Aim and Objective: This survey investigated bonding system type and composite application rationale by senior dental students at a dental school in Saudi Arabia.

Materials and Methods: Eighty-three questionnaires with 15 open and closed questions were randomly distributed to final year dental students about the use of etch and rinse versus self-etch adhesives and application techniques for posterior resin composite. Data were collected, and statistical analysis was done using Chi-square test (0.05) with two factors “question answer” and “gender.”

Results: For all questions, the impact of gender was statistically nonsignificant ($P > 0.05$). Etch and rinse adhesive was significantly ($P > 0.05$) favored by students with majority do not perform selective etching, use intermittent air for drying tooth structure, apply a single layer bonding agent and thin it by air, cure it for 20 s with the curing tip at close proximity to the cavity, use incremental application technique for composite restorations, cure it for 40 s, and neglect to do extra curing.

Conclusion: Students showed good knowledge regarding the bonding and composite application steps but with some clear mispractices such as low frequency of selective etching, less etchant washing, and the preference of vertical layering. Moreover, results from the current investigation should direct curricular updates in the future.

Keywords: Adhesive system, etch and rinse, posterior composite restorations, self-etch

INTRODUCTION

Recently, an increase in demands by patients for minimally invasive and high-quality esthetic restorations for their teeth is due to changed patterns of dental disease and enhanced oral hygiene together with consciousness of preventive protocols for control of dental caries. Consequently, a significant increase in the utilization of posterior resin composite restorations is proved in recent primary care-based studies.$^{[1-3]}$

However, the improvement of bonding strategies and composite resin materials, combined with an increased understanding of handling properties have added to their expansion in clinical use. Furthermore, recent bonding techniques have a remarkable role to play in the application of minimally invasive operative dentistry nowadays.$^{[1-4]}$

Today’s adhesives are mainly following the application technique of either an “etch and rinse” or “self-etch” approach. Clinical studies have approved that durable and relatively long-lasting adhesive restorations can be accomplished utilizing etch and rinse adhesives. Nevertheless, self-etch adhesives provide no intermediary rinse step which is considered a clinical advantage and result in less technique sensitive and more user-friendly. Furthermore, as self-etch adhesives dissolve/infiltrate the dentinal tubule smear plug rather than to open the tubules, (while etch and rinse adhesives opens dentinal tubules widely), they have been reported to decrease significantly postoperative hypersensitivity.$^{[5-13]}$

Failure of composite restorations still poses a concern. The success of this material in a clinical situation depends on multiple factors including accurate adhesive selection.
and correct application technique of the bonding agent as well as the resin material.

One of the established features of contemporary dental practice nowadays is a posterior composite resin restoration that’s why all new dental graduates ought to be competent in performing such treatment for their patients. In the United Kingdom and Ireland, and in addition North America, surveys of educational curricula have shown differences both inside and between dental schools.[1,4,14-18]

Students learn the majority of the adhesive types and application strategies during theoretical sessions; however, the transition of this knowledge into clinical practice might not always be optimum. Frequent auditing of the students during their clinical practice can help in detecting knowledge gaps and reinforcing correct clinical practice.

This survey aimed to investigate the type of bonding system and rationale for composite application used by senior dental students while treating their patients in comprehensive care clinical sessions (CCC sessions) at a government dental school in Saudi Arabia. A questionnaire consisting of 15 open and closed questions was filled in one-to-one interviews with the students. The student was given feedback at the end of the interview.

**Materials and Methods**

This research was approved by the Research Ethics Committee, Faculty of Dentistry, King Abdulaziz University, Institutional Review Board (IRB protocol #093-16) and was carried out in the spring semester of 2015. Eighty-three (23 males and 60 females) senior dental students were interviewed as part of this project. This total and purposive sampling was inclusive of all senior students found at the last academic year in a government dental school in Saudi Arabia. A one-to-one interview was conducted by one of the authors, and a fixed template [Figure 1] was used to guide the interview process. The students were asked about the type and rationale of using the bonding system that they favored as well as application technique during inserting posterior composite resin restorations during CCC sessions. Some questions were specific to occlusoproximal restorations. In the case, the student failed to answer a question, and some guidance was provided. After concluding the interview, feedback was provided to the student to provide a better clinical practice.

