In vitro evaluation of force delivered by elastomeric chains

Andréa Fonseca Jardim da Motta**, Adriana de Alcantara Cury-Saramago**, Lincoln Issamu Nojima***

Abstract

Objective: To evaluate and compare, *in vitro*, the decrease in the forces delivered in three groups of elastomeric chains, produced by the same manufacturer, according to the distance between links (short, medium, long). **Methods:** The segments of elastomeric chains were stretched and kept activated during the trial using a device developed especially for this purpose, which also allowed force readings. Force degradation was evaluated by measuring force along time and calculating the percentage of force decrease from initial force at each time interval and for each specimen under test. **Results and Conclusions:** Data were statistically analyzed and results showed that at the different time points after initial readings, force intensity varied within and between groups. Readings of remaining forces at each time moment compared with the initial reference force revealed statistically significant differences in all the comparisons in each group of elastics (short, medium, long). Although the comparisons between forces delivered at each time point revealed statistically significant differences, these differences do not seem to have a clinical significance. The space between links does not seem to be a clinically significant characteristic in force degradation along time.

Keywords: Orthodontic appliances. Dental materials. Elastomers.

Editor's summary

Elastomeric chains have been used in orthodontics since the 1960s, and their use has increased along time due to their many advantages. They are economic, comfortable and easily placed and removed, which reduces working time and does not require patient cooperation. Despite these advantages, elastomeric chains are not capable of producing continuous forces along time. Their mechanical properties change because of the variable amount of stretching to which they are submitted, water and saliva absorption, permanent deformation, sensitivity to saliva pH and temperature variations in the oral environment. The size of elastomeric chains, as well as their configuration — often described as short, medium or long — also seem to affect their behavior. This *in vitro* study evaluated and compared the decrease of the initial force delivered by elastomeric chains divided into three groups according to the distance between their links.

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** Adjunct Professor, Orthodontics, Federal University of Rio de Janeiro (UFRJ).
*** PhD in Dentistry and Orthodontics, UFRJ. Adjunct Professor at Federal Fluminense University, Rio de Janeiro.

Grey elastomeric chains produced by Dental Morelli were selected and classified according to the distance between links: short, medium and long (n=20). A device with two platforms, one fixed and one movable, and hooks in their ends was manufactured especially to keep the elastomeric chains activated during the experiment and to allow readings of the forces delivered. The elastomeric chain segments were placed in the device and stretched to deliver an initial force of about 200 gf. Measurements were made at the following time intervals: baseline, 1 hour, 24 hours, and 1, 2, 3 and 4 weeks after the chain activation.

The readings at baseline, 1 hour and 24 hours showed that the short elastics had statistically greater values than those in the medium and long groups ($p<0.05$). Medium and long elastics, in turn, had not differences from each other ($p>0.05$). There were no statistically significant differences in remaining forces between the elastomeric chain groups at 1 and 2 weeks after activation. In the 3rd week, short elastomeric chains had statistically lower values than the others. In the 4th week, all groups differed from each other, and the long group had the greatest mean values, followed by the short and medium groups. The authors concluded that the distance between links does not seem to be a clinically significant characteristic of force degradation along time.

Questions to the authors

1) According to the authors, about 20% of the initial force was lost. Based on that, would it be clinically acceptable to add 20% more force at the elastomeric chains placement time?

The application of forces greater than optimal for a certain orthodontic movement does not seem to significantly affect final clinical results of expected tooth movement. Moreover, a greater force might lead to complications, such as patient discomfort and indirect root resorption. It should also be noted that greater forces lead to equally greater losses in the first 24 hours. Therefore, there is no justification for the addition of force beyond what is classified as optimal in orthodontics.

2) Do you expect to see technological development of orthodontic elastics in the field of dental materials?

Although already being used for relatively long time, orthodontic elastomeric chains remain as object of studies whose findings are often contradictory. Clinical and laboratory studies using well designed methods and approaches that include biocompatibility, chromatic and morphological characteristics and the mechanical properties of materials should continue to be conducted, as their finding may be fundamental for the technological development of orthodontic elastomeric chains.

3) Is the efficiency of national and imported elastomeric chains similar?

The efficiency of the materials under study does not depend on its origin. Several factors affect the mechanical properties of elastics, such as material composition, manufacturer and sterilization methods. In addition, environmental variables, such as saliva, diet, temperature and pH may affect the clinical efficiency of elastomeric chains.

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Contact address
Andréa Fonseca Jardim da Motta (Ortodontia/UFF)
Rua Mario Santos Braga, nº 30, 2º andar, Campus Valonguinho
Zip code: 24.020-140 – Centro, Niterói/RJ, Brazil
E-mail: afjmotta@gmail.com