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Short communication

# Comparison of Fracture Resistance of Amalgam and Composite in Abrasioned Teeth

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Different materials and techniques are used in dental wear restoration with the objective of increasing teeth resistance, and providing an aesthetic appearance. The aim of this study was to compare the fracture resistance of amalgam and posterior composite in abrasioned premolar and molar teeth. In this study, 60 carries and restoration-free human permanent mandibular premolar and molar teeth, freshly extracted because of orthodontic, periodontal and surgery reasons, were used. Cusps of teeth were removed with a horizontally cut, and were randomly divided into four groups of 15 teeth each. Groups 1 and 2 received class II restorations with posterior composite and amalgam, respectively in 15 premolar teeth. Groups 3 and 4 had class II restorations with posterior composite and amalgam, respectively in 15 molar teeth. After finishing and polishing, all samples were subjected to 1.000 times thermocycling with a dwell time of 30 s at 5 ± 2 °C, and 55 ± 2 °C. Then, teeth were mounted in acrylic resin to a depth of 2 mm apical to the cemento-enamel junction, and force was applied to all samples in a universal testing machine until fracture occurred. The results obtained after fracture were analyzed using the Shapiro-wilk and one-way ANOVA tests. According to these results, the difference between groups 1-2, 1-3, 1-4, 2-3 and 2-4 was statistically significant ($P < 0.05$). The results of this study showed that posterior composite may be used in molar teeth which have suffered abrasion. In premolar teeth, the selection of restorative material must be made taking aesthetic expectations into consideration.

**Keywords:** Fracture resistance, amalgam, posterior composite

Dental wear is seen as chronic intra-oral destruction not caused by dental decay. Factors playing a role in the formation of wear include, attrition, erosion, abrasion, and abfraction. The wear formed as a result of tooth-tooth contact is defined as attrition. Substance loss as a chemical effect of acid is erosion. Loss of hard tissue from extra oral physical effects is abrasion, and wear occuring in the cervical region from the effects of excessive occlusal stress is abfraction (1, 2).

The term ‘abrasion’ is derived from the Latin words, abradere, abrasi and abrasum and has the meaning of ‘erase/scrape’. Mechanical events such as tooth grinding, rubbing or scraping imply wear of the tissue or structure.

Dental abrasion may develop with some habits and occupational features. In individuals who smoke a pipe, crack nuts with their teeth or chew their fingernails, wear may be seen at the incisal edges. Carpenters, tailors and musicians are among those in whom excessive dental wear may be seen because of occupational habits and features (3, 4).

Many different materials and techniques are used in the restoration of dental wear. With the restoration made, it is aimed to increase the resistance of the tooth, reduce the stress created in

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the cervical region, prevent sensitivity, preserve the pulp and provide an aesthetic appearance (5).

As a result of increasing patient expectations, and the development of several new dentin adhesive systems, the use of resin composites in the restoration of teeth in the posterior region has become more widespread (6). Composite resins are often preferred in abrasion treatment as they are resistant to wear (4).

Dental amalgam is a restorative material that has been used in dentistry for more than 100 years. Significant disadvantages of amalgam are that it does not adhere to dental tissue, has weak edge compatibility, non-aesthetic color, causes galvanic flow within the mouth, conducts heat and electricity, causes tooth discoloration with the placement of metal alloys within the dentin channels as a result of corrosion, and it contains mercury which is toxic for the organism. However, it has several advantages such as low cost, ease of application, and it has strong physical properties of durability, resistance to wear and the edges can be covered with corrosion products. Therefore, it is still in widespread use in dentistry clinical applications (6).

The aim of this study was to compare the fracture resistance of amalgam and posterior composite in premolar and molar teeth with abrasion.

## Materials and methods

### Study design

Sixty newly-extracted human, lower premolar and molar teeth were used. The teeth were extracted for periodontal, orthodontic or surgical reasons, and all were without decay or restoration. The approval for the teeth to be used for this study was granted by the local ethics committee of Dicle University Dentistry Faculty (2017/13). Any remaining tissue on the root surfaces was cleaned with a cavitron. Then, the extracted teeth were placed in distilled water for 24 h. The 60 teeth were randomly separated into 4 groups of 15. The dental tubercles of each tooth were cut vertical to the long axis. Using a diamond fissure burr (835/008-3 ML, Diatech Dental AG, Heerbrugg), standard class II cavities were opened, and at the gum stage to be 1 mm above the enamel-cement border with a high - speed drill, under air and water spray. The cavities were prepared so that the occlusal width was one-third of the distance between the tubercles, and the width in the proximal region was one-third of the buccolingual distance and the cavity depth was below the enamel-dentin border.

