Original Article

Clinical Assessment of Resin-coating Technique for Dentin after Cavity Preparation

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Abstract

Purpose: Many studies have been conducted on the resin-coating technique for indirect restorations, and its efficacy has been reported. This study investigated the clinical course of cases with the resin-coating technique for dentin after inlay cavity preparation and examined the efficacy of the technique clinically.

Methods: Twenty cases in 18 patients visiting one of three dental clinics that were collaborating with this investigation between September 2014 and October 2019 were evaluated. The patients were treated using the resin-coating technique by applying a thin coating material (Hybrid Coat II, HC II) after inlay cavity preparation. Patient dental and medical records as well as clinical information that included tooth site, procedures, materials used, and clinical symptoms before, during, and after the procedures and at the time of recall were obtained using set clinical evaluation criteria.

Results: Fifty percent of the restorations were performed in premolars and 50% in molars. Local anesthesia was used in all cases except one. Resin coating was performed using HC II alone in 40% of cases and HC II combined with a flowable resin in 60% of cases. After inlay placement, 95% of the cases (19 cases) had a favorable outcome. Of the 10 cases (50%) where the patient experienced pain on cold water stimulation before treatment, nine cases had a favorable outcome; however, in one case pain on drinking cold water persisted and the patient then presented with pulpal symptoms, thereby requiring a pulpectomy.

Conclusion: The results demonstrate the clinical efficacy of the resin-coating technique using HC II on inlay cavity preparations.

Key words: resin-coating technique, Hybrid Coat II, inlay cavity preparation

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Received for Publication: May 15, 2021/Accepted for Publication: August 11, 2021
DOI: 10.11471/odep.2021-005

Introduction

In recent years, the use of direct composite restorations in molars has improved with the advancement of adhesive materials and technologies. Currently, a composite restoration can be promptly performed by preparing the cavity such that only the 'caries-infected' dentin is removed and 'caries-affected' dentin is preserved, thereby protecting the remaining dentin and pulp. However, for extensive carious lesions in molars where the restoration is subjected to greater occlusal loading and the restorations may need to protect cusps, an indirect restoration such as an inlay or onlay can be selected. Generally, the degree of dentin exposure after preparation for an indirect restoration is much greater.

The resin-coating technique was introduced based on the idea of direct composite resin restorations and the application of a reliable adhesive system for indirect restorations. The resin-coating technique is used to cover the dentinal surface exposed after cavity preparation for an indirect restoration such as an inlay or crown with an adhesive system for protecting the exposed dentin and pulp[1–4]. Specifically, coating the exposed dentinal surface immediately before impression-taking with an adhesive system aims to form a thin film on the dentinal surface which helps protect the pulp and improves adhesion of the resin cement to the dentin, thereby improving the marginal seal[1]. By using the resin-coating technique, few adhesive failures of restorations at the dentinal interface occur due to the improvement in the adhesion of the resin cement to the dentin. This also leads to a decrease in the frequency of marginal and bacterial leakage which has been reported[2,5–13]. Conservation of tooth structure, decreased patient discomfort, and a favorable clinical course of indirect restorations have also been reported[1,2,14–19].

In Japan, the resin-coating technique for preparing vital abutment teeth has been covered under the Japanese national health insurance system since December 2019 and its use is expected to become more common. On the other hand, the clinical application of the resin-coating technique is still being improved[20]. Laboratory studies have demonstrated its superior performance; a clinical study on the resin-coating technique for crown preparation of vital teeth reported that the resin coating is a reliable treatment[21]. However, no clinical study has evaluated the resin coating for cavity preparations. Therefore, this retrospective study investigated the clinical performance of inlay restorations placed using a resin-coating technique in collaboration with three dentists who routinely employ the resin-coating technique for vital teeth, and assessed the validity and efficacy of the procedure.

Materials and Methods

1. Materials for resin coating

The composition of Hybrid Coat II (HC II Sun Medical, Moriyama, Japan), a resin coating material used in this study, is shown in Table 1. HC II is the next version of HC (Sun Medical), which has been available in the market since January 2010. HC II was developed on the concept of a one-step bonding agent, which consists of a one-bottle bonding agent and a dedicated sponge[22]. When HC II is used, a dedicated sponge containing adhesion promoters is used to apply the bonding material to the tooth surface. In Japan, HC II has been covered under the Japanese national health insurance system since December 2019 as a material for resin coating of prepared surfaces of vital abutment teeth.

2. Methods for investigation

This study was approved by the Ethics Committee of Asahi University School of Dentistry (approval number 32007). The study was conducted in collaboration with three dentists in private practice who frequently perform vital tooth inlay restorations using the resin-coating technique. The outline of the clinical study and its methods were explained to the dentists and their consent to join the study was obtained.

