THE ASSESSMENT OF ROOT CANAL SEALERS pH IN THE TREATMENT OF PERIAPICAL INFLAMMATION PROCESSES – AN IN VITRO STUDY

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ABSTRACT

Introduction: The endodontic treatment represents the best conservative option for irreversible endodontically affected teeth maintenance on the dental arch. Besides the rigorous mechanic-chemical treatment, in aseptic conditions, the regenerative or, on the contrary, inhibitive qualities of the root canal sealer on the periradicular tissue play an important role in the long-term success of the treatment. The aim of the study The object of this study consisted in analysing the pH values of frequently used root canal sealers in the endodontic treatment, to make a series of correlations with their therapeutically indications.

Materials and Methods We tested the following root canal sealers: AH-26 (De Trey), ZOE, Pulispad (Spad, Dijon), Sealapex (Kerr), Endomethasone (Septodont), Endospad (Spad, Dijon). The materials were prepared according to the producer indications. The pH recordings were made on different time points: immediately after the preparation, after 24 hours, after a week and after two weeks.

Results Our data analysis revealed a variation of the pH values of the 6 root canal sealers and differences in their pH values on different time recordings. The highest values were presented by Sealapex; in the alkaline values order, this was followed by Endomethasone and Endospad. The lowest pH values, to acid zones, were recorded from AH-26, ZOE and Pulispad.

Conclusions The presence in the root canal of an alkaline pH sealer ensures an additional opportunity for the infection control and tissue regeneration of the periradicular tissue. Due to this property, the root canal sealers that have calcium hydroxide in their composition are used more and more frequently.

Key words: endodontic space, microbial activity, root canal sealer, pH

INTRODUCTION

The endodontic treatment represents the best conservative option for irreversible endodontically affected teeth maintenance on the dental arch.

The efficiency of the root canal filling directly depends on the adequate elimination of the microorganisms and their toxins by mechanical debridement, by irrigations with antibacterial substances, by using antibacterial substances between the sessions (calcium hydroxide), when the clinical situation demands it, and a tight root canal sealing [1, 2, 3, 4]. But all these treatment phases do not ensure the sterilization of the root canal system, due to a complex anatomy that includes lateral ramifications, secondary canals and, in some cases, a large apical delta;
the remaining pathogenic agents, by multiplication, can destroy the periapical tissue [5, 6]. Furthermore, if the sealing is not perfect, the microorganisms can pervade after a few days since the instrumentation, determining periapical pathology [7, 8]. Therefore, the root canal sealer must present antimicrobial qualities [9].

Due to the ability of the canal sealers to diffuse beyond the root apex, their biocompatibility is a factor that has to be considered in choosing a sealer. The large variety of sealers, such as epoxidic resins, calcium hydroxide and zinc oxide eugenol based sealer, provide multiple possibilities. The majority of the studies suggest that paraformaldehyde or zinc oxide eugenol sealers might induce periapical irritation [10]. Furthermore, the releasing of a series of compounds that can diffuse in the periapical tissues might directly affect the periodontal cells, inducing an inflammatory response and even a cellular necrosis [10, 11].

Calcium hydroxide sealers are frequently used due to their excellent bactericide qualities determined by the alkaline pH, mediate the bacterial lipopolysaccharides degradation; they induce the dental hard tissue neo-formation and control the inflammatory radicular resorbtion [12, 13].

**The aim of the study**

The object of this study consisted in analysing the pH values of frequently used root sealers in the endodontic treatment, to make a series of correlations with their therapeutical indications.

**MATERIALS AND METHODS**

We tested the following root canal sealing materials in the Department of Endodontics of “Gr. T. Popa” University of Medicine and Pharmacy (Table 1):

1. AH – 26 (De Tray)
2. ZOE
3. Pulpispad (Spad, Dijon)
4. Sealapex (Kerr Europe)
5. Endomethasone (Septodont)
6. Endospad (Spad, Dijon).

The materials were prepared according to the producer indications. To register the pH values we obtained solutions of 0.5g sealer paste, combined with 20 ml sol. KCl 0.1 N; the mix was agitated for 5 minutes.

The pH recordings were made with SEIBOLD WIEN pH-meter, on different time points:
- immediately after the preparation
- after 24 hours
- after a week
- after two weeks.

**RESULTS**

The registered data reveal a pH values variation for the 6 sealers and differences of their pH values in time.

The results are succinctly presented in Figures 1, 2, 3 and 4.

We observed the highest pH values for Sealapex sealer (9.13), due, as it is known, to its calcium hydroxide compound. The value after preparation was 8.65, gradually rising after 24 hours, after a week and after 2 weeks, respectively.

In the alkaline values order, this was followed by Endomethasone and Endospad, with values between 8.24 and 8.90.

