

Microbiological Evaluation of Elastomeric Chains

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ABSTRACT

Objectives: To evaluate in vitro the surface of elastomeric chains of different manufacturers to verify the presence of pathogenic microorganisms at the moment of unpacking and analyze a possible inhibitory effect of the elastomeric chain when exposed to microorganisms of the oral cavity, for example, *Streptococcus mutans*, *Lactobacillus casei*, and *Candida albicans*.

Materials and Methods: Elastomeric chains from Ortho-Organizers Inc, 3M Unitek, and Dental Morelli were placed in petri plates with brain heart infusion agar medium and in sterile test tubes with brain heart infusion broth. The samples were incubated at 37°C and analyzed at 24 hours, 48 hours, 3 days, and 7 days. In addition, elastomeric chains from the three manufacturers were placed in dishes, inoculated with microorganisms, incubated at 37°C, and analyzed after 24 and 72 hours.

Results: No microorganism growth was detected after all incubation periods. No inhibition zones were identified surrounding the elastomeric chain.

Conclusions: The results suggest that the fabrication of elastomeric chain is in accordance with biohazard concepts. However, careful manipulation is necessary to avoid colonization of pathogenic microorganisms since the composition of the elastomeric chains analyzed do not include antimicrobial agents.

KEY WORDS: Elastomeric chain; Microorganisms; Contamination

INTRODUCTION

The rise in blood-originated diseases caused by viruses such as hepatitis B and C and HIV require enhanced safety measurements to control infections in dentistry.^{1,2} Despite the scarcity of scientific reports, there has been a great rise in sterilization and disinfection techniques since the 1990s. As a result, problems regarding the deterioration of instruments and alteration of the physical and chemical properties of materials used in dentistry have emerged.^{2,3}

One type of dental material that is very sensitive to

different processes of sterilization is the elastomeric chain.⁴⁻⁷ Although the exact composition of elastomeric chains is an industry secret, these polymers have been widely used by orthodontists since the 1960s.⁸ This outstanding orthodontic accessory is the most used force system for clinical dental movement to close diastemata, for canine retractions, and for correction of rotations.⁹ Some studies have shown that the elastomeric ring may exhibit bacterial plaque on its surface, with a higher number of microorganisms than can be verified on tooth surfaces because of its rough surface and the absorption properties of this material.^{10,11} However, no study has evaluated the presence of any bacterial contamination of elastomeric chains after unpacking or prior to its insertion into the oral cavity.

Normally, the elastomeric chain is cut off from the roll with a scissor and inserted in the oral cavity without being submitted to any process of disinfection or sterilization. With the advent of tougher biohazard measures, this clinical conduct has been questioned. Elastomeric chain material can be contaminated during processing, packaging, and manipulation by the dental assistant or orthodontist prior to reaching its final destination in the oral cavity.

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Figure 1. Brands of elastomeric chain used in the experiment (3M Unitek, Dental Morelli, and Ortho-Organizers Inc).

Therefore the aim of the present study is to evaluate in vitro elastomeric chains from different manufacturers to verify the presence of pathogenic microorganisms at the moment of unpacking.

MATERIALS AND METHODS

Elastomeric chain from Ortho-Organizers Inc, 3M Unitek, and Dental Morelli were selected for this experiment (Figure 1). The samples consisted of 4.5-m rolls of elastomeric chains of each brand that were placed 28 petri dishes in brain heart infusion (BHI) agar medium to allow microbial growth. Each dish held 4 bands of 16 cm at a distance of 1 cm from each other. Elastomeric chain strips of 16 cm were also submerged in three conic sterile test tubes of 15 mL containing brain heart infusion broth (BHIB). For each brand, they were subdivided into the beginning, middle, and end of each roll (Figure 2).

The elastomeric chains were cut with a scissor and fixed with the aid of tweezers and sterile swabs in test

tubes and petri dishes (Figure 3). The dishes were wrapped with PVC film to avoid accidental contamination. They were incubated at 37°C to favor microbial growth and examined at 24 hours, 72 hours, 3 days, and 7 days.

The samples were also tested for the capacity of rubbers to inhibit common microorganisms of the oral cavity such as *Streptococcus mutans*, *Lactobacillus casei*, and *Candida albicans*. Three elastomeric chain bands of the same manufacturer were placed in three Petri dishes with BHI agar medium. Each dish presented 3 bands of 16 cm at a distance of 2 cm from each other. Each dish was inoculated with different microorganisms and the elastomeric chain were stored at 37°C and examined after 24 and 72 hours.

RESULTS

After the incubation at different time points, there was no evidence of colonies and bacterial and fungal



Figure 2. Sample disposition in a Petri dish with agar brain heart infusion and 15-mL test tube with agar brain heart infusion broth.



Figure 3. Insertion of the elastomeric chain in the Petri dish with the aid of a swab.

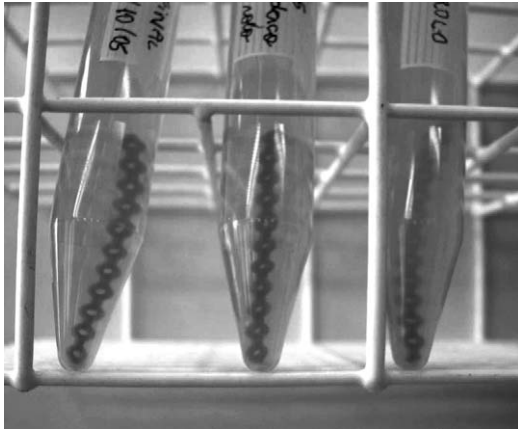


Figure 4. Bacterial and fungal sediments were not detected on the beginning, middle, and end tubes of the elastomeric chain of the Dental Morelli brand at the 24-hour time point. The liquid did not become cloudy in any tube.

sediments in all samples from dishes and test tubes, as demonstrated in Figures 4 and 5.

