlusion to be important?), S2 (What type of composite do you prefer for Class 2 restorations?) and S9 (In which cavities can indirect inlay restorations be preferred?).

**Conclusion:** The findings suggest that practical education in CAD-CAM technology has yet to be fully integrated into undergraduate dental education; however, there is an increasing awareness of its importance and a high level of interest among students for further education in this field.

**Keywords:** Inlay, CAD-CAM, Dental student

### ÖZ

**Amaç:** Bu çalışmanın amacı, dişhekimliği lisans öğrencilerinin Sınıf 2 çürüklerden etkilenen üst küçük azı dişlerinin dolgu restorasyonlarında CAD-CAM teknolojisinin kullanımına ilişkin bilgi ve uygulamalarını değerlendirmektir.

**Yöntemler:** Bu çalışmada kullanılan sorular daha önce yapılmış bir anketten uyarlanarak Türkçeye çevrilmiştir. CAD-CAM bilgisi, tercihleri ve grup özelliklerine ilişkin toplam 17 sorudan oluşan anket, diş hekimliği eğitiminin 1., 2., 3., 4. ve 5. yılındaki öğrencilere dağıtıldı. Gönüllü olan ve anketin tamamını dolduran katılımcılar çalışmaya dahil edilerek toplam 365 katılımcı (272 klinik öncesi ve 93 klinik öğrencisi) elde edildi. İki kategorik değişken arasındaki bağımsızlığı test etmek için Ki-kare bağımsızlık testi kullanıldı.

**Bulgular:** Çalışmamızda akademik yıllara göre dağılım şu şekildeydi: %75'i klinik öncesi öğrenciler, %25'i klinik öğrencileriydi. Klinik öncesi ve klinik yıllara ve toplam öğrenci sayısına göre gruplandırılan anketteki sorulara verilen yanıtların sayısı ve yüzdesinin analizi, S1 dışındaki tüm sorularda gruplar arasında anlamlı farklılıklar olduğunu gösterdi (Oklüzyonun bir hastalık olduğunu düşünüyor musunuz?) önemli mi?, S2 (Sınıf 2 restorasyonlar için hangi tür kompoziti tercih edersiniz?) ve S9 (İndirekt inlay restorasyonlar hangi kaviterlerde tercih edilebilir?).

**Sonuç:** Bulgular, CAD-CAM teknolojisindeki uygulamalı eğitimin henüz lisans diş hekimliği eğitimine tam olarak entegre edilmediğini; ancak önemine ilişkin farkındalığın giderek arttığı ve öğrenciler arasında bu alanda ileri eğitime yönelik yüksek düzeyde ilgi olduğu yönündedir.

**Anahtar kelimeler:** İnley, CAD-CAM, Diş hekimliği fakültesi öğrencileri



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## INTRODUCTION

It is very challenging to achieve esthetic results in dentistry, particularly with posterior teeth. Dental caries predominantly develops on the occlusal surfaces of posterior teeth. Manufacturers have recently developed composites that meet the needs of dentists and patients.<sup>1,2</sup> However, composites still have some minor drawbacks. They involve multiple steps, are technique-sensitive and time-consuming, and require excellent dental skills to achieve optimal esthetics and functional outcomes.<sup>3,4</sup> Completing restorations with composites takes more time when compared to amalgam.<sup>5</sup> Recently, computer-aided design, computer-aided manufacturing (CAD-CAM) technology, and intraoral digital scanners have gained popularity as alternatives to traditional impression-taking and casting methods. Inlay/onlay restorations represent a more conservative approach in comparison to full crowns and can be produced with less retention thanks to advancements in bonding procedures. Moreover, polymerization shrinkage for indirect restorations is limited to the cement area for composite resin restorations. The performance of CAD-CAM inlay/onlay restorations is satisfactory, with a success rate of 88.78% for ceramics over ten years and 84.78% for composite resin over 5 years.<sup>6-12</sup>

Manually achieving an esthetic restoration requires the dentist to have knowledge of occlusal anatomy and excellent skills. One of the best techniques to achieve a perfect blend of both function and esthetics is CAD-CAM restoration production. Current materials used for CAD-CAM inlay/onlay restorations in dentistry include glass-ceramic blocks and composite resin blocks.<sup>13</sup>

In dentistry, the synergistic effect of the digital technologies and the evolution of materials with suitable mechanical and esthetic properties has caused a significant change in prosthodontic restorative dentistry. Many dentists are adopting computer-aided design/computer-aided manufacturing (CAD-CAM) chairside technology, and manufacturers are expanding the range of materials to reduce chairside working times while maintaining high precision and safety standards.

The null hypothesis of this study is that undergraduate dentistry students' knowledge and practice regarding the use of CAD-CAM in inlay restorations of Class 2 caries in posterior teeth is sufficient.

