Clinical assessment of resin-coating technique applied to exposed dentin after crown preparation

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The resin-coating technique, in which exposed dentin surfaces are covered using a thin-film coating material, was approved in the Japanese public health insurance system in December 2019. The purpose of this study was to evaluate clinical cases treated using the resin-coating technique with Hybrid Coat II (HC II) after tooth preparation on vital teeth. A total of 134 cases from patients who visited nine dental clinics were examined from the clinical records. Clinical signs and symptoms of cases before, during, and after treatment and at the time of recall were evaluated. The resin-coating was applied as either a single application with HC II (86.6%) or a combined application of HC II and a flowable resin composite (13.4%). The success rate without any symptoms of sensitivity to cold water was 92.5% (124 cases). The current results indicated that the resin-coating with HC II is a reliable treatment for the tooth preparation of vital teeth.

Keywords: Resin coating technique, Resin cement, Pulp protection, Clinical study, Crown preparation

INTRODUCTION

The terminology “dentin-pulp complex” is named as such, as dentin and pulp are histologically and embryologically identical tissues¹. From this concept, exposure of dentin could be considered as a type of pulp exposure, and therefore protection of the exposed dentin after preparation for indirect restorations is necessary.

The resin-coating technique is a unique method for protecting the dental pulp of vital teeth by applying an adhesive resin on the exposed dentin surface after tooth cutting for indirect restorations, such as inlays/onlays, and crowns⁵. The specific clinical procedures are to apply a resin adhesive system to the exposed dentin surface just after the tooth (crown) preparation, and polymerize the applied resin adhesive to form a hybrid layer at the adhesive-dentin interface that forms a tight sealing film that covers the preparation. The additional application of a flowable resin composite on the cured adhesive is usually recommended to enhance dentin bonding performance with resin luting cements⁶. The thickness of the coating layer using the combination of adhesive and flowable resin composite is in the order of 100 μm⁶.

For the resin coating technique applied to crown preparations, it is an important requirement that thickness of the coating material should not affect the outline and retention forms of the crown preparation. Consequently, a thin-film coating material based on an all-in-one adhesive system has been developed for coating teeth for crown preparations⁶. It was reported that the coating layer formed after one application was ≤10 μm thick and even after a second application, the thickness was only approximately 15 μm⁷. Thus, a thin-film coating could be achieved without changing the contour of the preparation. Previous literature⁸⁻¹⁰ from laboratory study outcomes has demonstrated that the resin-coating technique is extremely reliable. However, there is little information about the application of the resin-coating technique from clinical evaluations.

The resin-coating technique for tooth preparation on vital teeth was introduced to the Japanese public health insurance system in December 2019. Therefore, a retrospective clinical survey of tooth restorations using the resin-coating technique based on the information of dental records was conducted with the cooperation of nine dentists who use the resin-coating technique for tooth preparation in clinical practice. The hypothesis for this study was that the resin coating technique for tooth preparation should be reliable to protect the pulp to aid the clinical success of the restorations.

MATERIALS AND METHODS

Examiners and participants

This study was conducted with the cooperation of nine dentists in private practice who have been regular users of the resin-coating technique for vital tooth preparations. The protocol of the clinical evaluation was initially provided to each dentist prior to obtaining their consent to participate in the evaluation.

This clinical evaluation was conducted by reviewing patient records who visited one of the nine dental clinics between October 1, 2009 and July 31, 2019. The resin coating technique was performed using Hybrid Coat II (HC II, Sun Medical, Moriyama, Japan) after tooth...
preparation on vital teeth.

Clinical evaluation protocol
This study was conducted with the approval of the Ethics Committee, School of Dentistry, Asahi University (Approval No. 32007). The clinical evaluation protocol included basic information such as the patient’s age and sex, the treated tooth site, the use or non-use of local anesthesia during the procedure, the presence or absence of pulp protective treatment, and the cement used for luting the restoration. In addition, clinical symptoms of treated teeth before and immediately after the resin coating, at the time of re-visit, and at the time of recall, as well as the presence of adverse events (including the management) were included. The procedures for each case were obtained from the information recorded in the dental records. The included cases were collected from the nine dentists after the completion of the evaluation period. Where points in the procedures were unclear these were confirmed with the treating practitioner by the evaluators.

