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Modified cavity surface preparation for composite restoration

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ABSTRACT

A composite restoration is placed in a cavity after removing dental caries. Composite restorations are very common today because of the growing prevalence of dental erosion and other dental problems. The objective of this study was evaluating the retention of composite material in conventional and modified cavity surface. A survey of practicing dentists and dental students was undertaken. The sample population was selected using stratified random sampling, which involves stratifying the target population into specific groups then using random selection to pick participants from each group. The target population will be stratified into two strata including the practicing dentists' stratum and the dental students' stratum. From the practicing dentists' stratum, three participants will be selected randomly while 20 dentists 80 students' participants will be selected from the dental students' stratum. Therefore, the sample population for the survey research will be 100 participants. The participants will be issued with survey questionnaires and will be required to fill them and return them for analysis. The analysis will involve quantitative and qualitative processes. About 73% of the participants are aware of were aware of the composite restoration and effectiveness of composite restoration whereas 54.8% of the participants were aware about modified cavity surface preparation for composite restoration. Thus, modified cavity surface preparation is hypothesized to provide greater bond structure. This study has strong support for the use of modified cavity preparation in composite restoration as an effective strategy in restorative dentistry.



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INTRODUCTION

In the field of dentistry, conservative dentistry is one of the major sub-fields. Conservative dentistry includes endodontics and operative dentistry. In

conservative dentistry, the various types of direct and indirect tooth restorations are conducted. Otherwise referred to as restorative dentistry, conservative dentistry is concerned with restoring defective teeth to prevent the complete loss of such teeth. Teeth can become defective because of various factors such as disease, abnormal development, and trauma. Conservative dentistry serves two main purposes including restoring teeth to their full function and ensuring aesthetic appeal of the teeth. While the purpose and importance of conservative dentistry are widely acknowledged, the specific procedure and effectiveness of different resins used in restorative dentistry is still a matter of debate. Based on this, this paper seeks the effectiveness of composite resin restorations.

Specifically, the paper seeks to determine the effectiveness of modified cavity preparation for composite restoration.

This research will seek answers to the following research questions.

Research question 1: Is composite resin restoration an effective and long-lasting dental restorative technique compared to amalgam restoration?

Research question 2: Does modified cavity surface preparation affect the longevity and effectiveness of composite restoration.

The current research will focus on modified cavity surface preparation as an essential step in composite restoration. Although composite restoration is a long process, the research will only be concentrated on the modified surface cavity preparation alone. Additionally, based on the two research questions, the research will only focus on the level of understanding and application of modified surface cavity preparation in the field of conservative dentistry.

MATERIALS AND METHODS

A survey of practicing dentists and dental students was undertaken. The sample population was selected using stratified random sampling, which involves stratifying the target population into specific groups then using random selection to pick participants from each group (Alomari, Q. D., *et al.*, 2001). The target population will be stratified into two strata including the practicing dentists' stratum and the dental students' stratum. From the practicing dentists' stratum, three participants will be selected randomly while 20 dentists 80 students' participants will be selected from the dental students' stratum. Therefore, the sample population for the survey research will be 100 participants. The participants will be issued with survey questionnaires and will be required to fill them and return them for analysis. The analysis will involve quantitative and qualitative processes (Carlen, A., *et al.*, 2001).

To ensure research ethics, several issues are considered. First, participation in primary research will be purely based on personal consent. A consent form will be issued to participants before they can accept to be part of the research. Second, the privacy of the participants will be ensured by not requiring them to provide personal details such as names, addresses, and telephone contacts that may lead to their identification.

RESULTS

From the research survey, several findings emerged. First, maximum response was recorded in that all the 100 participants returned their filled

questionnaires (Graph 1). Second, 73 participants (73 per cent) reported that they were aware of composite restoration. This comprised of the 20 practicing dentists and 53 dental students. Third, out of the 73 participants who were aware of composite restoration, the majority (73%) felt that composite restoration was as effective as or more effective than amalgam restoration. Fourth, only 40 out of the 73 participants who knew about composite restoration knew about modified cavity surface preparation for composite restoration. The ten practicing dentists were among the 40. Fifth, when asked whether modified cavity surface preparation improved the longevity of composite restorations, only 33 out of the 73 participants (45.5 per cent) responded positively

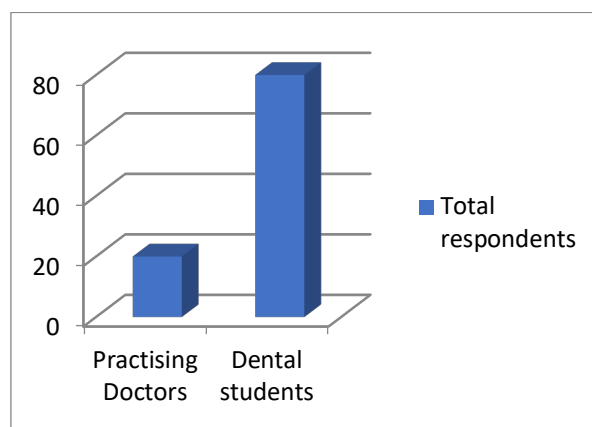


Figure 1: Total number of respondents

(Table 1 and Graph 2). Finally, when asked about the reasons why they thought modified cavity surface preparation was effective, some of the main responses included;

