Survival Rates from Fracture of Endodontically Treated Premolars Restored with Full-coverage Crowns or Direct Resin Composite Restorations: A Retrospective Study

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Abstract

Introduction: The aim of the present study was to compare the survival rates against fracture of premolar endodontically treated teeth (ETT) restored with resin composite or crowns and to identify risk factors associated with the fracture. **Methods:** Data from dental records and radiographs of premolar ETT with postendodontic restorations (ie, resin composite or crowns) were collected between 2012 and 2016 and selected following selected inclusion and exclusion criteria. Tooth location, type of restoration, number of proximal contacts, and amount of tooth surface loss were recorded. The incidence and restorability of postendodontic fractures were identified. Survival rates against fracture of the 2 restoration types were calculated using Kaplan-Meier survival analysis. Any potential factors associated with fractures were identified using Cox proportional hazards models. **Results:** The survival rate against fracture of ETT restored with crowns (95.1%) was higher than resin composite (77.0%). ETT restored with resin composite with 1 or 2 tooth surface losses and 2 proximal contacts had a high survival rate of 88.5% that was not significantly different from ETT with crowns. A higher incidence of restorability after fracture was observed in teeth restored with resin composite than crowns. The type of restoration and number of proximal contacts were identified as potential risk factors associated with fracture incidence. **Conclusions:** The survival rate against fracture of ETT restored with crowns was higher than resin composite. However, ETT with 1 or 2 tooth surface losses and 2 proximal contacts and restored with resin composite showed a high survival rate that was comparable with ETT restored with crowns. *(J Endod 2018;44:233–238)*

Key Words

Endodontically treated teeth, full-coverage crown, resin composite, survival rate, tooth fracture

Significance

For survival from fracture, endodontically treated premolars with no more than 2 surface coronal structure losses and 2 adjacent teeth can be restored successfully with either a crown or resin composite as determined at the 5-year recall.

Fracture of tooth structure is a concern for endodontically treated teeth (ETT), especially in the posterior region. ETT are weakened from carious lesions, preexisting large restorations, or improper restorative procedures (1, 2). Tooth fracture usually occurs when ETT are not immediately restored, which can lead to coronal bacteria leakage or an unrestorable fracture (3, 4). The success rate of ETT with permanent restorations was significantly higher than those with temporary restorations (5, 6). For this reason, a permanent restoration should be placed as soon as possible after the completion of endodontic treatment.

As a protective concept, posterior ETT should receive a cuspal-coverage crown restoration to protect the tooth from fracture (7, 8). Several clinical studies reported that cuspal-coverage restorations significantly improved the success rate of posterior ETT by reducing the chance of postendodontic fracture (8–10).

As a conservative concept, posterior ETT with minimal to moderate loss of tooth structure can be restored with direct resin composite as the final restoration (7). *In vitro*, a high fracture resistance of ETT restored with resin composite was reported (11, 12). This concept is supported by the result of a randomized controlled trial. In this clinical study, the success rate of the premolar ETT at 3 years with 1 or 2 proximal surface losses and restored with fiber posts and resin composite was as high as those restored with crowns (13). However, the longevity of resin composite restorations in ETT with moderate to severe loss of tooth structure is questionable (14). The concepts of suitable postendodontic restoration in posterior ETT (conservative or protective approach) (15) are still controversial.

Therefore, the purpose of this study was to compare the survival rates against fracture of premolar ETT restored with either non–cuspal-coverage resin composite or cuspal-coverage crowns using a retrospective cohort design. In addition, the potential risk factors associated with the fracture were identified.

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Materials and Methods

The protocol was approved by the institutional review board of the Faculty of Dentistry/Faculty of Pharmacy, Mahidol University (MU-DT/PY-IRB 2016/032.0508), Bangkok, Thailand. Dental records were searched from the patients' charts who attended the Endodontics Clinic, Faculty of Dentistry, Mahidol University. Dental records of patients who received complete nonsurgical endodontic treatment in premolars by undergraduate or postgraduate dental students and attended recalls between 2012 and 2016 were selected. Postendodontic restorations with direct resin composite or full-coverage crowns were provided for these ETT. All restorations were performed by undergraduate or postgraduate students, general dentists, or prosthodontists.

Endodontic and Restorative Procedures

In brief, endodontic treatment was performed using the following procedures. Rubber dam isolation was mandatory for root canal treatments. Coronal access and working length determination were performed. Root canals were cleaned and shaped with the crown-down technique using stainless steel hand files and/or rotary nickel-titanium instruments. Sodium hypochlorite at 2.5% and 17% EDTA solution (EndoClean; M Dent, Bangkok, Thailand) were used as root canal irrigants. Root canals were obturated with gutta-percha cones with zinc oxide–eugenol sealer (MU Sealer, M Dent) or epoxy resin–based sealer (AH Plus; Dentsply Maillefer, Tulsa, OK) using lateral or vertical compaction to the level of 1–2 mm below the orifices. Access cavities were cleaned using alcohol-soaked cotton pellets, washed with air/water spray, and dried before the restorative procedures.

