Cross-Sectional Study

QUALITY ASSESSMENT OF COMPOSITE RESTORATIONS DONE AMONG THE PATIENTS VISITING DENTAL SCHOOL CLINICS: A RADIOGRAPHIC CROSS-SECTIONAL STUDY

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ABSTRACT

Radiographic evaluations enable clinicians to detect hidden composite defects such as voids and margin irregularities and their assessment remains vital in dental school clinics especially for restorations done by supervised student trainees. These clinical environments serve as effective testing grounds for assessing restorative quality and tracking the pattern of failed restorations. A retrospective study utilizing the patients' data such as various types of radiographs. Patients' files from Namuthijiya and Muneseya campuses were accessed once ethical approval was acquired. The total sample of 200 students (with their patient files) included 100 males and 100 females. 25 x-rays from each level and gender were selected. Reasons of composite restoration failure including fracture, secondary caries, irregular margins, overhangs and lack of proximal contact were assessed and documented. Moreover, the patients' data such as gender, age, systemic disease and operator's level were also noted. Among the 200 files we screened. 22% of the files had subpar quality, out of which 41% of the patients were treated by male students, and 59% by females. The most commonly observed reason of composite restoration failure was secondary caries (34%), and overhangs being the least observed reason (11%). It can be concluded that the overall quality of dental students' placed restorations was satisfactory.

Key words: Composite restorations, Patients visiting, Dental school clinics, Radiographic cross-sectional.

Introduction

Restorative dentistry relies on composite restorations because these materials deliver remarkable appearances through their fast application processes along with diverse design flexibility. Dental professionals apply these materials broadly to treat cavities which damage teeth as well as fractured teeth. Composite restorations struggle to achieve extended lifespans because external hazards such as secondary caries combined with marginal failures and material damage obstruct their development. Inadequate margin sealing along with bacterial access through tooth structure pathways drives most restoration failures known as secondary caries. According to Nedeljkovic *et al*. (2020), Class II restorations experience marginal defects primarily because they frequently appear next to the gingiva [1].

Radiographic evaluations enable clinicians to detect hidden composite defects such as voids and untreatable caries and margin irregularities [2]. Assessment of dental restorations remains vital in dental school clinics especially for restorations carried out by supervised student trainees. These clinical environments serve as effective testing grounds for assessing restorative quality and tracking the pattern of failed restorations [3].

Literature review

Current material science developments have not solved the problems with secondary caries along with marginal degradation and material failure in dental applications. Secondary caries originating from poor bonding or polymerization shrinkage has become the primary reason for restoration failure. Gingival margins of class II restorations present the most susceptible location for secondary caries formation [1]. The detection of subclinical defects requires radiographic evaluations according to Petti *et al*. (2022) which enables timely treatment [2]. Skilled maneuvering by dental operators determines the exact quality of their restorations. Dental students' skills with protocol compliance are essential to achieve optimal restoration results.

Kanzow *et al*. (2017) demonstrated operator expertise serves as a major determinant affecting restoration survivability time [4]. According to Dawson *et al*. (2016) the material selection process matters because secondary caries and marginal failures occur with greater frequency in composite restorations in place of amalgam [5]. The outcome success of restorations is influenced by both patient-related factors and variables such as oral hygiene conditions and caries risk and underlying health problems. The outcome of restorative procedures deteriorates among at-risk patients with inadequate oral care practices yet preventive strategies along with patient education prove essential for success [6].

Large restorations made of composites in endodontically treated teeth needs greater monitoring since these teeth demonstrate higher failure chances particularly when multiple roots are present [7]. Recent developments in

composite materials technology improved both material wear resistance and decreased shrinkage effects which lead to superior clinical results. Long-term success demands maintaining correct placement methods as a primary requirement [3]. Multiple studies by Silnovic *et al*. (2023) along with other similar research show that radiographic examinations help reveal restoration weaknesses which ultimately increase treatment durability [8].