- i. Composite resins are different from amalgam resins hence the need for modification of cavity surface preparation.
- ii. Composite resins are quite different from the tooth material (enamel and dentine)

Conservative surface preparation, i.e. G. V. Black's cavity preparation was not appropriate for composite restoration because it created more room for secondary carries format.

DISCUSSION

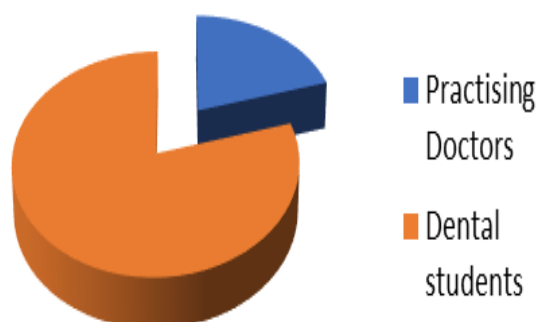
Composite restorations are quite common today because of the growing prevalence of dental erosion and other dental problems (Ceballos, L., *et al.*, 2001). Composite resins are widely used because they provide several advantages including strong physical and mechanical properties, dissolution resistance, and great aesthetics (Eakle, W. S. 1986). However, the popularity of composite resins was challenged about four decades ago when it emerged that amalgam restorations were better (Hossain, M., *et al.*, 2002). According to Leinfelder,

Table 1: Variation in the effectiveness of composite restoration

Parameter	Number	Composition
Total respondents	100(100%)	20 practicing 80 dental students
Awareness of Composite restoration	73(73%)	20 practising, 53 dental students
The effectiveness of Composite restoration	73(73%)	15 practising, 58 dental students
Awareness of modified cavity surface preparation	40 out of 73(54.8%)	10 practicing 30 dental students
Improved longevity	33(45.5%)	6 practicing 27 dental students

composite resins had higher rates of wear as well as the higher occurrence of carries compared to amalgam (Jamari, G. S., & Iqbal, Z. 2017). Over the recent years, composite resins have been enhanced to ensure less wear and occurrence of carries after composite restorations. In one of the study, it has stated that treatment with air abrasion (aluminium trioxide particle) is more effective and it may be suggested for composite repair (Jepson, N. J., *et al.*, 2003).

The effectiveness of composite restoration is based on several factors. First, it is based on the composition and load rate of the composite resins. A study which was done in 2001 stated that acid etching alone gave the lowest microleakage at the occlusal margin and no difference was found were found for microleakage on the gingival wall, although lased dentin surfaces presented several characteristics that appear to be advantageous for bonding (Johansson, A. K., *et al.*, 2012). According to Leinfelder, the rate of wear of composite resins can be reduced by partly Reducing the filler particle dimension as well as increasing load rate. However, this technique is only effective in reducing the rate of wear. It does not address the other main problem of formation of secondary carries (Karaarslan, E. S., *et al.*, 2012). On the other hand, it was stated in a study that ceramically reinforced glass ionomer demonstrated superior biocompatibility compared to conventional glass ionomer and composite resin (Lee, M. R., *et al.*, 2007)

**Figure 2: Effectiveness of composite restoration among 73 participants**

The problem of secondary carries formation is largely based on the cavity surface preparation before the composite restoration. According to Karaarslan *et al.* (2012), the removal of carries as an essential part of tooth surface preparation is crucial for the strong bonding between the resin and the tooth. Jepson *et al.* emphasize the importance of cavity surface preparation for successful composite restoration by noting that there is increasing evidence supporting the role of tooth preparation in enhancing the survival of composite restorations through improved bonding and resistance form (Leinfelder, K, F. 2011).

In reducing the formation of secondary carries after composite restoration, a major technique has been the modification of cavity preparation. Initially, G. V. Black's cavity preparation technique was widely used (Lutz, F., *et al.*, 1991). This preparation process was primarily meant for amalgam restoration and specifically targeted the tooth region with the highest concentration of plaque and bacteria. This meant that buccal and lingual preparation was minimized to avoid interfering with the strength of the affected tooth (Nordbo, H *et al.*, 1993). This left a considerable interfacial gap that provided a necessary environment for the invasion of microorganisms that produce carries (Paquette, D. E., *et al.*, 1983). This problem was significantly reduced when composite resins were used instead of amalgams. Composite restoration utilizes dentin-bonding agents, which require cavity preparation covering the full margin length leaving no interface for the invasion of microorganisms (P.Neelakantan, *et al.*, 20012).