## METHODS

The Ethics Committee for Clinical Research of the Dentistry Faculty of Afyonkarahisar Health Science University approved the study protocol (06.02.2023, protocol number 2011-KAEK-2). The survey questions used in this study were adapted from a previous study's questionnaire developed by Reshawn et al.<sup>14</sup> The questionnaire was translated into Turkish and then modified and used in its final form in this study. The questionnaire consisted of 17 questions assessing CAD-CAM knowledge, preferences, and group characteristics. The survey was distributed to 1<sup>st</sup>-, 2<sup>nd</sup>-, 3<sup>rd</sup>-, 4<sup>th</sup>-, and 5<sup>th</sup>-year dental students of Afyonkarahisar Health Sciences University. The principles of the Declaration of Helsinki were followed throughout the study process.

The survey questions were translated into Turkish by experts proficient in both languages (English and Turkish) and then back-translated into the original language. Five expert dentists evaluated the appropriateness and understandability of each item. Based on expert opinions, all items were retained due to difficulty understanding or similarity. The survey was administered to participants in Turkish. Factor analysis was conducted using principle components analysis (PCA) with variable rotation. The Kaiser Meyer-Olkin measure was found to be

0.594 and the result of Barlett's test to be  $P<.001$ . The reliability of the survey was determined through Cronbach's alpha analysis, resulting in  $\alpha=0.684$ .

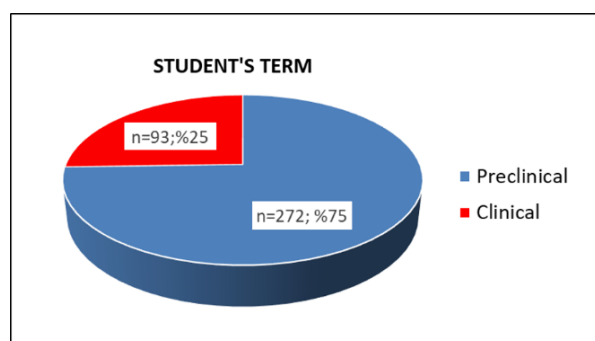
The study population comprised 462 undergraduate students (316 preclinical and 146 clinical students). The need for an answer using the formula  $n = N * t^2 * p * q / (d^2 * (N-1) + t^2 * p * q)$  was determined for a population of this size with a 95% confidence level ( $P=.5$ ;  $q=0.5$ ;  $t=1.96$  and  $d=0.05$ ). According to this calculation, a minimum of 210 students was targeted. Participants who participated in this study voluntarily and completed the survey were included in the analysis. A total of 365 participants (272 preclinical and 93 clinical students) were included in this study.

Demographic characteristics considered in this study included academic year (question 14), whether dentistry was their first choice of profession (question 15), and whether there were any dentists in their family (question 16).

IBM SPSS 25.0 software (IBM SPSS Corp., Armonk, NY, USA) was used for statistical analysis. Descriptive statistical methods, such as percentages and frequency, were used to evaluate the summarized data. The Chi-square independence test was employed to test the independence between two categorical variables. Relationships between categorized variables were investigated using Chi-square independence tests in 2x2 and 2x3 cross-tabulations. A p-value of  $P<.05$  was considered statistically significant.

## RESULTS

Figure 1 illustrates the percentage distribution by academic year in this study. Seventy-five percent of the participants were preclinical students, while 25% were clinical students.



**Figure 1.** Percentage distribution of undergraduate students participating in the survey by academic year

Table 1 describes the number and rate of answers to the questions given in the survey by preclinical and clinical years and the total number of students. In Table 1, the Chi-Square test results indicate whether there is a difference between the answers given by preclinical and clinical students. Except for questions S1 (Do you think occlusion is essential?), S2 (What type of composite do you prefer in Class 2 restorations?), and S9 (In which cavities can indirect inlay restoration production be selected?), there is a significant difference between the groups in other questions.

Table 2 shows the ratio of the questions given in the survey by whether dentistry is the student's first choice and whether there is a difference. Considering this variable, there was no significant difference between the answers given to the questions.

