**Determination of release of calcium ions by atomic absorption**

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**Introduction**

Promotion of secondary dentine is the basic mechanism for repairing pulp injury or artificial exposition at surgical accident. To treat exposed pulps calcium hydroxide is the most important material. The calcium hydroxide suspensions or cements promote the formation of new dentine[1-2]. The calcium hydroxide is a white powder obtain from calcium carbonate, CO3Ca = CaO+ CO2CaO + H2O = Ca(OH)2. It is not very soluble in water, the pH is alkaline, approximately 12.4.

Many authors have investigated the calcium hydroxide and its reparative action reaching encouraging conclusions with a success rate of 85%[3]. This depends fundamentally on the condition of the pulp [4], the outcome is better when there was no exhibition of caries [5]. The reparative action could be acceptable before 60 days, therefore speed and time of action of the material in its reparative function is important[3]. The material is known to be bactericidal to have corrosive effect aiding production of superficial necrosis, as a biological defence of the pulp.

It is proven that the power of calcium hydroxide resides in its alkaline pH value which acts on certain enzymes that are located in the cytoplasmatic membrane. These enzymes are also responsible for metabolism, cellular growth and division and participation at the last stages of cell wall formation [6], The pH of the material allows the pulp to build its calcium barrier, where the alkaline phosphates of the pulp is activated, permitting the deposit of calcium phosphate forming a strong bridge of calcified tissue that will protect the vital pulp, without inflammatory reaction [7]. Several different techniques for placing calcium hydroxide into root canals have been proposed [8].

The materials used right now are able to release calcium hydroxide and can be presented in a powder to be mixed with distilled water or a substance able to act as transport; they can also be presented commercially as a paste.

These commercial presentations can determine times and quantities of released substance. A mechanism to determine the calcium released by a material can be by atomic absorption, this complex procedure could be described with width but we choose to clarify a few concepts. In the spectroscopic atomic absorption the sample to be analyzed becomes an atomic vapour in which most of the atoms is in its fundamental or not excited state. In this condition the atoms can absorb radiation of a limited number of wave longitudes that correspond to their lines of resonance. The first of these lines is usually used for resonance that corresponds to the transition from the fundamental state to the state of lower excitement and the election of the line is in general very simple. Although it stops very complicated electronic structures it has several lines of resonance with approximately the same grade of absorption.

For each electronic transition the longitudes of wave resonance are given in nanometres (nm) the ionization potential in dotted lines.

The inherent width to the lines of resonance is very small, in the order of 10-5 nm and the most convenient way to measure the absorption in the peak of these lines is to use a source of light that emits a fine line and longitudinal intense of appropriate wave, that is to say a lamp that emits an atomic spectrum of high resolution of the metal coming from a lamp of hollow cathode. To get a good monochromatic is required separate the wanted line of any other line that can emit the source. If the width of the line of emission from the source is worthless regarding absorption of the atomic vapour under normal conditions, the coefficient of absorption of the peak of the line is proportional to the concentration of atoms in the state of vapour.

The quantitative determination of metallic elements for this technique is carried out in comparative form measuring the absorption of samples and patterns under the same operative conditions of the team.

The calibration curve, absorbance versus concentration, is usually obtained measuring the absorbance of solutions of well-known concentration of the metallic element that is sought to determine [9-10].

Much more could be said of this noble material in spite of its low mechanical properties, biological behaviour that was still not able to be overcome. The objective of this work was to determine the liberation of calcium ions by means of atomic absorption during one week in 6 materials with reparative action on the dental pulp.

**Materials and methods**

We analyzed the release of calcium in five dental materials.

5 samples were analyzed in each group:

Group 1. Calcium hydroxide with chemical reaction, Dycal (Dentsply)
Group 2. Calcium hydroxide with chemical reaction, Calcimol (Voco)
Group 3. Pure calcium hydroxide, Calasept (Nordiska Dental)
Group 4. Pure calcium hydroxide, Calcicur (Voco)
Group 5. Pure calcium hydroxide, Ultracal XS (Ultradent)

<u>Preparation of samples</u>

Small cylindrical moulds of polyethylene 4 mm high and 3 mm of diameter were used. They were weighed with a scale of precision. The cylinders leaned on preferably plane surface of glass. The cylinders were filled with the material to analyze. The cylinders were again heavy to obtain the real weight of the material release of calcium ions.

The samples were kept in a plastic recipient with 50 ml distilled water, the recipient closed tightly and exposed to ambient temperature for one week.

After seven days the water solution was extracted with the released calcium. The liquid was transported in a flask of 100 ml, 5 ml of chloral acid was added to 50% and the suitable volume was completed with water distilled until it was even.

<u>Preparation of the calcium solution</u>

Calcium solution 1000 mg per litre. Dissolving 2.4970 g of calcium carbonate for analysis in a minimum quantity of hydrochloric acid, diluted to one litre of water distilled in a flask. Thoroughly mixed within a polyethylene flask. The solution prepared contains 1.00 mg of calcium per ml solution.

<u>Preparation of the calibration curve</u>

In 6 flasks of 100 ml put 0 ml; 20 ml; 40 ml; 60 ml; 80 ml and 100 ml of the calcium solution, added with distilled water until filled and mixed.

Each one of the prepared solutions contains 0; 20; 40; 60; 80 and 100 mg of calcium in 100 ml of solution.

<u>Measuring absorbance patterns and samples.</u>

We estimate the target of the solution patterns and measure the absorbance, carrying out the same operation with all samples measuring absorbance in each case, obtaining mg calcium per gram material.

**Result:**

Table 1 shows respective values for each material (calcium).

| Material | Means mg Ca/g | Standard deviation | Tukey |
|---|---|---|---|
| Dycal | 13.5 | 3.5 | |
| Calcimol | 16.3 | 3.0 | |
| Calasept | 36.8 | 5.4 | |
| Calcicur | 33.2 | 4.0 | |
| Ultracal XS | 29.6 | 4.8 | |

Table 1.$P<0.05$

**Conclusions**

A notorious difference in the release of calcium ions was observed between materials that cure and those that are pure.

The materials releasing highest quantity of calcium were Calasept and Calcicur, with no significant differences among them. The value for Ultracal XS is attributed to the easy absorption and its calcium hydroxide content.

The values were obtained after 7 days, crucial time when closing a pulp, the values can vary due to draining of molecule content in this study.

Looking at the results it is advised to use materials that are presented commercially in a powder not as two components (powder/liquid).

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