

Evaluation of disinfection methods of orthodontic pliers

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Introduction: In recent years, a strong behavior change regarding the control of cross infection during dental treatment was perceived, except among some orthodontists who insist in the misconception that Orthodontics is a specialty of low risk in the transmission of infectious and contagious diseases.

Objective: The objective of this study was to evaluate the methods used by orthodontists for disinfection of pliers in their daily practice.

Methods: The bacteria *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Streptococcus salivarius* were inoculated in vitro in 30 orthodontic pliers. The pliers were divided into 3 groups (n = 10) and disinfected in different ways. Group 1: Brush, soap and water; Group 2: Cotton soaked in ethyl alcohol 70%; Group 3: Immersion in a solution of 2% glutaraldehyde for 30 minutes and then rinsed with water.

Results: The results showed that the ethyl alcohol 70% (Group 2) kept 20% of the pliers infected, being more efficient than the soap and water (Group 1), which maintained 60% of contaminated pliers. Only immersion in 2% glutaraldehyde was able to decontaminate all pliers and was statistically superior to the aforementioned methods (p = 0.030).

Conclusion: Based on these results, we concluded that among the tested methods, disinfection of orthodontic pliers with 2% glutaraldehyde is the only efficient method.

Keywords: Disinfection. Pliers. Orthodontics. Alcohol. Glutaraldehyde.

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INTRODUCTION

The interest in developing methods for controlling the infection of diseases is not new. Since the 70's, with the significant increase of cases of hepatitis B and Acquired Immunodeficiency Syndrome, the recognition of the importance of scientific research and strictness in the standards infection control was recognized.¹⁴

The practice of General Dentistry, and Orthodontics in particular, is characterized by high turnover of patients and variety of vehicles for transmission of infectious and contagious diseases.⁴ The negligence in cross infection control puts this area of Dentistry in second place for hepatitis B contamination.¹⁰

According to the American Dental Association (ADA), it is estimated that dental professionals and patients may be affected by around 40 different types of infectious diseases, when in routine clinical procedures.¹² All infectious diseases are initiated from the body exposure to pathogenic microorganisms. The use of gloves, masks, goggles and aprons is proven essential in all procedures that put in contact the instruments and body parts of the orthodontic team, with secretions or blood from patients, and to avoid the risk of cross infection.⁷

Orthodontics works with younger patients when compared to other specialties. With this thought, some orthodontists are reckless in controlling cross-infection by treating a group of low risk of inoculation of several diseases, besides considering orthodontics as a non-invasive specialty.¹⁸ This thought is a big mistake, because the patients attending the orthodontic clinic are 21% children (1-10 years), 52% adolescents (11-18 years) and 27% adults (older than 18 years), i.e. formed mainly by adolescents and adults. And orthodontists see blood in the patient's mouth at an average of ten times a week, meaning that Orthodontics cannot be considered as non-invasive.¹⁸

The main guide to achieve effective results in infection control is not to disinfect when you can sterilize.¹⁰ Sterilization is the destruction or removal of all forms of life, including spores, while disinfection is the inhibition or destruction of vegetative forms, not destroying spores and some resistant pathogenic microorganisms.⁸

Traditionally, inadequate methods of infection control have been adopted in a few orthodontic offices.¹⁶ The main justification for the professionals

who do not have an infection control program inside the office, is that this procedure takes time and money.¹⁰ Moreover, for a long time there was a concern that the heat or chemical substances could damage the instrument permanently, which undoubtedly contributed to the questioning of the method to be used for material sterilization.¹

Given the need to improve infection control in orthodontic practice, especially when it comes to pliers, this study aimed to evaluate the real effectiveness of the methods commonly used by orthodontists for disinfection of pliers in their daily practice.

MATERIAL AND METHODS

The efficacy of disinfection methods of orthodontic pliers used in everyday practice by orthodontists was evaluated, using 30 sterile pliers, polished, from various brands, contaminated *in vitro* with bacteria commonly found in the oral cavity, *Streptococcus salivarius*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

The microorganisms were grown in three separate test tubes containing BHI broth (brain and heart infusion) and incubated at 37° C/24h. After this period, the three stocks were mixed in equal quantities and homogenized.

