

# Longevity of Amalgam Build-Up Restorations in Endodontically Treated Teeth

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## Abstract

**Background and Aim:** Restoration of endodontically treated teeth is one of the most important and challenging topics in restorative dentistry. Longevity of such restorations is an essential factor in treatment planning. Amalgam build-up is a conservative method for restoration of endodontically treated teeth. Therefore, this study aimed to assess the longevity of this type of restoration in endodontically treated molar teeth.

**Materials and Methods:** In this retrospective study, 110 endodontically treated molar teeth of 98 patients that had received amalgam build-up restorations with at least one cusp coverage with 3-10 years of longevity were evaluated. The restorations included mesio-occluso-distal (MOD;40%), disto-occlusal (DO;23%), mesio-occlusal (MO;17%) and complex amalgam restorations (20%). Binary logistic regression and Kaplan-Meier tests were used for statistical analysis.

**Results:** Of all restorations, cracks were observed in 22.7% of restorative materials and 10.9% of teeth. Secondary caries was found in 29% of the teeth. Based on binary logistic regression, MOD restorations had significantly higher rate of marginal fracture and recurrent caries ( $P<0.05$ ). Teeth with one or four built-up cusps were significantly more resistant to fracture compared to other groups. Patients, who regularly used dental floss had significantly lower rate of secondary caries and restoration fracture ( $P=0.032$ ).

**Conclusion:** The average longevity of amalgam build-up restorations was 8.45 years, which is comparable to minimum longevity of casting restorations. Thus, amalgam restorations seem to be an acceptable conservative method for restoration of endodontically treated teeth.

**Key Words:** Longevity, Dental Amalgam, Dental Restoration, Permanent

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Received: 2 July 2017  
Accepted: 15 Sep 2018

Journal of Islamic Dental Association of IRAN (JIDAI) Autumn 2018 ;30, (4)

## Introduction

Restoration of endodontically treated teeth is one of the challenges in restorative dentistry [1]. Such teeth have often lost a large portion of their structure for various reasons such as previous caries or restorations or the endodontic treatment process [2]. Endodontically treated teeth are

believed to have lower longevity due to microleakage and loss of structure compared to sound teeth [3]. Various treatment options can be used for restoration of these teeth from simple direct to indirect restorations [4]. Crown restorations are often suggested to strengthen the teeth after endodontic treatment, but tooth fracture

may occur even after crown placement [2]. In spite of novel methods and new dental materials, failure of endodontically treated teeth restored with indirect techniques is comparable to that of other types of restorations. In direct restorations, numerous items should be considered to increase the longevity of restoration [5]. The longevity of restorations is the most important factor determining their clinical service [6].

Amalgam build-up is one method to restore endodontically treated teeth. The advantages of amalgam build-up restorations include conservative preparation compared to crown restorations, lack of laboratory procedures, affordability and reparability. Furthermore, this technique can well preserve the tooth structure [7]. However, weaker structure of amalgam compared to ceramics is one of the disadvantages of this type of restoration, which probably leads to failure. Some in vivo studies have been previously performed on endodontically treated teeth [4,5]. However, the details of restorations have not been mentioned in some previous studies [5]. Moreover, previous studies did not evaluate the effect of the number of amalgam cusp build-ups on the longevity of endodontically treated teeth. Opdam et al, [8] in a retrospective study compared the longevity of class I and II amalgam and composite restorations and found that the type of material had no significant effect on the longevity of restorations. Soares and Cavalheiro [9] showed that amalgam restorations in the posterior teeth have higher longevity compared to composite resin, regardless of the tooth type, number of restored surfaces or the restoration size.

This study aimed to assess the longevity of amalgam build-up restorations in endodontically treated molar teeth.

### Materials and Methods

In this retrospective study, the minimum sample size was estimated to be 50 according to a study by Opdam et al, [10] using SPSS version 22 considering  $\alpha=0.05$ ,  $P=0.6$  and  $d=0.1$ . An extensive pilot study on 98 patients was performed and 110 endodontically treated first and second molar teeth of the maxilla and mandible with at least one built-up cusp and 3 to 10 years of longevity were evaluated. Clinical examination

was done using a dental mirror and an explorer by a blinded examiner. Periapical radiographs were also obtained as part of routine dental examination of patients and not for the purpose of this study.

**Inclusion criteria:** Endodontically treated molar teeth with acceptable amalgam build-up restorations in occlusal contact with the antagonistic teeth in patients with class I occlusion.

