Clinical Efficacy of Latex Cover for Dental Handpiece

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The purpose of this study was to investigate the clinical efficacy of latex cover developed for dental handpiece on contamination of microorganisms during dental treatment and to determine whether it can be an alternative to conventional sterilization such as autoclaving.

E. fecaelis was used as a experimental microorganism instead of oral flora. Experimental bowl with 2 cm of rectangular cavity was fabricated for handpiece operating instead of oral cavity. Latex covers (Orokeeper®, Orobiotech Co., Korea) and several handpieces were used after sterilization by autoclave.

Four experiments were performed to evaluate bacterial contamination related with (1) various parts of dental handpiece, (2) swabbing time with alcohol sponge, (3) postoperative air-water spraying time and (4) consecutive use of latex covers without autoclaving.

The results show that face of handpiece uncovered with latex cover was severely contaminated than the covered area and that most bacteria were removed by swabbing face and head area of dental hand-piece and by air-water spraying more than 15 seconds nearly up to the level of sterilization.

Conclusively it can be suggested that use of latex cover for handpiece during dental procedure, swabbing with alcohol sponge is air-water spraying for more than 15 seconds after use of dental handpiece should be very useful and practical for prevention of cross infection and should be an alternative method for the sterilization of dental handpiece under some difficult situations not being able to sterilize a handpiece with autoclave.

Key words: Cross infection, Dental handpiece, Latex cover (Orokeeper®)

I. INTRODUCTION

In modern dental practice both patients and dentists are subjected to health hazards of varying degrees of severity directly or indirectly. Dental professionals are exposed to a wide variety of microorganisms in the blood and saliva of patients. These microorganisms cause infectious diseases such as the common cold, pneumonia, tuberculosis, herpes, hepatitis B, and acquired immune deficiency (AIDS) in people with weak immune defense.[1,2] There are possibilities of cross-infection not in patients as a source of infection or route of infection but also dentist and dental co-workers.[3-6]

In recent years many dental clinicians concern about infection by invisible aerosol with fluid droplets derived from dental handpiece.[7,8] Dentists and dental co-workers are apt to contaminated by many kinds of microorganisms spreading from dental handpiece during dental treatment, which is assumed

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of aerosol in the air and fall down to skin or surface of equipments in dental clinic.

Gordon et al. (2001) mentioned about protection program for dental workers,[9] however there is no obvious guideline for sterilization or disinfection in dental office-air pollution and beyond aseptic air supply yet.[10] So the need of air-aerosol protection has been emphasized lately.

According to the guideline of British Dental Association and Department of Health, instruments should be transferred to the decontamination area for reprocessing with autoclave at the end of the each patient treatment.[11] But repeated autoclaving makes dental handpiece break down and drop in output speed of 23.5~63.6% in one year of practice used.[12,13] As a result of economical or time efficacy, many clinicians pay no attention to sterilize dental handpiece which is likely to be a cross-infection source

The purposes of this study were to investigate the effectiveness of latex cover developed for dental handpiece on prevention of microbial contamination during dental treatment and determine whether it can be an alternative to conventional sterilization such as autoclaving.

II. MATERIAL AND METHODS

1. Materials

Enterococcus fecaelis bacteria (ATCC 29212) was cultured with BHI broth. The reason why *E. fecaelis* selected in this study is short period for culture time due to the fast differentiation (1 day) and it is a normal oral flora which has the low possibility of the safety concern during experiment. *E. fecaelis* were offered from Department of Oral Microbiology, Dankook University School of Dentistry.