Light-cured resin composite (Z250 or Z350; 3M ESPE, St Paul, MN) bonded with resin-based adhesive (etch-and-rinse adhesive [Adper Single Bond 2, 3M ESPE] or Excite F [Ivoclar Vivadent AG, Schaan, Liechtenstein] or 2-step self-etch adhesive [Clearfil SE Bond; Kuraray Noritake Dental, Tokyo, Japan) were placed. For the patients who declined a crown restoration or could not afford the cost of a crown or in ETT with only coronal access, resin composite restorations were placed as final restorations. In some cases, dual-cured resin core built-up material (MultiCore Flow; Ivoclar Vivadent Inc, Amherst, NY) bonded with resin-based adhesive (Excite DSC, Ivoclar Vivadent AG) was initially placed and covered with resin composite. Before placement of the resin-based material, the cavities were based with GIC (Vitrebond [3M ESPE] or GC Fuji VII [GC Corp, Tokyo, Japan]) at 1- to 2-mm thickness. For all ETT restored with resin composite restorations, a post was not placed.

For ETT planned to receive full-coverage crown restorations, the restored teeth were prepared for full metal, porcelain fused to metal, or all-ceramic crowns. If intraradicular posts were indicated, cast metal posts or prefabricated fiber posts (D.T. LIGHT-POSTS [Bisco Inc, Schaumburg, IL] or FRC Postec Plus [Ivoclar Vivadent AG]) were used and cemented into root canals with a resin-based core built-up material (MultiCore Flow) using the adhesive. The crowns were cemented with a resin-based cement (Rely X Unicem [3M ESPE] or Panavia F 2.0 [Kuraray Noritake Dental, Tokyo, Japan]).

Case Selection and Data Collection

Details of clinical and radiographic examinations were recorded at the recall visit. From the data, ETT were selected based on the following inclusion and exclusion criteria.

The inclusion criteria were as follows:

1. Premolar ETT, either nonsurgical root canal treatment or retreatment, with mature root formation
2. ETT restored with single crowns or direct resin composite
3. ETT with at least 1 opposing tooth with occlusal contact. The occluded tooth had to be a natural tooth or a fixed dental prosthesis. If the opposing tooth was a removable prosthesis, the tooth was not included.
4. Patients had to participate in the recall programs at least once.

The exclusion criteria were as follows:

1. ETT that were extracted for endodontic or periodontal reasons
2. ETT with chronic marginal periodontitis exhibiting bone loss in more than half of the root length
3. A history of previous cracks on a coronal or radicular tooth structure or a vertical root fracture was suspected
4. ETT with orthodontic appliances except those with orthodontic retainers were included

In addition, sex, tooth location, restoration type, the number of adjacent teeth, and the number of tooth surface losses were recorded. The incidence and restorability of postendodontic fractures were identified.

Criteria for Survival from Fracture Assessment

An overview of the methodology and fracture assessment is presented in Figure 1. The fracture assessment criteria are presented in Table 1. The fracture group was classified into 3 subgroups based on the type of fracture: a natural tooth, a restoration, or a combination of a natural tooth and a restoration. Fracture in a natural tooth, a restoration, or the combination group was further classified into 2 types: restorable and nonrestorable fractures.

Statistical Analysis

Kaplan-Meier survival analysis was used to calculate the survival time of teeth without fracture. The survival rate against fracture and subanalysis in the combination of tooth structure loss and contact surfaces of the premolar ETT restored with the 2 types of restorations were calculated and compared using the log-rank test.

To evaluate the potential factors related to the survival rate from fracture, statistical analysis was performed in 2 parts:

1. Univariate analysis for initially identifying the associations between the survival rate against fracture and any other potential factors
2. Multivariate analysis for finally concluding the potential risk(s) among the selected factors at the cutoff point P value ($\leq .25$ in the univariate analysis) (16).

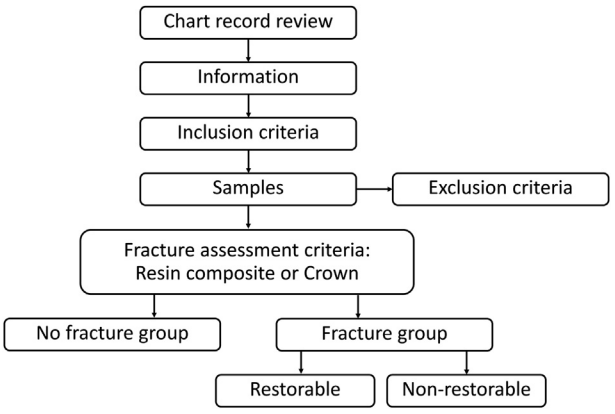

Figure 1. An overview of the methodology and fracture assessment.

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