



## REVISION ARTICLE

### Uses of TheraCal

Usos del TheraCal

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### ABSTRACT

**Introduction:** theracal is a new light-curing resin-modified calcium silicate cavity liner and base material designed to act as a barrier and protect the dentin-pulp complex. The precise placement of TheraCal allows it to be used in deep cavities.

**Objective:** to describe the usefulness of TheraCal as a protector of the dentin-pulp complex in direct and indirect pulp capping.

**Methods:** 48 articles on the subject were consulted, obtained from PubMed/MedLine, Google Scholar, Elsevier, SciELO, information from several repositories of the Autonomous University of Baja California was included and 21 were used as bibliographies, predominantly articles published during the last five years and others due to their relevance.

**Development:** the release of the components of TheraCal, especially tricalcium silicate, stimulates the formation of a secondary dentin bridge. It is indicated for use as a direct pulp capping agent by placing directly on pulp exposures once hemostasis has been achieved and as an indirect pulp capping agent in deep preparations, as a protective liner in extensive preparations, and as a base or sealer for use. It is used in resin, amalgam and cement restorations, in addition to being a desensitizer.

**Conclusions:** to be successful as a dentin-pulp protector, a hermetic and permanent sealing of the cavity must be achieved, which prevents the entry of microorganisms and reinfection, since the diffusion of toxins through the walls of the restoration to the pulp causes pulp damage and not the material itself.

**Keywords:** Calcareo Silicata; Protection; Calcium Hydroxide.

## RESUMEN

**Introducción:** el TheraCal es un nuevo material de base y revestimiento cavitario de silicato de calcio modificado con resina fotopolimerizable, diseñado para actuar como barrera y protector el complejo dentino pulpar. La colocación precisa del TheraCal permite utilizarlo en cavidades profundas.

**Objetivo:** describir la utilidad del TheraCal como protector del complejo dentinopulpar en recubrimientos pulpaes directos e indirectos.

**Métodos:** para su realización se consultaron 48 artículos sobre el tema, obtenidos de PubMed/MedLine, Google Scholar, Elsevier, SciELO; se incluyó información de varios repositorios de la Universidad Autónoma de Baja California y fueron utilizados 21 como bibliografías, predominaron los artículos publicados durante los últimos cinco años y otros por su relevancia.

**Desarrollo:** la liberación de los componentes del TheraCal en especial del silicato tricálcico estimula la formación de un puente de dentina secundaria. Está indicado para utilizarse como un agente de recubrimiento pulpar directo que se coloca directamente sobre las exposiciones pulpaes una vez que se ha conseguido la hemostasia, y como un agente de recubrimiento pulpar indirecto en preparaciones profundas, como forro protector en preparaciones extensas, y como base o sellador para uso. Se emplea en restauraciones de resinas, amalgamas y cementos, además de ser un desensibilizante.

**Conclusiones:** para tener éxito como protector dentino pulpar debe lograrse un sellado hermético y permanente de la cavidad lo que impide la entrada de microorganismos y la reinfección puesto que la difusión de toxinas a través de las paredes de la restauración hacia la pulpa causan daño pulpar y no el material por sí mismo.

**Palabras clave:** Calcarea Silicata; Protección; Hidróxido De Calcio.

## INTRODUCCIÓN

TheraCal is a new light-curing resin-modified calcium silicate filled (SCMR) base and liner material that achieves controlled curing time, is designed as a direct and indirect pulp capping with approximately 45 % mineral material, 10 % radiopaque component, 5 % hydrophilic thickener and approximately 45 % resin.<sup>(1)</sup>

The release of its components, especially tricalcium silicate, stimulates the formation of a secondary dentin bridge, once released they are in the concentration range necessary for the possible stimulating activity of the dental pulp and odontoblasts<sup>(2)</sup> They are used in resin restorations, amalgams and cements, besides being a desensitizer. It addresses certain advantages such as allowing sealing and strong adhesion, and its use considerably reduces pulp death.<sup>(3)</sup>

Pulp capping attempts to maintain the vitality of the pulp, it is mainly based on applying medication directly on the exposed pulp, calling this procedure direct pulp capping, or choosing to apply under the restorative materials, cements or other residual base materials, calling it indirect pulp capping.<sup>(4)</sup>

Comparative studies have been carried out between SCMR and other materials used in pulp capping (calcium hydroxide and MTA), where it has been determined that TheraCal has the capacity to release a greater amount of ions (calcium). Another characteristic attributed to TheraCal is that it forms an alkaline pH of 10 to 11, but returns to neutral pH in a short period of 3 days.<sup>(5)</sup>

