PULP-CAPPING STUDIES WITH ZINC OXIDE-EUGENOL, VARYING THE AGE OF MATERIALS, CORRELATED WITH FLUIDITY

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■ ABSTRACT: The zinc oxide-eugenol (ZOE) is a cement that has multiple uses in dentistry. Several authors have shown that this material is irritant to the pulp when used directly over that tissue. The present study was designed to evaluate the response from pulpal tissue when a mixture of ZOE is applied over it and the possible appearance of mineralization. It was observed that the irritant agent is the eugenol and if the cement components are new and the mixture dense, the formation of a dentin barrier may be stimulated without inflammatory reaction in the exposed pulp.

■ KEYWORDS: Zinc oxide-eugenol cement; biocompatible materials; dental pulp.

Introduction

The importance of preservation of a vital pulp has been studied for a long time, evidencing an effort in order to achieve success in preserving vitality.

Pulpotomy and capping are the suitable methods for treatment of pulp exposure. The choice of one of those procedures depends on many factors, such as the pulp conditions before the treatment, extent of exposure, age and patient health.

The zinc oxide-eugenol (ZOE) finds its principal application in the temporary cementation of restorations, temporary filling of teeth and as a cavity lining in deep cavities.[3,15] The contact of that material with pulpal tissue has been studied showing

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contradictory results, maybe due to lack of rigid proportions and quality of components.

The ZOE has therapeutic action on the pulp, but it is cytotoxic,[5] as stated by Barkin et al.[1] Three reaction types may be promoted by eugenol: direct tissue damage due to the nature of the medication; contact dermatitis; and true allergic reaction.[8] However, the zinc ions apparently have anti-inflammatory properties *in vivo* and promote wound healing.[2] They may be cytotoxic when studied *in vitro*.

The aim of the present study is to evaluate through histological methods the pulp tissue reactions when mixtures of ZOE are applied over experimental pulp exposures and to observe the possible induction to formation of a dentin bridge.

Material and method

Sixty-four rats (Rattus Norvegicus Albinus, Holtzman), aged 8-9 weeks, were used in this study. Each animal was anaesthetized with 10% Cloral Hidrate, in an approximate doses of 0.4 ml/100 g of body weight. Oclusal cavities were prepared in their upper first molar teeth, using an nº 33 1/2 cone bur with manual rotation. Care was taken to avoid salivary contamination using relative isolation with cotton; if saliva reached either one of the cavities, the animal was discarded from the study. The cavities were irrigated with water and dried with cotton, both sterile. The pulps were exposed by pressing on the cavity floor with a sharp right-angled probe. A zinc oxide – eugenol paste S. S. White was applied on the pulp and the cavity was restored with amalgam, as shown in Table 1.

Table 1 – Arrangement of rats for materials and periods

Groups	Materials	Periods in days				
		7	15	30	45	Total
I	ZOE new / dense	4	4	4	4	16
II	ZOE old / dense	4	4	4	4	16
III	ZOE new / fluid	4	4	4	4	16
IV	ZOE old / fluid	4	4	4	4	16
Total for periods		16	16	16	16	64

The zinc-oxide and the eugenol were made by S. S. White of Brazil.

The old eugenol has been used by students during two years in the Dentistry Clinic.

After 7, 15, 30 and 45 days, the animals were deeply anaesthetized with ether sulphuric and sacrificed (Table 1). Teeth in which the amalgam fillings were discarded.

The maxilla were dissected out and processed. The teeth were sectioned in a mesio-distal plane at a thickness of 6 μm. The sections were stained with hematoxylin and eosin.

Sections were examined for the presence of neutrophils, limphocytes, phagocytes, necrosis and presence of dentin bridge.

Results

Group I (new/dense): At 7 days was observed, next to exposed region of pulpal tissue, presence of moderate amount number of neutrophils and limphocytes were scarce (Figures 1 and 2). Discreet mineralized regions, next of the exposed area, suggested the formation of a dentin bridge (Figure 1).

After 15 days, discreet amount of lymphocytes were observed, whereas necrosis, phagocytes and neutrophils were absent (Figure 4). The dentin bridge developed and tended to isolate the capping material from direct contact with the pulp tissue (Figure 3). That mineralization was incomplete, being higher where fragments of dentin were present.

