



## **Calcium Hydroxide-based Therapeutic Pads as the Main Material in the Treatment of Deep Caries**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The article is devoted to increasing the efficiency of treatment of deep caries, which is an urgent problem of modern dentistry. The aim of this study was to evaluate the results of the treatment of deep caries using the KERR "Life" calcium hydroxide treatment liner, which is a radiopaque, durable material based on calcium hydroxide and salicylate ester, recommended for direct or indirect pulp capping and as a cementitious base for all restorative filling materials. The study involved 26 patients. The studies carried out have confirmed the efficiency of the treatment of deep caries with the Life pad and confirmed the possibility of its widespread use in practice.

**Keywords:** *Materials for medical pads; calcium hydroxide; bactericidal effect.*

## 1. INTRODUCTION

Direct and indirect pulp capping, employing various materials and clinical protocols, has been used for many years to preserve the health and vitality of the pulp complex and induce pulp cells to form hard tissue (reparative/tertiary dentin). Direct pulp capping is used when the pulp is visibly exposed (vital pulp exposure) due to caries, trauma, or iatrogenic insult such as accidental exposure during tooth preparation or caries removal. Indirect pulp capping is generally used in deep cavity preparations, with or without caries remaining, that are in close proximity to the pulp but with no visible exposure. The ultimate objectives of any pulp capping procedure should be to manage bacteria, arrest any residual caries progression, stimulate pulp cells to form new dentin, and provide a biocompatible and durable seal that protects the pulp complex from bacteria and noxious agents [1].

The basic principle of modern dentistry is a gentle attitude to tooth tissues. In cases where pathological changes in the pulp are reversible and its preservation is possible, it is necessary to have a healing pharmacological effect on the pulp, which stops the inflammatory process, prevents its further spread and stimulates reparative processes [2]. These are the properties of the medicinal pads, which are indicated in the following clinical situations: treatment of deep caries, in which the thickness of dentin between the filling and the pulp chamber is less than 1 mm; biological treatment of acute focal pulpitis; conservative treatment for accidental opening of the tooth cavity [3-5]. The following requirements are imposed on them: anti-inflammatory and odontotropic (formation of healthy tooth cells) effects, tightly seal dentin, high adhesion with a temporary and permanent filling, an insulating pad, inertness to the pulp (no annoying effect), similar properties with permanent fillings (the same shrinkage, resistance to temperatures, environment) [6-13]. Modern medical pads are made mainly on the basis of calcium hydroxide (Ca (OH) <sub>2</sub>), which, due to their high pH (up to 12), exhibit a long-term, intense antiseptic effect and create a barrier to acids - the state of acidosis is neutralized [14-19].

## 1.1 Objective

Evaluation of the results of treatment of deep caries using a medical pad based on calcium hydroxide "Life" by KERR in the short and long term.

## 2. MATERIALS AND METHODS

At the first stage of the study, based on the analysis of dental records of patients with a therapeutic profile, the criterion for inclusion and exclusion from the study were determined. The criterion for inclusion in the study was the presence of the diagnosis "K02.1. Dentin caries", which was based on positive primary and secondary examination methods, presented by clinical characteristics and dental radiography. The study involved 26 patients, aged 18 to 45 years. The treatment was carried out in the therapeutic department of the Dental Polyclinic of the North Ossetian State Medical Academy, Vladikavkaz, Republic of North Ossetia-Alania, Russian Federation.

During the treatment, we adhered to standard methods. In the prepared, medically treated cavity, a thin layer of a curative "Life" pad from KERR was introduced in a point, with the obligatory imposition of an insulating gasket made of GIC and closing with a composite material "ESTELITE ASTERIA" from Tokuyama Dental (Japan).

KERR's "Life" medical pad (a group of chemically cured calcium salicylate cements) is a radiopaque, durable material based on calcium hydroxide and salicylate ester, recommended for direct or indirect pulp capping and as a cementing base for all restorative filling materials, including amalgams. Consists of a base layer and a catalyst-paste. Knead for 10-15 seconds until smoothness.