It is very easy to handle with a good sliding of the product since it is presented in a syringe similar to a fluid resin, although it requires some methods so that its properties are not altered. Since it is a very radiopaque material, it should not be loaded in layers thicker than 1 mm. If a layer thicker than 1 mm is necessary, an incremental loading should be done so that the photopolymerization is performed correctly.<sup>(6)</sup>

TheraCal used in a precise manner can be used in all deep cavity preparations. It is important to note that the unique formulation allows a controlled setting by a visible polymerization unit, being a light-curing material will facilitate the placement by its thixotropic properties and immediate condensation, this unique formulation of the hydrophilic resin will provide stability and durability in the cavity base.<sup>(7)</sup>

This research provides enough relevant information about the properties, composition, function and indications for the use of TheraCal, so that it can be applied as a pulp protector in a certain dental organ that may present complications in its structure and function.

The objective of the present work is to describe the usefulness of TheraCal as a protector of the dentin-pulp complex in direct and indirect pulp cappings.

## METHODS

The scientific literature related to the properties, composition, indications and function of TheraCal was studied by consulting the databases of PubMed, Google Scholar, Elsevier, SciELO and SciELO.

Of the 48 articles selected, 21 were used as bibliographic references, with a predominance of articles published during the last five years and others due to their relevance. The inclusion criteria for the articles to be selected were: studies and clinical cases carried out on patients on the use of Theracal for both direct and indirect pulp capping and comparative studies of pulp capping materials, published in English or Spanish.

## DEVELOPMENT

Currently restorative dentistry establishes the preservation of the pulp health of the teeth that make up the stomatognathic apparatus, with the wide variety of materials, there is no master protocol for pulp protection that dentists should rely on. A direct pulp capping is where the vital pulp is exposed and is treated with a therapeutic material, then applying a base and restoration to guide a healing, achieving the main objective of maintaining the vitality of the pulp, protecting it from thermal, chemical and harmful stimuli.<sup>(8,9)</sup>

A recognized material within pulp capping is calcium hydroxide in permanent teeth, the effect of this pulp capping is the result of a chemical bond induced by hydroxide ions released during the hydration response in the surrounding environment, stimulating pulp defense and repair, in order to generate a restorative dentin bridge.<sup>(10)</sup>

Studies have revealed that 89 % of 192 dentin bridges structured with calcium hydroxide cement in monkeys may not provide a permanent barrier and a long-term biological seal against bacterial infection, because tunneling defects were identified in their structure.<sup>(11)</sup>

Additionally, the high solubility represents the main disadvantage of calcium hydroxide, which leads to the disappearance of the material, thus forming inconsistencies in the repair dentin below the veneering material, which provides a seal against bacterial invasion permanently.<sup>(12)</sup>

This characteristic of TheraCal with respect to solubility helps to promote better biosealing by chemically bonding to dentin, this strong bond to dentin allows the release of calcium and hydroxyl ions to form calcium apatite. Several studies have shown that this material has lower solubility and better sealing ability than Biodentine, ProRoot MTA, Angelus MTA and hard calcium hydroxide (paste-paste).<sup>(13)</sup>

Another feature of Theracal is its alkaline pH of 10,6, which remains stable after 3 hours of use and 24 hours without statistically significant changes in either case. The high alkalinity of the medium gives the material good antibacterial properties; they also have excellent biological properties, which is due to the formation or precipitation of calcium and phosphate at the dentin-material interface, leading to their sealing.<sup>(14)</sup>

Direct pulp protection is based on placing a medication directly on the pulp exposure or a liner in order to preserve the vitality of the pulp <sup>(15)</sup>. It is the method in which the dental pulp is exposed by accident, along the cavity preparation or by some type of fracture, is coated with a material that defends against additional injuries and at the same time, stimulates the formation of a barrier or reparative dentin bridge.<sup>(16)</sup>

TheraCal can be placed directly on pulpal exposures once hemostasis has been achieved, including: carious, mechanical and trauma-related exposures.<sup>(17)</sup>

As an indirect pulp capping it has a specific clinical behavior for the procedure of acute and severe caries wounds, mainly in adolescent patients, with symptomatology that corresponds to a pulp with a potentially reversible state, without visibly exposing the pulp.<sup>(3)</sup> The pulp is in a potentially reversible state once there is no record of spontaneous pain and once it responds to tactile and thermal stimuli, especially cold.<sup>(16)</sup>