**Exclusion criteria:** Patients with severe periodontal problems, rampant caries and parafunctional habits.

In this study, complex cavity was defined as a cavity that was restored with four cusp build ups (Figures 1 and 2).

Data were analyzed using SPSS 22 for windows (SPSS Inc., IL, USA). Binary logistic regression test was applied to assess the association between dependent and independent variables and the Kaplan-Meier curve was used to determine the average longevity of this type of restoration. P values less than 0.05 were considered significant.



**Figure 1.** A prepared endodontically treated tooth

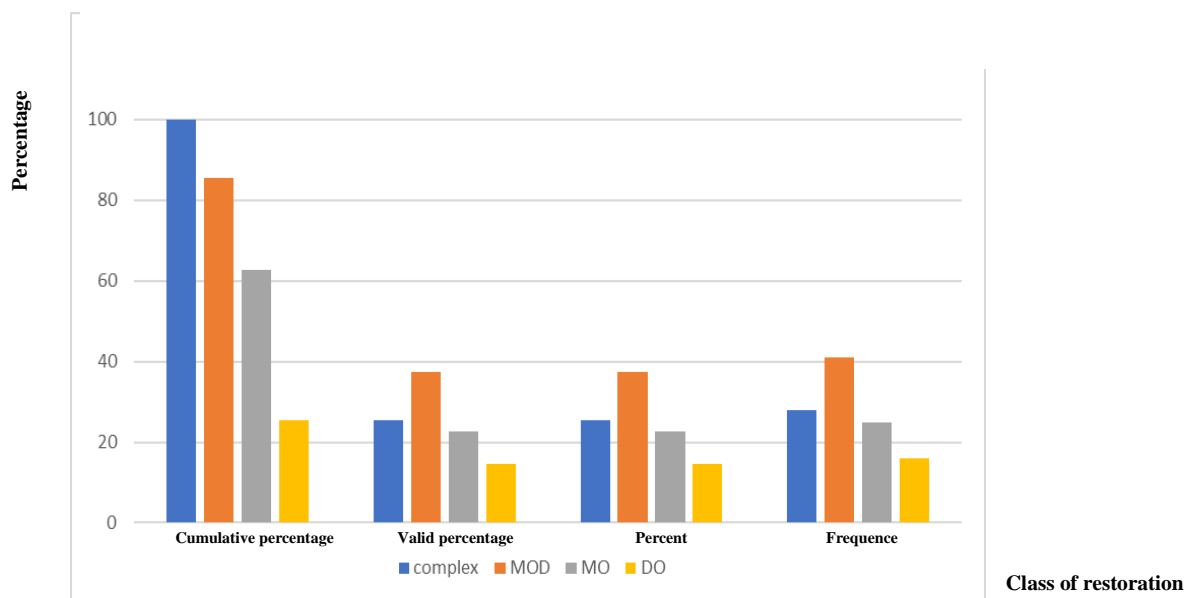


**Figure 2.** Amalgam build-up restoration

**Results**

This study reported data derived from 98 patients who were followed up between 3-10 years; totally, 110 teeth were evaluated. Of all, 68% were males and 38% were females with a mean age of 40.5 years. Regarding oral hygiene, 40.5% of patients reported tooth brushing more than twice a day, 30% twice a day, 60% once a day and 4.5% did not brush their teeth regularly. In addition, only 37.3% of patients reported regular use of dental floss. Teeth with mesio-occlusal (MO) or disto-occlusal (DO) cavities had at least one cuspal coverage and teeth with mesio-occluso-distal (MOD) cavities had one or more cuspal coverage with amalgam. Figure 3 shows the frequency of different classes of restorations. Also, distolingual cusp had been restored in 50%, distobuccal cusp had been restored in 63.6%, mesiobuccal cusp had been restored in 77.03% and mesiolingual cusp had been restored in 59.1% of patients. The number of cusps restored in each tooth is illustrated in Figure 4. Also, 29.1% of teeth had secondary caries. Fracture in amalgam mass was noted in 25 teeth (22.7%). In 17.3%, the fracture occurred in the cusp restored with amalgam and at the marginal ridge of restoration in 18.2%. Also, 12 teeth