Clinical evaluation of the effectiveness of the treatment of deep caries with the Life pad was carried out according to the following features: the presence of complaints, thermal reaction, dentine conductivity. Clinical signs were monitored at two weeks, two and six months. Intraoral X-ray, Rheodentography (study of the functional state of the vessels of the dental pulp) [20-21] and Electroodontodiagnostics (study of the electrical excitability of the sensory nerves of

the dental pulp by electrostimulation) [22-23] were used as additional methods of examination.

In this work we used direct pulp capping.

### 3. RESULTS AND DISCUSSION

If before treatment the main complaints were short-term pains, more often from thermal, as well as chemical and mechanical stimuli, then after 2 weeks, short-term pains were only from chemical stimuli, and by 2 and 6 months they completely disappeared.

When registering rheodontographic changes after 2 weeks, insignificant blood filling of the pulp was noted, by 2 months the pulp vasospasm decreased, tended to normalize, and by 6 months, it was completely absent, which led to an increase in the intensity of its blood supply. The indices of an intact tooth were taken as a basis and the information was calculated as a percentage of a healthy tooth (Table 1). The use of rheodontography in the treatment of deep caries, established that the KERR "Life" medical pad has good biocompatibility with tooth tissues, contributes to the complete normalization of the functional state of the pulp tooth, significantly

increasing the blood circulation in the pulp vessels and stimulating the proliferative function of odontoblasts with the subsequent formation and mineralization of dentinal tubules.

Thus, due to the high pH, the "Life" medical pad initially leads to the development of a zone of degeneration and necrosis at a depth of 50-150 microns. Subsequently, there is a normalization of the pulp blood supply, after 2 months - the formation of dentinal bridges, and the high alkalinity of the drug provides some antiseptic activity and neutralizes the acids released from the cements.

The values of Electroodontodiagnostics before treatment for dentin caries averaged 14.7  $\mu$ A, which is two times different from the norm, which indicates the absence of the irritating effect of the elements that make up the medicinal pad 6 months. (Fig. 1.)

No changes were found on the X-ray image during the entire study, that is, the "Life" treatment pad remained hermetically sealed, no areas of enlightenment under the insulating pad made of JIC were found, which indicates that this material has a low solubility in dentin fluid.