**Table 1.** Frequency, percentage rate and comparison of groups in the answers given to the questions

|                                                                                                                                                        |                                               | Q14.Which period are you in? |         |                 |         |               |         | P<br>Value<br>X <sup>2</sup> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------|---------|-----------------|---------|---------------|---------|------------------------------|
|                                                                                                                                                        |                                               | Preclinical (n=272)          |         | Clinic (n=93)   |         | Total (n=365) |         |                              |
|                                                                                                                                                        |                                               | N                            | Percent | N               | Percent | N             | Percent |                              |
| Q1.Do you feel occlusion is important?                                                                                                                 | No                                            | 4                            | 1%      | 2               | 2%      | 6             | 2%      | .802                         |
|                                                                                                                                                        | Yes                                           | 263                          | 97%     | 90              | 97%     | 353           | 97%     |                              |
|                                                                                                                                                        | May be                                        | 5                            | 2%      | 1               | 1%      | 6             | 2%      |                              |
| Q2.What type of composite do you prefer for class 2 restoration?                                                                                       | Flowable                                      | 18                           | 7%      | 4               | 4%      | 22            | 6%      | .347                         |
|                                                                                                                                                        | Both                                          | 153                          | 56%     | 60              | 65%     | 213           | 58%     |                              |
|                                                                                                                                                        | Packable                                      | 101                          | 37%     | 29              | 31%     | 130           | 36%     |                              |
| Q3.Is indirect inlay restoration production using CAD-CAM a precise technique?                                                                         | No                                            | 8 <sup>a</sup>               | 3%      | 4 <sup>a</sup>  | 4%      | 12            | 3%      | <.001                        |
|                                                                                                                                                        | Yes                                           | 136 <sup>a</sup>             | 50%     | 81 <sup>b</sup> | 87%     | 217           | 59%     |                              |
|                                                                                                                                                        | I don't know                                  | 128 <sup>a</sup>             | 47%     | 8 <sup>b</sup>  | 9%      | 136           | 37%     |                              |
| Q4.What are the difficulties that you face while restoring a class 2 cavity with composite?                                                            | Unable to mimic occlusal                      | 94 <sup>a</sup>              | 35%     | 20 <sup>b</sup> | 22%     | 114           | 31%     | <.001                        |
|                                                                                                                                                        | Saliva contamination                          | 59 <sup>a</sup>              | 22%     | 40 <sup>b</sup> | 43%     | 99            | 27%     |                              |
|                                                                                                                                                        | Technique sensitive                           | 119 <sup>a</sup>             | 44%     | 33 <sup>a</sup> | 35%     | 152           | 42%     |                              |
| Q5.Is indirect inlay restoration production using CAD-CAM better than the conventional method?                                                         | No                                            | 16 <sup>a</sup>              | 6%      | 3 <sup>a</sup>  | 3%      | 19            | 5%      | <.001                        |
|                                                                                                                                                        | Yes                                           | 80 <sup>a</sup>              | 29%     | 66 <sup>b</sup> | 71%     | 146           | 40%     |                              |
|                                                                                                                                                        | I don't know                                  | 176 <sup>a</sup>             | 65%     | 24 <sup>b</sup> | 26%     | 200           | 55%     |                              |
| Q6.What kind of material do you use for indirect inlay restoration production as CAD-CAM?                                                              | Composite                                     | 90 <sup>a</sup>              | 33%     | 14 <sup>b</sup> | 15%     | 104           | 28%     | .002                         |
|                                                                                                                                                        | Both                                          | 129 <sup>a</sup>             | 47%     | 51 <sup>a</sup> | 55%     | 180           | 49%     |                              |
|                                                                                                                                                        | Ceramic                                       | 53 <sup>a</sup>              | 19%     | 28 <sup>b</sup> | 30%     | 81            | 22%     |                              |
| Q7.How much time do you consume in finishing and polishing a posterior composite restoration done using conventional technique?                        | Less than 5 min                               | 37 <sup>a</sup>              | 14%     | 25 <sup>b</sup> | 27%     | 62            | 17%     | .012                         |
|                                                                                                                                                        | More than 5 min                               | 71 <sup>a</sup>              | 26%     | 22 <sup>a</sup> | 24%     | 93            | 25%     |                              |
|                                                                                                                                                        | 10 min                                        | 164 <sup>a</sup>             | 60%     | 46 <sup>a</sup> | 49%     | 210           | 58%     |                              |
| Q8.Is it possible to acquire restorations that are fully congruous with the cavity by fabricating indirect inlay restorations with the CAD-CAM method? | No                                            | 29 <sup>a</sup>              | 11%     | 13 <sup>a</sup> | 14%     | 42            | 12%     | <.001                        |
|                                                                                                                                                        | Yes                                           | 94 <sup>a</sup>              | 35%     | 59 <sup>b</sup> | 63%     | 153           | 42%     |                              |
|                                                                                                                                                        | I don't know                                  | 149 <sup>a</sup>             | 55%     | 21 <sup>b</sup> | 23%     | 170           | 47%     |                              |
| Q9.In which cavities can indirect inlay restoration production be preferred?                                                                           | Class 3 restoration                           | 18                           | 7%      | 4               | 4%      | 22            | 6%      | 0.579                        |
|                                                                                                                                                        | Class 2 restoration                           | 133                          | 49%     | 43              | 46%     | 176           | 48%     |                              |
|                                                                                                                                                        | Both                                          | 121                          | 44%     | 46              | 49%     | 167           | 46%     |                              |
| Q10.What do you believe to be the restricting factor in producing indirect inlay restorations?                                                         | Need for additional sessions                  | 111                          | 41%     | 59              | 63%     | 170           | 47%     | <.001                        |
|                                                                                                                                                        | Technical precision during ementation         | 161                          | 59%     | 34              | 37%     | 195           | 53%     |                              |
| Q11.Do you favor the manufacture of indirect inlay restoration?                                                                                        | Yes                                           | 104 <sup>a</sup>             | 38%     | 71 <sup>b</sup> | 76%     | 175           | 48%     | <.001                        |
|                                                                                                                                                        | No                                            | 16 <sup>a</sup>              | 6%      | 5 <sup>a</sup>  | 5%      | 21            | 6%      |                              |
|                                                                                                                                                        | I don't know                                  | 152 <sup>a</sup>             | 56%     | 17 <sup>b</sup> | 18%     | 169           | 46%     |                              |
| Q12.How to achieve occlusion in composite restorations?                                                                                                | During intraoral direct composite processing  | 99 <sup>a</sup>              | 36%     | 42 <sup>a</sup> | 45%     | 141           | 39%     | <.001                        |
|                                                                                                                                                        | In the finishing and polishing stage with the | 82 <sup>a</sup>              | 30%     | 43 <sup>b</sup> | 46%     | 125           | 34%     |                              |
|                                                                                                                                                        | With Cad Cam production method                | 91 <sup>a</sup>              | 33%     | 8 <sup>b</sup>  | 9%      | 99            | 27%     |                              |
| Q13. Do you have any information about indirect inlay restoration production using the CAD-CAM method?                                                 | No                                            | 72 <sup>a</sup>              | 26%     | 20 <sup>a</sup> | 22%     | 92            | 25%     | <.001                        |
|                                                                                                                                                        | Yes                                           | 62 <sup>a</sup>              | 23%     | 46 <sup>b</sup> | 49%     | 108           | 30%     |                              |
|                                                                                                                                                        | i don't know                                  | 138 <sup>a</sup>             | 51%     | 27 <sup>b</sup> | 29%     | 165           | 45%     |                              |
| Q15.Was dentistry your first choice?                                                                                                                   | No                                            | 97                           | 36%     | 51              | 55%     | 148           | 41%     | .001                         |
|                                                                                                                                                        | Yes                                           | 175                          | 64%     | 42              | 45%     | 217           | 59%     |                              |
| Q16.Is there a dentist in your family?                                                                                                                 | No                                            | 238                          | 88%     | 84              | 90%     | 322           | 88%     | .466                         |
|                                                                                                                                                        | Yes                                           | 34                           | 13%     | 9               | 10%     | 43            | 12%     |                              |
| Q17.What kind of cement do you use during the cementation phase of CAD- CAM inlay restoration?                                                         | Polycarboxylate cement                        | 46 <sup>a</sup>              | 17%     | 18 <sup>a</sup> | 19%     | 64            | 18%     | <.001                        |
|                                                                                                                                                        | Resin cement                                  | 127 <sup>a</sup>             | 47%     | 67 <sup>b</sup> | 72%     | 194           | 53%     |                              |
|                                                                                                                                                        | Glass ionomer cement                          | 99 <sup>a</sup>              | 36%     | 8 <sup>b</sup>  | 9%      | 107           | 29%     |                              |