Whereas Eakle has done a study to determine whether composite resin bonded to enamel and dentin can increase the fracture resistance, and he has concluded that teeth restored with combined enamel and dentin bonded composite resins were significantly more resistant to fracture than the unrestored teeth. Besides that according to Ghulam in his recent study which was conducted in 2017, he

stated that there was no postoperative sensitivity when tested with electric pulp test n cold after 2 and seven days. Yamada has stated that highly irregular surface may facilitate good adhesion of composite resin with enamel or dentin, and this irregular surface plays a major role in decreasing microleakage (Yamada, 2002). According to Alomari, he has stated that a statistically significant difference in gap formation with resin composite restorations (Polity, D., F., & Beck, C., T. 2004). One of the studies done by Nordbo, he has concluded that retention, resistance form, and wear resistance of the saucer-shaped cavity preparation were satisfactory after three years.

Furthermore, the use of low initial light intensity (270mW/cm (2)) for 10s followed by high-intensity light (600mW/cm (2)) for the 50s provides the best adaptation of resin composite to cavity walls and possibly the least polymerization contraction stress (Sirin Karaarslan, E., *et al.*, 2016). In addition, the representative one-step self-etching adhesive demonstrated the strongest bond to white mineral trioxide aggregate (WMTA) immediately after fabrication of MTA samples. Moreover, Lutz in the year 1991 has stated that excellent marginal adaptation extends the longevity of restorations.

However, some studies have also shown that modified cavity surface preparation as having poor outcomes in composite restorations. In a study to investigate the performance of composite resins in primary molars, Paquette *et al.* (1983), used two cavity preparations including the conventional cavity preparation and a modified cavity preparation to investigate the longevity of composite resins among a sample population. One of the main findings from the study was that modified cavity preparation had higher rates of failed restorations. This finding suggests that modified cavity surface preparation is not effective in improving the effectiveness and longevity of composite restoration (S Tamilselvam, *et al.*, 2013).

From the review of literature above, it is not clear yet whether the use of modified cavity surface preparation is an effective strategy for enhancing the longevity and effectiveness of composite restorations. There are mixed findings, which this research aims to clarify. However, there is growing evidence that composite restoration is becoming more common because of the improvements that have reduced some of the main shortcomings of composite resins (Terry, D., & Leinfelder, K. 2008).

From the research findings, it is apparent that composite restoration is a widely known concept. The fact that all the three practitioners knew about it and a majority of the dental students also knew about it shows that composite restoration is be-

coming a widely used and studied area. Additionally, the fact that majority of the participants felt that composite restoration was as effective or more effective than amalgam restoration supports this finding. If composite restoration were not equally effective as amalgam restoration, it would not be as popular as it is now. These findings are not surprising. From the literature review, Terry and Leinfelder (2008) noted that composite restorations were now as effective as amalgam restorations because of several improvements. Based on these findings, the first research question regarding the effectiveness of composite restorations has been answered. Specifically, the research findings provide great support for the assertion that composite restorations are indeed as effective as amalgam restorations. In a study, it was concluded that the adhesion between restoration and dental tissues appears to be crucial for cuspal reinforcement and cuspal deflection increased with increasing cavity dimension and C-factor (Yoshikawa, T., *et al.*, 2001)

With regard to the use and effectiveness of modified cavity surface preparation for composite restoration, the survey provided mixed findings. The application of modified cavity surface preparation was quite common in restorative dentistry. This is supported by the finding that all the three practicing dentists were aware of the procedure, which suggests that they may have used it or seen it being used. However, the understanding of the effectiveness of modified cavity surface preparation in improving the longevity of composite restoration is quite low. Less than 50 percent of the participants acknowledged that modified cavity surface preparation enhanced composite restoration longevity. The reasons provided for this are supported by previous studies. In a study to determine the surface characteristics of composite resin and glass monomer, Carlen *et al.*, (2001) established the polishing the surface of composite resins changed their characteristics in terms of biofilm and plaque formation. This implies that composite resins have different surface characteristics to tooth surface characteristics hence the need for modified cavity surface preparation. Just like Leinfelder (2011) argues, modified cavity surface preparation during composite restoration reduces the formation of secondary carries. Therefore, with regard to the second research question, there is some support for the assertion that modified cavity surface preparation enhances the longevity of composite restorations.

CONCLUSION

In conclusion, this study has provides strong support for the use of composite restoration as an ef-

fective strategy in restorative dentistry. Additionally, the study has provided some support for the use of modified cavity surface preparation in improving the longevity of composite restorations. Based on these findings, the study recommends the performance of additional research to establish a comprehensive understanding of composite restoration and how modified cavity surface preparation affects its longevity. Such studies should focus on specific issues and areas of concern. The findings from this study can provide a strong basis for such future studies.

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