

Is Alcohol Swabbing Sufficient to Clean Oscopes in Hospitals?

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병원 내 이경 소독법에 대한 고찰-알코올 스왑 소독

구철효 · 이영섭 · 서영준 · 봉정표

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Background and Objectives An otoscope is a basic instrument used by otorhinolaryngologists. An inappropriately sterilized otoscope has been reported to be a possible bacterial vector for infection. In this regard, we decided to investigate contaminated otoscopes for possible bacterial contamination and evaluate the efficacy of the otoscope disinfection methods.

Materials and Method We randomly drew 22 otoscope cones from university hospitals and 10 from private hospitals. Cones were divided into three groups accordingly to their sterilization methods: group 1 was wiped with 70% isopropyl alcohol, group 2 was soaked for 20 min in 70% isopropyl alcohol, and group 3 was soaked in CIDEX solution. The samples were cultured twice, first before the disinfection process and then after the disinfection process. Oscopes were cleaned for a week by employing these techniques.

Results Most of the pre-sterilized otoscopes (20/22) were obtained from the hospitals which demonstrated contamination with microorganisms. Staphylococcus was the most common bacteria found (16/22). After a week of cleansing, no bacteria were seen in group 1 (0%, 0/8), whereas group 2 (14.3%, 1/7), and group 3 (28.6%, 2/7) still showed remaining microorganisms. The three methods were significantly effective on sterilizing microorganisms.

Conclusion An otoscope can be a vector for spreading infection. We found that disinfection by alcohol-swabbing alone is sufficient for sterilizing otoscope cones. Clinically, this information may be useful to otorhinolaryngologists. However, further studies are required to establish the most appropriate disinfection protocol to prevent infection from microorganisms.

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Key Words Alcohol swab · Cross-infection · Disinfection · Oscope.

Introduction

An otoscope is a basic instrument used for ear examination, and often, to screen for therapeutic interventions. Otorhinolaryngologists use otoscope cones on a daily basis to examine the healthy and diseased ear canals of patients at the hospital.¹⁾ These cones repeatedly come into contact with the surface of the ear canal of several patients, and therefore, become contaminated with microorganisms. In hospitals, there

have been numerous reports of contaminated reusable instruments leading to morbidity and mortality among patients.^{2,3)}

Ear canal is susceptible to nosocomial infections caused by the use of contaminated equipment used for examination.⁴⁾ However, to the best of our knowledge, there is no known data reported study on veterinary or human nosocomial infections caused by a contaminated otoscope cone.

Although all reusable medical equipment are cleaned and maintained according to the manufacturer instructions to pre-

vent patient-to-patient transmission of infectious agents, no study has evaluated the efficacy of the cleaning techniques in a controlled environment. In a recent pilot study, alcohol-swabbing, alcohol-soaking, or autoclaved techniques were analyzed for their efficacy.⁵⁾ The goal of our current study is to evaluate the level of bacterial contamination in disinfected otoscope cones from different hospitals and compare the efficiency of the cleaning methods on, pre- and post-cleansing.

Materials and Methods

Overview of study design

This study was carried out from July 2015 to September 2015 at Wonju Severance Christian University Hospital, Yonsei Wonju University of Medicine. We randomly drew 10 otoscope cones from the department of otorhinolaryngology (ORL) and 2 cones from the appertained emergency department. We allocated numbers on sampled cones. After the first culturing stage, we allocated cleaning methods on the cones and divided them into 3 categories. Group 1 (alcohol-swabbing) cones were wiped using sterile gauze and cotton-tipped applicators soaked in 70% isopropyl alcohol (Fig. 1) before and after each use, for a week. Cones in group 2 (alcohol-soaking) were soaked for 20 min in separate sterile containers filled with 70% isopropyl alcohol, before and after use. Cones in group 3 (speculum cleaner) were scrubbed 5 times after passing the cone in and out of CIDEX[®] Activated Glutaraldehyde Solution (J&J Medical Ltd., Berkshire, United Kingdom). After a week of cleaning by employing each techniques, we cultured samples from the cones again by using the same culturing method.

To compare the bacterial species present in otoscopes from the University and private hospitals, We respectively evaluated the culture samples from otoscope cones of 10 sympatric private hospitals (4 pediatric hospitals and 6 ORL clinics) via the same culturing method. The cleaning methods used were also correlated with those mentioned above.

