

INFLUENCE OF CHELANT AGENTS ON DENTIN PERMEABILITY AND ON THE HEALING PROCESS OF PERIAPICAL TISSUES AFTER ROOT CANAL TREATMENT

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ABSTRACT: A paste (RC-Prep) and a liquid chelant agents were applied on the root canal dentin walls of extracted human teeth, before the avaluation of dentin permeability to the metilene blue dye. The statistical analysis of the obtained data showed higher permeability of dentin treated by the liquid chelant. Following, root canals of dogs teeth were biomechanically prepared by using the same substances. Ninety days after the root canal filling, the specimens were prepared for histological analysis. The results showed that both chelant agents did not disturb the periapical healing process.

KEY-WORDS: Dentin permeability; chelant; healing process.

The ethylenediamine tetra-acetic (EDTA) was introduced in endodontic practices for cleansing and widening of root canals (NYGAARD-OSTBY, 1957). The EDTA initially used in the liquid form was also used in the paste form, to add other properties to the product (STEWART *et al.*, 1969).

Some of the chelating agent properties were studied, as its actions on dentin permeability and biological compatibility. The effect on dentin permeability is important to a deeper action of the dressing utilized during root canal treatment. About this property some authors believe the EDTA can increase dentin permeability (HAMPSON and ATKINSON, 1964; STEWART *et al.*, 1969; COHEN *et al.*, 1970) but some others find it diminishes (MARSHALL *et al.*, 1960; FRASER and LAWS, 1976. Besides, the indica-

tion of a substance to be used into the root canals must be conditioned to a good compatibility with the periapical tissues. In what this concerns, the results one can find in the literature goes from discrete (TORNECK, 1961; PATTERSON, 1963) to a severe tissue reaction (ATTALLA and CALVERT, 1969).

The aim of this work is to study the influence of the EDTA in the liquid or paste form on the dentin permeability and on the healing process of the periapical tissues after root canal treatment.

MATERIAL AND METHOD

The influence of the EDTA in the permeability of dentin was verified on human

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teeth, recently extracted and stored in water up to the moment of its use.

The tested substances were the RC-Prep (Premier) and a saturated EDTA solution, prepared according to the following formula: disodium salt of EDTA, 202.81 g; Na(OH), 21.78 g; distilled water, 1000.00ml.

Saline solution was used in the control group. On the first part of the experiment, 42 single rooted human teeth were used. All the teeth were protected with a nail polish to avoid the penetration on the dye through the external walls of the roots. The teeth were then cut longitudinally through mesio-distal direction using a carborundum disc, so as to divide each tooth into equal parts. The remaining pulp tissue were then removed and the dentin areas cleaned with brush and running water. To avoid variation in dentin permeability, the substances were compared two by two, always using the two halves of a same tooth, giving rise to three groups of 14 teeth each (28 sections) for the three studied substances (RC-Prep X saline, EDTA X saline, and RC-Prep X EDTA). The two EDTA formulas and the saline solution were applied to the walls of the root canals, during 15 minutes, being renewed every 3 minutes, after an irrigation with sodium hypochlorite in the experimental groups and with the saline solution on the control group.

The testing substances were removed by a final and abundant irrigation with saline, 15 minutes after their initial use. Both halves of each tooth were next immersed in 2% methylene blue solution for 40 minutes. After this time, the staining solution was removed by rinsing the specimens in water.

The sections were dried and sectioned labiopalatally along the middle line with a carborundum disc under a jet of compressed air.

All the new sections were photographed under standardized conditions, and the obtained images projected over a distance to give an enlargement of 50 times. The projected images were impressed on white paper and

the areas of dye penetration were determined by using a planimeter in a standard surveying procedure. The obtained data were statistically treated by the use of the Wilcoxon test, at a 5% significance level.

In the second part of this investigation, we used 30 root canals of male mongrel dogs 1 to 2 years old. The pulp chambers of the teeth were opened under general anesthesia and with the teeth isolated by rubber dam. In each group of 10 root canals the biomechanical preparation was carried out up to a n.º 40 instrument 1 mm short of the apical foramen and by using the RC-Prep, EDTA or saline. In the group that received RC-Prep, the irrigations were made with sodium hypochlorite, were else in the other two groups, the proper substances being tested constituted the irrigation solutions.

