EFFECT OF CAVITY DESIGN ON POSTOPERATIVE SENSITIVITY IN CONVENTIONAL AND BONDED AMALGAM RESTORATIONS

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INTRODUCTION: Post-operative sensitivity is a major problem with amalgam restorations. Different approaches including bonding agents have been recommended to manage this problem. Bonding agents are claimed to improve retention, decrease microleakage and reduce post-operative sensitivity. We evaluated post-operative sensitivity in Class I & II preparations restored with conventional and bonded amalgam.

METHODOLOGY: A clinical trial was conducted at the Aga Khan University, Pakistan. We included class I and II cavities requiring amalgam restorations. Group "A" teeth were restored with conventional amalgam while Group "B" with bonded amalgam. The outcome (post operative sensitivity) was measured on the next day by giving cold stimulus using compressed air and chill spray application for 10 seconds. The response was recorded on an ordinal scale. Chi square test was applied to see the difference in tooth sensitivity in the two groups.

RESULTS: Bonded and conventional amalgam was restored in 67 teeth each. Out of 134 teeth studied, 93 were class I and 41 were class II. Class II restorations exhibited more post operative sensitivity than class I (p-value < 0.001). There was no difference in post-operative sensitivity in the conventional and the bonded amalgam restorations in both class I and II preparations.

CONCLUSION: Class II preparations were significantly associated with post-operative sensitivity than Class I. This association was irrespective of the restoration being conventional or bonded type.

KEY WORDS: Amalgam restorations, bonded amalgam, post operative sensitivity.


INTRODUCTION

Dental amalgam has been used as a directly placed restorative material in the posterior dentition where it can withstand high masticatory forces\(^1\,^2\). Although, it has certain disadvantages such as mandatory cutting of the tooth substance for its retention and poor aesthetics but still its use in the profession has remained more or less steady\(^2\). Conventional amalgam derives its retention from mechanical preparations such as undercuts, grooves locks, slots and coves\(^3\). This mechanical cutting of tooth structure is one of the causes for post-operative sensitivity. Other causes of post-operative sensitivity are microleakage at tooth-restorative interface, cusp deflection, abrasion and tooth wear etc. Studies have shown that the primary cause of the post-operative sensitivity is microleakage at the interface of tooth structure and restoration\(^4\).

A major disadvantage of amalgam restorations is lack of adhesion to tooth structure which may comprise marginal seal. In recent years, the availability of bonded amalgam has changed the paradigm of clinical practice. Studies have shown that the bonding the alloy restoration to tooth structure reduces the amount of tooth substance removal\(^5\,^7\). Bonded amalgam also reduces the potential of post operative sensitivity by reducing microleakage\(^8\). Although, it is established that bonded amalgam are equal or superior to conventional amalgam for less post-operative thermal discomfort but it's not clear whether cavity design has any effect on the sensitivity. We hypothesized that bonded amalgam restoration may exhibit less post-operative sensitivity in Class I and II cavity preparations compared to conventional amalgam.
OBJECTIVE

To compare post-operative sensitivity in Class I and II preparations restored with conventional and bonded amalgam.

METHODOLOGY

It was a clinical trial conducted at the dental clinics of the Aga Khan University Hospital, Karachi where we used non-probability purposive sampling to recruit subjects with posterior teeth with class I or II cavities requiring restorations. We excluded the teeth that were non restorable, pulpally involved teeth or that exhibited pre-operative sensitivity or teeth with excessive cavity width where cusp capping was indicated.

We calculated the sample size by using sample size calculator (Sample size Determination in Health Studies, WHO). We assumed that around 40% of bonded and 60% of conventional amalgam exhibit post-operative sensitivity. At a level of significance of 5% and power of the study 75%, the sample size requirement turned out to be 67 teeth. Since, we had two treatment groups so the total sample size requirement was 134 teeth. The protocol was approved by the ethics review committee of the Aga Khan University Hospital. Its reference was 1477-Sur-ERC-2010.

DATA COLLECTION

The patients at dental clinics of Aga Khan University Hospital who satisfy the inclusion criteria were included in the study. The data was collected on the prescribed proforma and the informed consent was obtained from them. The selected patients were divided into two groups. Group allocation was done by sealed envelope with equal number of treatment assigned. At baseline level, patients' response to cold stimulus was tested using Ortho Ice (chill spray, Dentsply, USA) on a cotton bud for 10 seconds applied on the buccal surface of the tooth in question. Patients who demonstrated exaggerated response were excluded.