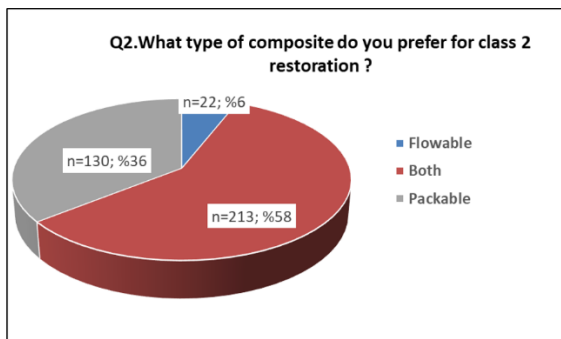
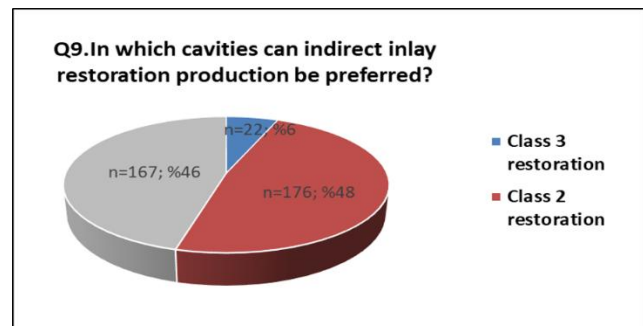
Letters (a-b) indicate differences in rows