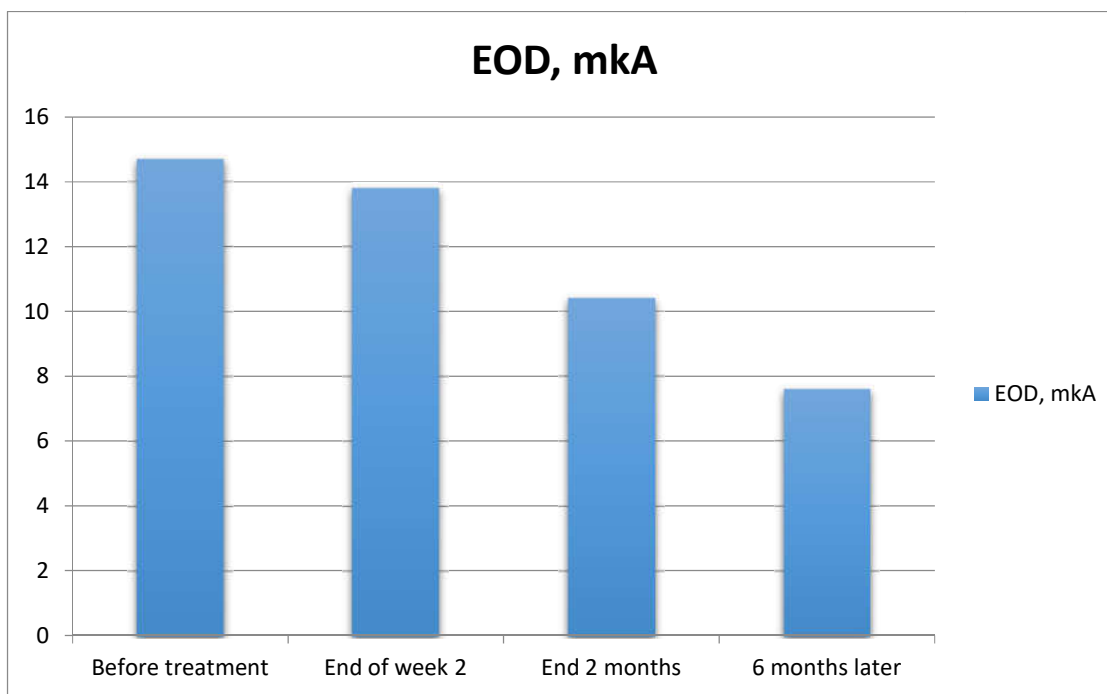
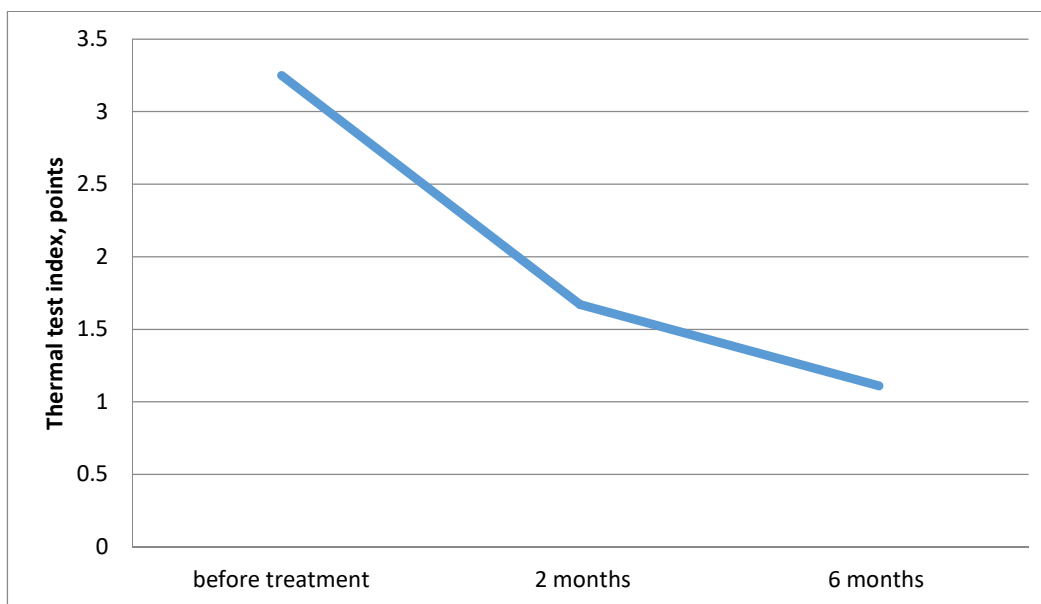


Fig. 1. Values of electroodontodiagnostics before treatment and after application of the "Life" medical pad by KERR

**Table 1. Values of the study of the functional state of the vessels of the pulp of the tooth before treatment and after the application of the "Life" medical pad by KERR**

Index	Intacttoothindicators	2 week	2 months	6 months
Indicators of the resistance of the tooth pulp to a high frequency electric current passing through it	100%	135%	103%	99%



**Fig. 2. Values of the Thermal Sample Index before treatment and after application of the KERR "Life" medical pad**

When determining the features of the thermal test and its comparison before and after treatment, it was revealed that before the treatment the thermal test index had a value of 3.25 points (moderately passing pain). Two weeks later, there was a highly significant decrease in the index to 1.67 points (no reaction). Six months after the start of treatment, the minimum value of the index was 1.11 points. (Fig. 2)

It should be noted that this material is easy to mix and offers sufficient working time to carry out multiple applications.

#### 4. CONCLUSION

The conducted studies have confirmed the efficiency of the treatment of deep caries with the Life pad and confirmed the possibility of its widespread use in practice. KERR LIFE ensures the formation of secondary dentin, has an optimal consistency for precise application, keeps the pulp viable, exhibits high early

compression rigidity and withstands normal pressure, protects the pulp from high temperatures, does not inhibit the polymerization of acrylic or composite preparations, and is resistant to acids, which corresponds with other authors [24-26].

#### ETHICAL APPROVAL & CONSENT

As per international standard or university standard guideline patients consent and ethical approval has been collected and preserved by the authors.

#### DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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