The capacity of elastics to inhibit common microorganisms of the oral cavity such as *S mutans*, *L casei*, and *C albicans* revealed the presence of bacterial and fungal colonies in the whole extension of the dishes, without zones of inhibition around the elastomeric chains (Figure 6).

DISCUSSION

This study showed the absence of contamination of packed elastomeric chains. This is an advantage as reports have confirmed that sterilizing or disinfecting elastomeric chains before using them is not viable.

Because of these negative results, it was questioned whether the material was sterile or if there was



Figure 5. Absence of bacterial and fungal sediments on dish 2 of the elastomeric chain of 3M Unitek. The same pattern without roughness of the elastomeric chain was presented in every sample.

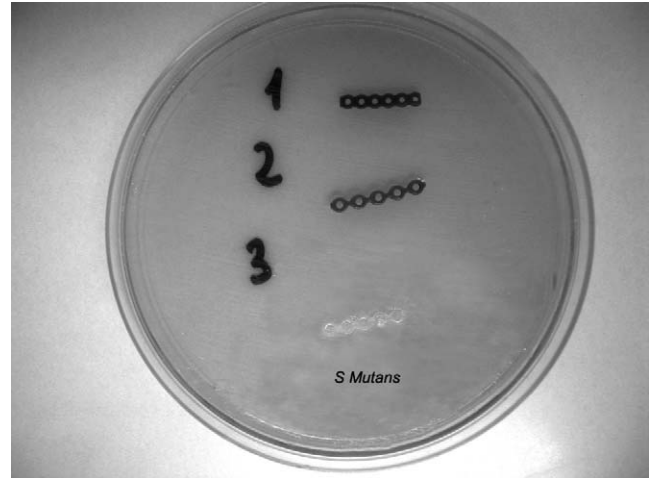


Figure 6. *Streptococcus mutans* growth was not inhibited by the elastomeric chain as evidenced by no inhibition rings around the chains in the growth media.

some component in the structure of the elastomeric chain that avoided bacterial colonization. This issue was brought to mind during the process of fabrication of elastomers. Ammonia is normally added to prevent the rise in alkalinity and retard microbial growth. In addition, it can raise the stability of rubber particles through incorporation of negative ions on its surface.¹²

However, in this experiment, rings of bacterial inhibition were not observed around the elastomeric chain, suggesting no antimicrobial agents in their composition. Literature accounts corroborated these results when comparing levels of bacterial colonization in 12 patients with fixed orthodontic braces.^{11,13} Brackets that were tied with elastomeric rings exhibited a greater number of microorganisms on the biofilm than brackets that were tied with metallic ligature due to greater adhesion of the bacteria to the surface of the elastomeric chain.^{11,13-15}

Most elastomeric chains are sold in 4-m rolls, which is a drawback because it obliges the orthodontist or dental assistant to cut a segment with scissors or wire cutters, which predisposes the chain to contamination before it is inserted into the oral cavity. Such contamination was observed during the present experiment, as a segment of elastomeric chain, manipulated without sterile gloves, presented a colony of bacteria around it after 24 hours. However, these bacteria were not identified as pathogenic (Figure 7).

The concern with the control of crossed contamination already exists. Many orthodontic companies provide individual distribution systems of elastomeric ligature strips with enough ligatures for both arches of a single patient.¹⁶ The orthodontist can sterilize or disinfect elastomeric materials when contamination occurs. However, these polyurethanes are not inert and

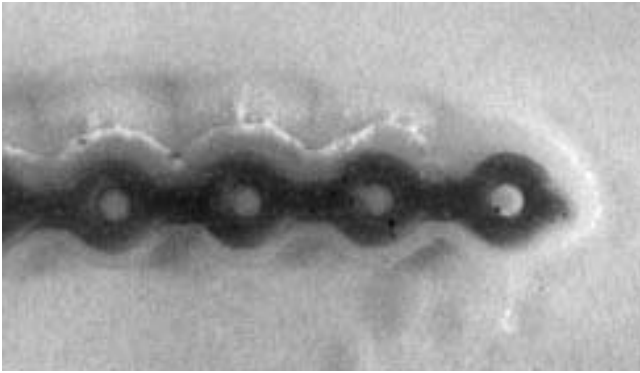


Figure 7. Segment of elastomeric chain contaminated by improper manipulation without disposable gloves.

are greatly influenced by heat, humidity, and contact with enzymes.^{6,7} Studies suggest that when exposed to water, the intermolecular forces of the elastomers weaken, which results in chemical degradation because there is incorporation of the hydrogen bonds between the macromolecules of these materials.¹⁷

Jeffries⁵ analyzed the effects of glutaraldehyde at 2% on the properties of the elastomeric chains. The results showed, *in vitro*, that the solution modified the material structure and affected the force and distension properties needed for a required 500-g force. Although the changes presented were considered clinically insignificant,⁵ the elastomeric chains immersed in glutaraldehyde at 2% showed cytotoxicity because of alteration of their chemical and structural composition through absorption of the solution and its release into the oral environment.⁴

Although the elastomeric chains show biocompatibility when autoclaved,⁴ the elastic chains lose their capacity to return to their original dimensions when submitted to high temperatures. Excessive forces may exceed the elastic property and cause permanent deformation.¹⁸

CONCLUSIONS

- The elastomeric chains tested in this project contained no evidence of any biological contamination due to their manufacturing process, even though they do not inhibit bacterial or fungal growth on their surfaces.
- During clinical use of these elastomers, care should be taken to avoid contamination by pathogenic organisms.
- Precut lengths of these chains would greatly reduce the risk of any biological contamination.

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