X<sup>2</sup> Chi square test of independence

**Table 2.** Comparison of the answers given to the questions according to frequency, percentage and first choice

|                                                                                                                                                         |                                               | Q15.Was dentistry your first choice? |         |            |         | P value<br>X <sup>2</sup> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|---------|------------|---------|---------------------------|
|                                                                                                                                                         |                                               | Yes (n=217)                          |         | No (n=148) |         |                           |
|                                                                                                                                                         |                                               | N                                    | Percent | N          | Percent |                           |
| Q1. Do you feel occlusion is important?                                                                                                                 | No                                            | 3                                    | 1%      | 3          | 2%      | .795                      |
|                                                                                                                                                         | Yes                                           | 211                                  | 97%     | 142        | 96%     |                           |
|                                                                                                                                                         | Maybe                                         | 3                                    | 1%      | 3          | 2%      |                           |
| Q2. What type of composite do you prefer for class 2 restoration?                                                                                       | Flowable                                      | 14                                   | 6%      | 8          | 5%      | .892                      |
|                                                                                                                                                         | Both                                          | 125                                  | 58%     | 88         | 59%     |                           |
|                                                                                                                                                         | Packable                                      | 78                                   | 36%     | 52         | 35%     |                           |
| Q3. Is indirect inlay restoration production using CAD-CAM a precise technique?                                                                         | No                                            | 4                                    | 2%      | 8          | 5%      | .173                      |
|                                                                                                                                                         | Yes                                           | 131                                  | 60%     | 86         | 58%     |                           |
|                                                                                                                                                         | I don't know                                  | 82                                   | 38%     | 54         | 36%     |                           |
| Q4. What are the difficulties that you face while restoring a class 2 cavity with composite?                                                            | Unable to mimic occlusal                      | 74                                   | 34%     | 40         | 27%     | .335                      |
|                                                                                                                                                         | Saliva contamination                          | 55                                   | 25%     | 44         | 30%     |                           |
|                                                                                                                                                         | Technique sensitive                           | 88                                   | 41%     | 64         | 43%     |                           |
| Q5. Is indirect inlay restoration production using CAD-CAM better than the conventional method?                                                         | No                                            | 11                                   | 5%      | 8          | 5%      | .545                      |
|                                                                                                                                                         | Yes                                           | 82                                   | 38%     | 64         | 43%     |                           |
|                                                                                                                                                         | I don't know                                  | 124                                  | 57%     | 76         | 51%     |                           |
| Q6. What kind of material do you use for indirect inlay restoration production as CAD-CAM?                                                              | Composite                                     | 65                                   | 30%     | 39         | 26%     | .718                      |
|                                                                                                                                                         | Both                                          | 106                                  | 49%     | 74         | 50%     |                           |
|                                                                                                                                                         | Ceramic                                       | 46                                   | 21%     | 35         | 24%     |                           |
| Q7. How much time do you consume in finishing and polishing a posterior composite restoration done using conventional technique?                        | Less than 5 min                               | 37                                   | 17%     | 25         | 17%     | .285                      |
|                                                                                                                                                         | More than 10 min                              | 49                                   | 23%     | 44         | 30%     |                           |
|                                                                                                                                                         | 5 to 10 min                                   | 131                                  | 60%     | 79         | 53%     |                           |
| Q8. Is it possible to acquire restorations that are fully congruous with the cavity by fabricating indirect inlay restorations with the CAD-CAM method? | No                                            | 21                                   | 10%     | 21         | 14%     | .401                      |
|                                                                                                                                                         | Yes                                           | 94                                   | 43%     | 59         | 40%     |                           |
|                                                                                                                                                         | I don't know                                  | 102                                  | 47%     | 68         | 46%     |                           |
| Q9. In which cavities can indirect inlay restoration production be preferred?                                                                           | Class 3 restoration                           | 15                                   | 7%      | 7          | 5%      | .0128                     |
|                                                                                                                                                         | Class 2 restoration                           | 112                                  | 52%     | 64         | 43%     |                           |
|                                                                                                                                                         | Both                                          | 90                                   | 41%     | 77         | 52%     |                           |
| Q10.What do you believe to be the restricting factor in producing indirect inlay restorations?                                                          | Need for additional sessions                  | 99                                   | 46%     | 71         | 48%     | .658                      |
|                                                                                                                                                         | Technical precision during cementation        | 118                                  | 54%     | 77         | 52%     |                           |
| Q11.Do you favor the manufacture of indirect inlay restoration?                                                                                         | Yes                                           | 97                                   | 45%     | 78         | 53%     | .321                      |
|                                                                                                                                                         | No                                            | 13                                   | 6%      | 8          | 5%      |                           |
|                                                                                                                                                         | I don't know                                  | 107                                  | 49%     | 62         | 42%     |                           |
| Q12.How to achieve occlusion in composite restorations?                                                                                                 | During intraoral direct composite processing  | 86                                   | 40%     | 55         | 37%     | .134                      |
|                                                                                                                                                         | In the finishing and polishing stage with the | 66                                   | 30%     | 59         | 40%     |                           |
|                                                                                                                                                         | With Cad Cam production method                | 65                                   | 30%     | 34         | 23%     |                           |
| Q13. Do you have any information about indirect inlay restoration production using the CAD-CAM method?                                                  | No                                            | 59                                   | 27%     | 33         | 22%     | .567                      |
|                                                                                                                                                         | Yes                                           | 62                                   | 29%     | 46         | 31%     |                           |
|                                                                                                                                                         | I don't know                                  | 96                                   | 44%     | 69         | 47%     |                           |
| Q17.What kind of cement do you use during the cementation phase of CAD- CAM inlay restoration?                                                          | Polycarboxylate cement                        | 36                                   | 17%     | 28         | 19%     | .442                      |
|                                                                                                                                                         | Resin cement                                  | 112                                  | 52%     | 82         | 55%     |                           |
|                                                                                                                                                         | Glass ionomer cement                          | 69                                   | 32%     | 38         | 26%     |                           |

