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Microbial Infection of Orthodontic Synthetic Intermaxillary Elastics in Differents Types of Manipulation: An *In Vitro* Study

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Abstract

Background: Intermaxillary elastic is considered important sources of energy in orthodontic movement. However, the majority of this type of material, mainly those of Brazilian brands, is sold in packets containing 1000 units, which obliges the orthodontist or assistant to manipulate these, in order to separate them into a smaller quantity for each patient. The care taken by the working team is essential for preserving the integrity of the health of both the team and patients.

Aim/objectives: the purpose of this study was to perform an in vitro evaluation of synthetic intermaxillary elastics from different manufacturers, to verify the presence of microorganisms at the time of opening the package and its application, by different forms of manipulation.

Methods: 120 synthetic intermaxillary elastics were divided into four groups according to different trademarks and type of manipulation. These were incubated at 37ºC and evaluated after time intervals of 24 hours, 48 hours, 72 hours, 4 days, 7 days and 10 days. The cultures were analyzed by visual inspection and when the culture medium presented turbidity, the presence of contamination was considered.

Findings/results: Bacterial contamination was only found in the groups that occurred hand manipulation of the materials.

Discussion: The elastics tested in this study presented no evidence of microbial contamination before manipulation; manipulation of the elastics with the use of gloves and sterile forceps prevented contamination by microorganisms; the elastic manipulation with hands is not recommended.

Keywords

Synthetic elastics; Microbial infection; Disinfection; Clinical care

Introduction

Corrective orthodontic treatment consists of the load transmission on teeth with the aim of moving them to an adequate position. Therefore, elastic materials are considered important sources of energy in orthodontic movement, besides springs and loops incorporated into the archwires [1]. Orthodontic intermaxillary elastics are used for many different purposes, such as correction of interarch relationships [2] and treatment of some open bite cases [3].

Clinically, the use of these materials requires minimal care, so patients do not acquire diseases by means of cross infection [4]. In the 1980s, in the dental community, the warning alert appeared for prevention and control of cross infection, including the emphasis on the creation of a series of regulations and demands by government agencies. However, professionals in health area, particularly orthodontists, still show relative resistance about regarding the procedures of organization of materials, the use of Personal Protective Equipment (PPE), specialized clothing and methods of infection control and it may occur due to the lack of specific knowledge of microbiologyassociated with habits in daily life of orthodontics [5].

The natural microflora in the mouth has a characteristic composition, and most of the time this remains in equilibrium with the host. Major disturbances may occur in the habitat, which disturbs its stability, particularly due to the presence of microorganism with the potential to cause some disease (opportunist pathogens). In Orthodontics, the most common forms of interference in the equilibrium of the buccalflora, that may cause an infectious reaction tocomprise: the handling of materials such as elastomeric chain and ligatures, pencils for marking wires, radiographs, dental casts or the act of making notes on the patient's record chart [4,6,7].

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The care taken by the working team is essential for preserving the integrity of the health of both the team and patients. This care includes procedures of sterilization and disinfection of all the materials and instruments used on the patient. The hands of healthcare workers provide a major source for transmission of healthcare-associated pathogens [8,9].

Human hands are a conduit for exchanging microorganisms between the environment and the body and they can harbor pathogenic species, such as methicillin-resistant *Staphylococcus aureus* (MRSA) or *Escherichia coli*; particularly within high-risk environments, such as healthcare settings [10].

Synthetic intermaxillary elastics, used on a large scale during orthodontic mechanics, are removed from the packaging and inserted into the patient's mouth without any sterilization or disinfection process. These materials canbe contaminated during storage, manipulation by the orthodontist or assistant, before it reaches the patient's buccal cavity and manipulation of synthetic elastics by the patient is also pointed out once they need to change the elastics at least once a day.

The aim of this study was to make an in vitro evaluation of synthetic intermaxillary elastics from different manufacturers, to verify the presence of microorganisms at the time of opening the package and its application, by different forms of manipulation.

Material and Method

The sample containing 120 synthetic intermaxillary elastics was divided into four groups according to different trademarks: Group 1 GAC ¼ elastics; Group 2 American ¼ elastics; Group 3 Morelli ¼ elastics and Group 4 Uniden ¼ elastics (Chart 1).

Chart 1: Experimental Groups (Commercial Brands): n= 30 units per group
Group 1: GAC ¼ Elastic
Group 2: American ¼ Elastic
Group 3: Morelli ¼ Elastic
Group 4: Uniden ¼ Elastic

The elastics were manipulated reproducing the procedures that occur during their clinical application. Each group containing thirty synthetic elastics was divided into five sub-groups, with six elastics in each, according to the manner of manipulating the material: sub-group 1 collected with a sterile autoclaved forceps; Sub-group 2 collected with a non-sterile procedure glove (Satari); Sub-group 3 collected with a non-sterile procedure gloves (Satari) but disinfected with 70% alcohol on the gloves and rubbing the hands until the alcohol has been spread over their entire surfaces; Sub-group 4 collection with washing hands with neutral soap and water, (Protex, sufficient quantity of liquid soap to cover all the surfaces of the hands) rubbing the soap into all the areas, up to the wrists, with particular emphasis on the areas around the nails and between the fingers, with a duration of 40 to 60 seconds before rinsing with cold water; Sub-group 5 collection with washing the hands and 70% alcohol, according the procedures described above (Chart 2).

For each sub-group, six empty sterile test tubes were used for collection and transport of the material between the clinic and the laboratory, and three tubes for inoculation containing 1 mL of BHI (bovine brain heart infusion) culture medium. These were incubated at 37ºC and evaluated after time intervals of 24 hours, 48 hours, 72 hours, 4 days, 7 days and 10 days.

