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Clinical case

Calcium Silicate as Indirect Pulp Capping under Posterior Direct Restorations

Miguel A Saravia-Rojas[1], Jesely Torres-Ramirez[1], Victor A Huanambal-Tiravanti[1], Rocio Geng-Vivanco[2]

1. Universidad Peruana Cayetano Heredia, Facultad de Estomatología. Lima, Perú.
2. Universidad de Sao Paulo, Facultad de Odontología de Ribeirao Preto, Departamento de Materiales Dentales y Prótesis. Ribeirao Preto, SP, Brasil.

Correspondence author:
Dr. Miguel Ángel Saravia Rojas
E-mail: miguel.saravia@upch.pe

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Abstract

Introduction: In the pursuit of conservative approaches to treat deep carious lesions, pulp capping has been proposed. This technique aims to halt the progression of caries and induce the formation of reparative dentin. Among the available options, calcium silicate-based liners stand out as bioactive materials that promote the formation of carbonate apatite. **Objective:** To present a clinical case in which a resin-modified calcium silicate-based liner was employed. **Case presentation:** A 22-year-old male patient attended the teaching dental clinic of a university in Lima, Peru. Clinical and radiographic examinations revealed the presence of deep carious lesions in teeth 46 and 47. After removal of caries-infected tissue, a resin-modified calcium silicate-based liner was applied to the dentin close to pulp chamber. The cavities were subsequently restored

using a self-etching adhesive system, fluid and composite resin. Clinical intraoral photographs and dentoalveolar radiographs were taken after 1 year. No pain or signs of internal or external resorption, nor periapical lesions, were reported. **Conclusions:** The procedure with the resin-modified calcium silicate-based liner used in this clinical case showed that it is an appropriate material for indirect pulp capping since no sensitivity or periapical lesions were reported after 1 year postoperatively.

Keywords: bioactive material, calcium silicate, deep carious lesions, indirect pulp capping, vital pulp therapy.

INTRODUCTION

In the search of conservative approaches to treat deep carious lesions, pulp capping has been proposed[1,2]. The technique aims to stop the progression of caries, protect the pulp from thermal, chemical and harmful stimuli, and promote the formation of reparative dentin[2]. Calcium hydroxide is considered the "gold standard" for direct and indirect pulp capping in permanent teeth[3]. This material stimulates the defence and repair of the pulp, promoting the formation of a dentin bridge that covers and protects this tissue[3]. However, chemically pure calcium hydroxide exhibits high solubility, which can lead to dissolution of the material and formation of defects in the restorative dentin[3]. In addition, it lacks chemical and mechanical adhesion to dentin[3].

Calcium silicate-based liners are bioactive materials that release ions to form biocompatible carbonated apatite[4]. bisco's TheraCal LC® is a single-paste light-curing, resin-modified calcium silicate-based liner, indicated as direct and indirect pulp capping, and as a base or protective coating under restorations[2,5]. Due to its opacity and "whitish" colour, it is necessary to apply it in thin layers so as not to affect the final tone of the restoration[2]. TheraCal LC® must be applied to moist dentin to achieve adequate mechanical and physical properties[2]. In addition, the material absorbs dentin fluids, releasing calcium and hydroxide ions that stimulate the proliferation and differentiation of dental pulp cells, as well as the formation of mineralized hard tissues[2]. It also ensures physical coating despite the presence of dentin fluids[6,7], demonstrating better sealing capacity and fewer interfacial gaps than other pulp capping materials[2,7]. Despite its indication as direct pulp capping, previous studies advise against its application on exposed dental pulp due to the toxicity of the resin components that remain unpolymerised[8]. However, its use as an indirect pulp capping material is supported, showing successful short-term results[2,9].

The present case report describes the conservative approach performed on permanent posterior teeth with deep carious lesions, using the TheraCal LC® liner based on resin-modified calcium silicate as indirect pulp capping.

