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Degree of Conversion and Ph for Calcium Formed Pulp Capping Materials (An in Vitro Study)

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Abstract

The purpose of this study is to look into the effects of calcium hydroxide and theracal the degree of polymerization of a dual cure liner, as well as pH at various times. Materials and procedures • The liner was made up of forty discs of the tested materials (resin modified calcium silicate and calcium hydroxide pulp capping). Each tested material was separated into two subgroups according to the test to be done (each subgroup n=10) and tested. Cylinders of 8mm diameter and 2mm thickness were photoactivated for 15 seconds and then divided into two groups according to their type. Dgree of conversion A Fourier-transform infrared spectrometer with a high conversion degree was used. By putting a 1 mm-thick sample on the crystal and light curing it for 20 seconds, the time DC of Theracal and dycal were determined. The activated light had a wavelength of 450–490nm and a power density of 1,500 mW/cm². Theracal and calcium hydroxide (dycal) degrees of conversion (DC) mean during curing for a period of 20 seconds were measured and analyzed • A PH reading The pH of each material's supernatant was measured using a pH meter. The findings were calculated immediately, three hours later, and 24 hours afterwards. As a control, a buffering solution was applied. The standard deviation of the pH mean values was then calculated.. T test is used to assess the data. **Results:** Dycal and theracal tested materials Showed a very alkaline pH afte 3 hours and gradual decreased in pH after 24 hours with no significant differences between the tested materials. Photo activation of the tested materials provided more polymerization of theracal than dycal with no significant difference between them(p value >0.05). **Conclusion:** Different modification should be made to increase the physical and chemical activity of the pulp capping materials.

Introduction

The primary goal of vital pulp treatment is to maintain its function and vitality(1) . For physiological tooth growth and the maintenance of the oral cavity environment's equilibrium, preserving tooth vitality is critical. The use of vital pulp materials has the goal of stimulating dentinogenic pulp cells (1). To increase the success rates of indirect and direct pulp capping measures, calcium hydroxide and hydraulic tricalcium silicate cements (TCS) have been used for important pulp treatment(2) • In the presence of water these cements theracal and calcium hydroxide (CH) release hydroxyl ions and calcium(3),which aid in the curing of pulp tissue and the creation of mineralized tissue while preventing microbial growth. These cements' alkalinity has anything to do with it(4). Despite CH well-known significance, the required dose release from pulp medicinal compounds is unknown, necessitating research into these materials, It's crucial to understand PH antibacterial properties as well as its involvement in dentine repair (5). The use of additives can alter the characteristics of cement Specifically, even when the beneficial effects are there, While the benefits of pure calcium silicates and the use of inert radio pacifiers as a bismuth oxide substitute are undeniable, there is still a heated dispute in the scientific community over the impact of further modifications. As a result, inserting a resin matrix or a combination of silicon oxide has been discovered to indicate the hydration of materials and the release of calcium hydroxide to varying degrees.(6,7) Furthermore, the use of light cure monomers, such as those found in TheraCal LC (8,9) allows the material to be facility cured, reducing difficulties with composite resin adhering to the underlying pulp capping liner(10). As a result, determining the degree of polymerization is a crucial step in displaying the material's qualities. The goal of this research is to determine the impact of a PH alteration in a dual cure liner and Examine the degree of polymerization of these calcium-dependent pulp capping compounds at various intervals.