Groups 1 and 3 received class II restorations with posterior composite (Filtek P60, 3M ESPE, USA) in 15 premolar and 15 molar teeth, respectively. In these groups, after the application of a clear matrix band, posterior composite resin was placed in 2 mm layers starting from the gingival step and each layer was polymerized for 40 s with light. The clear matrix band was removed and any overflowing parts were removed with fine-grained diamond burrs which were finer towards the tip (858/012-8 UF, Diatech Dental AG, Heerbrugg), and polishing was applied with aluminium discs graded from thick to thin (Sof-lex Pop-on, 3M, St.Paul, Minnesota,USA). Polishing of the interfaces was made with interface sandpaper.

Groups 2 and 4 had class II restorations with amalgam (Amalgam Capsules, DR ROBERT'S, Istanbul, Turkey) in 15 premolar and 15 molar teeth, respectively. In these groups, after the application of a stainless steel band, amalgam was condensed and placed in the cavity starting from the gingival step. When hardening was completed, the matrix band was removed and overflowing sections were removed. Polishing procedures were made 24 h later using amalgam rubbers. Polishing of the interfaces was made with interface sandpaper.

After the finishing and varnishing procedures, all samples underwent 1000 thermal cycles (30 s waiting time) in water baths at temperatures between 5°± 2 °C, and 55°± 2°C. Then, the teeth were embedded in acrylic blocks up to 2 mm below the enamel-cement border. Using a universal test machine (TSTM 02500; Elista Ltd. Sti., Turkey), force was applied at 1 mm/min until fracture (Figure 1). The fracture points

were recorded as Newtons (Nw) and the results were statistically evaluated using the Shapiro-wilk and Statistical analyzes

The Shapiro-wilk test, in which the data were normally distributed, was used.

The one-way ANOVA analysis was used to test the parametric tests for the comparison of the groups with normal distribution according to the Shapiro-wilk test results. The difference between the groups was statistically significant according to the variance analysis result at P< 0.05. The Tukey HSD test was used in the post hoc (multiple comparison) tests in the comparison between the two groups. one-way ANOVA tests.

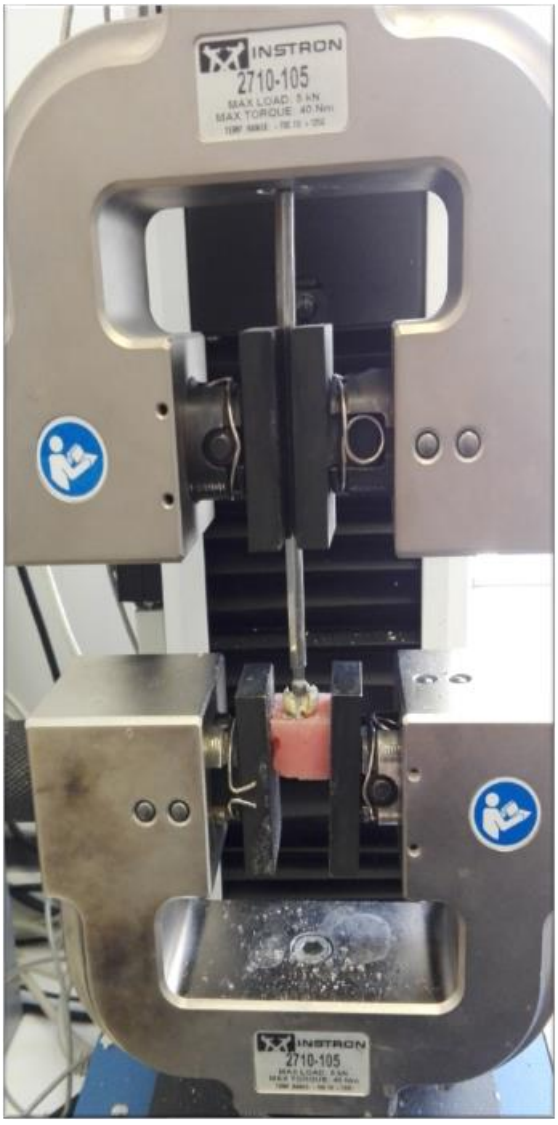


**Figure 1.** The analysis procedure for the samples using the universal test machine (TSTM 02500; Elista Ltd. Sti., Turkey). Force was applied at 1 mm/min until fracture.

## Results

The fracture resistance of amalgam and posterior composite in premolar and molar teeth was compared and the values obtained from the samples are shown in Table 1. According to these results, Tukey HSD test showed that the difference between groups 1-2, 1-3, 1-4, 2-3 and 2-4 was statistically significant (P <0.05).