The lowest pH values, to acid zones, were recorded from AH-26, ZOE and Pulpispad (between 5.80 and 6.81).

At the same time, we observed a slight rising of pH values in time, after the preparation of the sealer, excepting AH-26, which presented close values. We also calculated the standard deviations of pH values using the ANOVA system (p<0.05).
<table>
<thead>
<tr>
<th>SEALER</th>
<th>PRODUCER</th>
<th>COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AH 26</td>
<td>De Trey</td>
<td>Epoxidic resins</td>
</tr>
<tr>
<td>ZOE</td>
<td></td>
<td>Zinc Oxide, Eugenol</td>
</tr>
<tr>
<td>PULPISPAD</td>
<td>Spad, Dijon</td>
<td>Powder: Ag., Diodtimol, Zinc oxide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid: Menthol, Camphor, Parachlorphenol, Eugenol</td>
</tr>
<tr>
<td>SEALAPEX</td>
<td>Kerr Europe</td>
<td>Catalyst-Sulfat Ba, Dioxid Ti.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base: Zinc-oxid, Ca(OH)₁, Butilbenzen, Sulphonamide, Zinc Stearate</td>
</tr>
<tr>
<td>ENDOMETHASONE</td>
<td>Septodont</td>
<td>Dexamethasone 0.01 g, Hidrocortisone 1.00 g,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diodtimol 25 g, Paraformaldehyde 2.20 g,</td>
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<tr>
<td>ENDOSPAD</td>
<td>Spad - Dijon</td>
<td>Diodtimol, Enoxolan, Zinc-oxid, Ag. powder</td>
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</tbody>
</table>

**Tabel 1. The composition of the root canal sealers used in the study**

DISCUSSIONS

Taking the pH value of Sealapex sealer (based on calcium hydroxide) as a reference point, demonstrated also by the present study, whose positive effects on the apical lesions are highly recorded in the literature, we observe that, with a higher alkaline value of the sealer (in biological limits, to avoid the strong irritation of the tissues) this will present even more effective antibacterial effects, therefore
determining a reduced inflammation of the periapical tissue and promoting the tissue healing. As long this effect is prolonged, it creates optimal conditions for the alkaline phosphatase to react, a marker for the osseous tissue neo-formation [14].

Likewise, the calcium hydroxide sealers present antibacterial effects due to the ionisation process, releasing OH\(^{-}\) ions that determine the rising of the pH value above 9; this high alkalinity reversibly or irreversibly inactivates the bacterial membrane enzymes, determining their biological and pathogenic activity cessation [5, 15].

A series of studies in the specialty literature contradict our results, supporting a cytotoxicity of the calcium hydroxide based sealers [11, 16]; this aspect can be explained by the initially high pH value that induces a host cells response. Other studies confirm our results, demonstrating a high biocompatibility of these sealers [17, 18, 19, 20].

The rising of the pH value to an alkaline zone determines antibacterial properties for the substance by inhibiting the microbial enzymes and stimulation the remineralisation processes, therefore, the regeneration of the damaged tissues by controlling the inflammatory phenomena. An acid pH value, on the contrary, will activate the acid hydrolase, stimulating the osteocalstic activity in the osseous demineralisation and resorbtion.

Nevertheless, ZOE and AH-26, due to the formaldehyde content, exhibit a high antibacterial effect and the eugenol determines anti-inflammatory and anti-oxidative actions for the ZOE sealer [19, 21].

Even if our results reflect “in vitro” studying, we can affirm certain suppositions regarding the influence that these sealers may exert on the periapical tissues.

In the endodontic practice, in situations of periapical lesions or large apical foramen, the elected material for root canal sealing will be the one with higher pH value, in our case - Sealapex, Endomethasone or Endospad.

The other materials will be used in cases with slightly affected or pristine apical area, determining only a tight sealing of the root canal, by a proper filling technique.

In Fig.5 we present a clinical case of infectious periapical pathology. We observe on the initial radiograph a significant osseous lysis on the mesial root of 3.6 molar, its extent on the furcation level and to the distal root. We conducted a rigorous mechanical-chemical treatment, in a series of sessions. After 6 month we observed a considerable remineralisation of the periapical tissue; after another 6 months since the root sealing with Sealapex (Fig. 6), the radiograph revealed a full restituto ad integrum.

CONCLUSIONS

Knowing that most microorganisms do not resist to high alkaline pH, the presence in the root canal of an alkaline pH sealer ensures an additional opportunity for the infection control and regeneration of the periradicular tissue. Due to this property, the root canal sealers that have calcium hydroxide in their composition are used more and more frequently. In our study, the order of the highest alkaline values was as follows: Sealapex, Endomethasone and Endospad.

REFERENCES