

EFFECT OF ZINC ACETATE ON THE SEALING AND IRRITATING PROPERTIES OF THE ZINC OXIDE—EUGENOL CEMENT.

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ABSTRACT: The influence of the zinc acetate on the sealing properties of the zinc oxide-eugenol cement was analyzed twenty four hours and fifteen days after root canal fillings of human teeth in vitro. The results showed that the zinc acetate increased significantly the marginal infiltration of the dye, twenty four hours after the root filling. The zinc acetate also elicited a more intense inflammatory reaction of the rat connective tissue, 7 days after the implantation.

KEY-WORDS: Marginal infiltration; zinc oxide-eugenol; zinc acetate; connective tissue reaction.

The success of the endodontic treatment is directly related with the apical sealing quality of the root filling (DOW and INGLE, 1955). Good sealing property of the zinc oxide-eugenol has been reported (TAKAYAMA *et al.* 1968). Nevertheless, some others have considered it as a bad sealer (GRIEVE, 1972).

MOLNAR and SKINNER (1942) recommend the use of the zinc acetate to accelerate the setting-time of the zinc oxide-eugenol. According to some reports the zinc acetate can alter the sealing quality of this material (WEINE, 1972; OGAWA *et al.* 1974; HOLLAND *et al.* 1976).

However, besides the sealing quality, the success of the root canal treatment has some relation with the biological properties of the filling material. A lot of researchs studied the tissue reactions to zinc oxide-

eugenol cement (ERAUSQUIM and MURUZABAL, 1967; HOLLAND and LEONARDO, 1968) but there is a lack in the study of the effect of this material with zinc acetate on the connective tissue reaction.

The subject of this paper was to study the effect of zinc acetate on the sealing quality and on the connective tissue reactions to zinc oxide-eugenol.

MATERIAL AND METHOD

Sixty human teeth recently extracted and stored in water were employed to study the sealing quality of zinc oxide-eugenol. The teeth were dried and the root external walls were covered with nail polish to hinder lateral infiltration of the dye.

The root canals were instrumented until up the Kerr file n.º 60, thoroughly irrigated

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with distilled water and dried. They were then filled by the single cone technique using gutta-percha points and zinc oxide-eugenol cement with or without zinc acetate in the following proportion: zinc oxide, 300 mg; zinc acetate, 15 mg e eugenol, 0,1 ml.

After root filling, the teeth were stored in moist chamber, at 37.°C, during twenty four hours or fifteen days. After this time the roots were immersed in 2.0% metilene blue dye solution. Twelve hours later the teeth were dried and broken along their long axis. The marginal infiltration was measured with a micrometric ocular and the obtained data submitted to a statistical analysis.

In order to analyse the influence of zinc acetate on the connective tissue reaction to the zinc oxide-eugenol, 30 rats were employed. Dentin tubes, 5-7 millimeters in length, made from human dental roots were autoclaved and filled with zinc oxide-eugenol with or without zinc acetate. The tubes were then implanted in the rat subcutaneous connective tissue. The animals were sacrificed, 7, 15 and 30 days after the treatment and the pieces removed for histological analysis. After fixation in 10 percent neutral buffered formalin the specimens were decalcified in formic acid-sodium citrate and embedded in paraffin wax. Serial sections 6 micrometers thick were stained with hematoxylin and eosin.

RESULTS

Marginal infiltration

The marginal infiltration average was 30.15 for zinc oxide-eugenol and 45.53 for zinc oxide-eugenol-zinc acetate, after 24 hours, but after longer period (15 days), the averages were 47.27 and 43.80, respectively. The statistical analysis showed significance at 5% level for the difference observed after 24 hours, but the one observed after 15 days was not significant, at the same level.

Rat connective tissue reaction.

Seven days after the implantation of the cement without eugenol there was an intense neutrophilic infiltration, reaching 150 micrometers in depth and showing a lot of cells in degeneration. Next to this inflammatory reaction there was a fibrous capsule, with an average thickness of 450 micrometers, infiltrated by chronic inflammatory cells and exhibiting fibroblast proliferation (figs. 1 and 2). The zinc oxide-eugenol with zinc acetate elicited an inflammatory reaction more intense and extense. The fibrous capsule involving the area of intense inflammatory reaction was thicker than the one observed in the other experimental group (figs. 3 and 4).

Fifteen days after the implantation, no differences were observed between the groups. The inflammatory reaction was less intense and extense and some fibroblastic proliferation nearest the implanted material was observed. The fibrous capsule around the dentin tube had an average thickness of 450 micrometers and presented a mild to moderate chronic inflammatory reaction (figs. 5 and 6).

In the final period of observation the results were also similar with the two studied materials. In direct contact with the implanted materials there was a thin layer of neutrophils in degeneration or connective tissue infiltrated by chronic inflammatory cells and some neutrophils. The fibrous capsule was thinner with an average thickness of 150 micrometers. The capsules were well irrigated and had an intense cellular population infiltrated by moderate to intense number of chronic inflammatory cells (figs. 7 and 8).