Inoculation and sampling for culture

Each cone, inoculated with bacteria using the same technique, was grasped at the otoscope attachment site with a sterile hemostat and vertically dipped into the center of a container filled with bacterial broth until the narrow tip of the cone touched the bottom of the container. The cone was immediately removed from the broth and placed into a separate sterile container to dry for 10 min. We used 4 culture plates as the broth medium: blood agar plate, MacConkey agar plate, plate count agar plate, and R2A agar. We picked up only the dominant bacteria from the colonies formed on the plate to compare the efficacy of disinfection. Quantitative analysis of the cultures was performed using a calibrated loop technique.^{6,7)} The culture plate was inoculated with a calibrated 1/50 mL (0.02 mL) loop of saline and incubated for 24 hours. The colonies were counted and multiplied by 50 to calculate the number of colonies per milliliter of saline. When more than 100 colonies were present, a 1:100 diluted solution of the sample was created.

Results

Table 1 shows the major cultured isolated microorganism from the otoscopes. Almost all the otoscope cones obtained from the hospitals, except for two, demonstrated contamination with microorganisms before cleaning. *Staphylococcus* was the most common isolated bacteria. *Pseudomonas* species were present (25%) only in the otoscope cones from the University hospital. *Staphylococcus aureus* (*S. aureus*) was dominant (33.3%) in cones from the ORL department of the University hospital (Table 2); moreover, 2 ORL otoscopes (16.7%) yielded bacteria with fungi.

The alcohol-swabbing method of cleaning was used in 36.4% (8/22) of the cones. No bacteria were seen in any of the cones that were swabbed with alcohol after a week. Despite that *Pseudomonas aeruginosa* (*P. aeruginosa*) were detected in the cones, cleaning with alcohol-swabbing removed their presences remarkably. Otoscopic cones soaked in alcohol or

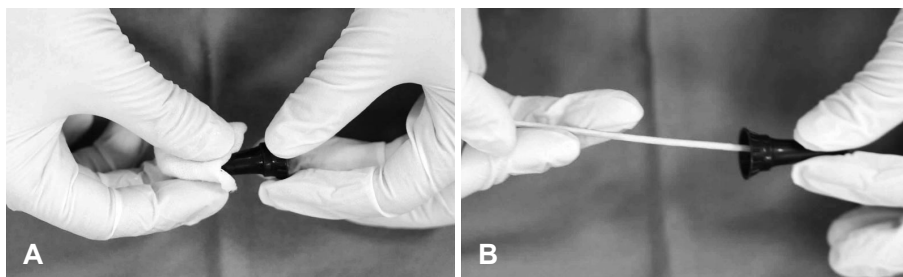


Fig. 1. After the cone was wiped with sterile gauze (A). 70% isopropyl alcohol soaked cotton-tipped applicator was used to cleanse the inside of the cone (B).

Table 1. Major microorganism species cultured from each otoscope and the cleaning method utilized for each otoscope

Hospital	Microorganism (Pre)				Microorganism (Post)				Cleaning method
	BAP	MAC	PCA	R2A	BAP	MAC	PCA	R2A	
1 (ENT)	<i>S. auricularis</i>	—	—	—	—	—	—	—	Alsoaking
2 (ENT)	—	—	—	<i>P. aeruginosa</i>	—	—	—	—	Alsoaking
3 (ENT)	<i>S. auricularis</i>	—	<i>S. caprae</i>	—	—	—	—	—	Cidex
4 (ENT)	<i>S. aureus</i>	—	—	<i>P. aeruginosa</i>	—	—	—	—	Alswab
5 (ENT)	<i>S. aureus</i>	—	—	—	—	—	—	—	Alswab
6 (ENT)	<i>S. epidermidis</i>	—	—	—	—	—	—	—	Cidex
7 (ENT)	<i>S. aureus</i>	<i>S. aureus</i>	<i>S. aureus</i>	<i>S. aureus</i>	—	—	—	—	Alswab
8 (ENT)	<i>C. minutissimum</i>	—	—	—	—	—	—	—	Alswab
9 (ENT)	<i>S. caprae</i>	—	—	—	—	—	—	—	Cidex
10 (ENT)	—	—	<i>Candida</i>	—	—	—	—	—	Alswab
11 (ER)	<i>P. aeruginosa</i>	<i>P. aeruginosa</i>	<i>P. aeruginosa</i>	<i>P. aeruginosa</i>	—	—	—	—	Alswab
12 (ER)	<i>S. caprae</i>	<i>S. caprae</i>	<i>S. caprae</i>	<i>S. caprae</i>	<i>S. aureus</i>	—	<i>S. aureus</i>	<i>S. aureus</i>	Alsoaking
13 (L-P)	<i>S. caprae</i>	—	—	<i>S. caprae</i>	<i>S. caprae</i>	—	<i>S. aureus</i>	<i>S. aureus</i>	Cidex
14 (L-P)	<i>S. epidermidis</i>	—	<i>Y. kristensenii</i>	—	—	—	—	—	Alsoaking
15 (L-P)	<i>S. epidermidis</i>	—	—	—	—	—	—	—	Cidex
16 (L-P)	<i>S. aureus</i>	—	<i>S. aureus</i>	<i>S. aureus</i>	—	—	—	—	Alsoaking
17 (L)	—	—	—	—	—	—	—	—	Cidex
18 (L)	—	—	—	—	<i>S. caprae</i>	—	—	—	Cidex
19 (L)	<i>S. epidermidis</i>	—	<i>S. epidermidis</i>	<i>S. epidermidis</i>	—	—	—	—	Alswab
20 (L)	<i>S. caprae</i>	—	—	—	—	—	—	—	Alsoaking
21 (L)	<i>S. caprae</i>	—	—	—	—	—	—	—	Alsoaking
22 (L)	<i>S. caprae</i>	—	<i>S. caprae</i>	<i>S. caprae</i>	—	—	—	—	Alswab