The study included 18 patients (ten males, eight females; mean age, 51.4 years old) visiting one of the three dentists between September 2014 and October 2019. Patient records were identified for those who received an inlay for a vital tooth. The age of the patients is shown in Table 2. Nineteen cases in 18 patients who could be followed up after the restoration and who also consented to join the investigation were investigated.

Immediately after the cavity preparation, the prepared tooth was resin-coated using HC II followed by impression-taking. At the next visit, an inlay was placed with a resin cement.

Table 1 Composition and usage of resin-coating material

Brand	Manufacturer	Composition	Procedure
Hybrid Coat II (HC II)	Sun Medical (Moriyama, Japan)	liquid : acetone, MMA, 4-META others, water Powder in coat sponge/micro-brush sponge : aromatic amine, aromatic sulfinate	①Liquid stirring and mixing with a coat sponge/micro-brush sponge ②After applying the mixed solution for 10 s, air-blowing for 5 s ③Light irradiation for 5 s

MMA : methyl methacrylate, 4-META : 4-methacryloxyethyl trimellitate anhydride

Table 2 Baseline information of the participants

Category	Sex		Age (yrs)					Treatment tooth	
	Male	Female	20–29	30–39	40–49	50–59	60–69	Premolar	Molar
Number of cases (Percentage)	10 (55.6)	8 (44.4)	1 (5.6)	3 (16.7)	4 (22.2)	3 (16.7)	7 (38.9)	10 (50.0)	10 (50.0)
	Total 18		Average 51.4					Total 20	

We used a clinical investigation proforma to obtain basic information about each patient (age, sex), the intervention site and investigated procedures such as whether local anesthesia had been administered, if pulp protection had been provided, methods for resin coating, the resin cement used for adhesion, and any clinical symptoms before, during, and after the restorative procedure and at the time of latest recall based on the dental records. Personal information including patient name and address was excluded from the data forms to maintain anonymity.

3. Data collection and analysis

After the investigation was completed, the evaluation forms were collected from the dentists. When there was any doubt about the information provided in the form, the dentist who completed it was asked directly for confirmation and clarification. Thereafter, all data were collated and analyzed.

Results

The results of the investigation are shown in Table 3. In this study, the restorations were performed on premolars in 10 cases (50%) (five cases on maxillary premolars and five cases on mandibular premolars) and molars in 10 cases (50%) (three cases on maxillary molars and seven cases on mandibular molars). The average period between cavity preparation and inlay placement and between inlay placement and recall was 11 days and 289 days, respectively. The total period of the investigation was 10 months on average.

Before commencing the cavity preparation, local anesthesia was used in all cases except one. Also, local anesthesia was used for inlay placement in 10% of the cases.

The resin-coating technique was performed on each cavity using a single application of HC II in eight cases (40%) and a combination of HC II with a flowable resin composite in 12 cases (60%). No case required direct pulp capping during the cavity preparation. The restorations comprised inlays covered under insurance in 14 cases (70%) (metal inlay in 12 cases and a resin composite inlay in one case) and self-financed inlays in six cases (30%) (hybrid resin inlay in one case, gold alloy inlay in two cases, ceramic inlay in two cases, and a zirconia inlay in one case).

In 19 cases (95%), a dual-cure resin cement was used for the cementation, SA Luting Plus (Kuraray Noritake Dental, Tokyo, Japan), G-Luting (GC, Tokyo, Japan), and other dual-cure resin cements described as listed in the clinical data forms. In one case (5%), Super-Bond C & B (Sun Medical), a methyl methacrylate-based resin cement, was used.

After inlay placement, the clinical outcome was determined to be favorable in 19 cases (95.0%). Although discomfort such as pain on drinking cold water was observed before treatment in nine cases (45%), the outcome was determined to be favorable

Table 3 Evaluation outcomes collected from the protocols

Content of survey			Number of cases (Percentage of cases)
Local anesthesia	Cavity preparation	Yes	19 (95.0)
		No	1 (5.0)
	Inlay placement	Yes	2 (10.0)
		No	18 (90.0)
Resin-coating procedure	Single application of HC II		8 (40.0)
	Combination of HC II with a flowable resin		12 (60.0)
Resin cement	MMA-based resin cement		1 (5.0)
	Dual-cure resin cement		19 (95.0)
Restoration category under the national insurance system		Approved	14 (70.0)
		Not approved	6 (30.0)
Adverse event after placement of the restoration		No	19 (95.0)
		Yes	1 (5.0)

after treatment in eight of the nine cases. Of the cases where discomfort was experienced before treatment, pain on drinking cold water persisted after treatment and even at the time of recall occurred in only one case, which subsequently required a pulpectomy 155 days after the commencement of treatment (Table 3).