For statistical analysis, Chi-square test was used with two factors “question answer” and “gender.” If gender was significant, a detailed analysis of the subgroups (males and females) was done using Kruskal-Wallis test. Significant level was set at 0.05, and SPSS 16.0 (SPSS Inc, Chicago, IL, USA) statistical software was used for all tests.

**Results**

Overall, for all questions, the impact of gender on the choices was statistically nonsignificant ($P > 0.05$) [Table 1].

**Type of Adhesive**

Etch and rinse adhesive technique was significantly ($P > 0.05$) favored by students with majority do not perform selective etching. For etching time, 15 and 30 s were significantly used by more students compared to 10 and 20 s. Still, 7.4% of the total students, who favored etch and rinse technique, perform underetching for 10 s. For the rinsing and drying times used etch and rinse technique, there was no specific durations favored by students. However, majority of students use intermittent stream of air for drying tooth structure.

**Bonding Technique**

Most of the students apply bonding agent as a single layer and use air to thin it. Curing is mostly done for 20 s with the curing tip at close proximity to the cavity but not touching tooth structure.
The majority of students use incremental application technique with thickness at 2 mm or less. The use of vertical incremental application was favored over oblique and horizontal technique. The average curing time/increment of 40 s was reported more significantly...
Nassar and El-Shamy: Bonding system choice and practices among dental students

compared to other curing periods with the curing tip not touching the tooth structure. Regarding extra curing of composite after removal of matrix band, majority of students reported that they do not follow this technique; however, in the fraction that does, no favored curing time was reported.

**Discussion**

Composite application in a clinical setting is a technique-sensitive procedure. Enhancing the bond strength of the resin is paramount in achieving predictable service of the restoration. Both the bonding step and composite application technique has great effect on the success and longevity of the composite restoration. The main objective of this study was to evaluate the common practices that senior students utilize during composite bonding and application in local government dental school in Saudi Arabia. To investigate this objective, outcomes were depicted from students’ answers to interview questions to determine choice of adhesive system and application technique used.

The survey was conducted in the form of one-to-one interviews carried out by one of the authors before a clinical session. Both authors supervised the students regularly although this was compensated by utilizing a survey template during the interview to reduce bias. All senior students (23 males and 60 females) were randomly interviewed between the two authors.

Majority of the students favored the use of etch and rinse system although both bonding systems were available in the clinical area. This could be due to the more focus on etch and rinse approach in lectures since it is the more basic approach where clear steps of the adhesion process can be illustrated. These results indicate that most students understand the difference between etch and rinse and self-etch techniques. This is really important since each technique has its own indications depending on the substrate to be adhered to. For example, self-etching is mainly indicated in cavities with majority of exposed dentin, but it is less indicated in esthetic situations where all cavity walls are located in enamel.

Among the students favoring the etch and rinse approach, less than half perform selective etching which has been shown to enhance the bond strength of resin to enamel. The conventional etching time of selectively etching dentin for 15 s while etching enamel for 30 s was observed, when the total sample was combined. However, when each gender was considered separately, female students tend to underetch the cavity. Although overetching the cavity, as seen with male students, can lead to postoperative sensitivity, the impact of underetching enamel can affect the bond strength and could consequently lead to leakage and secondary caries. Segregating the etching time as in the conventional selective etching approach (15 and 30 s for dentin and enamel, respectively) was rarely reported by students. Still, it is somewhat alarming to observe that 7.4% of students etch for only 10 s. This pattern of underetching will provide less than optimum substrate and will hinder adequate penetration of the adhesive producing insufficient bonding. These issues have to be emphasized in theoretical classes for this and future cohorts.