In the next period, the dentin bridge was completed and after 60 days it was enlarged and uniform (Figures 5 and 6).

Group II (old/dense): In the first period, presence of moderate numbers of neutrophils and discreet numbers of limphocytes were seen (Figures 7 and 8). The dentin bridge was similar to the one observed in Group I. After 15 days, discreet numbers of lymphocytes and neutrophils were found (Figure 9). The other event observed after 60 days were similar to what was observed in Group I.

Group III (new/fluid): The characteristics of pulp response were similar to the previous group. After 7 days, the presence of neutrophils was more intense and after 15 days, it was discreet/moderate. The other characteristics and periods presented no significant differences as compared to the previous group (Figure 10).

Group IV (old/fluid): After 7 days, intense neutrophilic and moderate limphocytic infiltrates were seen. Necrosis and phagocytes were absent, as well as mineralized areas. After 15 days, moderate/intense numbers of neutrophils and limphocytes, higher than in Groups I, II and III were seen. After 30 days, abscess areas, necrosis regions and small dentin bridge formation were observed, allowing direct contact of materials with the pulp tissue (Figures 11 and 12).

In the last period, degenerative alterations of the root pulp located under the exposure appeared, while the other roots showed sound pulp tissues.

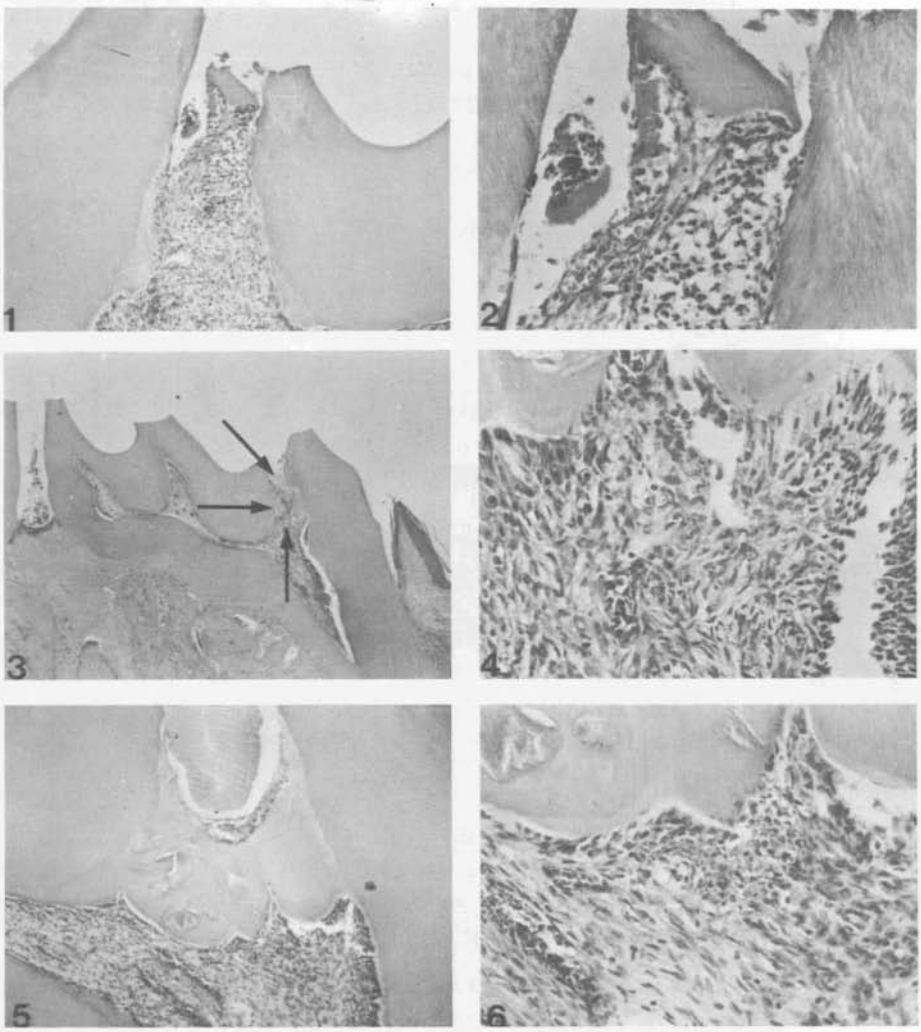

FIGURE 1 – Group I – 7 days. Exposed pulp tissue. Observe initial dentin bridge formation. HE; 125X