Discussion

The results of this study showed that as cavity preparation for vital teeth was accompanied by the cutting of intact dentin, local anesthesia needed to be used for cavity preparation in almost all cases. Some studies have indicated that damage to the pulp is associated with the cutting of vital dentin when using an air-turbine hand piece[23,24]. If protecting the vital tooth structures is prioritized based on the idea of minimally invasive dentistry, a direct composite restoration should be selected for caries treatment. However, when an inlay restoration is inevitably selected as the treatment of choice, the tooth preparation should be carefully performed while using air-water spray from the handpiece and a very light touch preparation to minimize damage to the pulp. On the other hand, local anesthesia was not used in one case. The reason was not unclear, but cutting intact dentin might have been minimal in this case. According to Fusayama's concept[25], local anesthesia is not necessary if cutting is limited only for 'caries-infected' and 'caries-affected' dentin.

A favorable outcome free of any discomfort after placement of the restoration in 95% of cases was determined, which indicated that the resin-coating technique was effective after cavity preparation in vital teeth. The clinical outcomes were favorable in 8/9 cases that originally presented with pain upon cold water stimulation before the treatment. The resin-coating technique was able to protect the prepared dentin surface and isolated it from pain-causing stimuli. However, one case still experienced pain on cold water exposure at the time of recall and finally presented with pulpal symptoms, thereby requiring a pulpectomy. Currently, it is challenging to accurately diagnose the pulp response of a tooth where the patient experiences discomfort. In cases requiring a pulpectomy, it is difficult to diagnose the pulpal condition for an inlay restoration. Under the current circumstances, in cases with discomfort due to pulpal sensitivity, the restoration should be performed after recovery from the discomfort. In cases requiring a restoration, it is crucial to carefully perform the restorative procedures after providing the patient with an adequate explanation of the benefits and risks of the procedure and then obtaining consent.

The resin-coating technique may improve the bonding performance of resin cement to dentin for indirect restorations and also enhance the marginal seal between the restoration and the cavity wall[26-28]. This evaluation used dual-cure resin cements for luting restorations in most cases. Such cements are routinely used for the luting of tooth-colored restorations, such as resin composite and ceramic inlay/onlay restorations,

because the light-curing of the cement effectively improves the bond strength of the tooth-colored restorations to the underlying tooth structure. On the other hand, self-cure resin cements, such as Super-Bond C & B, should ideally be used for metal inlay restorations. It was reported, however, that the immediate dentin bond strength of Super-Bond C&B was significantly lower than that of dual-cure resin cements, but after 24 h a high bond strength could be achieved[29]. Further investigation of the clinical outcomes of restorations cemented with various types of resin cement, including cement removal after restoration placement, is required to expand the current evidence base[30,31].

Resin coating was performed by using HC II alone in 37% of cases and HC II combined with a flowable resin in 63% of cases. As the coating with HC II forms a thin coating of approximately 5 μm thickness per application, HC II does not alter the overall contour of the prepared surface[18,32,33]. Meanwhile, when HC II is combined with a flowable resin, any undercuts within the cavity preparation can be easily blocked out by placement of the flowable resin. In this study, interviews after collecting the evaluation forms confirmed that the cavity morphology had been modified by the additional use of a flowable resin. In addition, it has been reported that HC II combined with a flowable resin improved the adhesion of a resin cement to dentin[4,10,11,34,35]. Resin coating using HC II alone is suitable for cases requiring high-precision preparation methods, such as crown preparation of abutment teeth for a fixed prosthesis. On the other hand, resin coating using HC II combined with a flowable resin is suitable for cases requiring smooth and stress concentration-free cavity forms such as resin or ceramic inlays.

The resin-coating technique has been covered by the Japanese national health insurance system for the preparation of vital teeth since 2019, however, it does not include inlay and onlay cavities. The results of this study revealed the efficacy of the resin-coating technique on inlays and onlays. It is strongly hoped that the resin-coating technique will be covered within the insurance system for inlay and onlay cavities in the future. This study verified the short-term clinical outcomes of the resin-coating technique; however, its long-term clinical outcomes need to be investigated.

Conclusion

1. Local anesthesia was used for cavity preparation in a vital tooth in almost all cases.
2. The outcome was favorable after placing the restoration with the resin-coating technique using HC II alone and HC II combined with a flowable resin in 95% of cases.
3. Of the nine patients who experienced discomfort before the procedure, the clinical outcome was favorable in eight cases (89%); however, discomfort persisted in one case, which required a pulpectomy (11%).
4. These results revealed that the resin-coating technique using HC II was effective in protecting the dentin and pulp after cavity preparation.

Conflict of Interest

The authors declare that there are no potential conflicts of interest with regard to the publication of this article.

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