

Comparison of effectiveness disinfection of 2% glutaraldehyde and 4.8% chloroxylenol on tooth extraction instruments in the Department of Oral Maxillofacial and Surgery, Faculty of Dentistry, University of North Sumatera



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Abstract

Objective: To compare disinfecting effectiveness of 2% glutaraldehyde and 4.8% chloroxylenol on tooth extraction instruments at the Department of Oral Surgery, Faculty of Dentistry, University of North Sumatera.

Material and Methods: This was an experimental study with post-test only control group design approach. Purposive technique is applied to collect samples which are lower molar extraction forceps. In this study, sample were divided into 2 groups and each consisting of 18 instruments. The treatment group was treated with 2% glutaraldehyde

while the control group was treated with 4.8% chloroxylenol. Each instrument was pre-cleaned using a brush, water and soap for both groups underwent the disinfection process.

Results: The results were statistically analyzed using Mann-Whitney Test. The comparison between glutaraldehyde and chloroxylenol showed a significant difference to the total bacteria count on instrument after disinfection ($p=0.014 < 0.05$).

Conclusion: 2% glutaraldehyde was more effective than 4.8% chloroxylenol at disinfecting lower molar extraction forceps.

Keyword: Disinfection, Glutaraldehyde, Chloroxylenol, Forceps

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Introduction

Based on RISKESDAS 2013, Indonesian citizens have DMF-T index of 4.6 with the biggest component of missing teeth with score of 2.9, which means that each of Indonesian citizen has approximately three teeth that are extracted.¹ An extraction procedure is high-risk for the transmission of infection because there is contact with blood and saliva of patients either directly or indirectly through contaminated instruments.²

Infection control can be done to reduce cross-contamination, such as disinfecting reusable instruments. Disinfection is divided into three categories which are high-level disinfection, intermediate level, and low level. High-level disinfection can eliminate all types of microorganism except spores. Glutaraldehyde and chloroxylenol are disinfectants that are widely used in the field of dentistry. Glutaraldehyde is a high-level disinfectant, whereas chloroxylenol is a intermediate level disinfectant.^{3,4} Glutaraldehyde works by changing the synthesis of proteins, DNA and RNA of microorganisms, while chloroxylenol change the cell wall and enzyme inactivation of microorganisms.^{5,6}

A study about the disinfection effectiveness on orthodontic pliers showed that only 2%

glutaraldehyde is able to decontaminate all pliers (100%), where as ethyl alcohol and water with soap are unable to decontaminate all pliers in the study.⁴ A study about disinfection effectiveness on x-ray equipment and accessories showed 4.8% chloroxylenol and 2% dichloroxylenol have the same efficacy which is fail to decontaminate 4.9% of the total sample.⁷

This study aimed to compare disinfecting effectiveness of 2% glutaraldehyde and 4.8% chloroxylenol on tooth extraction instruments that are categorized as critical items, items that are high-risk of causing infection because it penetrates to sterile tissues located under skin or mucosa membrane.³

Material and Methods

This study is an experimental with post-only control group design approach. Sampling method used in this study is purposive sampling and used lower molar extraction forceps in the Department of Oral Surgery and Maxillofacial, Faculty of Dentistry, University of North Sumatera as sample. In this study, samples are divided into two groups, the treatment group and control group, that consist of 18 instruments each. A 2% glutaraldehyde solution

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was used in the treatment group and a 4.8% chloroxylenol solution was used in the control group.

Previously used lower molar extraction forceps were first cleaned with a brush, water and soap to eliminate visible blood and saliva on the forceps before disinfection. The forceps were then immersed into a container that contained 250 mL of disinfectant solution for 1 hour for both groups. The forceps were removed from disinfectant, rinsed with sterile aquades and dried with sterile gauze. The beak of forceps were immersed in 50 mL of saline for 5 minutes and the container was closed tightly and sent to a microbiology laboratory for bacterial cultivation and colony bacteria count.

The sample solutions were diluted to 10^{-3} and cultivated on an agar plate and incubated for 24 hours. The number of bacterial colonies formed on the agar plate were counted using bacteria colony counter. From the bacteria colonized on plate count agarose was taken to make pure culture of the colony on nutrient agar and incubated for 24 hours. Pure culture was used to observe the gram type of the bacteria. Data processing was done with computerized analysis using Mann-Whitney test.

Results

This study showed that out of 36 lower molar extraction forceps, 18 were disinfected using 2% glutaraldehyde and 18 were disinfected with 4.8% chloroxylenol. Out of 18 forceps disinfected using 2% glutaraldehyde, 1 (5.56%) was still contaminated by bacterial colonies formed on the agar plate which is 8.10^3 CFU/mL. Out of 18 forceps disinfected using 4.8% chloroxylenol, 7 (38.89%) samples were still contaminated with the maximum score of 812.10^3 CFU/mL [table 1](#). The mean results of each group obtained are $444.44 \pm 1.885.62$ CFU/mL for treatment group and 82.500 ± 196.043 CFU/mL for control group [table 2](#). The Shapiro-Wilk test was conducted to determine the normality of data and the result was not distributed normally, and then the Mann-Whitney test is used [table 3](#).