**Table 1.** The fracture resistance values (Newton) obtained from the samples

| | Group 1 (Nw) | Group 2 (Nw) | Group 3 (Nw) | Group 4 (Nw) |
|---|---|---|---|---|
| **1** | -372.52 | -946.325 | -781.077 | -1202.25 |
| **2** | -282.612 | -1393.7 | -1671.82 | -3002.07 |
| **3** | -1026.59 | -1360.32 | -3215.25 | -1497.32 |
| **4** | -521.472 | -1500.81 | -1883.41 | -2338.98 |
| **5** | -704.694 | -908.458 | -2929.89 | -2308.52 |
| **6** | -362.52 | -966.325 | -791.077 | -1262.25 |
| **7** | -272.612 | -1373.7 | -1691.82 | -3022.07 |
| **8** | -1046.59 | -1340.32 | -3205.25 | -1417.32 |
| **9** | -541.472 | -1560.81 | -1893.41 | -2378.98 |
| **10** | -754.694 | -928.458 | -2949.89 | -2328.52 |
| **11** | -382.52 | -956.325 | -771.077 | -1232.25 |
| **12** | -292.612 | -1383.7 | -1651.82 | -3012.07 |
| **13** | -1006.59 | -1350.32 | -3225.25 | -1457.32 |
| **14** | -501.472 | -1530.81 | -1873.41 | -2358.98 |
| **15** | -654.694 | -918.458 | -2909.89 | -2318.52 |

Group 1: posterior composite premolar teeth; group 2: amalgam premolar teeth; group 3: posterior composite molar teeth; group 4: amalgam molar teeth.

## Discussion

With an increase in decay prevention interventions in dentistry, it is now common to encounter patients with teeth in their mouth for a longer period. In a patient with the complaint of dental wear, the type of wear must be determined by first identifying the agent of wear. After removal of the agent, protective treatment should be applied to the patient. In more complicated cases, the option of restorative treatment should be evaluated together with protective treatment.

Previous studies have investigated the effect of amalgam, glass ionomer and many types of composite resins in the resistance of teeth to fracture (7).

The vast majority of amalgams on the market today are amalgams with a high copper content. In these types of amalgams that are susceptible to corrosion, the γ2 (Sn8Hg) phase has been eliminated (6). The amalgam used in the current study was one where the γ2 phase had been eliminated and which could undergo corrosion. In the present study, both class II amalgam and posterior composite restorations applied to the premolar teeth were extremely successful in respect of resistance to breakage. Therefore, amalgam may be applied to premolar teeth which have disto-occlusal cavities as aesthetics are not important in these cases.

It has become a necessity in recent years to apply tooth colored restorations to posterior teeth and this has now come into widespread use. Consequently, many materials and techniques have been developed, and developments are still ongoing. The aim is to provide tooth-colored restorations that are as durable and functional as they are aesthetic (8). The posterior composite used in the current study was Filtek P60.

In a study by Bahsi et al. which examined the fracture resistance of the core materials of different glass ionomer, cement, and composite restorations, it was concluded that Filtek P60 was the most resistant material (9). In the present study, both class II amalgam and posterior composite restorations applied to the molar teeth were successful in respect of resistance to fracture. Therefore, posterior composites may be used as an alternative to amalgam in teeth in the posterior region in respect of fracture resistance.

Amalgam is fundamentally suitable for the physical properties of dental tissue. The elasticity modulus of amalgam is very close to the elasticity modulus of dentin (10). The basic problem of traditional amalgam restorations is that they do not bind to dental tissues, and the stress distribution associated with this is dangerous (11). To overcome this stress distribution pattern in teeth which have undergone abrasion, composite restorations may be preferred as they have a greater capability for flexibility than amalgam.

In another study, no significant difference was found between the fracture resistance of ormocer, hybrid, and nano-filling composite resins, and amalgam restorations (7). In the current study, the groups can be ranked from the most resistant to the least resistant to fracture as molar tooth-posterior composite > molar tooth-amalgam > premolar tooth-amalgam > premolar tooth-posterior composite.

A different study concluded that the use of Admira and InTen-S restorative materials with MOD preparation, significantly strengthened maxillary premolar teeth (12). Another study concluded that the thickness of amalgam in combined amalgam-composite restorations did not affect fracture resistance of the teeth (13). Also, Zirconia reinforced glass ionomer cement (Zirconomer) was compared with other conventional posterior restorative materials like glass ionomer cement and amalgam, and it was concluded that Zirconomer can be used as a potential substitute for amalgam in posterior teeth (14).

Overall, our results suggest that regarding resistance to fracture, posterior composite may be used as an alternative to amalgam in teeth with abrasion, particularly in molar teeth. In premolar teeth, the selection of restorative material must be made taking aesthetic expectations into consideration. Further, long-term, clinical studies are required to confirm the results of this study.

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**Conflicts of interest**

We wish to confirm that there are no known conflicts of interest associated with this publication.

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