Contamination of 30 orthodontic pliers was performed, through total immersion in broth. After drying this broth, on the surface of each plier was placed a sterile aluminum foil mask, 10 cm x 4 cm, with a hole of 5 cm x 0.7 cm, to standardize and determine the location of collection of the microorganisms (Fig 1). A sterile swab moistened with saline solution for 15 seconds swept over the entire surface of each plier defined by the aluminum foil mask, was used for the collection of microorganisms. The swab was inserted into a test tube containing 2 ml of saline solution and stirred for one minute. From this suspension three dilutions in 0.9% saline solution (1:10, 1:100, 1:1000) were prepared. The seeding was performed from the undiluted suspension and its dilutions: 0.1 ml of each individual solution was transferred to the surface of plates containing selective and differential media. Mitis salivarius agar medium to isolate *Streptococcus salivari*, MacConkey agar medium for the isolation of *Pseudomonas aeruginosa* and Baird Parker Agar

medium for the isolation of *Staphylococcus aureus* were used. This material was spread on the surface of the media prepared in disposable petri plates, using sterile Drigalski handle. After seeding, plates were incubated at 37° C for 48 hours.⁵

Soon after the first collection of these microorganisms of 30 pliers, they were randomly divided into three groups, with 10 pliers each, to receive disinfection treatment as follows:

- a) Group 1 (rinsing): Pliers were individually rinsed for one minute with the aid of a sterile brush for each plier, using water and coconut soap bars (n = 10).
- b) Group 2 (70% alcohol): A sterile cotton swab soaked with 70% ethyl alcohol was rubbed on each individual pair of pliers for a minute (n = 10).
- c) Group 3 (sodium 2% glutaraldehyde): Pliers were fully immersed in 2% glutaraldehyde for 30 minutes and then rinsed with running water (n = 10).

After disinfection treatment of all pliers, new samples were performed, in its surface as described above, but carrying out the collection in a different location.

After the incubation period, microorganism counting on the sown petri plates was performed, before and after disinfection treatment, with the aid of manual colony counter Phoenix CP 608 (Phoenix Industry and Trade of Scientific Equipment LTDA, Araraquara, Brazil). In accordance with standard microbiological techniques the plates containing between 30 and 300 colonies of bacteria were selected for reading.

STATISTICAL ANALYSIS

The significance of the results presented in this research was analyzed by the Mann-Whitney test, which is a non-parametric test, and also the chi-square test.

The Mann-Whitney test was conducted to determine whether the amount of pliers effectively decontaminated is greater than the amount of contaminated pliers. Hence, one-tailed test was carried out with 5% of significance, which gives a coefficient of 95%.

The chi-square test was performed to verify whether the results obtained with the treatments were independent or not from the type of treatment adopted. Thus, two-tailed tests were performed at 5% of significance, as the Mann-Whitney test.

RESULTS

After evaluation of bacterial growth in culture medium (MacConkey Agar, Baird Parker agar, Mitis Salivarius agar) it was verified that all pliers had more than 300 colony forming units (CFU) prior to disinfection treatments. This count aimed to prove that there was contamination.

After disinfection treatment of orthodontic pliers, it was possible to get the results presented below, in a descriptive manner in graphs and tables.

Table 1 presents the values of pliers contaminated and decontaminated (removal of all bacterial colonies) after treatment with disinfectant soap and water, ethyl alcohol 70% and 2% glutaraldehyde.

According to Table 1 it can be verified that:

- a) Twenty-two pliers were decontaminated and ten remained infected.
- b) The solution with water and soap had good results in only four of the ten treated pliers.
- c) All pliers undergoing treatment with a solution composed of glutaraldehyde were decontaminated.
- d) The solution based on 70% ethyl alcohol decontaminated eight of pliers undergoing treatment.



Figure 1 - Window for collecting microorganisms.

Table 1 - Number of investigated pliers, according to the disinfection treatment.

Treatment	Decontaminated after disinfection	Contaminated after disinfection	Total
Water and Soap	4	6	10
Ethyl Alcohol 70%	8	2	10
Glutaraldehyde 2%	10	0	10
TOTAL	22	8	30

As for the treatment and bacteria, the results are shown in Table 2.

Regarding the amount of colonies found in eight pliers that remained contaminated even after having been submitted to treatment, it was found that:

- a) All pliers that remained contaminated presented colonies of *Staphylococcus*.
- b) From the pliers that remained contaminated, none presented colonies of *Streptococcus*.

DISCUSSION

The disinfection methods tested in this study were: Rinsing with soap and water, ethyl alcohol 70% and 2% glutaraldehyde. Table 1 shows that, after treatment with soap and water of contaminated orthodontic pliers *in vitro*, there was a slight reduction in the amount of bacteria present on the surfaces of the pliers.

