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Research On The Bacteriostatic Effects Of Zinc Phosphate And Germicid Cements (*)

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Zinc phosphate cements have been among the main elements of dentistry since 1878. Structurally there is no difference between zinc phosphate and germioid cements; however, Cupper and Silver salts are added at the ratio of % 2 to germioid cements for the purpose of rendering them bacteriostatic.

Both type of cements have similar functions, for example, while zinc phosphate cements are used for :

a) cementing the fixed restorations

b) cementing the orthodontic bands

c) cementing the temporary restorations

d) base material

germicid cements are used for :

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a) cementing the fixed restorations

b) cementing the orthodontic bands

c) cementing the temporary restorations

As seen above the only difference is that zinc phosphate cements are used as «base material» also. The liquid solutions of both cements contain phosphoric acid and therefore they are acidic and their pH values change during setting.

Plant and Tyas stated that pH values of S.S White Zinc Phosphate cement are 1.7,4 and 6; two minutes, one hour and twenty-four hours consequtively after the powder and the liquid solution are mixed.

Skinner and Phillips stated that the pH value of zinc phosphate cement is 1.6 at the time it is inserted in the tooth, increases as the reaction proceeds and the final pH may be about 7.

The effect of bacteriostatic agent changes proportionally with the solubility of the set germicid cement.

The more soluble the more bacteriostatic effect will be caused by the cement; however, as the solubility of the cement is increased its stability is decreased and vice versa.

In general pathology the harmful effect of heat which is a physical agent on the living tissues have been widely defined.

While investigating the harmful effects of heat exerted during setting of zinc phosphate and germicid cements on the vital pulp AKIN found that both type of cements had the same harmfull effects on the pulp because their setting temperatures were the same. He also stated that the setting temperatures of 9 different cements varied from 56°C to 73.5°C.

The study of related literature showed that bacteriostatic offects of various cements are caused by the setting temperatures and the acid present in the liquid solution before setting. We also know that metallic salts are added in zinc phosphate cement in order to utilize their oligodinamic effect and to increase their bacteriostatic effects.

Our research subject was to find out what way and in what proportions different metallic ions added into the cement would effect the bacteria.

— MATERIALS AND METHOD —

In this research two types of zinc phosphate and germicid cements were used. Belger and Akın stated the setting temperatures of these cements as following :

	Types of Cements Used	Setting temp.
1)	Cuprit Zn Phosphate «cupper» cement	70°C
2)	S. S. White Zn Phosphate cement	66°C
3)	C-C'S Crown-Bridge Phosphate cement	73.5°C
4)	S. S. White Zn Phosphate «silver» cement	55°C

The examination material was taken from caries of vital tooth. As culture media glucose boullion and nutrient gelatin was used. The culture media produced 2 different types of bacteria :

1 — Streptococcus

2 — Neisseria

In three separate Petri dishes containing only nutrient gelatin culture media; Streptococcus type, Neisseria type and a mixture of both were spread and incubated for 24 hours. Four types of cements were prepared in the form of discus, having viscosity whilst a fixed prosthesis is cemented in the mouth, according to the manufacturer's directions.

The cements were applied :

a) Immediately after powder and liquid solution were mixed

b) One hour after powder and liquid solution were mixed

c) Six hours after powder and liquid solution were mixed

d) Twenty-four hours after powder and liquid solution were mixed

Test materials applied after one, six and twenty-four hours later were kept in sterile Petri dishes.

— FINDINGS —

After the cements were applied, the culture media was incubated for bacteria growth. The next day they were examined and the findings are shown in Table I, II and III.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	4 mm.
S. S. White Zn Phosphate	2 mm.
C-C'S Crown-Bridge Phosphate	4 mm.
S. S. White Zn Phosphate (silver)	4 mm.

Table I — a) Effect of the cements applied immediately after mixing the powder and liquid solution on Alpha Hemoliticus streptococcus

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	0 mm.
S. S. White Zn Phosphate	0 mm.
C-C'S Crown-Bridge Phosphate	0 mm.
S. S. White Zn Phosphate (silver)	1 mm.

Table I — b) Effect of the cements applied one hour after mixing the powder and liquid solution on Alpha Hemoliticus streptococcus

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	3 mm.
S. S. White Zn Phosphate	0 mm.
C-C'S Crown-Bridge Phosphate	2 mm.
S. S. White Zn Phosphate (silver)	0 mm.

Table I — c) Effect of the cements applied six hours after mixing the powder and liquid solution on Alpha Hemoliticus streptococcus

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	0 mm.
S. S. White Zn Phosphate	0 mm.
C-C'S Crown-Bridge Phosphate	0 mm.
S. S. White Zn Phosphate (silver)	0 mm.