Letters (a-b) indicate differences in rows  
X<sup>2</sup> Chi square test of independence

**Figure 2.** Graphic representation of the answers to questions about which type of composite is preferred for class 2 restorations**Figure 3.** Graphical representation of the answers to the question of which cavities' indirect inlay restoration production can be preferred

**Table 3.** Comparison of answers according to frequency, percentage and whether there is a dentist in the family

|                                                                                                                                                        |                                               | Q15.Was dentistry your first choice? |         |                 |         | P Value<br>X <sup>2</sup> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|---------|-----------------|---------|---------------------------|
|                                                                                                                                                        |                                               | Yes (n=322)                          |         | No (n=43)       |         |                           |
|                                                                                                                                                        |                                               | N                                    | Percent | N               | Percent |                           |
| Q1.Do you feel occlusion is important?                                                                                                                 | No                                            | 4                                    | 1%      | 2               | 5%      | .174                      |
|                                                                                                                                                        | Yes                                           | 312                                  | 97%     | 41              | 95%     |                           |
|                                                                                                                                                        | May be                                        | 6                                    | 2%      | 0               | 0%      |                           |
| Q2.What type of composite do you prefer for class 2 restoration?                                                                                       | Flowable                                      | 16                                   | 5%      | 6               | 14%     | .670                      |
|                                                                                                                                                        | Both                                          | 190                                  | 59%     | 23              | 53%     |                           |
|                                                                                                                                                        | Packable                                      | 116                                  | 36%     | 14              | 33%     |                           |
| Q3.Is indirect inlay restoration production using CAD-CAM a precise technique?                                                                         | No                                            | 10                                   | 3%      | 2               | 5%      | .231                      |
|                                                                                                                                                        | Yes                                           | 187                                  | 58%     | 30              | 70%     |                           |
|                                                                                                                                                        | I don't know                                  | 125                                  | 39%     | 11              | 26%     |                           |
| Q4.What are the difficulties that you face while restoring a class 2 cavity with composite?                                                            | Unable to mimic occlusal                      | 98                                   | 30%     | 16              | 37%     | .546                      |
|                                                                                                                                                        | Saliva contamination                          | 87                                   | 27%     | 12              | 28%     |                           |
|                                                                                                                                                        | Technique sensitive                           | 137                                  | 43%     | 15              | 35%     |                           |
| Q5.Is indirect inlay restoration production using CAD-CAM better than the conventional method?                                                         | No                                            | 16                                   | 5%      | 3               | 7%      | .663                      |
|                                                                                                                                                        | Yes                                           | 127                                  | 39%     | 19              | 44%     |                           |
|                                                                                                                                                        | I don't know                                  | 179                                  | 56%     | 21              | 49%     |                           |
| Q6.What kind of material do you use for indirect inlay restoration production as CAD-CAM?                                                              | Composite                                     | 89                                   | 28%     | 15              | 35%     | .387                      |
|                                                                                                                                                        | Both                                          | 163                                  | 51%     | 17              | 40%     |                           |
|                                                                                                                                                        | Ceramic                                       | 70                                   | 22%     | 11              | 26%     |                           |
| Q7.How much time do you consume in finishing and polishing a posterior composite restoration done using conventional technique?                        | Less than 5 min                               | 54                                   | 17%     | 8               | 19%     | .849                      |
|                                                                                                                                                        | More than 10 min                              | 81                                   | 25%     | 12              | 28%     |                           |
|                                                                                                                                                        | 5 to 10 min                                   | 187                                  | 58%     | 23              | 53%     |                           |
| Q8.Is it possible to acquire restorations that are fully congruous with the cavity by fabricating indirect inlay restorations with the CAD-CAM method? | No                                            | 35                                   | 11%     | 7               | 16%     | .580                      |
|                                                                                                                                                        | Yes                                           | 136                                  | 42%     | 17              | 40%     |                           |
|                                                                                                                                                        | I don't know                                  | 151                                  | 47%     | 19              | 44%     |                           |
| Q9.In which cavities can indirect inlay restoration production be preferred?                                                                           | Class 3 restoration                           | 16                                   | 5%      | 6               | 14%     | .054                      |
|                                                                                                                                                        | Class 2 restoration                           | 159                                  | 49%     | 17              | 40%     |                           |
|                                                                                                                                                        | Both                                          | 147                                  | 46%     | 20              | 46%     |                           |
| Q10.What do you believe to be the restricting factor in producing indirect inlay restorations?                                                         | Need for additional sessions                  | 151                                  | 47%     | 19              | 44%     | .738                      |
|                                                                                                                                                        | Technical precision during mentation          | 171                                  | 53%     | 24              | 56%     |                           |
| Q11.Do you favor the manufacture of indirect inlay restoration?                                                                                        | Yes                                           | 155                                  | 48%     | 20              | 47%     | .531                      |
|                                                                                                                                                        | No                                            | 20                                   | 6%      | 1               | 2%      |                           |
|                                                                                                                                                        | I don't know                                  | 147                                  | 46%     | 22              | 51%     |                           |
| Q12.How to achieve occlusion in composite restorations?                                                                                                | During intraoral direct composite processing  | 131 <sup>a</sup>                     | 41%     | 10 <sup>b</sup> | 23%     | <b>.049</b>               |
|                                                                                                                                                        | In the finishing and polishing stage with the | 104 <sup>a</sup>                     | 32%     | 21 <sup>b</sup> | 49%     |                           |
|                                                                                                                                                        | With Cad Cam production method                | 87 <sup>a</sup>                      | 27%     | 12 <sup>a</sup> | 28%     |                           |
| Q13. Do you have any information about indirect inlay restoration production using the CAD-CAM method?                                                 | No                                            | 80                                   | 25%     | 12              | 28%     | .905                      |
|                                                                                                                                                        | Yes                                           | 96                                   | 30%     | 12              | 28%     |                           |
|                                                                                                                                                        | I don't know                                  | 146                                  | 45%     | 19              | 44%     |                           |
| Q15. Was dentistry your first choice?                                                                                                                  | No                                            | 136                                  | 42%     | 12              | 28%     | .072                      |
|                                                                                                                                                        | Yes                                           | 186                                  | 58%     | 31              | 72%     |                           |
| Q17.What kind of cement do you use during the cementation phase of CAD- CAM inlay restoration?                                                         | Polycarboxylate cement                        | 59                                   | 18%     | 5               | 12%     | .546                      |
|                                                                                                                                                        | Resin cement                                  | 169                                  | 52%     | 25              | 58%     |                           |
|                                                                                                                                                        | Glass ionomer cement                          | 94                                   | 29%     | 13              | 30%     |                           |