Latex cover (Orokeeper®, Orobiotech Co., Korea) (Fig. 1), microcentrifuge tubes and all the instruments should be sterilized with autoclave (Auto clave® HS-1321, Hanshin Medical Co.LTD, Korea)

To investigate in laboratory a cube block (experimental bowl) with 2 cm diameter hole was fabricated with brown stone. After making an experimental bowl, the internal surface of bowl was coated with resin for waterproof (Plaquit®, Dreve Dentamid Co. Germany / JM Lite INDILUX® Dental Search Co., Korea) and sterilized to get rid of microorganisms in the surface completely. (Fig. 2)

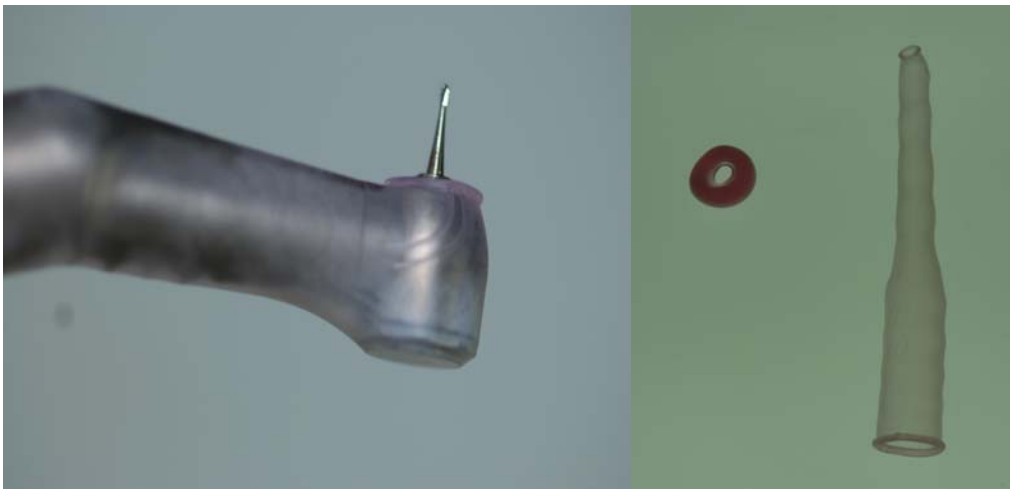

Fig. 1. Latex cover (Orokeeper® Orobiotech Co.,Korea) used in this study. Handpiece equipped with latex cover(left) and latex cover unrolled completely(right).

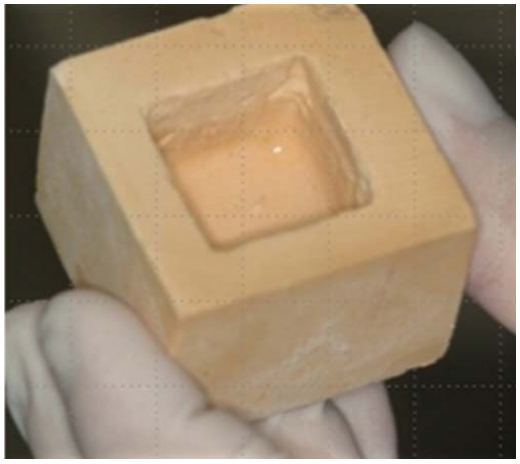

Fig. 2. Experimental bowl

Fig. 4. Bacterial exposure to the dental high speed handpiece covered with latex cover

2. Methods

1) Method of using latex cover(Orokeeper®).(Fig. 3.)

A. An extruded part of rolled Orokeeper® was located upwards and its rolled margin was pushed laterally to flat an extruded part of orifice.

B. The orifice of Orokeeper® was placed on head of handpiece and pushed and unrolled to cover all surfaces of handpiece.

C. Head of handpiece was checked not to cover an air and water nozzles of handpiece.

2) Method of bacterial exposure

After application of latex cover (Orokeeper®) to the dental high speed handpiece, operate the engine like as movement of preparing the tooth cavity in the experimental bowl filled with E. fecaelis while keeping the handpiece in the distance of 1 cm from the bowl (Fig. 4).