Study rationale

Findings of this study will help in determining the reasons of composite restoration failures and addressing these to the students in order to improve their clinical performance.

Research question

Is the level of composite restorations done by dental students satisfactory?

Hypothesis

The quality of dental students' composite restoration is satisfactory.

Study aim

To assess the quality of undergraduate dental students when it comes to composite restorations.

Study objectives

- To determine the prevalence of failed/faulty composite restorations in the clinics.
- To list down the causes of composite restorations failure.
- To compare the prevalence of failure on the basis of students' dentistry levels.

Materials and Methods

Study design

A retrospective study utilizing the patients' data such as various types of radiographs.

Study sample

Sample size was calculated using https://www.calculator.net

Confidence level: 95%

Margin of Error: 5%

Population portion: 50%

Population size: 1000

Minimum sample size: 200

Inclusion criteria

- Radiographs for the patients treated by level nine to twelve students.
- Patients treated between January 2021 to December 2024.
- Composite restorations of posterior teeth (1st and 2nd premolars and 1st molars).
- Patients aged between 13-30 as other factors may affect the restorations after the age of 30.
- Radiographs free of any artifact.

Exclusion criteria

- Radiographs for the patients treated by level 8 or interns.
- Composite restorations of anterior teeth and 2nd molars.
- Radiographs which are not clear or having an artifact.

Methodology

Patients' files from Namuthijiya and Muneseya campuses were accessed once ethical approval is acquired. The total sample of 200 students (with their patient files) was included 100 males and 100 females. 25 x-rays from each level and gender were selected. Two examiners reviewed each radiograph (bitewings and OPGs) and interrater reliability was measured. Reasons of composite restoration failure including fracture, secondary caries, irregular margins, overhangs and lack of proximal contact were assessed and documented. Moreover, the patients' data such as gender, age, systemic disease and operator's level were also noted.

Data analysis

Data were entered into the Statistical Package for Social Sciences (IBM SPSS Statistics for Windows) version 21. Descriptive as well as inferential statistics were performed and presented in tables and graphs. Chi-square test was done to compare the prevalence of restoration failures on the basis of students' levels and gender.

Ethical approval

This study requires an ethical approval and was registered in the Riyadh Elm University's research portal.

Results and Discussion

Table 1. Descriptive statistics related to the failed composite restorations

Variables	Frequencies	P-value
Gender	Males: 41% Females: 59%	<0.05*
Dentistry level	Level 9: 32% Level 10: 28% Level 11: 23% Level 12: 17%	<0.05*
Reasons of restoration failure	Secondary caries: 34% Irregular margins: 24% Overhangs: 11% Lack of proximal contact: 17% Fracture: 14%	

This table displays the descriptive statistics from the study

regarding the failed composite restorations focusing on gender, level of dentistry, and the failure reason. The woman proportion is greater than the male proportion as 59 percent of the sample are females while males were 41 percent. The <0.05 p-value shows that there is gender difference and it is statistically significant meaning that the gender difference has important impact within the context of the study.

In terms of the study's categorization, the majority of the participant's experience level is dentistry level 9 with 32 percent followed by level 10-28 percent, level 11-23 percent, and level 12-17 percent. The level of acquired skill indicated p-value < 0.05 having statistically significant relationship with the study sample outcomes, which suggests that the higher the level of expertise, the lower the failure rates in composite restorations.

The table provides different reasons for the restoration failures. The primary cause for the failures seems to be secondary caries , which makes up 34% of failure cases, then follows irregular margins (24%), lack of proximal contact (17%), fractures (14%), and overhangs (11%). Even though the table does not offer a p-value for the reasons of failure, these frequencies shed light on the most prevailing causes of restoration failure. These findings indicate how multifaceted restorative dentistry is, and they have to use these issues to improve the results of treatment.

In general, the table demonstrates why both demographic and professional level factors matter when considering the failure of restoration and what particular aspects of failure the clinician has to concentrate on so that the rate of failure gets reduced and restoration succeeds in the long run.