(10.9%) had fracture or crack in tooth structure. According to chi-square test, there was a significant association between the class of restoration and secondary caries (P=0.00) and marginal ridge fracture (P=0.0351). Based on the performed tests, MOD restorations showed significantly higher frequency of secondary caries and marginal ridge fracture than other classes of restorations. However, the number of cusp build-ups and cusp fractures (with or without marginal ridge fracture) had no significant correlation (P>0.05). Teeth with three restored cusps showed significantly higher risk of restoration fracture (P<0.05). The number of built-up cusps was significantly correlated to fracture of teeth; it means that rate of fracture in teeth with one or four built-up cusps was significantly less than that in teeth with two or three built-up cusps (P=0.001). Meanwhile, there was no correlation between gender, rate of recurrent caries and fracture (P>0.05). Assessment of oral hygiene status in patients with recurrent caries yielded the following results: Patients who used dental floss were significantly less prone to secondary caries and restoration fracture (P=0.032; Diagram 1-4).



**Diagram 1.** Frequency of samples based on class of restoration

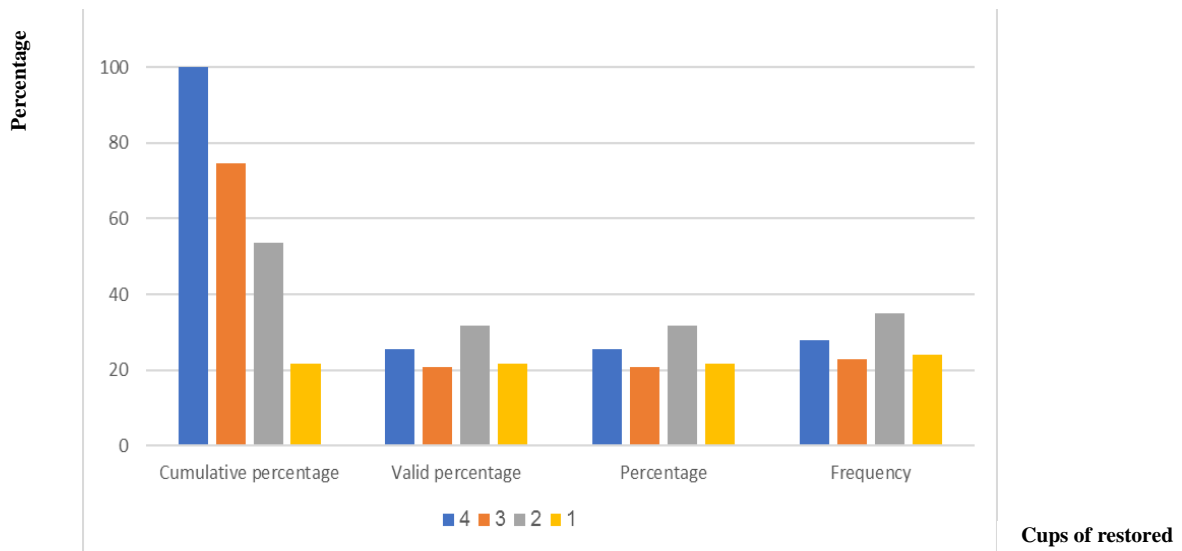


Diagram 2. Number of cusps restored

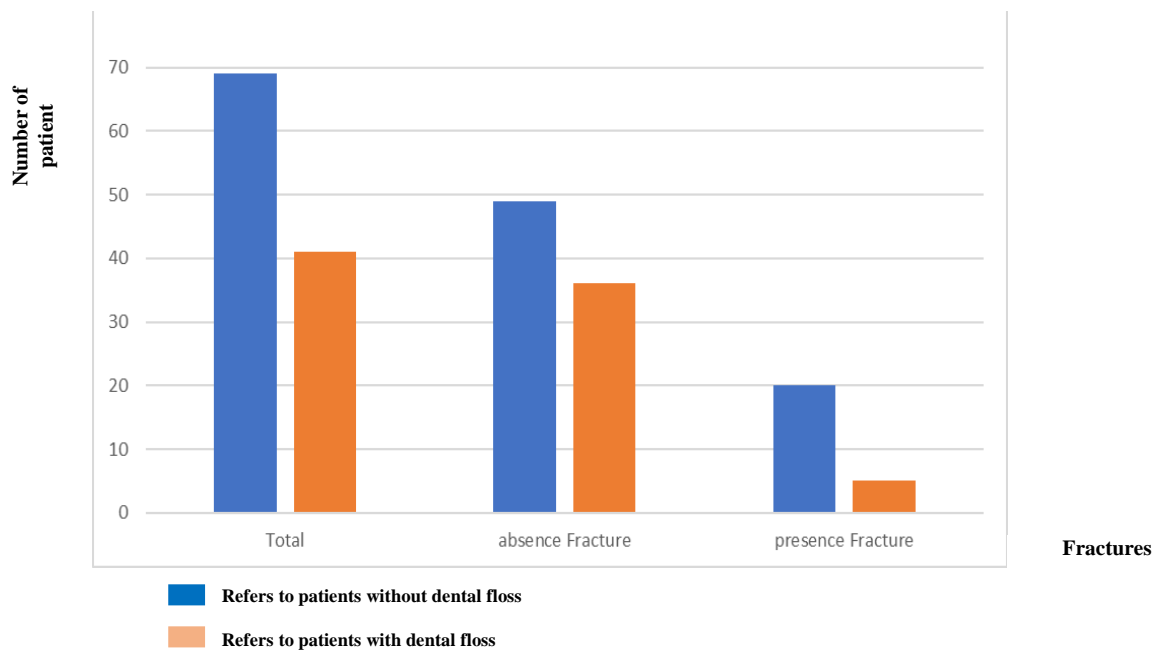