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TheraCal is indicated as a capping agent in deep preparations, as a protective liner in extensive preparations, and as a base or sealer for use: under amalgam restorations, Class I and Class II composite restorations, base materials, cements and as an alternative to calcium hydroxide, glass ionomer/RMGI, cavity sealer varnish, zinc phosphate and IRM/ZOE (intermediate restorative material).<sup>(17)</sup>

In these types of pulp capping techniques will be used as follows:<sup>(18)</sup>

### Indirect pulp capping technique

1. Isolate the tooth and perform a conventional preparation of the cavity. Remove all infected decayed tooth structure and proceed to apply TheraCal directly to the bottom of the cavity in incremental layers. The depth of each layer should not exceed 1 mm.
2. Manipulate the product to form a smooth surface covering all deep dentin areas and light cure between layers.
3. Light cure each incremental layer for 20 seconds.
4. Place the desired base, restoration or adhesive following the manufacturer's instructions.
5. Continue with the restoration of the tooth.

### Direct pulp capping technique

1. Finish the preparation of the cavity in a field using rubber dam isolation, achieving hemostasis by placing a piece of cotton moistened with sterile physiological solution.
2. Gently dry the preparation with cotton swabs.
3. Apply TheraCal directly to the exposed pulp in incremental layers. The depth of each layer should not exceed 1 mm.
4. Sweep all exposed areas and spread TheraCal at least 1 mm over the healthy dentin surrounding the exposure area.
5. Light cure between layers, each incremental layer for 20 seconds.
6. Place the desired adhesive, base or restoration according to the manufacturer's instructions.
7. Continue with the restoration of the tooth.

TheraCal should be further studied in both in vitro and in vivo studies prior to its clinical application as a direct pulp capping material, as it should be better evaluated whether the release of calcium ions in conjunction with the cytotoxic effect with the nonpolymerizable resin monomers of which TheraCal is composed, directly influences the clinical and biological performance.<sup>(19)</sup>

On the other hand, the use of TheraCal in indirect pulp capping treatments yielded extremely favorable results with percentages of 90,09 % effectiveness in both clinical and radiographic evaluations, thus recommending that its use is excellent in indirect treatments in young permanent teeth.<sup>(20)</sup>

In a case reviewed with TheraCal, 9 % presented sensitivity to heat, no sensitivity to cold and no pain. Eighty-one percent had no sensitivity to cold or heat, and no pain.<sup>(21)</sup>

Direct pulp capping is considered a conservative treatment to maintain the vitality of the pulp when it has been exposed, therefore this procedure is considered a controversial procedure, since research on the use of this technique is scarce and was developed on the basis of empirical knowledge and as a result there is mistrust by professionals towards these conservative procedures, despite advances in the practice of direct capping, at this time, there is still no evidence of an ideal protocol to be followed by dentists to preserve pulp vitality.

To establish the success or failure of direct pulp capping, the tooth should be monitored with a follow-up of 21 months with the possibility of performing the definitive restoration, it should always be taken into account that the pulp should not present an irreversible lesion, since it will not respond to the stimuli for the formation of tertiary dentin nor will it have the capacity to regenerate. Therefore, the probability of success will also depend on finding a hemostatic,

antibacterial and dentinogenesis-inducing material, accompanied by an aseptic, hemostatic and minimally invasive technique.

TheraCal (resin-modified calcium silicate) is a direct and indirect pulp protector. This material acts as a barrier and protector of the dentin-pulp complex and is characterized by being light-curing, which saves time, as well as having a great capacity to form the dental bridge. The precise placement of TheraCal allows its use in all deep cavity preparations.

The success of good pulp capping is not only dependent on the material, there are more factors to consider. However, it has been shown that certain materials favor greater success in this process. The goal of any pulp protection procedure should be to control bacteria, stimulate cells to form new dentin and provide a biocompatible and durable seal.

Among the calcium silicate-based materials, TheraCal is easy to apply because it comes in a direct dispenser and there is no pre-mixing or need for a mixing device such as an amalgamator. To be successful, a tight and permanent seal must be achieved to prevent entry of microorganisms and reinfection since the diffusion of toxins through the walls of the restoration into the pulp causes pulp damage and not the material itself.

### Conflict of interest

The authors declare that there is no conflict of interest.

### Authors' contribution

All authors participated in conceptualization, formal analysis, project management, writing - original draft, writing - revision, editing and approval of the final manuscript.

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