Group A patients teeth were restored with conventional amalgam (Tytin, Kerr, USA) without applying any liner or base while group B participants were subjected to bonded amalgam (i.e. Tytin, Kerr, USA along with Panavia 21 adhesive, Kurray Dental Inc, Japan). Equal lengths of base and catalyst paste were dispensed. No additional liner or base was applied in this group.

Local anesthesia 2 % lidocaine solution in 1.7 ml cartridge (Xylestesin-A, 3M, USA) was given using standard technique. Rubber dam isolation was obtained. Cavity preparation was done with standardized technique using high speed drill with 330L (SS White, USA) bur followed by low speed drill using round bur. Cavity preparation was smoothened with hand instruments. Class II preparations were later subjected to Automatrix (a retainer-less matrix system by Dentsply, USA). Panavia 21 adhesive was applied in the bonded group only. Amalgam was placed in the prepared cavities using increments. Carving and burnishing was done and restorative material was allowed to set. Matrix band removed and occlusal adjustments were carried out in centric and lateral movements. Patients were reminded to mandatorily visit the next day for polishing.

On the next day, the response to thermal stimulus was recorded using visual analogue scale pain. For practical purpose, we interpreted the results on an ordinal scale of No pain, mild pain, moderate pain and severe pain. These findings were recorded on the customized proforma.

DATA ANALYSIS

Data was analyzed on SPSS 19.0. The frequency distribution of the qualitative variables such as type of cavity, gender, type of treatment, pre-op diagnosis and postoperative sensitivity (outcome) were determined. Chi square test was applied to determine the difference between the post-operative sensitivity in the two treatment groups (bonded versus conventional amalgam). Similarly, Chi square test was also applied to determine the difference between Class I and Class II preparation. The level of significance was kept at 0.05. The confounding variables such as age, gender and type of cavity were controlled by randomized group allocation.

RESULTS

- Study groups had similar representation of the genders, arches and teeth type (table 1).
- There were 51 conventional and 42 bonded amalgams placed in Class I cavities while there were 16 conventional and 25 bonded amalgam placed in class II cavities. There was no statistically significant difference (p value 0.067)
There was no statistically significant difference (p-value 0.481) observed between the conventional and bonded amalgam for post-operative sensitivity as shown in Figure 2.

However, there was a highly significant difference observed between Class I and Class II cavities for post-operative sensitivity (p < 0.001) as shown in Figure 3.

Table 2 shows that Class II preparations were found to be significantly associated with post-operative sensitivity.

### Table 1: Distribution of study groups with respects to age, gender, arch and teeth

<table>
<thead>
<tr>
<th>Categories</th>
<th>Conventional amalgam n = 67</th>
<th>Bonded amalgam n = 67</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>48</td>
<td>40</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Females</td>
<td>19</td>
<td>27</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Age 40 years or less</td>
<td>30</td>
<td>25</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Age more than 40 years</td>
<td>37</td>
<td>42</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Maxillary teeth</td>
<td>35</td>
<td>31</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Mandibular teeth</td>
<td>32</td>
<td>36</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Premolars</td>
<td>24</td>
<td>17</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Molars</td>
<td>43</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

Chi square test was applied at 0.05 level of significance

### Table 2: Cross tabulation for post-operative sensitivity in Class I versus Class II preparation in bonded versus conventional restorations

<table>
<thead>
<tr>
<th>Type of restoration</th>
<th>Post-operative sensitivity</th>
<th>Class I</th>
<th>Class II</th>
<th>Total</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Amalgam n = 67</td>
<td>No sensitivity</td>
<td>42</td>
<td>12</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mild sensitivity</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate sensitivity</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bonded Amalgam n = 67</td>
<td>No sensitivity</td>
<td>45</td>
<td>12</td>
<td>57</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Mild sensitivity</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate sensitivity</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>93</td>
<td>41</td>
<td>134</td>
<td></td>
</tr>
</tbody>
</table>

Chi square/ fisher exact test with level of significance kept at 0.05
sensitivity than Class I. This association was irrespective of a restoration being conventional or bonded type.