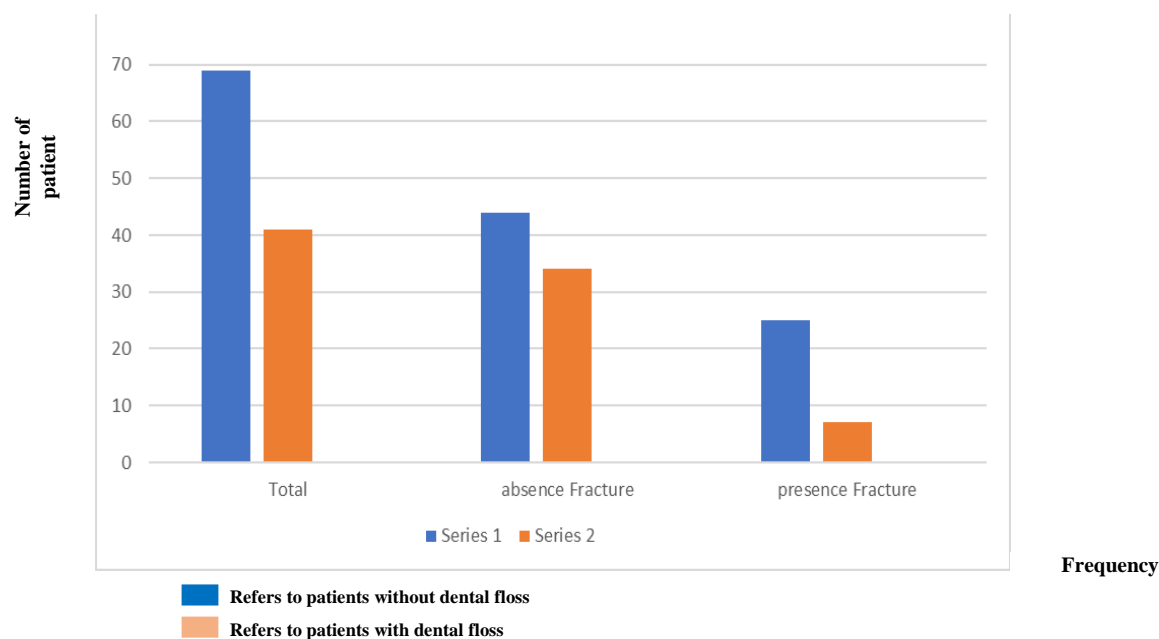


Diagram 3. Frequency of tooth fracture in patients using dental floss



**Diagram 4.** Frequency of recurrent caries in patients using dental floss

## Discussion

Success or failure of cuspal coverage in amalgam restorations of endodontically treated molars depends on accurate assessment of the case. Amalgam build-up restoration of endodontically treated premolars has been previously studied [11]. However, comprehensive studies on endodontically treated molar teeth are lacking. Thus, this study focused on this subject. In a study by Smales [12], the survival rate of amalgam restorations after 15 years was 72%; however, he did not evaluate the restoration of endodontically treated teeth and did not classify the success rate by type of restoration. Another study claimed that cast restorations reinforce tooth after endodontic treatment but tooth fractures are frequent even after crown restorations [2]. In a previous study, the rate of fracture of teeth with amalgam cuspal coverage was approximately 24.3% [2] while in the current study, this rate was 10.9%. Obviously, selection of cusps that require reduction or reinforcement and attempts to preserve them will decrease the rate of tooth fracture. Also, the current study showed that teeth with two or three built-up cusps were more susceptible to fracture but teeth