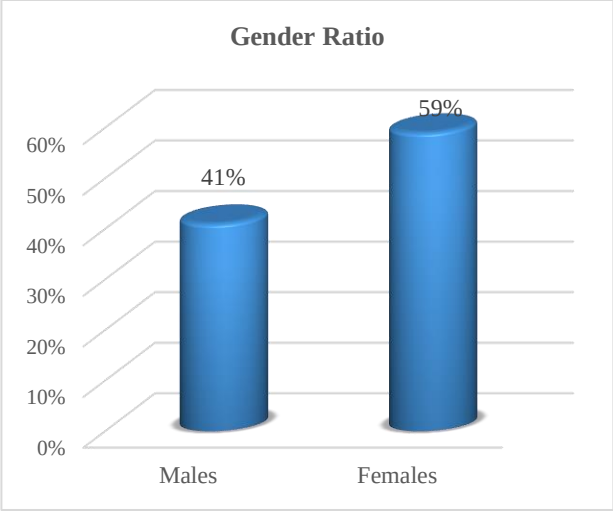

Figure 1. Prevalence of failed composite restorations on the basis of gender

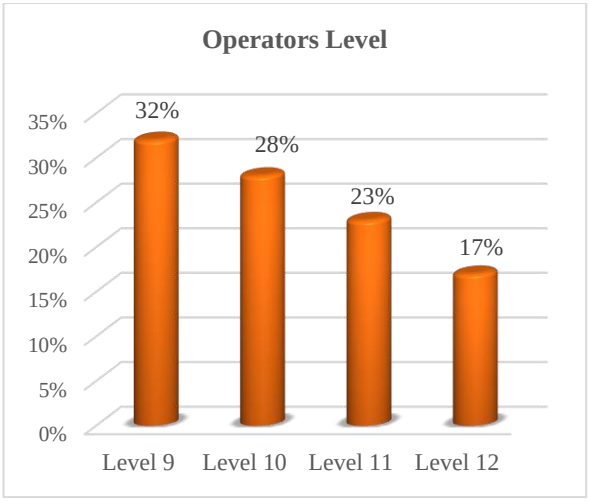

Figure 2. Prevalence of failed composite restorations on the basis of operator's level

Figure 3. Reasons of restoration failure observed among the prevalent cases

In this study, the failure of composite restorations was also analyzed one the basis of gender, level of dentistry, and reason for failure. Patient factors and operator skill level were analyzed with the type of restoration with which patients were treated, and some other studies focused on these components. In this discussion, our aim is to analyze the outcome of our present study in relation to what the previous studies have done and expose the similarities and differences in the results.

Gender and restoration failure

An important finding of this study was the statistically significant difference between male and female participants and their respective failure rates. The sample consisted of 59% females and 41% males. A p-value of <0.05 indicated that there was an effect of gender on the outcome of failures in restorations. In contrast, previous studies have shown

mixed results regarding the association between gender and restoration failure. For instance, Wanyonyi *et al*. (2013) found that female patients placed more acceptable class II composite restorations than males [9], a finding similar to ours, where females had a higher percentage of failures. However, unlike us, they did not discuss the differences in gender failure rates. Other studies, such as those by Pallesen *et al*. (2013) and Wong *et al*. (2021), found no evidence for an effect of gender regarding the failure rates and rather attributed the failures to oral hygiene, age, and specific restorative techniques employed [10, 11].

The results of our study may suggest a number of uncontrolled factors, including differences in hormones that can affect the preservation of the restorative materials, variations in patient oral care routines, and other patient specific factors that have not been explored in previous research. These other factors could be addressed in future research in the context of gender differences to uncover more profound reasons behind failure.