Letters (a-b) indicate differences in rows  
X<sup>2</sup> Chi square test of independence

Table 3 shows whether there is a significant difference in other questions, such as whether there is a dentist in the family or not. There was a significant difference in Q12 (How do you achieve occlusion in composite restorations?) ( $P = .049$ ). Participants who had a dentist family member indicated that the occlusion of the composite restoration was achieved through the finishing and polishing stages. Conversely, participants who did not have a dentist in their family reported that occlusion was achieved during the direct intra-oral composite processing phase.

Figure 2 shows the overall percentage distribution of the type of composite used; 6% gave the answer "flowable", approximately 36% gave the answer "packable", and the remaining 58% gave both answers.

Figure 3 shows the percentage distribution of the question asking in which cavity inlay restorations are used; 48% gave the answer "class 2", 6% gave the answer "class 3", and 46% gave both answers.

The null hypothesis of this study was rejected because undergraduate dentistry students' knowledge and practices regarding the use of CAD-CAM in inlay restorations of Class 2 caries in posterior teeth needed to be revised.

## DISCUSSION

Recently, a global effort has been made to integrate CAD-CAM applications into dental undergraduate curricula.<sup>15-17</sup> These initiatives are thought to affect both dental education institutions and students positively, and it is emphasized that the results will be beneficial in the long term despite the challenges encountered.<sup>15</sup>

Given the results of the survey conducted in this study, there is already an awareness of CAD-CAM technology among dentistry students in Afyonkarahisar Health Sciences University. This finding is consistent



with those reported in previous studies. Brownstein et al.<sup>18</sup> developed a 19-item survey to determine the penetration of 12 dental practice technologies into the US dental curriculum. He administered these questions to 62 dental schools in the USA. As a result, they found that dental faculty who were 60 years old or older were less interested in adopting new technological advancements.