The cultures were analyzed by visual inspection and when the culture medium presented turbidity, the presence of contamination was considered.

Chart 2: Experimental Sub-Groups (according to the type of manipulation): n= 6 units per sub-group
Sub-group 1: Sterileforceps
Sub-group 2: Glove
Sub-group 3: Glove + disinfection with 70% alcohol.
Sub-group 4: HandWashing.
Sub-group 5: Hand Washing+ disinfection with 70% alcohol.

Results

The results found can be observed in detail in Tables 1 to 3.

24 Hours	Sub 1			Sub 2			Sub 3			Sub 4			Sub 5		
Group 1	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	N	N
Group 2	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	P_B	N
Group 3	N	N	N	N	N	N	N	N	N	P_B	N	N	P_B	P_B	P_B
Group 4	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	N	N	N

N = negative result; P_B = positive result for contamination by bacteria.

Table 1: Presence of bacterial infection after the incubation period of 24 hours

48 Hours	Sub 1			Sub 2			Sub 3			Sub 4			Sub 5		
Group 1	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	N	N
Group 2	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	P_B	N
Group 3	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	P_B	P_B
Group 4	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	N	N	N

N = negative result; P_B = positive result for contamination by bacterias

Table 2: Dynamics of microorganisms after the incubation period of 48 hours

72 Hours	Sub 1			Sub 2			Sub 3			Sub 4			Sub 5		
Group 1	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	N	N
Group 2	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	P_B	P_B
Group 3	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	P_B	P_B	P_B
Group 4	N	N	N	N	N	N	N	N	N	P_B	P_B	P_B	N	N	N

N = negative result; P_B = positive result for contamination by bacteria.

Table 3: Maintenance of quantity of contamination in time intervals of 72 hours, 04, 07 and 10 days of incubation

Discussion

In the 1980s, greater attention was given to the cross-infection control in the dental community. In orthodontics, with concern about cross infection, many companies provide individualized systems, such as for example, the presentation of elastics packages a sufficient quantity for one patient. Thus, avoiding manipulation of the material by another person.

Nevertheless, the majority of synthetic intermaxillary elastics, mainly those of Brazilian brands, are sold in packets containing 1000 units, which represent a disadvantage, as it obliges the orthodontist or assistant to manipulate these, to separate them into a smaller quantity for each patient. This maneuver predisposed the remainder of the elastics to contamination before they are distributed to other patients, and this is the reason for this study.

In the present research, no contamination of the synthetic elastics was observed, in any of the time intervals studied, for samples collected with sterile forceps, with glove and glove plus disinfection with 70% alcohol, demonstrating that the elastics do not present contamination during their manufacturing process, and that if handled with care, they will not present contamination after the opening of the packages and distribution of the elastics. However, in the samples collected by only hand washing or the samples collected by hand washing and disinfection with 70% alcohol colonies of bacteria were presented after 24 hours.

When analyzing the hands' skin, bacterial flora of the transitory and resident types was found, constituting the source of a large number of bacteria. The transitory flora colonizes the more superficial layers and is generally removable by washing with soap and water or destroyed/inactivated by the use of antiseptics [11]. Once acquired contact with the environment whether it is animate or inanimate, they have a high pathogenic potential and are easily transmitted, and are related to hospital infections: *Staphylococcus aureus*, *enterococcus*, *gram-negative bacteria, fungi,* and *viruses*. The resident microflora colonizes the deeper layers of the epidermisand is more resistant to removal by the cleaning techniques. It is composed of bacteria normally present on the skin surface: *Staphylococcus*, diphtheroid and micrococcus [12].

Another result found thatthe proliferation of bacteria in the period of incubation increased, as in Group 2, Sub-group 5, probably due to the superficial washing of the hands, leaving the microflora bacteria resident. However, some particularities became evident, such as in Group 4 (Uniden brand) Sub-group 5, when there was hand washing plus 70% alcohol, there was no contamination of the elastics in any time interval. This phenomenon may have occurred due to the greater efficiency of manipulating the material in comparison with the other groups, or by some chemical component added to the synthetic elastic structure during the manufacturing process of this material. Latex consists of chains of cis-1,4-poly-isopropene, the main raw material of orthodontic elastics, which is stabilized by the addition of preservatives (usually ammonia). The ammonia added also prevents the increase in alkalinity and retards microbial growth, in addition to increasing the stability of the rubber particles by the incorporation of negative ions into the surface [12]. The response to incubation was similar, both for the brands in which the elastics are sold in individual packets, and for the brands in which there are a larger quantity of elastics in the packets, and there is a need to manipulate the package.

The readout of the results demonstrates the need for the use of preventive measures to avoid cross infection in orthodontic dental offices, by contamination of the orthodontic team and patients. Of the preventive measures studies, the use of disposable latex gloves is a fundamental conduct to prevent contamination. Studies have shown a reduction in the risk of contamination by the Hepatitis B virus in professionals who use this resource [13]. Prior handwashing with antiseptic soap with residual action is justified by the fact of diminishing transitory bacterial multiplication [11]. Ethyl and isopropyl alcohols have low power bactericidal agents and irregular antiviral activity, in addition,they are irritant to the skin when left on for prolonged periods. Moreover, it rapidly evaporates with minimal residual activity, which may become more effective by adding another chemical product [14].

Therefore, when the contamination of the synthetic orthodontic elastics occurs, it is probably due to inadequate manipulation by the professional team, who should be alert to the adoption of efficient methods of infection control.

Because of the inherent limitations of the *in vitro* studies we recommend that futures studies be performed to show the microflora population existing in these orthodontic materials after these types of manipulations where the contamination has been found.

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