Operator experience and dentistry level

There was a significant statistically proven relation with the level of the experience of the dental operator and the frequency of the restoration failing from our study. This aligns with other studies regarding the impact of operator experience on the outcomes of restoration procedures. According to Al-Asmar *et al*. (2023), the academic grade of the student executing the restoration had no considerable influence on the failure rate in comparison with other factors such as oral hygiene or age [12]. In our investigation, however, the grade of the students at the dentistry school, divided into grades 9, 10, 11, and 12, demonstrated marked differences in the ranges of results achieved through the restorations performed with the higher grade students achieving superior results. Moreover, prior works like Heintze (2015), correlate our findings suggesting that more experienced operators achieve better quality restorations [13]. In contrast, Al-Asmar *et al*. (2023) did not observe a considerable disparity in failure rates with respect to students' level, which may stem from differences in methodology, sample size, or focusing on oral hygiene and other patient-related factors [12].

One of the significant differences is that our study integrates all levels of dentistry. Moura *et al*. (2011) and Baldissera *et al*. (2013) highlight more advanced above mentioned students as having higher performance, which, according to the authors, is associated with the use of advanced techniques and techniques and the reduction of errors associated with restoration failures [14].

Reasons for restoration failure

In our study, the most frequent reason for failure was secondary caries (34%), followed by irregular margins (24%) and proximal contact (17%), fractures (14%), and overhangs (11%). This is consistent with many previous studies that grouped together the failures of composite restorations because of fractures, caries, and marginal defects. Wong *et al*. (2021) had similar findings in his study where restoration fractures along with caries and defective margins were the primary reasons of failure [11]. These fractures are most likely the result of the material's inability to endure chewing forces over time or proper adhesion and sealing not being achieved. Fractures, especially in Class IV restorations, were reported as the most common failure reason in several studies [13]. While our study had a smaller percentage of fractures (14%) aligned with other studies, fractures remained a notable source of failure in our study. This indicates that although fractures may not be as prevalent in our study, the persistent concern of restorative dentistry remains.

A secondary difference in our study was that secondary caries was found to be the most prevalent cause of failure when, for Wong *et al*. (2021), caries was a less frequent finding [11]. This might have been due to the differences in the patient population, the materials that were used, or the duration of the follow-up periods. In the Kuwaiti study, Pallesen *et al*. (2013) also reported a high prevalence of recurrent caries (71.4%) as a major reason of failure, which is markedly higher when compared to the 1% failure rate due to secondary caries in our study [10]. This discrepancy may stem from differences in follow-up time, sample size, and even the emphasis placed on posterior restorations in their study.

While overhangs as well as secondary caries and fractures are often the most frequent reasons for failure, other studies have pointed out the need to consider other reasons, such as lack of proximal contact, improper margins, or even overhangs. Wanyonyi *et al*. (2013) pointed out overhangs as one of the commonest defects in Class II restorations, a finding that corresponds with ours [9], where overhangs were noted in 11% of failed restorations. Overhangs result from inadequate material placement and finishing, poor bonding, or inadequate bonding—deficiencies that are common in student restorations.

Conclusion

In the conclusion, explaining the reasons for the failure of composite restorations, the gender of the patient, and the operator's experience did impact the outcome. However, it is notable that there are some discrepancies with prior studies. For example, the operator experience related to the restoration was in fact in line with previous research, but the absence of notable gender difference in some of the studies suggest that there are other more powerful factors that determine why there are high failure rates. Also, the reasons for restoration failure, especially secondary caries, overhangs, and fractures do align with past observations, showing that there is still a concern regarding techniques related to placement, choice of materials, and restoration make.

The reasoning as such underscores the need for more comprehensive investigations involving extended above mentioned factors, greater number of participants, and consideration of other relevant patient factors like level of oral hygiene practiced, age, and socioeconomic status in order to achieve a full understanding of composite restoration failure. Studies centered on the long-term use of various composite materials, operator education, and training also tend to be helpful in increasing restoration success rates.

Clinically, these findings indicate that greater attention should be directed towards the skill and training of the dentists, especially concerning the more intricate restorations, as well as the typical reasons for failure like recurrent caries, overhangs, and abutments. Additionally, patient related factors such as oral hygiene must be taken into account when assessing the longevity of success attributed to restorative recapturing cavities.

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