3) Method of evaluation : All experimental procedures were done aseptically

A. Method of bacterial evaluation in each part of the dental handpiece.

a. Two dental handpieces were sterilized with autoclave before experiment. One of them was included in the experimental group using latex cover and the other was used as the control group.
b. Each handpiece was exposed to bacteria for 30 seconds.
c. Each region of dental handpieces, with or without latex cover, was swabbed respectively with sterile cotton pellets after bacterial exposure.
d. Culture with BHI broth was performed for a day
e. Above procedures were repeated three times.

B. Method of bacterial evaluation, according to the postoperative cleansing time with alcohol sponge.

Fig. 3. Application method of latex cover (Orokeeper®) to the dental high speed handpiece.

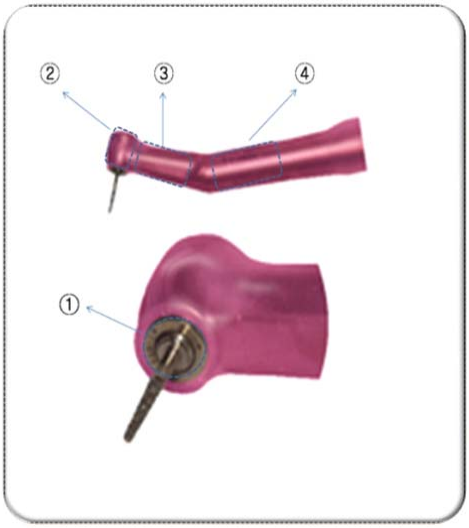

Fig. 5. Four regions of dental handpiece examined in this study
(① : face, ② : head, ③ : neck, ④ : body)

a. Three handpieces were exposed to bacteria for 30 seconds respectively.
b. After bacterial exposure, each face and head parts of the dental handpieces were cleaned with the alcohol sponge for 5, 10, and 15 seconds.
c. After the alcohol cleaning, bacteria was collected from the face and head of a dental handpieces with sterile cotton pellet.
d. Culture with BHI broth was performed for a day
e. Above procedures were repeated three times.

C. Method of bacterial evaluation of the dental handpiece according to the time of postoperative air water spray after the bacterial exposure
a. Three handpieces were exposed to bacteria for 30 seconds respectively.
b. After withdrawal from the bowl, air water spraying was applicated for each dental handpiece for 5, 10, and 15 seconds, respectively.
c. After air water spraying bacteria was collected from the part of face and head of the dental handpieces with the sterile swab.
d. Culture with BHI broth was performed for a day.
e. Above procedures were repeated three times.

D. Method of bacterial evaluation according to accumulative use of latex cover
a. Sterile latex cover was fitted to the sterile dental handpiece.
b. Handpiece was exposed to bacteria for 30 seconds.
c. After removing the latex cover, face and head part of the dental handpiece was swabbed with the alcohol sponge 15 seconds respectively
d. Bacterial collection with sterile swab from the part of face and head of the dental handpiece was performed.
e. Another new sterile latex cover were fitted after taking off the existing contaminated latex cover and above procedures from step b. were repeated for 8 times
f. Culture with BHI broth was performed for a day.
g. Above procedures were repeated three times.

4) Statistical analysis

All measurements were statistically analysed using SPSS version 14.0 program. Repeated 2 way ANOVA was calculated to analyze differences of the means and standard deviation between the groups with and without latex cover according to regions of handpiece, cleansing time with alcohol sponge, time of postoperative air water spray after the bacterial exposure.

Ⅲ. RESULTS

Table 1 and Fig. 6 demonstrate bacterial CFU count on different regions of dental handpiece according to using latex cover or not. There is a significant decrease of bacterial CFU count in most areas of handpiece with latex cover except exposed face area compared to handpiece without latex cover ($p=0.000$).

Table 2 and Fig. 7 show the changes of bacterial CFU count in the head face region of dental handpiece with or without using latex cover and cleansing time with alcohol sponges after dental handpiece was exposed to *E. fecaelis*.