The Mann-Whitney test was conducted to determine whether there are significant differences between disinfecting lower molar extraction forceps using 2% glutaraldehyde and 4.8% chloroxylenol. The result of Mann-Whitney test between the treatment group and control group resulted in a p-value of 0.014 that was <0.05 [table 3](#). This result showed that there was a significant difference in the number of bacterial colonies between the glutaraldehyde and chloroxylenol post disinfection methods. Besides the number of bacterial colonies, this study also observed the gram type of bacteria remaining on the sample and found that all the contaminated samples were gram-negative bacteria.

Discussion

The disinfectants tested in this study were 2% glutaraldehyde and 4.8% chloroxylenol. Glutaraldehyde has been used widely as high-level disinfectant for over 30 years because of its favourable materials compatibility, cheaper cost and immersion time is longer. Chloroxylenol is also widely used in the household and in medical field as antiseptic and disinfectant as well as a

Table 1 Total plate count after disinfection

No	Total Plate Count (10^3 CFU/mL)	
	2% glutaraldehyde	4.8% chloroxylenol
1	0	0
2	0	0
3	0	0
4	0	168
5	0	0
6	0	812
7	0	158
8	0	22
9	0	0
10	0	234
11	0	0
12	0	1
13	8	0
14	0	0
15	0	0
16	0	0
17	0	90
18	0	0

Table 2 Mean result of total plate count of two groups

Group	Sample	Mean (CFU/mL)	Standard deviation (CFU/mL)
2% glutaraldehyde	18	444.44	1.885.62
4.8% chloroxylenol	18	82.500	196.043

Table 3 Normality test and statistical test of two groups

Group	Mean \pm Standard Deviation (CFU/mL)	P-value (Shapiro-Wilk)	P-value (Mann Whitney)
2% glutaraldehyde	$444.44 \pm 1.885.62$	0.000	0.014
4.8% chloroxylenol	82.500 ± 196.043	0.000	

surface/environmental cleaner.^{8,9} The Spaulding classification describes three instrument/risk categories (critical, semi-critical and non-critical), each of which has specific reprocessing requirements. According to the Spaulding classification, lower molar extraction forceps are classified as critical items, objects that enter sterile tissue or vascular system should be sterile because any microbial contamination could result in disease transmission.^{3,10}

The result from the 13th glutaraldehyde (G13) sample group was 8.10^3 CFU/mL, where this is the only sample that still contaminated after disinfection with glutaraldehyde. This may be caused by some factors, such as patient oral hygiene status and pathological findings such as severe caries, periodontal disease, pulp necrosis or abscess during tooth extraction. Recent studies showed *Streptococcus mutans* is frequently isolated from caries lesions, non-mutans streptococcus, actinomyces, lactobacillus and bifidobacterium were from dental biofilms covering white-spot lesions. Acute abscess frequently caused by caries, trauma and failed root canal treatment. In dental abscess culture, usually polymicrobial were found including streptococcus viridans, prevotella sp. and fusobacterium sp. A recent study showed bacteroides and porphyromonas sp. were found on the abscess culture as well. *Treponema* sp. is an obligate anaerobes, helix-shaped and usually related to periodontal disease, as well as found in dental acute abscess.^{11,12} Besides that, environmental sterility during the sampling procedures and bacterial cultivation procedure in laboratory and operator negligence could increase number of bacteria colonies cultivated.

The chloroxylenol group showed lower disinfection effectiveness than the glutaraldehyde group. There were 7 samples still contaminated after the disinfection which was C4, C6, C7, C8, C10, C12 and C17. A number of bacterial colonies were mostly higher in this group, at the maximum of 812.10^3 CFU/mL. It is because chloroxylenol is an intermediate level disinfectant, while glutaraldehyde is a high-level disinfectant. Patient oral hygiene status and pathological findings along with environmental sterility and operator negligence could cause the number of bacterial colonies cultivated to increase.

In this study, observation of the gram type bacteria is also done to see whether it is gram-positive or gram-negative. After the observation of the 8 contaminated samples, all of them were stained red which means shows gram-negative bacteria.

Conclusion

According to the results presented above, it can be concluded that 2% glutaraldehyde is more effective at disinfecting lower molar extraction forceps than 4.8% chloroxylenol, therefore 2% glutaraldehyde is recommended to be used for disinfecting lower molar extraction forceps.

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Conflict of Interest

The authors report no conflict of interest.

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