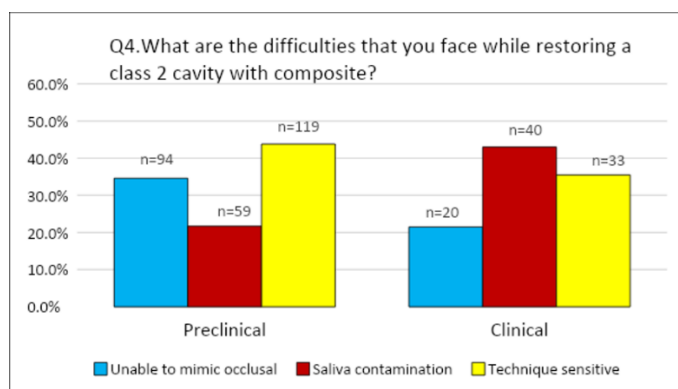
It was observed in this study that CAD-CAM education at the undergraduate level needs to be more present in practice. Therefore, almost all faculties will be inadequate in preparing their graduates to use this technology, and they will need to address these gaps through post-graduation training. Current literature data also indicate a global resistance to integrating CAD-CAM technology into fundamental dental education.<sup>19</sup>

The results achieved in this study showed that reproducing occlusal anatomy using the CAD-CAM method is accurate and less time-consuming.<sup>20</sup> These results indicate that participants in all groups need more knowledge and awareness of using CAD-CAM production techniques in regular clinical practice.

When asked about the material used in Class II restorations, approximately 6% reported using flowable composite, 36% reported using packable composite, and 58% reported using both.

Regarding the materials used during CAD-CAM production, 28% mentioned using composite, 22% mentioned using ceramic, and 49% indicated using both materials.

Tambake et al.<sup>21</sup> stated that it takes less time to recreate occlusal anatomy using the CAD-CAM production technique, which reduces chairside time and material consumption. Figure 4 illustrates the significance of the challenges encountered in composite restorations among preclinical and clinical students (Table 1). Most clinical students find saliva contamination challenging, while preclinical students consider it time-consuming. The p-value indicates statistically significant results.



**Figure 4.** Graphical representation of the answers given by preclinical and clinical students to the question, "What difficulties did you encounter while restoring a class 2 cavity?"

In a study carried out by Patil et al.<sup>22</sup>, the CAD-CAM production technique prevented primary occlusal trauma, leading to functional restoration and accurate occlusal anatomy. Alshehadeh et al.<sup>23</sup> reported quickly achieving a good fossa relationship with opposing teeth and using the CAD-CAM production technique in intensive dental practices. However, in the present study, approximately 39% of the students reported that occlusion could be achieved during intraoral direct composite processing, approximately 35% during intraoral finishing and polishing, and 27% using the CAD-CAM fabrication technique in composite restorations. This result indicates that undergraduate

students need more opportunities and awareness regarding the use of CAD-CAM.

It was expected that participants would rank shortened treatment duration and the opportunity for standard production with minimal errors as the essential advantages of CAD-CAM since Fernandez et al.<sup>19</sup> highlighted similar features as distinct advantages of the technology in a study on US dental schools. Current dental education should reflect the level of advancement digital dentistry has reached worldwide<sup>17</sup>. While it is known that CAD-CAM is covered in the undergraduate level theoretical curriculum,<sup>17</sup> it needs to be integrated into the curriculum in practical applications, given that practical applications are an integral part of dental education. It is difficult to make significant changes to the fundamental dental curriculum; many educational institutions will be reluctant about adding new practices to the curriculum until evidence-based results emerge, and it takes a long time for new applications to produce evidence-based outcomes.<sup>15</sup> However, once positive evidence is achieved, institutions should be more open to changing the established curriculum and disrupting the well-functioning system.<sup>18,19</sup> Thus, it is easier to integrate new technologies into the curricula of institutions during the development phase.<sup>18</sup>

This study's limitations include geographical restrictions and sample size. Future studies should expand the geographical scope, increase the sample size, and enhance awareness and knowledge of CAD-CAM use in inlay cavities in undergraduate curricula.

## CONCLUSION

The development of new technologies in the field of dentistry and their utilization by dentists require a specific educational process. Postgraduate courses are often provided to help dentists keep up with rapidly evolving innovations. On the other hand, educational institutions must provide their students with curricula that are up-to-date with current knowledge. During their undergraduate years, students should have the opportunity to learn the practices they will frequently use in their profession after graduation. This study aimed to investigate the extent to which CAD-CAM technology is incorporated into undergraduate dental curricula in Turkish dental faculties. The results suggest that CAD-CAM has yet to be included in undergraduate applied education. The level of awareness is still increasing, and there is a high level of interest in this regard.

**Ethics Committee Approval:** The Ethics Committee for Clinical Research of Afyonkarahisar Health Science University Faculty of Dentistry approved the study protocol on 02.06.2023, under protocol number 2011-KAEK-2.

**Informed Consent:** Written consent was obtained from all participants participating in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – K.K., R.Z.E.; Supervision – K.K., R.Z.E.; Resources – K.K.; Materials – K.K., R.Z.E.; Data Collection and/or Processing – K.K., R.Z.E.; Analysis and/or Interpretation – K.K., R.Z.E.; Literature Search – K.K.; Writing Manuscript – K.K.; Critical Review – K.K., R.Z.E.

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