After 15 second cleansing time with alcohol sponges on dental handpiece, CFU count was

Table 1. Means and standard deviations of colony forming unit (CFU) count measured in different regions of dental handpiece experimented with or without latex cover (Orokeeper®). (n=3)

Group	Examined regions of a dental handpiece				
	Face	Head	Neck	Body	ANOVA
With latex cover	3331±475	13±18	10±5	0±0	p=0.000
Without latex cover	2725±638	395±85	3385±594	11±7	
ANOVA	p=0.000				p=0.000

Unit : CFU / ml

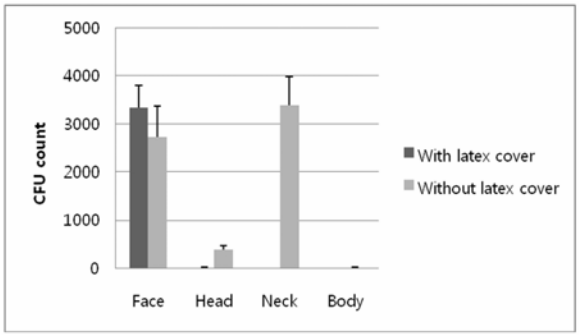

Fig. 6. Comparison of CFU count on the different regions of dental handpiece experimented with and without latex cover (Orokeeper®)

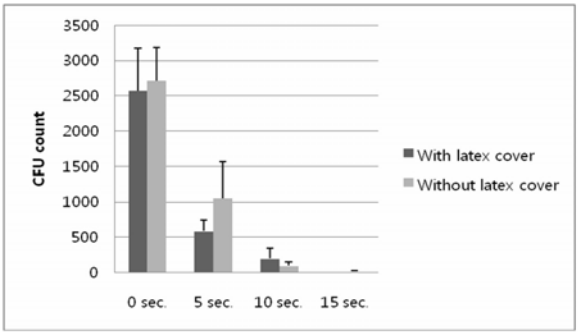

Fig. 7. Comparison of CFU count between groups with and without latex cover (Orokeeper®) according to cleansing time with alcohol sponge.

reduced remarkably, up to zero in the group using latex cover (p=0.000). But there was no difference between groups with or without latex cover.(p=0.353, Table 2)

Table 3 and Fig. 8 show the changes of CFU count according to post operative air-water spraying time of dental handpiece with or without latex cover. There was a significant decrease in bacterial CFU count below 200 according to air water spraying time, especially in 15 second spraying group, although no difference was found between 10 second and 15 second spraying groups (p=0.000). There was, however, no statistical differences between with or without latex cover. (p=0.146, Table 3)

Cleansing face and head region of dental handpiece with alcohol sponges for 15 seconds after exposureto bacteria with latex cover without autoclaving was

Table 2. Means and standard deviations of colony forming unit (CFU) count measured between groups with and without latex cover (Orokeeper®) according to cleansing time with alcohol sponge. (n=3)

Group	Cleaning time with alcohol sponge (face and head regions)				
	0 sec.	5 sec.	10 sec.	15 sec.	ANOVA
With latex cover	2570±601	588±158	196±150	0±0	p=0.353
Without latex cover	2715±469	1053±516	96±52	13±18	
ANOVA	p=0.000				p=0.514

Unit : CFU / ml

Table 3. Means and standard deviations of colony forming unit (CFU) count measured between groups with and without latex cover (Orokeeper®) according to air and water spraying time. (n=3)

Group	Air and water spraying time (face and head regions)				
	0 sec.	5 sec.	10 sec.	15 sec.	ANOVA
With latex cover	3008±576	271±110	90±63	1±2	p=0.146
Without latex cover	2986±434	791±268	283±85	3±5	
ANOVA	p=0.000				p=0.335

Unit : CFU / ml

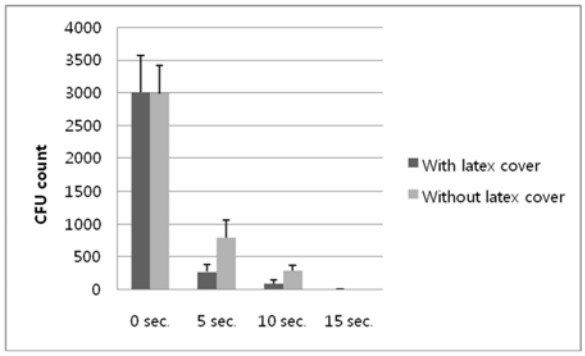

Fig. 8. Comparison of CFU count between groups with and without latex cover (Orokeeper®) according to air water spraying time.