Alsoaking: alcohol-soaking, Alswab: alcohol-swabbing, Cidex: Cidex-soaking, R2A: R2A agar, ENT: at the department of otorhinolaryngology, ER: at the emergency medicine department, L-P: at the pediatric private hospital, L: at the otorhinolaryngology private hospital, BAP: blood agar plate, MAC: MacConkey agar plate, PCA: plate count agar plate, *S. auricularis*: *Staphylococcus auricularis*, *S. aureus*: *Staphylococcus aureus*, *S. epidermidis*: *Staphylococcus epidermidis*, *C. minutissimum*: *Corynebacterium minutissimum*, *S. caprae*: *Staphylococcus caprae*, *P. aeruginosa*: *Pseudomonas aeruginosa*, *Y. kristensenii*: *Yersinia kristensenii*

Table 2. Profile of organisms isolated from all otoscopes (both ORL and non-ORL otoscopes)

Microorganism	University hospital		Private hospital		Total
	ORL	Non-ORL	ORL	Non-ORL	
<i>S. aureus</i> group	3	1	0	1	5
<i>S. auricularis</i> group	2	0	0	0	2
<i>S. epidermidis</i> group	2	1	4	3	10
<i>P. aeruginosa</i>	2	1	0	0	3
<i>Candida albicans</i>	1	0	0	0	1

ORL: otorhinolaryngology, *S. aureus*: *Staphylococcus aureus*, *S. auricularis*: *Staphylococcus auricularis*, *S. epidermidis*: *Staphylococcus epidermidis*, *P. aeruginosa*: *Pseudomonas aeruginosa*

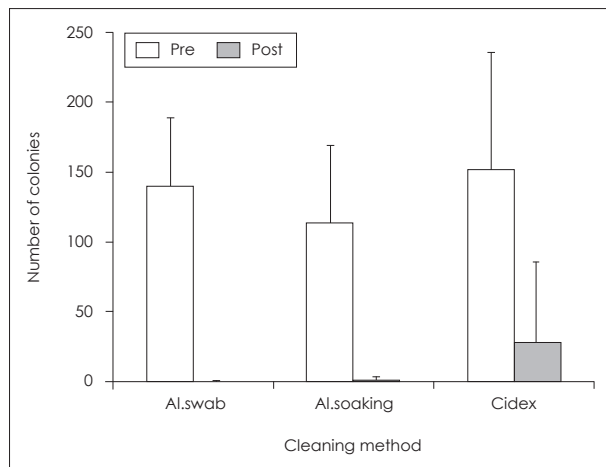


Fig. 2. The changes of number of colonies (all microorganisms) by cleaning methods. Data with a normal distribution is expressed as the mean+standard deviation. Al.soaking: alcohol-soaking, Al.swab: alcohol-swabbing, Cidex: Cidex-soaking.

Cidex still exhibited the presence of microorganisms on the cones, as seen in group 2 (14.3%, 1/7) and group 3 (28.6%, 2/7).

Fig. 2 shows a similar variation in the level of contamination among the 3 groups. There was no statistically significant difference in the proportion of contaminated samples among the different cleaning techniques used. The 3 methods were significantly effective; however, a few bacteria (15%) were able to survive in the Cidex-cleaning group.

Discussion

Many studies have reported that reusable medical devices can be hazardous as they may act as bacterial vectors, subjecting patients to risk of cross infection from one person to another.^{8,9)} There is growing concern that an otoscope can be a vector for spreading infection, and hence, numerous disinfection methods for cleaning the device have been developed. However, there are no definite confirmative methods for clean-

ing otoscope cones.