FIGURE 2 – Detail of Figure 1 showing dentin fragment and moderate numbers of neutrophils next to regions of pulp exposure. HE; 400X

FIGURE 3 – Group I – 15 days. Dentin bridge (horizontal arrow), which did not isolate the capping material (oblique arrow) from direct contact with the pulp tissue (vertical arrow). HE; 125X

FIGURE 4 – Detail of Figure 3 showing the pulp tissue with scarce lymphocytes. HE; 400X

FIGURE 5 – Group I – 30 days. The dentin bridge was completed, isolating the capping material from contact with the tissue. HE; 125X

FIGURE 6 – Detail of Figure 5. Pulp tissue under the dentin bridge, showing scarce lymphocytes. HE; 400X

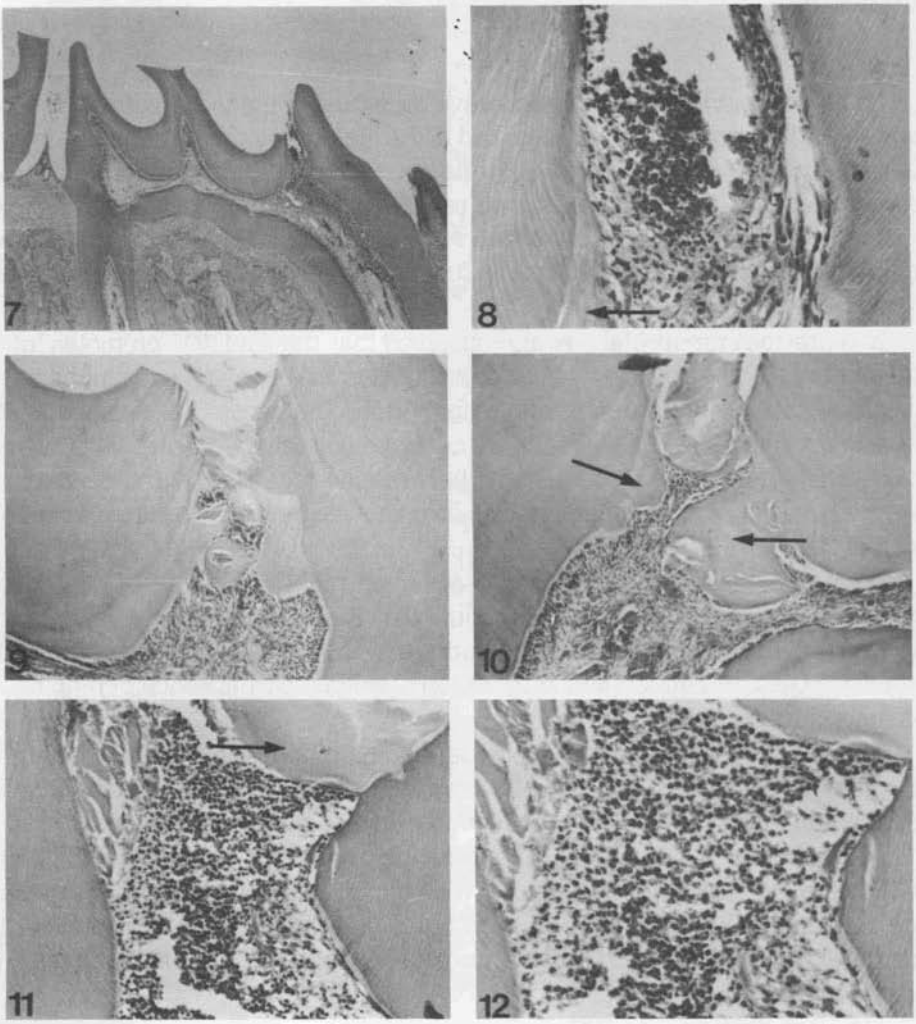

FIGURE 7 – Group II – 7 days. View of the pulp exposure region. HE; 32X

FIGURE 8 – Detail of Figure 7, where the presence of moderate number of neutrophils and discreet numbers of lymphocytes can be seen. Adjacent and immediately under, the beginning of dentin bridge formation (arrow), can be observed.