Only *Streptococcus* were completely eliminated, *Pseudomonas* and *Staphylococcus* were found in significant amounts. These results show the inefficiency of this method as a low-level disinfectant, which can be explained by Chu et al,⁶ who said that despite the rinsing procedure being effective in reducing microbial levels deposited the instruments after use, recontamination process may occur resulting in increasing the number of microorganisms. However, our result is at disagreement with Carvalho et al,⁵ that disinfected rubber toys from pediatric dentistry offices with soap and water and obtained full decontamination of toys. The results of this study showed that there was no decontamination of pliers post-disinfection treatment with 70% ethyl alcohol, showing the inefficiency of this method as an intermediate level disinfectant (Table 1). Only *Streptococcus* were completely eliminated, *Pseudomonas* and *Staphylococcus* were found in significant amounts. This result can be explained by the fact that alcohol has quick evaporation, not allowing a further reduction in the number of colonies. This result is consistent with the results obtained by Silva and Jorge¹⁷ who used ethyl alcohol 77% in surface and did not obtain a complete decontamination and Navarro et al,¹⁶ who did not obtain complete disinfection of orthodontic pliers using iodized 70% alcohol. Guimarães Junior¹¹ said that ethanol is not approved by the ADA as a surface disinfectant or

Table 2 - Amount of pliers investigated after treatment according to the kinds of bacteria and treatments.

Bacteria	Water and soap		Ethyl alcohol		Glutaraldehyde	
	Dec.	Cont.	Dec.	Cont.	Dec.	Cont.
<i>Streptococcus</i>	10	0	10	0	10	0
<i>Pseudomonas</i>	5	5	8	2	10	0
<i>Staphylococcus</i>	4	6	8	2	10	0
TOTAL	19	11	26	4	30	0

immersion. And he goes further by stating that its use is not recommended for disinfecting surgical instruments because of their poor sporicidal activity and its incapacity to penetrate protein-rich materials, although it is tuberculocidal, fungicidal and virucidal, it excludes the hydrophilic, such as hepatitis viruses. However, our result do not agree with Carvalho et al,⁵ and Knorst et al,¹³ who achieved complete disinfection of rubber toys using 70% ethyl alcohol.

The glutaraldehyde solution is an efficient disinfectant or sterilizing method, depending on the time in which the objects are immersed in this solution. Table 1 shows that after the disinfection treatment with 2% glutaraldehyde, the bacteria were completely eliminated from the surfaces of orthodontic pliers. Results of this study showed the efficiency of 2% glutaraldehyde as a disinfectant agent when the objects are immersed for 30 minutes, since the minimum time of contact with glutaraldehyde to effect the high-level disinfection is 30 minutes according recommendations from manufacturers.² It is noteworthy that there was no presence of spores or virus resistant to disinfection, such as hepatitis, in this experiment. Therefore, it is fair to say that glutaraldehyde is one effective method of disinfecting, in 30 minutes, against all pathogens. This result is in agreement with Chapman et al,⁵ who disinfected rubber toys with the use of glutaraldehyde and Freitas et al⁹ who, reported that glutaraldehyde at room temperature is effective in destroying vegetative forms of pathogenic microorganisms, influenza viruses, enteroviruses and tuberculosis bacilli when immersed for 10 to 30 minutes. The authors went further by claiming that glutaraldehyde is effective against highly resistant spores for a period of 6 to 10 hours. The 2% glutaraldehyde solution is chosen for disinfecting instruments. It is the only one who acts in the presence of organic matter.

It is fungicidal, virucidal and bactericidal in 30 minutes and sporicidal at 10 hours.¹⁰ However, it is believed that the 2% glutaraldehyde can destroy vegetative bacteria in less than two minutes and sporulated bacteria in three hours.¹¹ Myers¹⁵ disagrees, and says that glutaraldehyde is not recommended because the process takes ten hours of exposure, the efficiency is difficult to monitor, it causes skin irritation, is toxic, discolors and has a corrosive effect on metals. The Ministry of Health³ recommended an exposure of ten hours for proper sterilization.

After this work, it was found that the disinfection is not a substitute for sterilization, as found in virtually all papers researched. All materials that can be sterilized should never suffer disinfection alone.

Given the above, the need to improve control of infection in orthodontic practice, especially in relation to pliers, is indispensable. It is known that currently, the percentage of adult patients in orthodontic clinics is high, which drops the argument used by orthodontists that patients are very young

and therefore have a low risk of inoculation of diseases. Besides, Orthodontics is an invasive specialty, differently from what some orthodontists say.¹⁸

The bacteria used in this experiment were selected due to cause cross-infection via contaminated instruments and have less resistance to decontamination than spores, hepatitis viruses, and AIDS. Therefore, if disinfection treatment used in this study were unable to eliminate them, let alone would they eliminate the pathogens, which are more resistant.

CONCLUSION

According to the results presented above, it can be concluded that:

- a) Decontamination of pliers depends on the treatment adopted.
- b) The solution with water and soap is the least efficient of the three methods investigated in this work.
- c) The glutaraldehyde-based treatment is the most efficient of the three respondents in this study.

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