**DISCUSSION**

It's not uncommon to have some degree of post-operative sensitivity after amalgam restorations. The likely causes are microleakage at tooth restorative interface, tooth cutting, proximity of the cavity walls to the pulp, and the thermal conductivity of freshly placed metal alloy\(^1\). Thus, the higher sensitivity in class II restoration can easily be explained by the amount of missing tooth substance that is lost in tooth preparations and subsequently restored with bulk volume of the alloy\(^1,3\).

It is known that most amalgam restorations have an initial gap between the preparation walls and the restorative material that allows a slow movement of dentinal fluid. Application of cold stimulus may cause a sudden contraction of the fluid, resulting in a rapid increase in the flow, which is perceived by patient as pain\(^4\).

There are several amalgam bonding agents available on market such as All-Bond 2 (Bisco), Amalgambond Plus (Parkell), Optibond 2 (Kerr), Panavia EX and Panavia 21 (Kuraray). The active chemical agent in them is either 4-META (4-methacryloxy-ethyl trimellitate anhydride) or 10-MDP (10-methacryloxydecyl dihydrogen phosphate). Investigators have used these materials for not only improving retention\(^8\) of the restorative but have also suggested to use them for getting better resistance form and reduced post-operative sensitivity\(^8,11\). In addition to the chemistry of the adhesive, it is the method of condensing amalgam onto unset adhesive resin liner that does the job. It’s the creation of an intimate mechanical interlocking of amalgam with adhesive liner that is considered to offer retention and reduce post-operative sensitivity\(^12,13\). However, there is a convincing evidence that has shown that there is no difference in post-operative sensitivity in cases with and without bonding agents thus have seriously questioned the benefits of using bonding agents for sensitivity management\(^14,15\). Our results are in agreement with Mahler\(^14\) where use of bonding agent failed to demonstrate any advantage in reducing post-operative sensitivity.

There are studies on the effect of cavity liners\(^16\) and bases or even on cavity disinfection\(^17\) affecting post-operative sensitivity. But, there is very scarce data on any relationship with cavity design and bonding agents. Our study has addressed an important research question whether bonding agents are advantageous in Class II preparations. Nearly 50% of all Class II cavities exhibit mild to moderate post-operative discomfort. However, use of cavity adhesive failed to provide any benefit in such preparations. We infer that amalgam bonding agents are not protective against post-operative sensitivity. Lack of sensitivity in Class I cavities in both groups can simply be explained by less amount of tooth reduction and hence less microleakage around restorations.

The primary strength of our study was that we had an adequate sample size that was calculated scientifically. We had equitable representation of the two genders, arches and teeth type (table 1). Although, there were more Class II cavities in the bonded amalgam group but the difference for their distribution was not statistically significant thus, within the limitations of our study, we were able to answer the research question for both classes of tooth preparations.

The main limitation of our study was that the cavity dimensions were not measured. The amount of tooth substance removed during tooth preparation varies with cavity dimensions and hence the proximity to the pulp. This has substantial impact on the post-operative sensitivity. However, as the teeth were randomly allocated so we assume that both arms get similar dimensions of cavity preparation. Another important limitation in our study was that our outcome was evaluated at just 24 hours interval. With clinical experience, we know that post-operative sensitivity is usually settled on its own in a week or two. Therefore, a follow up of sensitivity would have shown the progress of treatment in the two study groups. Moreover, our outcome of interest i.e. experience of post-operative sensitivity is a subjective entity as individuals may have different tolerance level, so its impossible to actually measure it on an objective criterion. Higher sensitivity in the class II restorations can also be explained by gingival trauma from matrix band and wedge placement rather than the restoration method employed.

**CONCLUSIONS**

- There was no difference in the post-operative sensitivity in the conventional and the bonded amalgam restorations in the Class I preparations.
- Class II preparations were significantly associated with post-operative sensitivity than Class I preparations.
This association was irrespective of the restoration being conventional or bonded type.

- Amalgam adhesive (Panavia 21) does not offer any significant protection against post-operative sensitivity in Class II preparations.

REFERENCES


CONFLICT OF INTEREST

There were no conflicts of interest or commercial benefits involved.

ACKNOWLEDGEMENTS

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