

EXPERIMENTAL STUDY ON THE ANTIBACTERIAL EFFECTS OF ROOT CANAL FILLING MATERIALS*

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根管充填材料의 殺菌效果에 關한 實驗的 研究

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國文抄錄

著者は 臨床에서 널리 사용되는 根管充填材料인 酸化亞鉛유지늘, N 2, MN2 및 Triozinc Paste의 殺菌效果를 比較하기 위하여 寒天培養基 및 血液加寒天培養基上에서 白色葡萄狀球菌 및 α -溶血性連鎖狀球菌의 두菌株를 使用, 實驗하여 다음과 같은 結果를 얻었다.

- 1) 白色葡萄狀球菌을 심은 寒天培養基上에서 非乾燥圓板을 使用한 實驗群에서의 菌成長抑制帶는 MN2, 6. 83; Triozinc paste, 5. 77; N 2, 5. 61; 酸化亞鉛유지늘, 3.49mm였다.
- 2) 白色葡萄狀球菌을 심은 寒天培養基上에서 乾燥圓板을 使用한 實驗群에서의 菌成長抑制帶는 MN2, 4. 40; Triozinc paste, 1. 46; 酸化亞鉛유지늘, 0.99; N2, 0.84mm였다.
- 3) 白色葡萄狀球菌을 심은 血液加寒天培養基上에서 乾燥圓板을 使用한 實驗群에서의 菌成長抑制帶는 MN 2, 1.15; Triozinc paste, 0.55; 酸化亞鉛유지늘, 0.54; N2, 0.43mm였다.
- 4) α -溶血性連鎖狀球菌을 심은 血液加寒天培養基上에서 乾燥圓板을 使用한 實驗群에서의 菌成長抑制帶는 MN 2, 2.14; Triozinc paste, 1.00; 酸化亞鉛유지늘, 0.75; N 2, 0.43mm였다.

INTRODUCTION

Root canal treatment is one of the most important method in dentistry to save individual tooth.

The object of root canal filling is an artificial substitution of an inherent, hermetic sealing agent for the extirpated pulp, in order to prevent subsequent infection by way of periapical exudate from draining into the unfilled portion of the root canal, and by way of any microorganisms that might be transported to the periapical tissue during a transient bacteremia from lodging in the unfilled portion of the canal.

A number of materials are used to fill root canal, and one of the essential requirements

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is to provide long lasting antiseptic effect. Sterilization of root canal has the greatest influence to the success.

The antibacterial effects of various medicaments and materials were studied clinically, histopathologically, and pharmacologically.

Updegraff, Chang, and Joos¹⁾ investigated the antibacterial activity of twenty-one different brands of restorative materials.

Mangi, et al.¹¹⁾ conducted a similar study on dental cements and their ingredients.

Yoon²⁾ investigated the antibacterial effects of root canal disinfectants against staphylococcus aureus.

Weber³⁾ tested N2 against staphylococci, streptococci, and m. coli.

Bertolini³⁾ reported that the disinfecting power of N2 is superior to that of iodoform cement.

Sekine⁴⁾ reviewed the triozinc paste which were formulated by Hanazawa.

Onose, et al.⁷⁾ reported the antibacterial effects of the pulp capping and canal filling agents.

As comparative study about the antibacterial effects of various canal filling materials has not been performed satisfactorily, the author made a series of experimental study on the antibacterial effects of canal filling materials such as zinc oxide eugenol, triozinc paste, N2, and MN2 against staphylococcus aureus and α -hemolytic streptococcus.

MATERIALS AND METHODS

1. Chemical agents examined:

The following commercial products for the purpose of canal filling were used for these studies. The formulas of these materials used in this experiment are as follows.

(1) Triozinc paste

Zinc oxide	88%	} powder 7gm
Paraformaldehyde	5%	
Zinc anhydrosulphate	5%	
Asbestos	2%	
Tricresol	40%	} liquid 10ml
Glycerin	50%	
Alcohol	10%	

(2) N2

Zinc oxide	3.850gm	} powder 7gm
Azonaphthol-sulphonic acid	0.035gm	
Calcium hydroxide	1.680gm	
Allyl-alkyl sulphonic acid	0.035gm	
Phenylmercuric borate	0.210gm	
Titanium oxide	0.175gm	
Trioxy methylene	0.630gm	
Barium sulfate	0.385gm	

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| Azonaphthol-sulphonic acid | 0.025ml | } liquid 5ml |
| Oil of clove | 4.975ml | |
| (3) MN2 | | |
| Hydroxy-dimethyl-octodien | 0.15gm | } powder 5gm |
| Phenylmercuric borate | 0.01gm | |
| Titanium oxide | 2.90gm | |
| Trioxymethylene | 0.30gm | |
| Barium sulfate | 0.10gm | |
| Calcium hydroxide | 0.10gm | |
| Zinc oxide | 1.44gm | } liquid 5ml |
| Hydroxy-dimethyl-octodien | 2.15ml | |
| Eugenol | 2.85ml | |
| (4) Zinc oxide eugenol | | |

2. Bacterial strains used:

The following two bacterial strains were offered for this examination of antibacterial effects.

- (1) Staphylococcus aureus
- (2) α -hemolytic Streptococcus

3. Culture media:

Nutrient agar and blood agar were used for staphylococcus and streptococcus.