CLINICAL CASE PRESENTATION

A 22-year-old male patient, in good general health, attended a dental teaching clinic of a Faculty of Dentistry in Lima, Peru. During the intraoral clinical examination, carious lesions were detected on the occlusal surfaces of teeth 46 and 47 (Figure 1. A). The interproximal radiograph

showed deep lesions with dentin involvement (Figure 1. B), so the patient was administered truncal anaesthesia. The surgical field was completely isolated with a rubber dam and the biofilm was removed using an Abbott-Robinson brush, water and a 2.5% sodium hypochlorite solution. The carious lesions were removed using round diamond-tipped burs (Diamond burs, MDT Micro Diamond Technologies Ltd., Afula, Israel) in a high-speed handpiece. In areas close to the pulp, tungsten carbide burs were used in a micromotor.

Following removal of caries-infected tissue (Figure 1. C), a layer approximately 1 mm thick of resin-modified calcium silicate-based liner (TheraCal LC®, bisco Inc., Illinois, USA) was applied to the dentin close to the pulp chamber (Figure 1. D). The liner layer was light-cured for 40 s using an led curing unit (3M™ Elipar™ DeepCure-S led Curing Light, 3M espe Deutschland GmbH, Germany) with an intensity of 1,200 mW/mm^2. Subsequently, selective enamel etching was performed with 37% phosphoric acid (Condac 37, FGM Dental Group, Santa Catarina, Brazil) for 10 s (Figure 1. E). Then, it was washed with continuous water for twice the time and the excess was removed with absorbent paper, two layers of the self-etching adhesive system (BeautiBond, Shofu Inc., Kyoto, Japan) were applied using a microbrush (Figure 1. F). After evaporating the solvents for 5 s using contaminant-free air, both adhesive layers were photoactivated for 20 s using the led curing unit.

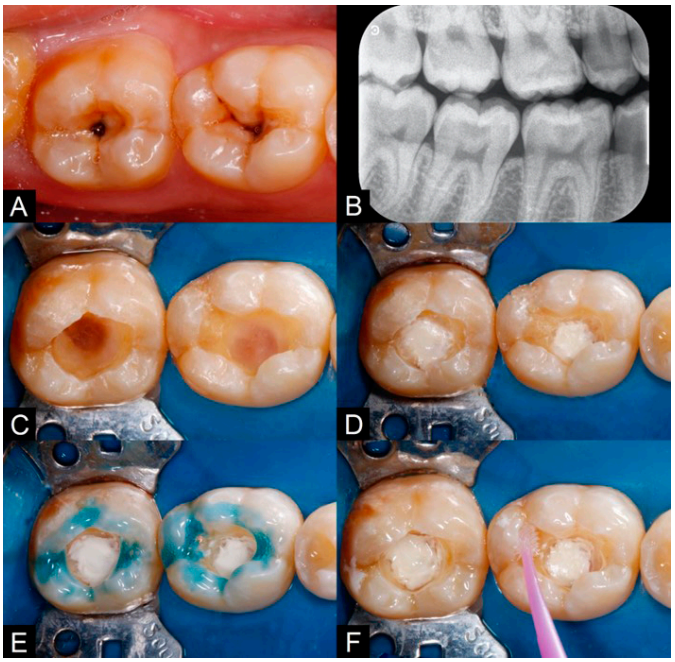

Figure 1. Initial photographs. A. Carious lesions on the occlusal surfaces of teeth 46 and 47. B. Initial Bitewing radiograph. Radiolucent image in dentin compatible with deep carious lesion. C. Removal of caries lesions. D. Application of the calcium silicate-based liner on the dentin close to the pulp chamber. E. Selective enamel etching with 37% phosphoric acid. F. Application of the self-etching adhesive system.

In the sequence, a layer of fluid resin (Beautifil Flow Plus-F00, Shofu Inc., Kyoto, Japan) was applied over the entire surface of the cavity floor, with a thickness of approximately 2 mm (Figure 2. A). The fluid resin was light-cured for 40 s using the led curing unit. Next, the composite resin (Beautifil II-A2, Shofu Inc., Kyoto, Japan) was applied using the oblique incremental technique

(Figure 2. B), and each layer was light-cured for 40 s. After removing the rubber dam, the occlusion test was performed, eliminating unwanted occlusal contacts with fine, superfine and ultrafine grit diamond-tipped burs. Finally, the surfaces were polished with abrasive rubbers and brushes (Figure 2. C).