Material And Methods

The liner was made up of forty discs of the tested materials (resin modified calcium silicate and calcium hydroxide pulp capping). All discs were manufactured in accordance with and placed in a plastic mold of 8mm diameter and 2mm thickness (Valley's et al., Ramos et al.,2016)(11) the materials were mixed according to the manufacturer's instructions and photoactivated for 15 seconds at room temperature for 24 hours, after which all materials were removed from the plastic disc mold, the discs were divided into two groups based on their type, and each subgroup was divided into two subgroups based on the test to be performed (each subgroup n=10), and tested as follows:

Degree of convesion

The spectrometer employed was a Fourier-transform infrared spectrometer. By putting a 1 mm-thick sample on the crystal and light curing it for 20 seconds, the time DC of Theracal and dycal were determined. 1 mm was established as the distance between the curing light and the specimen. The activated light had a wavelength of 450–490nm and a power density of 1,500 mW/cm². The intensity of the 1600 cm⁻¹ peak corresponding to –CH=CH₂ stretching vibration was monitored for a decrease in intensity.

Theracal and dycal degrees of conversion mean (DC) during curing for a period of 20 seconds were measured and analyzed.

PH test

After tested materials have fully set, they are crushed and combined with ionized water to make a suspension with a concentration of 60 mg/ml. After that, all of the samples were centrifuged for 60 seconds to obtain a clear suspension,

Group (1) theracal suspension was measured after 3 and 24 hours. group (2) dycal suspension was measured after 3 and 24 hours .

The pH of each material's supernatant was measured using a pH meter,The findings were calculated immediately.

As a control, distilled water was used, The standard deviation of the pH mean values was then calculated.

Result:

Result of degree of conversion

The result of photo activation of the tested materials provided more polymerization of theracal than dycal with no significant difference between them ($p > 0.05$) as shown in Table (1).

Result of pH test

Dycal and theracal tested materials Showed a very alkaline pH after 3 hours Table(2). gradual decreased in pH after 24 hours with no significant differences between the tested materials p value > 0.05 . Paired t -test showed significant differences within same material after 3 hours and 24 hours at $p > 0.05$ result showed in Table (3) and descriptive statistic .

Discussion:

The pulp treatment is important to keep the it's functional. According to a Nemours study, ionic separation of hydroxyl ions from contemporary dental pulp protection treatments is critical for therapeutic activity. The mobility of calcium hydroxide aqueous solutions, which allows for good dissociation and hence an increase in pH, is highlighted by researchers.(12) Between 3 and 24 hours, they demonstrated a propensity to lose their capacity to elevate the pH of most materials. This is why, in the current

investigation, pH measurements were only taken after 3 and 24 hours.(13) The peak of alkaline pH was reached after 3 hours, according to the authors. This argument backs up what our research found concerning the pH level after a 24-hour period According to Torabinejad et al., the alkaline pH reached its greatest level after around 3 hours. This result because of short setting time of tested materials which decrease the chance of the calcium ion release these results agree with Torabinejad et al. (14) present study showed no significant difference between Theracal and calcium hydroxide in degree of polymerization this may be to poor polymerization (DC) during the light curing time (20 s). In the perfect light curing situations as proven in the present experimental Study, the DC of a resin materials ranges between 60 75 percent. (15) The causes for the tested materials were owing to their shade, which may have hampered the curing process by preventing enough light transmission (16), resulting in a considerable number of unreacted monomers remaining after curing.(17,18)

Conclusion:

Changes in the traditional construction of a radiopacified hydraulic cement in an effort to increase physical and chemical properties or handling characteristics should be examined, as combination of additive may reduce physical and chemical characteristics.

Table (1): showed descriptive statistic and p value of t -test of the DC of the tested materials.

5 DC	mean	St.	P value
theracal	74.300	6.16532	0.95
dycal	73.000	4.89898	0.96

Table (2): showed the results of the tested groups descriptive statistic and T -test with no significant difference between tested groups $p > 0.05$.

Group PH	mean	St.	P value
theracal	11.2070	0.14712	0.615
dycal	11.2410	.14970	0.973

Table (3): paired samples T_test between same material at different times showed significant differences with $p > 0.05$ *significant .

Groups	Mean+_ SD	P value
Pair 1 pht3_pht24	0.65800+_ 0.22365	0.001*
Pair 2 phd3_phd24	0.73600+_ 0.23982	0.000*

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