In our study, we disinfected otoscope cones via alcohol-swabbing, soaking in alcohol, and CIDEX® activated Glutaraldehyde Solution. We found that there were no bacterial growth, including pathogenic or non-pathogenic species, in the alcohol-swabbing group.

Hospital devices contain plenty of microorganisms, which may cause nosocomial infections. In particular, devices that come into frequent contact with skin can transfer bacteria from one patient to another, and can be an infectious source of disease. Moreover, several studies have reported that viral transmission can occur through the use of endoscopes and that an otoscope can be a potential vector for bacterial as well as viral cross infection.¹⁰⁾

In our study, we isolated numerous microorganisms from otoscope cones. We believe that the microorganism isolated from the otoscope cones are originated either from the diseased ear canal or from physicians's hand contact. A total of 22 cones were examined and we identified the *Staphylococcus* species as the most common species (8/12 from the university hospital samples and 8/10 from the local hospital samples), with *P. aeruginosa* reported in 4 otoscope cones from the university hospital. The most common bacteria were *Staphylococcus epidermidis*. Korkmaz, et al.⁴⁾ tested 24 otoscope head samples and reported that 16/24 of them were contaminated; *S. aureus* was the most common. Our test results showed similar trends as well.

Staphylococcus species are the most common bacteria transmitted through skin contact. In our study, we found that they were the most common of all bacteria present on otoscope cones. *Staphylococcus* species isolated from the otoscope cones could be as a result of contamination due to touching by hand. Recently, it has been reported that a high percentage of nosocomial infections are caused by highly resistant bacteria such as the methicillin-resistant *S. aureus* (MRSA), and this is posing a serious challenge in hospitals.¹¹⁾ Cohen, et al.¹⁰⁾ reported that *S. aureus* are present in 83% of otoscopes and amongst these, 9.5% were MRSA. Hence, there is substantial potential that MRSA can be transfected through the otoscope. Therefore, our results, which conclude that only alcohol-swabbing sufficiently removes both pathogenic and non-pathogenic organisms, not via a high level disinfecting agents. It is interesting to note that the *Pseudomonas* species were detected in only samples from hospital-used otoscope cones. Three out of the 12 cones from the university hospital showed *Pseudomonas* species growth, which

are the most common bacteria isolated from the chronically discharging ear and cause serious complications such as malignant otitis externa.^{12,13)} It is possible that *Pseudomonas* cross-infection can occur among patients through contaminated otoscopes. It is, therefore, important to note from our results that cleaning via alcohol-swabbing removes *Pseudomonas* thereby preventing cross-infection.

Isopropyl alcohol is very effective in disinfecting not only bacteria such as *Escherichia coli* and *S. aureus* but also viruses like hepatitis B virus and Herpes virus.¹⁴⁾ Cohen, et al.¹⁰⁾ reported that wiping with alcohol and air-drying can decrease microorganism levels by 96.3%. Our study demonstrated that alcohol-swabbing as an effective method for disinfection as well.

Glutaraldehyde is considered to be the most effective disinfection agent especially for the disinfection of fiberoptic endoscopes. Although glutaraldehyde has been reported to have a toxic effect for long-term handling hospital worker, exposure below the standard level can be ensured for safe usage.¹⁵⁾ Glutaraldehyde has also been reported for its effectiveness for disinfection from exposure to blood, sporeforming microbes.¹⁶⁾

Although CIDEX[®] Activated Glutaraldehyde Solution is an advanced sterilization agent, cleaning via soaking in CIDEX[®] demonstrated a few cases of bacterial growth in this study. However, many studies have proved the bactericidal effect of CIDEX. The difference in our data could result from individual variation in the method of disinfection rather than the type of sterilization product used.

One limitation of this study was its small sample size. Therefore, it is important that further studies with more samples be performed to evaluate the effectiveness of alcohol-swabbing in otoscope disinfection. Our study did not estimate the virucidal effect after cleaning using these methods, which is another limitation as there are several pathogenic viruses that can be transfected from otoscopes such as hepatitis B and C or human immunodeficiency virus. However, the strength of this study is its adherence to the same protocol. Moreover, our study was designed prospectively and all the studies were done simultaneously, which has its significance.

In our study, we found that disinfection by alcohol-swabbing alone is sufficient for sterilizing otoscope cones, and will

be a great help for the otorhinolaryngologist. Further studies are required to establish the most appropriate disinfection protocol.

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