Table 4. Means and standard deviations of colony forming unit (CFU) count measured between groups with and without latex cover (Orokeeper®) according to air and water spraying time. (n=3)

(n=3)

Exam	Mean±SD
1st	33.33±18.93
2nd	151.67±79.74
3rd	153.33± 7.64
4th	8.33±14.43
5th	41.67±30.55
6th	101.67±60.23
7th	83.33±66.02
8th	72.50±67.95

Unit : CFU / ml

repeated 8 times and the measurements is seen in Table 4.

All measurements are below 200 CFU count, which means not contaminated microbiologically.[14)]

Ⅳ. DISCUSSION

The dental handpiece could be the main source of the cross infection during the dental treatment.[15)] To reduce the possibility of cross infection, Guidelines for Infection Control in Dental Health Care Settings (2003) of CDC[16)] and a criterion to prevent the dental diagnosis infections 2006 of the Ministry of Health and Welfare (in present Ministry for Health, Welfare and Family Affairs),[17)] describes the matters that must be followed during the dental treatment. Therefore, dental handpieces are recommended to be sterilized (destroys all the microbes including bacterial spore) or to be disinfected at high class (it destroys all the microbes but not in the every bacterial spore) or to be disinfected in above at middle class (destroys the bacteria and most of fungi and virus). However, we admit that all the dental handpieces could not be sterilized before every treatments. If we can not sterilized, the dental handpiece should be disinfected after rubbing out the filth in the dental handpiece.[18)]

There are enforcement steps to sterilize the dental handpiece. The first, disinfection before sterilization (the solution of phenol composition which were diluted with ratio of 1:32), the second, rinsing before the sterilization (rubbing out the instruments with the hands, cleaning with ultrasonic or by using the dish washer that cleans out the instrument) and

finally, sterilization (by using steam autoclave, chemical steam pressure sterilizer, dry heat oven and glass beads).[18,19]

Among the procedure, final step that uses the autoclave repeatedly is invariably needed matter for the sterilization. However repeated autoclaving inevitably causes detrimental influences on the life span and the rotation efficiency of dental handpiece.

Generally, it takes about an hour for the preparing, sterilizing and cooling the dental handpiece.[20]

Also we can determine the number of dental handpiece needed to each treatment. If one patient should be treated in an hour, then it needs two dental handpieces, and if two patients should be treated in an hour, it needs three dental handpieces, as recommendation.

However, it is not easy to possess sufficient number of dental handpieces for sterilization in clinic setting. Therefore the possibility of inattentive managing the dental handpiece is high and the cross infection risk gets much higher.

In this study to measure the change of bacterial number before and after use of dental handpiece according to disinfection time with alcohol sponge and postoperative air water spraying time with latex cover or not, and to an accumulative use of latex cover, the specific part of the dental handpiece such as head and face part was selected as experimental areas, because the other areas of handpiece were covered with latex cover. And we adopted standard of valuable differences on CFU under 200 CFU, by standard of dental unit water system (DUWS) in American Dental Association (ADA)[14] before and after procedures.

It has been known that alcohol (ethyl alcohol) have a sterilization effect in 70% of concentration. In this study, bacterial colonies were nearly disappeared significantly after 15 seconds of swabbing with alcohol sponge and this swabbing time was selected to study the effect on the accumulative use of dental handpiece with swabbing with alcohol sponge. Table 2 and Fig. 7 show that 15 seconds of swabbing with alcohol sponge was enough to remove bacteria completely, even though being repeated several times.