RESULTS
The baseline information on participants is provided in Table 1. The participants in this study included 44 males (42.3%) and 60 females (57.7%), thus totalling 104 patient cases. The breakdown of the patient numbers and age group is provided in Table 1. The mean age of participants was 52.3 years. From the patient pool, a total of 134 prepared teeth were able to be investigated. The distribution of restorations within the arch is as follows: anterior teeth (27.6%), premolars (43.3%), and molars (29.1%).

The outcome data of this evaluation are shown in Table 2. Local anesthesia was used in almost every case (99.3%). For the resin coating, a single application with HC II was used in 77.6% of cases, while the application with the combination of HC II and a flowable resin was used in the remaining 22.4% of cases. However, the proprietary name of the flowable resin for each case was not included. There were nine cases (6.7%) where a direct pulp capping treatment with materials such as Dycal (Dentsply Sirona, Charlotte, NC, USA)

| Male-to-female ratio | Number of cases | Percentage of cases (%) |
|----------------------|----------------|-------------------------|
| Male                 | 44             | 42.3                    |
| Female               | 60             | 57.7                    |

| Participants (by age group) | Number of cases | Percentage of cases (%) |
|-----------------------------|-----------------|-------------------------|
| 30–39 yrs                   | 2               | 1.9                     |
| 40–49 yrs                   | 22              | 21.2                    |
| 50–59 yrs                   | 15              | 14.4                    |

| Tooth location | Number of cases | Percentage of cases (%) |
|----------------|----------------|-------------------------|
| Anterior tooth | 37             | 27.6                    |
| Premolar       | 58             | 43.3                    |
| Molar          | 39             | 29.1                    |

| Content of survey            | Number of cases | Percentage of cases (%) |
|------------------------------|-----------------|-------------------------|
| Infiltration anesthesia      | Yes             | 133                     | 99.3                    |
|                              | No              | 1                       | 0.7                     |
| Resin coating treatment      | HCII alone      | 104                     | 77.6                    |
|                              | HCII+flowable resin | 30           | 22.4                    |
| Pulp capping treatment       | Direct capping  | 9                       | 6.7                     |
|                              | Indirect capping| 7                       | 5.2                     |
| Resin cement                 | MMA-based resin cement | 58              | 43.3                    |
|                              | Dual-cure resin cement | 76            | 56.7                    |
| Adverse event (After crown placement) | Yes (Cold water pain) | 10 | 7.5 |
|                              | No              | 124                     | 92.5                    |
and TheraCal LC (Bisco, Anaheim, CA, USA) were performed. A further seven cases (5.2%) had an indirect pulp capping placed prior to resin coating, however, the details of the material used was unclear. The resin luting cements used for the placement of crowns, included a MMA-based resin cement (Superbond C&B, Sun Medical) in 43.3% of cases, and various dual-cure resin cements (SA Luting Plus, Kuraray Noritake Dental, Tokyo, Japan; G-Luting, GC, Tokyo, Japan and others.) in 56.7% of the cases evaluated. The frequency of patients having no symptoms at the time of recall was 92.5% (124 cases). Clinical symptoms, such as pain with cold-water stimulus were observed in 50 cases (37.3%) prior to starting the restorative treatment. The number of patients exhibiting continuous pain after restoration placement was 19 cases (38.0%); this had reduced to 10 cases (20.0%) at recall. In the nine cases with a direct pulp capping treatment, pain to cold water stimulus was recorded in the five cases at the time of crown insertion, however, the sensitivity had disappeared by the recall appointment, while pain with cold water stimulus remained up to recall in three cases. In the seven cases with the indirect pulp capping treatment, pain to cold water was recorded in one case at the recall. Unfortunately, one patient (2.0%) exhibited pulpal symptoms at the time of recall, leading to pulpectomy.

**DISCUSSION**

In conventional indirect restorations, the dentin surface exposed during cavity/crown preparations is routinely protected by temporary sealing materials or provisional restorations until the next patient visit. However, such temporary sealing materials have poor sealing ability and often fall off by the next visit, consequently exposing the dentin surface which may lead to pain for the patient. Persistent plaque accumulation on the exposed dentin leads to the possibility of bacterial invasion to the pulp via any patient dentinal tubules, which may lead to pulpitis.

Clinical application of the resin coating technique was introduced in the first half of the 1990s when the reliability of dentin bonding had significantly improved. It became possible to protect the dentin and pulp by applying an adhesive resin to exposed dentin to form a hybrid layer, as the hybrid layer is more acid-resistant than dentin. Furthermore, the application of the dentin–resin coating technique can significantly reduce the pain caused by external physical and chemical stimuli, because the dentinal tubules are sealed which eliminates dentinal permeability.