Finishing the biomechanical preparation, the canals were dried up and filled with gutta-percha cones and zinc oxide and eugenol cement. Ninety days after the treatment, the animals were sacrificed and the specimens removed for morphological studies. Tissues were fixed in 10 per cent neutral buffered formalin, demineralized in formic acid-sodium citrate, embedded in paraffin and serially sectioned at 6 micrometers. All sections were stained with haematoxylin and eosin.

RESULTS

The results obtained on the first part of this study showed that the total area of dye penetration was greater after use of EDTA. The statistical analysis of the obtained data showed no significant difference on a direct comparison of the RC-Prep with the saline solution. The comparison of EDTA with saline solution, also did not present any significant difference. Finally a direct comparison of the RC-Prep with EDTA showed statistically significant differences in between them, occurring larger and more intense infiltration in the EDTA group.

On the second part of this work, the histological examination showed the presence of debris on the apical portion in about 50% of the cases. The debris were composed by organic material from pulp tissue and dentin fragments. In few cases, almost only dentin fragments were seen, for this reason, each experimental group, made out of 10 roots, were subdivided in cases with and without debris as follows: saline group, 6 cases with debris and 4 without: EDTA group, 6 cases with debris and 4 cases without: RC-Prep group, 5 cases with debris and 5 without.

The results of the specimens without debris were approximately the same in between them, irrespectively to the Kind of the substance used. Except rare cases, the majority exhibited necrosis of the pulp stump, with reflexes next to the periapical tissues. Therefore, it was noted a chronic inflammatory reaction, of intensity and extension some what variable. In general the periodontal ligament presented widened and filled with connective tissue infiltrated by a moderate number of inflammatory cells. No active reabsorption areas were detected, but some evidence of neoformation was seen in bone tissue. Also cementum reabsorption or microabscess were rather rare (figs. 1-4).

It was quite evident the difference of results when chelant agents were used or not in the specimens with debris. The worse results were noted on the control group irrigated with saline. These specimens showed morphological data almost identical to those found in case of absence of debris. Only one case showed closure by the deposition of cementum on the surface of the pulp stumps. In this case, it was very rare to find inflammatory cells on the periodontal ligament, which exhibited normal thickness. Opposed to the control group, the others exhibited much more favourably results. It was relatively frequent the preservation of the pulp stump vitality and the closure by cementum deposition. In general, the periodontal ligament exhibited normal thickness and few chronic inflammatory cells. In some cases

there was even a complete absence of such cells. (figs. 5-8).

DISCUSSION

To study the influence of chelant agents on dentin permeability, we rather prefer the methodology proposed by FRASER and LAWS (1976) that always compare the testing substances over one same tooth. SIMPSON (1967) demonstrated that comparisons in between different groups of teeth may influence the results, what was confirmed by our study, since it was found a marked variation on the depth of the dye penetration when comparing the results of different teeth with the same substance.

The statistical analysis of the results obtained with dye penetration showed that there was no significant differences in the depth of the infiltration when comparing the RC-Prep with saline. This results is different than those presented by STEWART *et al.*, (1969), which say that RC-Prep markedly increases the permeability of dentin when comparing it with sterile distilled water.

The results of the comparison between EDTA with saline did not show any statistically difference on dye penetration. This data is in agreement with the one other authors. MARSHALL *et al.*, (1960) found that EDTA did not alter significantly the dentin permeability whereas HAMPSON and ATKINSON (1964) observed only a small increase of the dentin permeability on the coronary and medium third of the root, but on the apical third it did not show alterations.

Comparing the results of RC-Prep with those of the EDTA one can see that the last one produced higher permeability then the first one. The smaller permeability obtained with RC-Prep in relation to EDTA may be related to some remainder of the paste over the dentine walls, as demonstrated by ZURBRIGGEN *et al.*, (1975). On the other hand, with the use of EDTA in a liquid form McCOMB *et al.*, (1976) and GOLDBERG

and ABRAMOVICH (1977) demonstrated that the dentin tubules stayed completely opened.