Table I — d) Effect of the cements applied twenty-four hours after mixing the powder and liquid solution on Alpha Hemoliticus streptococcus

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	4.5 mm.
S. S. White Zn Phosphate	5 mm.
C-C'S Crown-Bridge Phosphate	3 mm.
S. S. White Zn Phosphate (silver)	4 mm.

Table II — a) Effect of cements applied immediately after mixing the powder and liquid solution on Neisseria type.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	1 mm.
S. S. White Zn Phosphate	2 mm.
C-C'S Crown-Bridge Phosphate	0 mm.
S. S. White Zn Phosphate (silver)	1 mm.

Table II — b) Effect of cements applied one hour after mixing the powder and liquid solution on Neisseria type.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	2 mm.
S. S. White Zn Phosphate	2 mm.
C-C'S Crown-Bridge Phosphate	1 mm.
S. S. White Zn Phcsphate (silver)	3 mm.

Table II — c) Effect of cements applied six hours after mixing the powder and liquid solution on Neisseria type.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	1 mm.
S. S. White Zn Phosphate	2 mm.
C-C'S Crown-Bridge Phosphate	2 mm.
S. S. White Zn Phosphate (silver)	2 mm.

Table II — d3 Effect of cements aplied twenty-four hours after mixing the powder and liquid solution on Neisseria type.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	4 mm.
S. S. White Zn Phosphate	3 mm.
C-C'S Crown-Bridge Phosphate	2 mm.
S. S. White Zn Phosphate (silver)	4 mm.

Table III — a) Effect of cements applied immediately after mixing the powder and liquid solution on mixt bacteria.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	2 mm.
S. S. White Zn Phosphate	2 mm.
C-C'S Crown-Bridge Phosphate	1 mm.
S. S. White Zn Phosphate (silver)	2 mm.

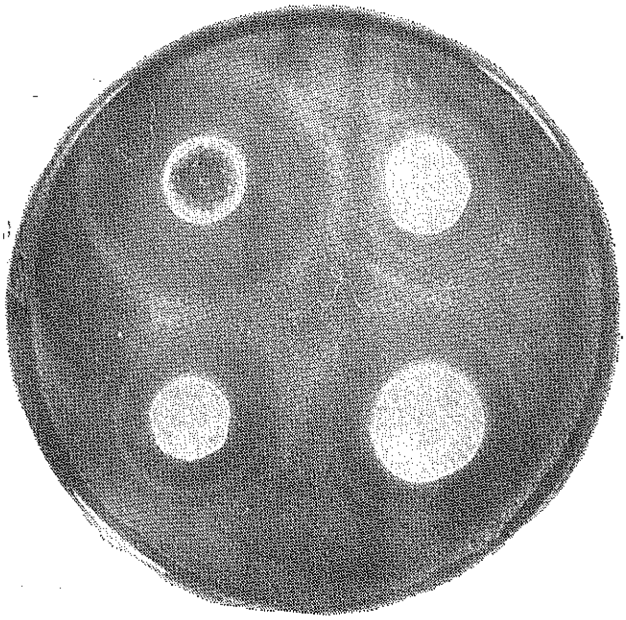
Table III — b) Effect of cements aplied one hour after mixing the powder and liquid solution on mixt bacteria.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	4 mm.
S. S. White Zn Phosphate	3 mm.
C-C'S Crown-Bridge Phosphate	5 mm.
S. S. White Zn Phosphate (silver)	4 mm.

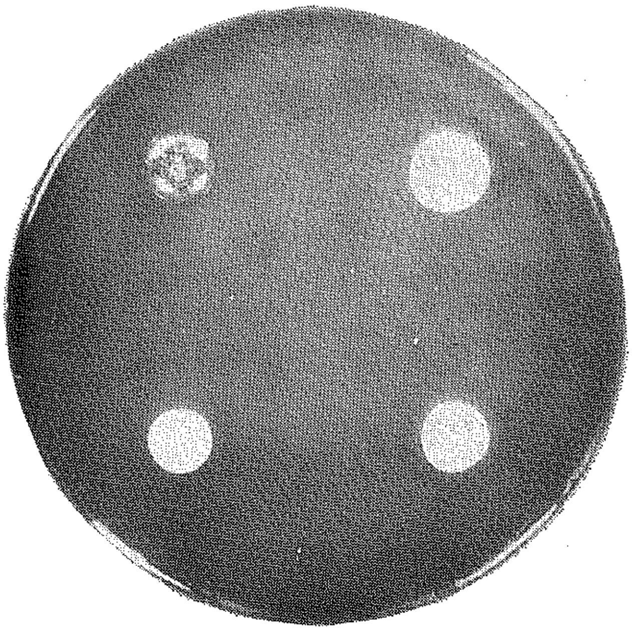
Table III — c) Effect of cements applied six hours after mixing the powder and liquid solution on mixt bacteria.

