



## The Effect of Disinfectant on the Microstructure of Dental Stone at Different Time Intervals

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### Abstract

Gypsum products have been considered to be among the most widely used model and die materials. Modifications of these materials by adding chemicals or salts result in a change in their structure. This study was designed to evaluate the effect of the addition of Calcium Hypochlorite disinfectant on the microstructure of dental stone.

Calcium Hypochlorite disinfectant in aqueous solution in different concentrations (0.5, 1.0, 1.5 and 2.0%) was added to type III dental stone. The microstructure of the dental stone samples was examined under the microscope and then photo scoped, pictures were taken at different time intervals (immediately, after 10, 30 min., 1 and 2 hours) for all the test groups.

The results of this study showed that at different time intervals, from the beginning of mixing of dental stone with Calcium Hypochlorite disinfectant solution, deformation in the microstructure was produced (calcium sulfate dihydrate crystals).

Microscopically appearance of dental stone samples mixed with Calcium Hypochlorite disinfectant solution revealed a deformation in size and shape of the calcium sulfate dihydrate crystals when compared with the control group.

**Key words: Dental stone, Disinfectants, Microstructure.**

### Introduction

Dentists, dental assistants and laboratory technicians are always at risk of cross-contamination, especially those who do not wear gloves because of their sensitivity to latex rubber or due to the reduction in their working skills as a result of glove-wearing.<sup>(1,2)</sup> on the other hand, several dental materials, instruments and pieces of equipments can't be easily sterilized. Thus a potential for bacterial cross-contamination between the dental operator and the prosthetic laboratory has been established, constituting a potential health hazard in prosthetic practice. At the same time, the dentist is faced with the possibility of contamination of the prostheses from the dental laboratory as well as a

potential pathogenic hazard to both professional staff and patients.<sup>(3)</sup>

Dental impressions become contaminated with microorganisms from the patient's saliva and blood, which can cross-infect stone casts poured against them.<sup>(4)</sup>

A number of these microorganisms cause infectious diseases that may be incurable, such as those caused by the hepatitis C and HIV viruses.<sup>(5)</sup>

American Dental Association (ADA) and the Centers for Disease Control and Prevention suggested methods for the disinfection of dental casts, including immersion in or spraying with a disinfectant<sup>(6)</sup>

The potentially damaging effects of the immersion technique, the difficulty in covering the entire surface of the cast with the spray disinfecting solution, and

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the inability to assume that every impression presented to the laboratory has been disinfected has led to the need for incorporating a disinfectant directly into the calcium sulfate hemihydrate.<sup>(7)</sup>

Studies by Abdelaziz et al.<sup>(7)</sup> and Ivanoveski et al.<sup>(8)</sup> reported a reduction in strength values with most of the gypsum products tested especially those mixed with povidone iodine, glutaraldehyde, sodium hypochlorite. Recently, a study done by Twomey et al.<sup>(9)</sup> showed that the addition of calcium hypochlorite as a disinfecting agent to dental stone was microbiologically effective at 0.5%.

## Materials and methods

Type III dental stone (Elite model, Zhermack SPA, Rovigo, Italy) was used to prepare the samples and Calcium Hypochlorite (BDH, Laboratory prepared, England) was used to prepare the testing solutions.

The stone samples were prepared and divided into five groups, according to the concentration of Calcium Hypochlorite 0, 0.5, 1.0, 1.5, 2.0%.

**Group A** → Stone powders mixed with Distilled water only.

**Group B** → Stone powders mixed with 0.5% Calcium hypochlorite solution

**Group C** → Stone powders mixed with 1 % Calcium hypochlorite solution

**Group D** → Stone powders mixed with 1.5% Calcium hypochlorite solution

**Group E** → Stone powders mixed with 2% Calcium hypochlorite solution

A mixture of dental stone powder and testing solution, distilled water and calcium hypochlorite disinfectant solutions in different concentrations from 0.5 - 2%, was prepared with W/P ratio of 0.25/1 by volume because the presence of too many particles made observation difficult. A drop of the

mixture was placed on the microscopic slide and the cover slip was placed over it immediately.

The sample of each mixture was examined under the Olympus photomicrographic system, model PM-10AD (with control unit), Japan. The sample was then photo scoped at different time intervals for each of the test groups to show the crystallization shape and size and to compare the control group photo scope with that of the test groups. The magnification power of 40 X was used for all tested materials.