Lee et al, in 1998[21] stated that the reduction of microbial count by flushing time of dental handpiece using after 2 to 6 minutes. In this study, the result is below 200 CFU which is the standard measurement as it shows in Table 5 in spite of relatively short time of 5~15 seconds. It can be thought that this sterilization effect should be obtained from swabbing face and head of handpiece with alcohol sponge and using latex cover to keep the other parts of handpiece from contamination. After disinfection with alcohol sponge for 15 seconds to recycle dental handpiece, bacterial count remains below 200 CFU when new latex cover are used in each patent.

Furthermore, we used a dental handpiece 8 times repeatedly by changing with new latex cover and swabbing handpiece with alcohol sponge for 15 seconds every time, but there was no increase in CFU count above the standard of dental unit water system (DUWS) in American Dental Association (ADA).[14] It is believed, therefore, that this should be a safe method to restrict a contamination of dental handpiece in practice.

In this study, it was very interesting to have similar disinfection effect between swabbing alcohol sponge and using latex cover after only 15 seconds of postoperative air water spraying. It can be suggested, therefore, that it is more effective to use latex cover after 15 seconds of postoperative air water spraying and 15 seconds of alcohol sponge swabbing .

It can be concluded that this should be an alternative method for the sterilization of dental handpiece under some difficult situations not being able to sterilize a handpiece with autoclave.

V. CONCLUSION

Exposed region such as face of handpiece was severely contaminated compared to covered area with latex cover. Most of bacteria were, however, removed in the face and head of dental handpiece

after swabbing and/or after air water spraying more than 15 seconds nearly up to the level of sterilization.

Conclusively it can be suggested that use of latex cover for handpiece such as Orokeeper® during dental procedure, swabbing with alcohol sponge of ≥ 15 seconds and/or air water spraying of ≥ 15 seconds after use of dental handpiece should be very useful and practical for prevention of cross infection and should be an alternative method for the sterilization of dental handpiece under some difficult situations not being able to sterilize a handpiece with autoclave.

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국문요약

치과 핸드피스용 감염방지구의 임상적 효용성

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이기호[1] · 백동헌[2]

본 연구의 목적은 치과 치료 시 라텍스 감염방지구가 핸드피스의 오염을 방지하고 고압 멸 균 소독과 같은 전통적 소독을 대신하는 방법이 될 수 있는 지 조사하는 것이다. 구강 내 상주균 대신 사용한 균주는 E. fecaelis (ATCC 29212) 이며 구강을 대신하는 2cm 의 정방형 cavity 가 형성된 실험용 bowl 을 제작하였다.

라텍스 재질의 덮개는 Orokeeper® (Orobiotech Co., Korea)를 사용하였으며 모든 실험 핸드피스는 고압멸균소독기에서 멸균 후 사용하였다. 4가지 실험으로 이루어 졌다 : 핸드 피스의 다양한 부위에 대한 세균 오염 평가, 알코올 소독솜으로 핸드피스의 전면 및 헤드부 에 소독 후 소독시간에 따른 세균오염 평가, 핸드피스 사용 후 air-water spray 시간에 따른 핸드 피스의 전면 및 헤드부에 대한 세균오염 평가, 라텍스 덮개의 반복 사용에 따른 핸드피스의 오염도에 대한 평가 등이다.

실험결과 라텍스 감염방지구로 덮여진 부분과 비교할 때 덮여져 있지 않은 부위의 오염 도가 매우 심하였다. 그러나 핸드피스 사용 후 15초간 알코올 솜으로 닦아내거나, 15초간 기수분사를 한 후에는 소독 수준 까지 균이 감소하였다. 결론적으로 오로 키퍼 같은 라텍스 감염방지구는 15초간의 알코올 세척 또는 사용 후 15초 기수분사와 함께 사용하면 멸균 소독을 할 수 없는 어려운 상황에서 교차감염 방지를 목적으로 사용이 가능하리라 사료된다.

주제어: 교차감염, 치과 핸드피스, 감염방지구