Type of cements	Inhibition zone
Cuprit Zn Phosphate (cupper)	3 mm.
S. S. White Zn Phosphate	4 mm.
C-C'S Crown-Bridge Phosphate	5 mm.
S. S. White Zn Phosphate (silver)	4 mm.

Table III — d) Effect of cements applied twenty-four hours after mixing the powder and liquid solution on mixt bacteria.

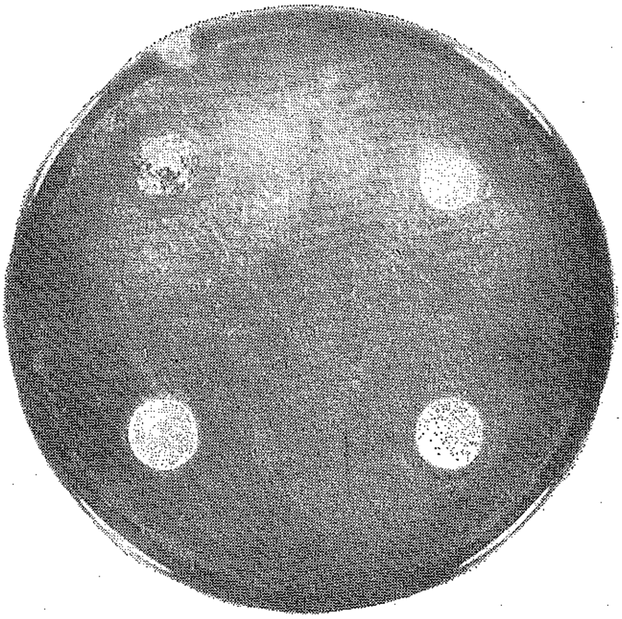


a)

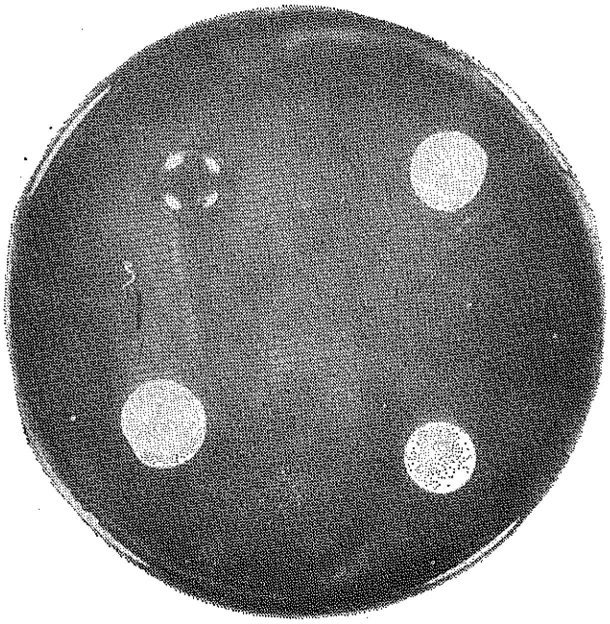


b)

FIG. 1 — Effect of 4 types of cements applied, a) immediately, b)one hour, c) six hours, d) twenty-four hours after the powder and liquid solution is mixed on streptococcus.



c)



d)

— DISCUSSION —

The destructive effects of dental cements numbered 1,3 and 4 applied to the Alpha hemelitic streptococcus seemed to be equal. The destructive effect of the 2nd cement was half of above cements. The cements numbered 1 and 4 were germicid and the 3rd one was zinc phosphate. According to this finding the bacteriostatic effect of zinc phosphate and germicid cements were similar. Therefore, the destructive effect of cements was not caused by their being germicid but by their high setting temperatures.

For example, the setting temperature of zinc phosphate cement numbered 3 was 73.5°C. Our opinion was strengthened by the fact that the destructive effect of cement no. 2 which had a setting temperature of 66°Cwas half less than the other 3 cements. It should not be forgotten that Morits and Davis stated that the setting heat for the living organisms start at 40-45°C. However, the setting temperatures of the above mentioned four cements were a lot higher than that. Naturally, a dental cement mixed and immediately applied will have a bacteriostatic effect because of its acid content.

But this effect decreases quickly and disappears when the cement sets. A mixture prepared properly for cementing bridges and crowns sets within 3 minutes. This effect is nearly zero for the bacteria which are resistant to acids.