## Results

The examination of the diluted mixture of dental stone with water under the microscope for each of the testing groups elaborated the following:

The calcium sulfate dihydrate crystals for the control group appeared as needle like crystals at different time intervals. (Figure 1)

### **Immediately:**

For group B (0.5 %) the shape of calcium sulfate dihydrate crystals was deformed and some appeared larger in size, this result was the same for other test groups. (Figure 2)

### **After (10 min.):**

For group B: the shape of calcium sulfate dihydrate crystals was deformed and few appeared larger in size than the control group. (Figure 3)

For group C: the shape of calcium sulfate dihydrate crystals was deformed and appeared larger in size than crystals of group B. (Figure 4)

For group D: the shape of calcium sulfate dihydrate crystals was deformed and appeared larger in size than the crystals of control group. (Figure 5)

For group E: the shape of calcium sulfate dihydrate crystals was deformed and appeared large in size than the control group. (Figure 6)

**After (30 Min.):**

For group B: the shape of calcium sulfate dihydrate crystals was deformed and few appeared larger in size than the control group. (Figure 7)

For group C: all calcium sulfate dihydrate crystals appeared spherical in shape and smaller in size than the control group. (Figure 8)

For group D: the shape of calcium sulfate dihydrate crystals was deformed and fewer appeared spherical and larger in size than the control group. (Figure 9)

For group E: the shape of calcium sulfate dihydrate crystals was deformed and few appeared larger in size than the control group. (Figure 10)

**After (1hour):**

The shape of calcium sulfate dihydrate crystals was deformed and few appeared larger in size, for all of the testing groups when compared with the control group. (Figure 11)

**After (2 hours):**

The shape of calcium sulfate dihydrate crystals was deformed and few appeared larger in size, for all of the testing groups when compared with the control group. (Figure 12)

**Discussion**

Gypsum products have been considered among the widely used model and die materials. Modification of these materials by adding chemicals or salts would result in changes in their structure as well as their properties.<sup>(10)</sup>

The microbiological efficiency of the disinfectants used in this study had already been established.<sup>(9)</sup>

The diluted mixture of dental stone with water for the control group and with calcium hypochlorite disinfectant solution in different concentrations for the test groups was examined under the microscope. The microscopical pictures of the test groups, when examined at different time intervals,

showed deformation in the size and shape of the crystals when compared with the control group. Our finding was in agreement with results of Abdelaziz et al. and Jørgensen & Posner<sup>(7,11)</sup>.

The ions from the Calcium hypochlorite disinfectant solution may have caused dissolution of the calcium sulfate hemihydrate crystals. Or, the ions from the calcium hypochlorite may have altered the crystal structure, which could affect the ability of the crystal to inter mesh. As a result, hemihydrate particles may have shown incomplete solubility in the calcium hypochlorite and so the final percent of hemihydrate / dihydrate conversion was affected.<sup>(7)</sup>

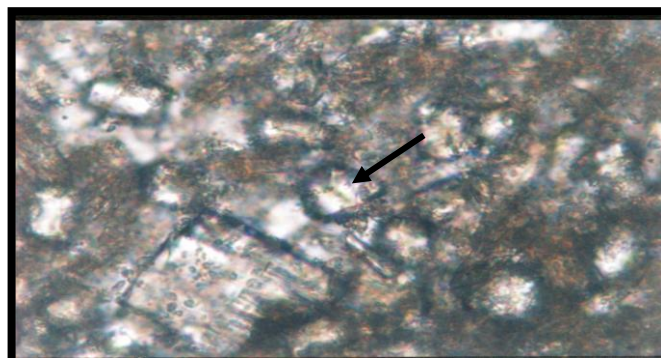
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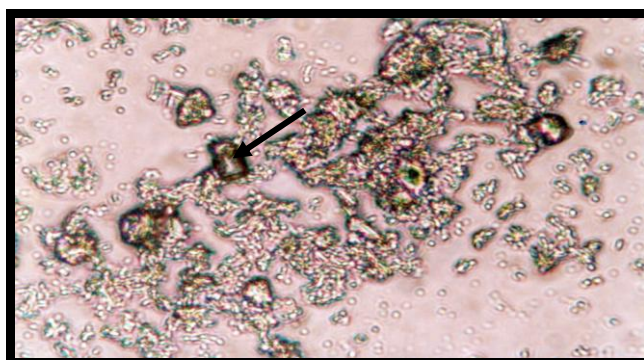
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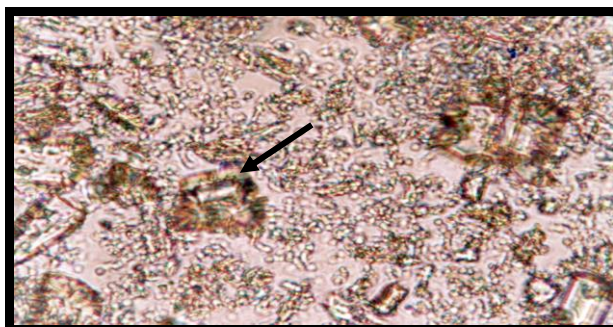
**Figure 1:**The calcium sulphate dihydrate crystals for the control group at different time intervals



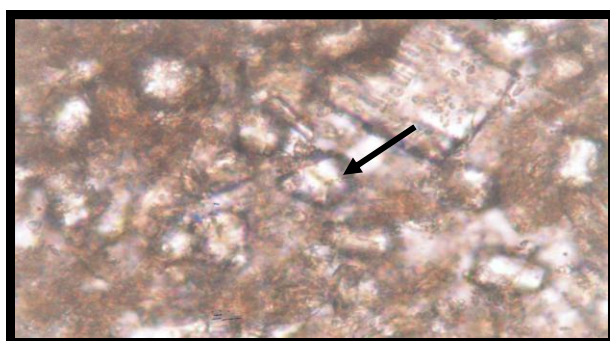
**Figure 2:**The calcium sulphate dihydrate crystals for the testing groups immediately