Postoperative pain may be caused by damage to the pulp due to cutting as well as irritation before and after the restorative procedures. The discomfort for patients in the immediate postoperative period can be significant. The resin coating technique is clinically beneficial because it can avoid irritation before and after placement and reduces the discomfort.

HC II is a thin-film coating material pharmaceutically approved in October 1, 2009 to be used for crown preparation after its predecessor, Hybrid Coat (Sun Medical). The resin-coating technique for tooth preparations on vital teeth was approved for use in the Japanese public health insurance system in December 2019. The excellent performance of thin-film coating materials has been reported in laboratory studies, however, no clinical studies on the thin-film coating have been reported. Therefore, we evaluated the effectiveness of this treatment method by conducting this evaluation in cooperation with nine dentists who used the resin coating technique in private clinic setting.

The current results indicate that local anesthesia was used for most cases before and during the preparations. Cutting sound dentin is unavoidable for tooth preparation of the vital tooth, the consequences can be damage of the pulp leading to devitalization of the tooth.

The majority of the cases (92.5%) evaluated exhibited a good clinical outcome with no discomfort reported after cementation of the definitive restorations, indicating that the HC II-applied resin coating technique is a suitable means of protecting the dentin after crown preparation. In 50 cases (37.3%) a reaction to cold-water was observed preoperatively, which continued even after cementation of the definitive restoration up to the time of the recall evaluation visit. Unfortunately, in one case, pulpal symptoms developed postoperatively, leading to commencement of endodontic therapy. It is difficult to accurately predict dental pulp reactions prior to commencing the operation. However, it is necessary to provide a sufficient explanation about the potential for pulpal sensitivity and/or death to the patient before commencing the final treatment. The preparation method must provide sufficient care to protect the dental pulp during the tooth cutting procedures. Since the resin coating material is based on all-in-one adhesive technology, the proper bonding procedures must follow the manufacturer’s instructions to achieve good clinical performance.

The resin-coating technique can protect the pulp and also improve the dentin bonding of the resin cement. The MMA-based resin cement, Superbond C&B (Sun Medical) or dual-cure resin cements were used in the evaluated cases to bond the crowns to the resin-coated preparations. A short-term evaluation was only performed in the current study, however, continued investigations of the long-term clinical prognosis should be carried out.

For the resin coating, the use of HC II in combination with a flowable resin was recorded in 13.4% of cases. The coating layer of HC II is approximately 5 μm thick, and its effect on the adaptability of the restoration and the modified surface after tooth preparation is considered to be minimal. However, the mechanical strength of the coating layer is low because of its thin film, and the coating layer can be easily destroyed when the tip of an ultrasonic scaler touches it during the removal of the temporary sealing material. Therefore, sufficient care is necessary for handling the surface coating when coating is performed with HC II alone.
In this study, indirect pulp capping was described in the protocol depending on the case, but when it was confirmed with the dentists concerned, the shape of the prepared teeth was corrected and contoured by the additional application of flowable resin after HC II application. It has been reported that the adhesive strength of resin cements to dentin is improved by the combined use of a flowable resin, and the use of HC II in combination with a flowable resin (as required) is clinically effective.

In the national dental health developments, only the resin coating technique for crown/bridge abutments for vital teeth was listed in the public health insurance system, and the resin-coating technique for inlays and onlays is not covered by the insurance. The authors are concerned that the lack of insurance coverage for resin coating of inlays and onlays may result in more cases of crown preparation that could have been adequately treated with an onlay. The resin-coating technique should be applied for the protection of the surface of indirect restoration preparations, and it is desired for the resin coating technique for inlay/onlay restorations also to be included in the insurance system as soon as possible.

Thus, the hypothesis of this study was totally accepted from the current results. The dentin resin-coating technique, in which HC II was applied to tooth preparation on vital teeth proved to be clinically effective. This study focused on short-term clinical outcomes, and long-term clinical outcomes will be reported. In addition, this prospective clinical study was only able to provide limited information to evaluate the efficacy of the resin coating technique with respect to pulp protection. Therefore, a randomized controlled trial should be carried out in future to determine how this technique may protect pulpal tissue.

CONCLUSIONS

1. When the resin-coating technique was applied after tooth preparation, 92.5% of patients showed no symptoms related to pulpal sensitivity after cementation of the definitive crown.
2. The study confirmed the effectiveness of the resin-coating technique for teeth using HC II.

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