FIGURE 9 – Group II – 15 days. Dentin bridge, which did not isolate the capping material from contact with the pulp tissue. HE; 125X

FIGURE 10 – Group III – 15 days. Vision of the pulp exposure region (arrow) with the dentin bridge formation under it. HE; 32X

FIGURE 11 – Group IV – 7 days. Observed the pulp capping material (arrow) in contact with pulp tissue which that shows the intense presence of neutrophils. HE; 250X

FIGURE 12 – Detail of Figure 11, where the formation of dentin bridge has not begun. HE; 400X

Discussion

Many different species of animals have been used in the testing of pulp response to materials. The most commonly reported in the literature include primates, dogs and rodents. Most authors have used only one species in all their studies.[17] This study used rats, because this animal has good resistance,[6] including against infection and are easy to handle.[11] Although the behavior will not necessarily be the same for humans,[14] this test can be used as preliminary to demonstrate the degree of irritation promoted by dental materials.

In a previous report Mello et al.[12] observed that the fluid ZOE promotes intense inflammatory reaction with more neutrophils next to the exposure and limphocytes in adjacent regions, without dentin bridge formation. The dense ZOE resulted in more favorable observations. Those results are confirmed by Milanezi[13] and Holland et al.,[7] but are different from the present study, because here the fluid ZOE caused discreet presence of neutrophils and lymphocytes, and allowed dentin bridge formation in the period of 30 days.

Berman & Massler[2] and Maresca[10] observed that ZOE can also promote good results after long periods, hypothesis confirmed by Englander et al.[4] and Tananbaum,[16] that demonstrated high rate of clinic success using ZOE. These are contested by Restarski,[14] Glass & Zander[5] and Magnusson[9], which report absence of pulp healing many months after operation.

Then, we proposed to vary the powder/liquid proportion and the age of eugenol, trying to explain if the eugenol is really the most irritant component and to observe if the old liquid promotes adverse pulp reactions higher than the new liquid.

Analysing the results, the inflammatory pulp reactions were milder in Groups I and II, being higher in Groups III and IV. The dentin bridge formation occurred in all groups, but was better organized and larger in Group I than in Group II. That mineralization was smaller in Group III, and did not appear in the initial periods (7 and 15 days) in Group IV.

Conclusion

The results allowed to conclude, within the experimental conditions of the present study, that the mixture of ZOE estimulates the formation of dentin bridges next to the exposed pulp region, which is enlarged and organized as the time passes by. The material is more irritant in its fluid form of cement and proportionally to the age of the liquid, showing not only that the irritant agent is the eugenol, but also that the older and more oxidated liquid will enhance the unfavorable action upon the pulpal tissue.

Thus, the more irritant cement to the pulp was the fluid ZOE consisting of old eugenol and the irritant action decreased in the following sequence of test Groups: III, II and I.

If the eugenol is new and the mixture dense, that cement could be used directly on the pulp tissue. Other tests are necessary to confirm those results using different animal models, as suggested by the F. D. I.

COSTA, C. A. S. et al. Estudos em capeamento pulpar com óxido de zinco e eugenol, variando a idade dos materiais, correlacionados com a fluidez. *Rev. Odontol. UNESP*, São Paulo, v. 22, n. 2 p. 223-230, 1993.

■ *RESUMO: O óxido de zinco e eugenol (ZOE) é um cimento que apresenta múltiplas funções dentro da Odontologia. Muitos autores demonstraram que este material é irritante à polpa quando aplicado diretamente sobre este tecido. O presente trabalho tem o objetivo de avaliar a resposta do tecido pulpar quando uma mistura de ZOE é aplicada sobre ele e a possível formação de tecido mineralizado. Foi observado que o agente irritante é o eugenol e, se, os componentes do cimento são novos e a mistura densa, ocorre a formação de barreira de dentina, sem reação inflamatória junto à exposição pulpar.*

■ *UNITERMOS: Cimento do óxido de zinco e eugenol; materiais biocompatíveis; polpa dentária.*

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