One year after, a clinical control was carried out (Figure 2. D) in which a pulp vitality test was performed using cooling spray (Roeko Endo-Frost Cold Spray, Coltène/Whaledent AG, Altstätten, Switzerland). Both teeth responded positively to the cold stimulus, indicating pulp vitality. The periodontal tissues were also in good periodontal condition and the patient reported no pain. Likewise, dentoalveolar radiographs were taken (Figure 2. E-F), in which no signs of internal or external resorption or periapical lesions were observed.

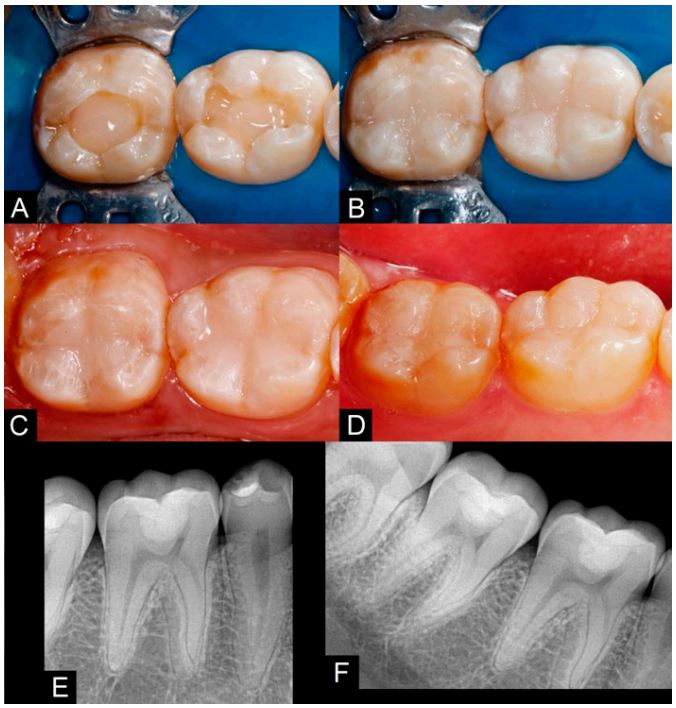

Figure 2. Continuation of the procedure. A. Application of the fluid resin. B. Application of the composite resin. C. Final result. D. Intraoral photograph at one year. E. Dentoalveolar radiograph of tooth 46 after one year. F. Dentoalveolar radiograph of tooth 47 after one year.

DISCUSSION

TheraCal LC® is a dental material that was introduced to the market a few years ago and has demonstrated excellent results as a dentin-pulp protector[8]. Although the manufacturer states that this calcium silicate-based liner can be applied directly to the exposed pulp, previous studies have reported that it may be toxic to pulp cells, causing inflammation[2,8,10]. The resinous monomers in its composition, which are not polymerised, could irritate the pulp, inhibit the remineralization process and form incomplete dentin bridges[2,8,10].

In the present clinical case, the aim was to preserve the maximum amount of dental tissue. Following the concept of Minimally Invasive Dentistry, the caries-infected dentin was removed with low-speed rotary instruments and dentin curettes. The dentin affected by caries was

preserved, since it can be remineralized[11]. TheraCal LC® was applied with the purpose of protecting the dentin-pulp complex and repairing the dental tissue[11]. The liner was placed on moist dentin to facilitate the initial setting process of the material[6,7].

TheraCal LC® exhibits low solubility and excellent mechanical properties, including high compressive and flexural strength[2,12]. Being a resin-modified material, it must be light-cured with an led curing unit with adequate power and time[8,10]. Due to its opacity and "whitish" color, it must be applied in thin layers so as not to affect the final shade of the restoration[2]. To date, few clinical trials support the use of TheraCal LC® as indirect pulp capping. There is only one randomised clinical trial that has demonstrated the success of the treatment[9]. We performed a clinical and radiographic follow-up after one year. The patient reported no pain or signs of internal or external resorption[9], and no periapical lesions were observed. However, follow-up is required to assess the long-term clinical success of the treatment.

CONCLUSIONS

The resin-modified calcium silicate-based liner used in the present clinical case proved to be a suitable material for indirect pulp capping, since no sensitivity or periapical lesions were reported one year postoperatively. Additionally, it could be considered as an alternative to calcium hydroxide.

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