The setting temperature rises quickly to its highest degree as soon as the cement is mixed and then, decreases slowly to the same temperature as in the beginning. Morits and Davis have stated that the rapid rise in temperature is more harmful to the living tissues. This shows that a rapidly decreasing acid effect is a lot less destructive than the rapid increase and change in the setting temperatures.

There was no evidence of any destructive effects of the cement which was applied one hour after mixing to the Alpha hemolitic streptococcus. However, the germicid cement no. 4 and cements no. 1 and 3 applied 6 hours after mixing showed little bacteriostatic effects.

Our opinion that set cements are not effective on bacteria was proven by the uneffectiveness of four types of cements applied on bacteria 24 hours after mixing.

These four cements applied immediately to the Neisseria showed the same bacteriostatic characterietios . In other appkoations done 1,6 and 24 hours after mixing said cements showed average effectiveness. These findings showed that the Neisseria types were more resistant to zinc phosphate and germicid cements than Alpha hemoliticus Streptococcus.

Another point was that the posphate cements showed the same bacteriostatic effect as germicid cements on less resistant bacteria.

The germicid types of the four different cements which were applied to the mixed bacteria showed more bacteriostatic effects than the posphate cements; however, the bacteriostatic effect of cements applied one hour after mixing were in lesser degree than the ones applied six and twenty-four hours later.

Phosphate cements had more bacteriostatic effects than the germicid cements in the last two applications. Considering their effectiveness, in the first application germicid cements were more effective, in the second application they were the same, in the third and fourth applications the posphate cements seemed to be more effective. Therefore, we believe that posphate and germicid cements have very similar effects on mixed bacteria.

The four types of cements showed bacteriostatic effect on different types of bacteria mostly in the first application. On the other hand the same effects were seen in all applications on mixed bacteria. This situation can be explained as the destructive effect of the foreign substances exerted by the decomposition of some bacteria.

RESULTS

1 — The destructive effects of zinc posphate and germicid cements on bacteria were similar.

2 — All cements render bacteriostatic effect.

3 — The bacteriostatic effects of cements are caused by the high setting temperature.

4 — Cements are more effective on the mixed bacteria.

5 — The rapid transformation of cements from acid to alkaline condition decreases their acid effectiveness on bacteria.

6 — The bacteriostatic effects of cements on other types of bacteria should be investigated.

7 — Experiments which will be made in the future with new types of cements having setting temperatures that do not exceed 36°C will definetely explain the relationship between setting temperatures and the bacteriostatic effects on similar types of bacteria.

8 — The increase in bacteriostatic effects should be investigsted by adding different metallic salts or other materials to germicid cements.

SUMMARY

Bacteriostatic effects of Zinc Phosphate and Germicid cements on bacteria is researched. 4 types of cements are applied immediately, one hour, six hours and twenty-four hours after mixing the powder and liquid solution on bacteria, (Alpha hemoliticus streptococcus - Neisseria - and mixture of Alpha H. S. + Neisseria).

According to the findings all cements rendered bacteriostatic effect. It was coused by the high setting temperatures of the cements and they were more effective on mix bacteria.

Experiments that will be made with cements having setting temperatures below 36 C may explain the relationship between setting temperatures and the bacteriostatic effects on bacteria.

ÖZET

Dişhekimliğinde kullanılan çinko fosfat simanlar ile aynı simanın tozuna maden tozları karıştırılarak bakteriostatik etki sağlanmaya çalışılan germisid simanların bakteriler üzerindeki etkileri araştırılmıştır.

Çürük diş kavitesinden alınan maddeler üretilerek elde edilen bakterilere, 2 çinko fosfat ve 2 germisid siman uygulanmıştır. Elde edilen bulgular değerlendirildikten sonra aşağıdaki sonuçlara varılmıştır.

1 — Çinko fosfat ve germisid simanların bakteriler üzerindeki öldürücü etkisi aynıdır.

2 — Tüm simanlar bakteriostatik etkilidir.

3 — Simanların bakteriostatik etkisi reaksiyon sıcaklıklarının çok yüksek olmasından ötürüdür.

4 — Mixt bakterilere simanlar daha etkili olmaktadır.

5 — Simanların kısa sürede asit görünümden baz görünüme dönüşmeleri, bakteriler üzerindeki asit etkisini azaltır.

6 — Simanların bakteriostatik etkileri öteki tür bakteriler üzerinde de araştırılmalıdır.

7 — Reaksiyon sıcaklığı 36°C yi geçmeyen yeni tür simanlarla yapılacak bu tür bir araştırma, reaksiyon sıcaklığının bakteriostatik etki ile kesin ilişkisini ortaya çıkaracaktır.

8 — Germisid simanlara değişik maden tozları ya da başka maddeler katılarak bakteriostatik etkinin arttırılması araştırılmalıdır.

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