with one or four built-up cusps were more resistant to fracture. The reason may be related to the important role of tooth integrity in one cusp build-up and restoration integrity in teeth with four built-up cusps. McCracken et al. [5] demonstrated that increase of restoration size affected its longevity; also, the failure rates were four times greater than the failure rate in simple restorations. Restorations with smaller size show higher durability; thus, increasing the involved surfaces will affect the longevity of restorations [13]. Also, the longevity of amalgam restorations is higher than that of composite resins particularly in extensive restorations with cuspal coverage [14]. A previous study reported 17.1% amalgam fracture [2], but did not report individual fracture rates based on the class of restoration. Our study indicated 22.7% fracture rate; of which, 3.8% occurred in cusps, 4.7% in marginal ridges and 13.2% in both cusps and marginal ridges. Totally, two teeth had fractured cusps and marginal ridge in the restoration and dentinal tissue. The prevalence of secondary caries was 29% in the current study, which corresponded to the rate reported by Burke et al, [15]. In their study, the general reason for

replacement of amalgam restorations was secondary caries. Also, in the study by Opdam et al, [8] the most common reason for failure was caries (29%) followed by root canal therapy (12%) and tooth fracture (13%). The percentage of failure attributed to secondary caries under amalgam restorations in other studies was as follows: 66% in the study by Bernardo et al, [16] 50% in the study by Forss and Widstrom [17], 43% in the study by Soncini et al [18] and 23% in the study by Opdam et al [10]. The highest rate of caries recurrence was found in MOD restorations, probably due to cuspal deflection and lack of intact marginal ridge. The difference in the modulus of elasticity of tooth and amalgam results in formation of gap, microleakage and recurrent caries under occlusal loads. Although the amalgam build-up restorations may fail, repair is a more effective alternative compared to replacement of restoration and is known as a minimally invasive option [7,11,19,20].

Nagasiri and Chitmongkolsuk [2] reported that the overall survival rate of endodontically treated molars without crown coverage was 96%, 88% and 36% after one, two and five years, respectively. The median survival rate was 3.7 years [2]. The average longevity of restorations in our study was 8.45 years. In a study by Van Nieuwenhuysen et al, [21] which compared the long-term outcome of amalgam, composite and crown restorations, only 60% of premolar and molar teeth had been treated endodontically. Based on the Kaplan-Meier curve, the median survival times were 12.8 years for amalgam restorations, 7.8 years for resin restorations, and more than 14.6 years for crowns. All retreatments were considered as failures. They finally concluded that extensive amalgam restorations could be an appropriate alternative to crowns. The longevity of casting restorations has been reported to be higher than amalgam restorations. Although the longevity of amalgam build-up restorations of endodontically treated teeth is less than that of casting restorations, their durability is longer than the minimum longevity of casting restorations. Thus, this method might be as acceptable as the casting restoration; meanwhile, it requires less preparation, cost and time.

In the current study, vertical fractures were not observed. It may be due to exclusion of cases with abnormal occlusion and oral habits (clenching and

bruxism). A systematic review by Stavropoulou and Koidis [22] indicated that endodontically treated teeth under crowns had higher long-term survival rate ( $81\pm 12\%$  after 10 years) than endodontically treated teeth without crown coverage ( $63\pm 15\%$  after 10 years). But, it should be noted that the survival rate for endodontically treated teeth without crown coverage was quite satisfactory for the first 3 years ( $84\pm 9\%$ ), while there was a dramatic decrease in the survival of endodontically treated teeth after this period [22]. A review study by Goldstein [23] reported secondary caries, fracture, marginal defects, wear, and postoperative sensitivity as the main reasons for restoration failure. Amalgam restorations illustrated lower annual failure rate compared to other direct and indirect restorations.

### Conclusion

- 1- Conservative methods such as cusp coverage by amalgam build-up should be considered in restoration of endodontically treated teeth.
- 2-The longevity of amalgam restorations of endodontically treated molar teeth was 8.45 years in our study, which is comparable to that of most casting restorations.
3. Teeth with one or four built-up cusps were more resistant to fractures in contrast to teeth with two or three built-up cusps.
4. The MOD restorations should be regularly evaluated and the restoration should be repaired, replaced or substituted with crown as soon as noticing a fracture or development of recurrent caries.

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