The histological analyses of the periapical tissues, 90 days after root canal filling, did not show differences among the control and the experimental groups when the debris were absent. This suggests a good tissue tolerance to the EDTA, a fact also observed by NYGAARD-ÖSTBY (1957) over the dental pulp and periapical tissues, and by TORNECK (1961) and PATTERSON (1963) in rat subcutaneous connective tissue. Therefore, the inflammatory reaction observed on the periapical tissue must be related to the presence of zinc oxide and eugenol, an irritating filling material, accordingly to some experiments (HYAKUSOKU, 1959; ERAUSQUIN and MURUZÁBAL, 1967; HOLLAND *et al.*, 1971). On this work we observed debris between the filling material and periapical tissue in about 50 per cent of the cases. There are numerous experiments where that evidence is related (SKILLEN, 1926; LAWS, 1971; STROMBERG, 1971; LEONARDO, 1973; LAMBJERG-HANSEN, 1974). Opinions about the influence of those debris on healing process vary. Some related its presence in apical region with a larger tissue irritation (ERAUSQUIN and MURUZÁBAL, 1967; 1968); some others, believing on its good action, recommend its interposition between the filling material and the pulp stump or periapical tissues (KUTTLER, 1959; KETTERL, 1963; BAUME *et al.*, 1971, a; b).

We observed that the groups with EDTA or RC-Prep produced better results on the specimens that had debris. On these specimens, it was common the presence of vital pulp stump, and also some cases of closure by cementum apposition. But this was not frequent on the control group, which exhibited results almost similar to those with absence of debris. Although some relate the presence of debris with good results, it must be considered that its accidental condensation during the biomechanical preparation

may cause that pulp tissue residues are incorporated to the dentin fragments. A posterior deterioration of that organic tissue may generate the liberation of irritating products to the periapical tissues. That inconvenience may be avoided, or diminished, by the condensation of the dentin plug only after the biomechanical preparation is concluded. Besides the presences of pulp tissues debris, a contamination of the dentin plug may influence unfavourably the results (HOLLAND *et al.*, 1980). In our experiment, although being a case of vital pulpectomy, we can not discard the possibility of contamination during the biomechanical preparation. Even though, the best results obtained in the presence of debris on the EDTA groups suggest that such a product modified the biological behaviour of debris in some way. The microorganisms accidentally present in the debris could have been eliminated by the EDTA, as its bactericidal property was already demonstrated by PATTERSON (1963). It remains to be know what kind of action EDTA would have on the pulp tissue fragments incorporated with the dentin debris.

CONCLUSIONS

The influence of two chelant agents on the permeability of the dentin walls of extracted human teeth and the influence of the same substances on the healing process of dogs teeth periapical tissues after root canal treatment were studied. The data obtained permitted verify that the interference on the chelants on the dentin permeability is not very much expressive. Although the RC-Prep may have produced a small reduction of the permeability, when compared to the saline solution this difference was not statistically significant at the level of 5%. Data very similar were also found on the comparison of EDTA with the saline solution, with a small advantage of the first. Although, in a direct comparison of RC-Prep and EDTA the dentin permeability was larger on the specimens submitted to the action of the ED-

TA and this superiority was statistically significant.

Our results also made it evident that the RC-Prep and the EDTA do not disturb the periapical tissue healing process. On the contrary, in cases where occurred the presence

of debris between the filling material and the pulp stump they seem to have acted favorably on healing process.

These facts suggest that, on the biological point of view, it would be indifferent to utilize chelants in the liquid or paste form.

ZINA, O., SOUZA, V., HOLLAND, R. & SALIBA, O. Influência de agentes quelantes na permeabilidade dentinária e no processo de reparo dos tecidos periapicais após tratamento endodôntico.

RESUMO: Este trabalho foi desenvolvido em duas fases. Na primeira foi analisado o efeito do EDTA tri-sódico e do RC-Prep sobre a permeabilidade da dentina de dentes humanos extraídos, tendo o soro fisiológico como substância controle. Na segunda etapa as mesmas substâncias mencionadas foram empregadas durante o preparo biomecânico de canais de dentes de cães, os quais foram obturados com óxido de zinco e eugenol e examinados histologicamente 90 dias após o tratamento. A análise estatística dos dados obtidos na primeira fase não mostrou diferenças significativas, quando comparados o RC-Prep ou EDTA com o soro fisiológico. No entanto, quando comparados os resultados do EDTA com o RC-Prep, a análise estatística evidenciou diferenças altamente significantes, salientando uma maior permeabilidade da dentina submetida ao EDTA, na forma líquida. Os resultados obtidos na segunda etapa deste trabalho experimental mostraram dados semelhantes tanto com o emprego do EDTA na forma pastosa (RC-Prep) quanto na forma líquida. Esse fato sugere que do ponto de vista biológico e dentro das condições experimentais deste trabalho é indiferente empregar-se o EDTA na forma líquida ou pastosa.