DISCUSSION

Marginal infiltration

Twenty four hours after root canal filling, the sealing quality of the paste without zinc acetate was better, being the difference of results statistically significant. However the marginal infiltration was higher in the period of fifteen days. These facts suggest the occurrence of dimensional alterations in

the filling material, probably a contraction. These data are in agreement with several other experimental works where a higher marginal infiltration is observed as the time goes by (SWARTZ and PHILLIPS, 1962; KAKAR and SUBRANIAN, 1963; CURSON and KIRK, 1968; HOLLAND *et al.*, 1976).

The zinc acetate did not improve the zinc oxide-eugenol sealing qualities. On the contrary, in the 24 hours period it made worse the sealing qualities. WEINE (1972) reported the zinc acetate does not alter the sealing properties of zinc oxide-eugenol. This data agree with our results in the 15 days postoperative period. But the results in the 24 hours period are in agreement with OGAWA *et al.* (1974) data and in disagreement with GOING *et al.* (1960) and HOLLAND *et al.* (1976) ones. These disagreements are elucidated by the fact that little amounts of zinc acetate may cause worse the sealing qualities of the cement, while higher amounts improve this qualities (HOLLAND *et al.* 1976). In the experimental group of zinc oxide-eugenol with zinc acetate the results were the same in both postoperative periods. This occurred probably the zinc acetate not only accelerates the setting time but also the volumetric alterations.

Connective tissue reaction.

The reactions of the connective tissue showed that zinc oxide-eugenol is an irritant material. This data agree with the results of others experimental works (MITCHELL, 1959; RAPPAPORT *et al.*, 1964; McSHANE *et al.*, 1970; HOLLAND *et al.*, 1971). The irritational power of the studied material has direct relation with its components. The few works that studied the tissue reaction to the zinc oxide showed it is not so irritant (DIXON and RICKERT, 1933; TAGLIAVINI, 1973). The zinc acetate was considered highly irritant to the connective tissue (TAGLIAVINI, 1973). But the most stu-

died component was the eugenol. Many experimental researchs showed this substance is highly irritant to the connective tissue (COOLIDGE, 1932; TORNECK, 1961; HOLLAND *et al.*, 1969) and that the irritation power of the zinc-oxide-eugenol has a direct relation with the amount of eugenol in the cement (HOLLAND *et al.*, 1971; MILANEZI and HOLLAND, 1973).

MOLNAR (1967) and BEIGELIS and MACCHI (1976) reported that after the setting remains free eugenol in the cement. According to MOLNAR (1967) the amount of free eugenol affects the connective tissue response. BEIGELIS and MACCHI (1976) believe that accelerating the setting time of the cement, with a chemical accelerator, a higher amount of free eugenol will be obtained. This fact would elucidate the more severe reaction of the connective tissue to the cement with zinc acetate, 7 days after the treatment. However, the similarity of results in the other experimental period suggests that most part of free eugenol was eliminated by the organism.

The results of the tests on the sealing property and the ones about the connective reaction do not encourage the use of zinc acetate in the zinc oxide-eugenol cement.

CONCLUSIONS

Twenty four hours after the cement preparation, the zinc acetate increases, significantly at the level of 5%, the marginal infiltration of the zinc oxide-eugenol to the methylene blue dye. In the period of 15 days no statistical significant differences were observed. The zinc acetate increases the rat connective tissue reaction to the cement, in the period of 7 days after the implantation; in longer postoperative periods (15 and 30 days) the connective response was the same for both cements with or without zinc acetate.

MOREIRA, G.H., SOUZA, V., HOLLAND, R. & SALIBA, O. Efeito do acetato de zinco na qualidade seladora e na reação do tecido conjuntivo do rato ao cimento de óxido de zinco e eugenol.

RESUMO: Com a finalidade de verificar a influência do acréscimo de acetato de zinco ao cimento de óxido de zinco e eugenol, o presente trabalho foi desenvolvido em duas etapas. Na primeira, 60 dentes humanos foram instrumentados e seus canais obturados com cimento de óxido de zinco e eugenol acrescido ou não de acelerador. Após as obturações dos canais, os espécimes foram armazenados em câmara úmida. Decorridos os períodos de 1 e 15 dias, dez espécimes de cada grupo, dentro de cada período, foram mergulhados em solução de azul de metileno a 2% durante 12 horas. Seguiu-se o seccionamento longitudinal das raízes ao nível dos canais radiculares e a mensuração da infiltração do corante, com o auxílio de uma lupa ocular micrometrada. As medidas obtidas foram analisadas estatisticamente. Na segunda etapa, 30 ratos receberam implantes dorsais bilaterais de tubos de dentina preenchidos com cimento de óxido de zinco e eugenol, acrescido ou não de acetato de zinco. Decorridos os períodos experimentais de 7, 15 e 30 dias, os animais foram sacrificados e os espécimes processados para permitir análise histológica. Observou-se que o acréscimo de acetato de zinco ao cimento de óxido de zinco e eugenol, no período inicial (24 horas), produziu um aumento de infiltração marginal, estatisticamente significativa ao nível de 5%. No período mais longo (15 dias) não houve diferenças estatísticas nos dois grupos experimentais. Em relação aos implantes, verificou-se que o acréscimo de acetato de zinco ao cimento de óxido de zinco e eugenol, no período inicial (7 dias), evidenciou uma resposta inflamatória mais intensa por parte do tecido conjuntivo subcutâneo do rato. Nos períodos longos (15 e 30 dias), não houve diferenças na resposta tecidual ao cimento de óxido de zinco e eugenol acrescido ou não de acetato de zinco.