Washing and drying the cavity after selective etching did not show any specific pattern except for the use of intermittent stream of air to dry the cavity. Literature shows that it is beneficial to wash the cavity for duration comparable to the etching time to ensure adequate removal of dissolved minerals and to avoid white halos around cavity margins. The majority of student’s report applying only one layer of bonding agent regardless of the bonding system used. The application of multiple layers of bonding agent has been previously found to compensate for polymerization stresses by acting as a cushion during the elastic phase of polymerization. A similar percentage reports the use of air to spread the bonding agent to avoid pooling of the adhesive in the cavity, and most of the cohort cure the bonding agent for the minimally required 20 s while keeping the tip of the curing unit close but not touching the tooth structure or cavity margins to avoid contamination of the tip with composite residues and as an infection control precaution. However, students were encouraged to place the curing tip as close as possible to the tooth structure to avoid composite under cure as recent studies demonstrate that the increase of distance between the tip of the light-curing unit from the increment of composite may endanger the polymerization because of a reduction of irradiance and scattering and dispersion of light by restorative material can hinder the monomer conversion on deeper surfaces, increasing the activity of solvents and lixiviation process. Under curing of composite material is a major problem that can lead to composite failures. Incomplete monomer conversion is a well-known drawback of dental resin composites, and the subsequent monomer release could at least partially account for failures observed clinically, including persistent postoperative sensitivity and/or the need for endodontic treatment as well as secondary caries. Further, the release of unreacted monomers was suggested to be in charge of undesirable biological responses, for example, cytotoxicity or disturbance of pulp progenitor cells differentiation even at nontoxic concentrations. In this manner, incomplete polymer...
conversion and the increased potential for monomer release are prone to influence the fragile harmony between healing and chronic inflammation in damaged pulp tissues. In addition, suboptimal polymerization of resin composites may promote bacterial colonization at its surface.\textsuperscript{[30,33]}

However, our results showed that the majority of the students use increments that are 2 mm or less and cure of 20 s or more; both help in reaching the required degree of curing for adequate clinical service of the material. Still, vertical layering significantly reported more than other patterns even though oblique layering technique was encouraged during lectures. Studies showed that layering techniques in resin composite restorations affected the microtensile bond strength between the resin composite and the dentin, and those horizontal and oblique techniques have shown differences in polymerization shrinkage stress patterns.\textsuperscript{[34,35]} Finally, the majority of students do not perform extra curing after the removal of matrix band and retainer in class II restorations for at least 20 s although there is an increase in the degree of conversion of posterior composite restorations during the extra curing period.\textsuperscript{[33]}

As with any study, the present investigation has some limitations. Only one class was used as the study population. It would be interesting to compare different cohorts as well students from different academic levels (juniors vs. seniors and undergraduate students vs. postgraduates) which will be the scope of future investigations. Further, some information such as correlating the answers provided by students with their academic achievements, measured as Grade Point Average (GPA) or course score, is not presented and can be part of future studies as well. Finally, the interview process was conducted through two investigators which could lead to some bias; however, this was minimized as much as possible using a standardized template as well as practice sessions after a pilot study.

\section*{Conclusion}

From the present survey, several patterns can be observed that require reinforcing in theoretical and clinical sessions. Although students showed good overall knowledge regarding the bonding and composite application steps, some clear mispractices were noted. Low frequency of selective etching, less etchant washing than adequate, and the preference of vertical over oblique layering are some of the issues that can be improved in the current cohort. These points were raised after the end of the interview as a form of counseling and intervention method. Moreover, results from the current investigation should direct curricular updates in the future. It could also help in understating how students perceive and practice concepts introduced in theoretical and practical sessions as well as guide future course and program development. Definitely, additional studies are warranted to further comprehend these views.

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\section*{Conflicts of interest}

There are no conflicts of interest.

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