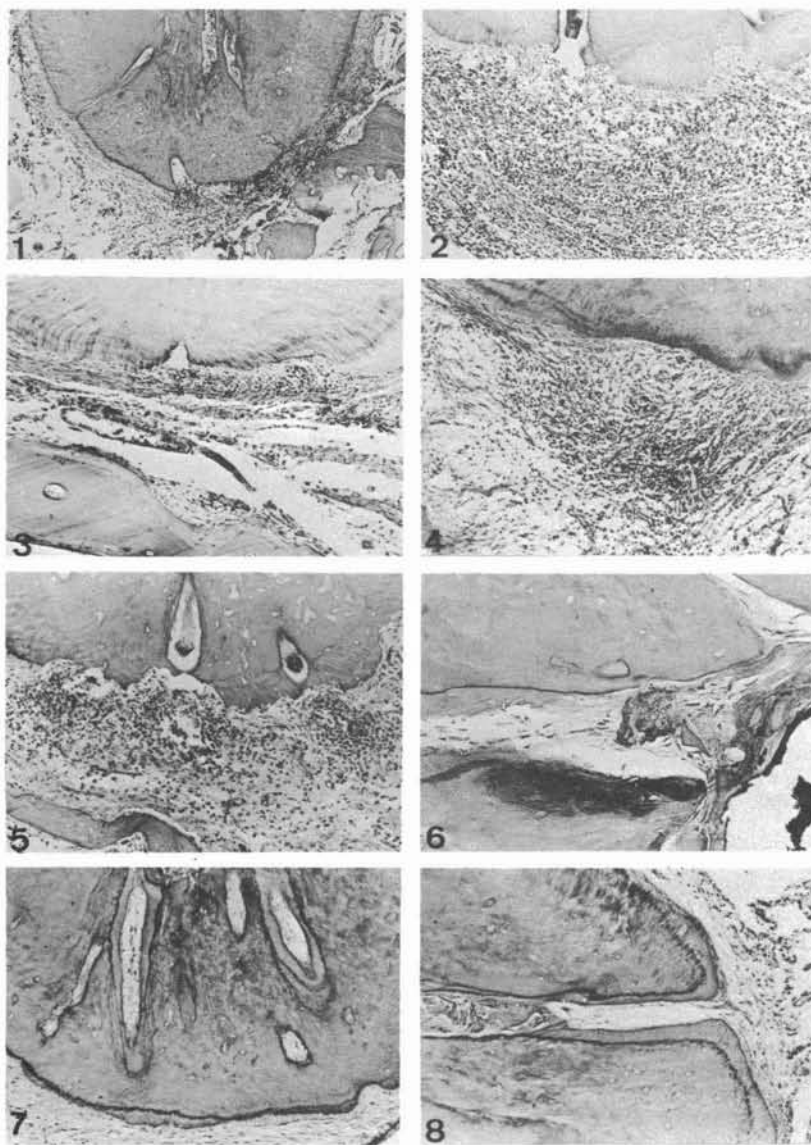
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CHELANTS IN DENTIN PERMEABILITY AND PERIAPICAL TISSUES



- Fig. 1 — Root canal free of debris irrigated with saline. There are a moderate inflammatory reaction and necrotic pulp stump. H. E. X 40.
- Fig. 2 — Root canal free of debris irrigated with saline. The pulp stumps are necrotic and there are root resorptions and moderate chronic inflammatory reaction. H. E. X 100.
- Fig. 3 — Root canal free of debris irrigated with EDTA. There are root resorption and a mild chronic inflammatory reaction. H. E. X 100.
- Fig. 4 — Root canal free of debris irrigated with RC-Prep and sodium hypochlorite. There is a moderate chronic inflammatory reaction in the periodontal ligament. H. E. X 100.
- Fig. 5 — Root canal with debris and irrigation with saline. Necrosis of the pulp stumps and areas of root resorptions. There is a moderate chronic inflammatory reaction in the periodontal ligament. H. E. X 100.
- Fig. 6 — Root canal irrigated with EDTA. There are debris on the surface of the vital pulp stump. Cementum apposition on the walls of the cementary canal. H. E. X 200.
- Fig. 7 — Root canal with debris and irrigation with RC-Prep and sodium hypochlorite. The pulp stumps are vital and closed off by cementum apposition. H. E. X 100.
- Fig. 8 — Root canal with debris and irrigation with RC-Prep and sodium hypochlorite. Biological closure by cementum apposition on the surface of the pulp stump. There is a mild chronic inflammatory reaction. H. E. X 100.