The nutrient agar contained beef 3gm, peptone 5gm, and agar 15gm in one liter of distilled water and the final pH of the agar was 6.88.

The blood agar was made by adding 5% human whole blood in nutrient agar.

4. Paste preparation:

Liquid and powder ratio was determined as 0.05ml of liquid to 0.1gm of powder. These paste were painted on 14 filter paper disks of 6.30mm in diameter.

5. Antibacterial test:

The antibacterial activity of each sample disk was assayed by laying the sample on a agar plates inoculated staphylococcus aureus and α -hemolytic streptococcus.

After a forty-eight hour incubation period at 37°C, the zones of complete inhibition of the bacterial growth were measured by use of calliper.

This inhibition zones were recorded by subtracting the diameter of the disk from the total diameter of the zone of inhibition and diving by two.

RESULTS

The results obtained from this experiment are summarized as follows; (Table 1)

Table 1: Antibacterial Activity of Canal Filling Materials

Type of Microorganism	Disk Condition	Total No of Cases	Type of Media	Zone of Inhibition(mm)			
				ZOE+	TZP++	N2	MN2
Staphylococcus Aureus	Wet disk	35	NA*	3.49	5.77	5.61	6.83
	Dry disk	15	NA	0.99	1.46	0.84	4.40
		15	BA**	0.54	0.55	0.24	1.15
α -Hemolytic Streptococcus	Dry disk	30	BA	0.75	1.00	0.43	2.14

* NA, Nutrient agar

** BA, Blood agar

+ ZOE, Zinc oxide eugenol

++ TZP, Triozinc paste

DISCUSSION

With the advance of suitable technique and medicament, the clinical value of the canal filling has become to be recognized in the endodontic field. Accordingly, the frequency of its clinical application became increased.

In performing canal filling, it should be a cardinal principle to give an aseptic and biologic treatment.

Bacteriological tests of N2 executed by K. Weber were made with staphylococci, streptococci, and m. coli. The inhibition zones were 12.5; 10.5; 10mm respectively after 24 hours.³⁾

Mooser examined N2 against staphylococcus pyogenes aureus and found an inhibition zone of 35mm(diameter of the paste sample: 9mm).

Bertolini examined N2 against staphylococcus oxford, streptococcus viridans, escherichia coli, and candida albicans, and the results found on the four respective cultures were as follows: 29; 25; 26; 22mm.

The results of author's experiments showed the inhibition zones of N2 and MN2 in wet disks against staphylococcus aureus on nutrient agar were 5.61; 6.83mm(except the diameter of the disk, 6.30mm).

About these difference, the author considers as the results came from different bacterial strains, experimental procedures, and different media.

Permanent disinfecting property was examined for N2 by Weber against staphylococci, streptococci, and coli, and he found that N2 was strongest in its disinfecting power when in the soft phase.

In these experiments, all materials showed the strongest disinfecting power when in the soft phase, and setting weakened this power, but disinfection remained permanent.

Gysi⁴⁾ formulated triopaste for the first time that its main component was trioxymethylene, and many studies for this material were made clinically and pharmacologically. Thereafter, triozinc paste were formulated by Hanazawa and its main component was paraformaldehyde that had a strong antiseptic effect with tricresol.

On the other hand, the toxic effect of the agent upon bacteria may be often countered by its toxic effect upon periapical tissue.

Rappaport, et al. found N2 highly irritating, and Ehrmann has reported a case of paresthesia of the lower lip and mental area from N2 which had gone through the apical foramen and reached the mandibular canal.

Since root canal filling materials sealed in the root canal permanently, its irritating effect may also continue to disturb the tissue repair if its antiseptic effect should last permanently. It is ideal that bactericidal effect of root canal filling material should prolong for a certain period during which biological repair of periapical tissue is completed.

From this point of view, bactericidal activity of MN2 is so strong that it's toxic effect may act upon periapical tissue. Therefore, it is considered that zinc oxide eugenol is more useful material for it's mild irritating, antiseptic activity, though it's bactericidal activity is far weak in comparison with MN2 or triozinc paste.

SUMMARY AND CONCLUSION

Four different brands of canal filling materials were studied these antibacterial activity against staphylococcus aureus and α -hemolytic streptococcus on nutrient agar and blood agar.

The results of this experiment are as follows;

- 1) In the group of wet disk on nutrient agar inoculated staphylococcus aureus, inhibition zones of MN2, Triozinc paste, N2, and Zinc oxide eugenol were 6.83; 5.77; 5.61; 3.49mm respectively.
- 2) In the group of dry disk on nutrient agar inoculated staphylococcus aureus, inhibition zones of MN2, Triozinc paste, Zinc oxide eugenol, and N2 were 4.40; 1.46; 0.99; 0.84mm.
- 3) In the group of dry disk on blood agar inoculated staphylococcus aureus, inhibition zones of MN2, Triozinc paste, Zinc oxide eugenol, and N2 were 1.15; 0.55; 0.54; 0.43mm.
- 4) In the group of dry disk on blood agar inoculated α -hemolytic streptococcus, inhibition zones of MN2, Triozinc paste, Zinc oxide eugenol, and N2 were 2.14; 1.00; 0.75; 0.43mm.

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