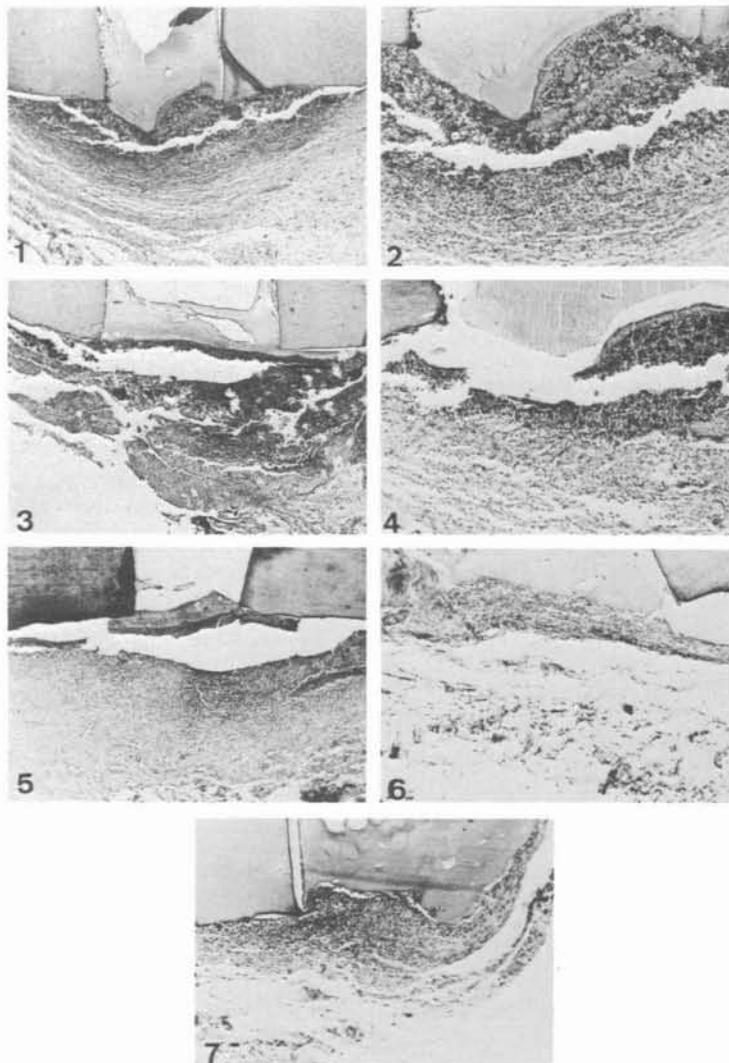
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- Fig. 1 — Zinc oxide-eugenol without zinc acetate, 7 days after the implantation. The material is surrounded by severe acute inflammatory reaction. H.E. X40.
- Fig. 2 — Higher magnification of figura 1 showing details of the inflammatory reaction. H.E. X100.
- Fig. 3 — Zinc oxide-eugenol with zinc acetate, 7 days after the implantation. The severe acute inflammatory reaction is more extensive than the one observed in figure 1. H.E. X40.
- Fig. 4 — Zinc oxide-eugenol without zinc acetate, 15 days after the implantation. There are numerous neutrophils in contact with the implanted material. The extension of the inflammatory reaction is minor than the one observed in the 7 days postoperative period. The area infiltrated by neutrophils is surrounded by a fibrous capsule with chronic inflammatory cells. H.E. X100.
- Fig. 5 — Zinc oxide-eugenol with zinc acetate, 15 days after the implantation. There is a thin area of neutrophilic infiltration between the material and the fibrous capsule. H.E. X40.
- Fig. 6 — Zinc oxide-eugenol without zinc acetate, 30 days after the implantation. A fibrous capsule with moderate chronic inflammatory reaction contacts the material. H.E. X100.
- Fig. 7 — Zinc oxide-eugenol with zinc acetate, 30 days after the implantation. There is a moderate chronic inflammatory reaction in the fibrous capsule near the implanted material. H.A. X100.