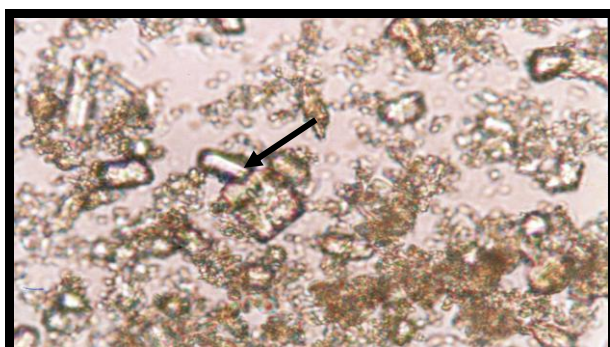
**Figure 3:**The calcium sulphate dihydrate crystals for group B after 10 Min.



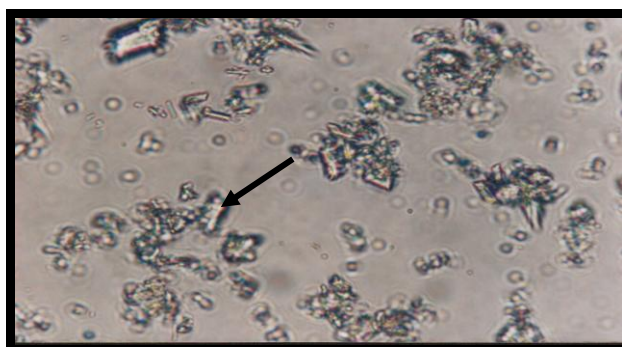
**Figure 4:**The calcium sulphate dihydrate crystals for group C after 10 Min



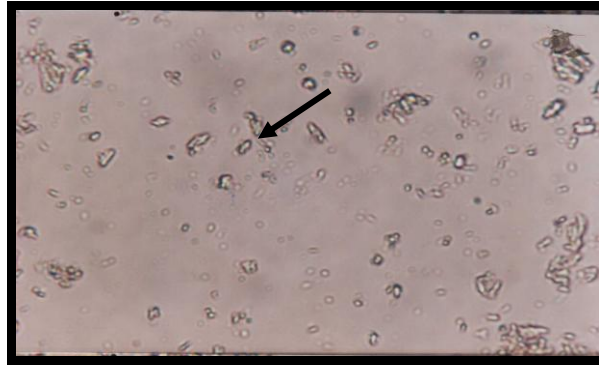
**Figure 5:**The calcium sulphate dihydrate crystals for group D after 10 Min



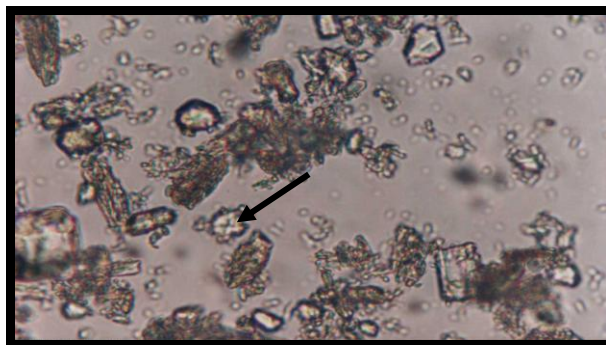
**Figure 6:**The calcium sulphate dihydrate crystals for group E after 10 Min



**Figure 7:**The calcium sulphate dihydrate crystals for group B after 30 Min



**Figure 8:**The calcium sulphate dihydrate crystals for group C after 30 Min



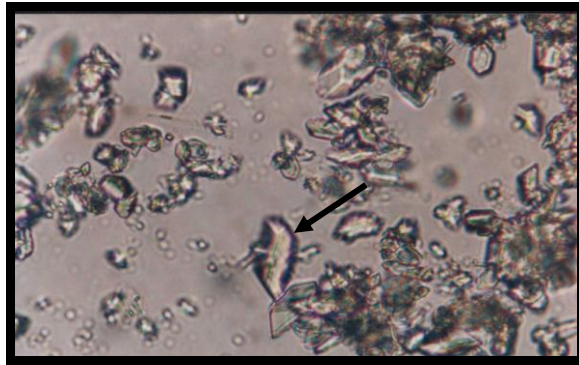
**Figure 9:**The calcium sulphate dihydrate crystals for group D after 30 Min



**Figure 10:**The calcium sulphate dihydrate crystals for group E after 30 Min



**Figure 11:**The calcium sulphate dihydrate crystals for the testing groups after 1 hour



**Figure 12:**The calcium sulphate dihydrate crystals for the testing groups after 2hour