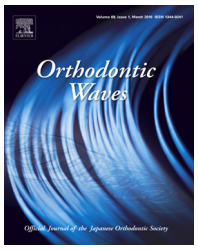
Available online at www.sciencedirect.com
ScienceDirect
journal homepage: www.elsevier.com/locate/odw



Original article

Effect of four different mouthwashes on force-degradation pattern of orthodontic elastomeric chains

AmirHossein Mirhashemi [a], *Niloofar Farahmand* [b], *Atefe Saffar Shahroudi* [a], *Mohammad Sadegh Ahmad Akhoundi* [c,*]

[a] *Department of Orthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran*
[b] *School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran*
[c] *Dental Research Center, Dentistry Research Institute, Tehran, Iran; Department of Orthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran*

ARTICLE INFO

Article history:
Received 1 April 2016
Received in revised form
12 November 2016
Accepted 30 November 2016
Available online xxx

Keywords:
Elastomeric chains
Force decay
Mouthwashes

ABSTRACT

Purpose: Elastomeric chains are widely used for exerting force in orthodontics. Since orthodontic patients are prone to plaque accumulation they are usually advised to apply antibacterial agents. The aim of this study was to compare the effects of three different mouthwashes including persica, chlorhexidine, sodium fluoride and the combination of chlorhexidine and sodium fluoride on force decay of orthodontic elastomeric chains.

Materials and methods: In this study, 315 pieces of elastomeric chains were divided into 5 groups: persica, chlorhexidine 0.2%, sodium fluoride 0.2% and the combination of chlorhexidine and sodium fluoride and a control group. The samples were kept in artificial saliva and were soaked in the mouthwashes twice a day for 60 s each time. The control group was kept in artificial saliva throughout the day. The forces exerted by the samples were measured by a universal testing machine at initial, 1 day, 7, 14 and 28 days. To compare the results, repeated measure ANOVA was performed.

Results: A significant force-degradation over time was observed in all groups ($p < 0.005$). However, there were no significant differences among study groups and between study groups and the control group.

Conclusions: Application of persica, chlorhexidine, sodium fluoride and the combination of chlorhexidine and sodium fluoride mouthwashes had no adverse effect on the force-degradation of orthodontic elastomeric chains.

* *Corresponding author*. Fax: +98 2122923041.
E-mail address: ahmadakh@tums.ac.ir (M.S. Ahmad Akhoundi).

http://dx.doi.org/10.1016/j.odw.2016.11.007
1344-0241/

Please cite this article in press as: A.H. Mirhashemi, et al., Effect of four different mouthwashes on force-degradation pattern of orthodontic elastomeric chains, Orthod Waves (2016), http://dx.doi.org/10.1016/j.odw.2016.11.007

1. Background

During an orthodontic treatment, the force is exerted to the teeth by different appliances including elastomeric chains, stainless steel spring and NiTi coil springs etc. Among them elastomeric chains (ECs) are more popular due to ease of application and low cost [1]. ECs are polyurethane elastomeric products that have been used from 1960 in orthodontic treatment for inter-arch tooth movements. However, there are some disadvantages including discoloration, plaque accumulation and force degradation from which the latter is the most challenging problem [2]. ECs undergo permanent deformation and force decay over time that results in inadequate tooth movement which in turn leads to more frequent appointments to change the chains and elongate the length of the whole treatment [3,4].

Force decay characteristics and force relaxation patterns of elastomeric materials are influenced by various factors such as manufacturing techniques, environmental conditions, temperature, moisture, pH, saliva enzymes, patient diet, sterilization technique and chemical composition as well as morphology and dimensions of the chains [5–11]. Thus, any changes in oral environment caused by drinks, beverages, foods and medicines can potentially affect the force-degradation of ECs.

Mouthwashes have been widely used as a means of oral hygiene to decrease the load of cariogenic oral microorganisms and decrease caries and gingival inflammation. Orthodontic appliances facilitate plaque accumulation and compromise oral hygiene, which in turn predispose the patient to dental caries and periodontal problems [12,13]. Thus, the application of antimicrobial agents is more commonly advised during orthodontic treatment [14]. Chlorhexidine glucunate is a well-known antibacterial agent that is frequently used and its effectiveness as a therapeutic mouthwash in controlling the Streptococcus mutans and lactobacilli levels of orthodontic patients with fixed appliances has been shown in previous studies [15,16]. Recently chlorhexidine and fluoride combination was found to be a more effective way to reduce possible caries-associated problems in patients who undergo fixed appliance therapy [17]. Another type of mouthwashes is herbal ones which have been advocated in preserving periodontal health, and reduction of microbial plaques. Persica is a kind of herbal mouthwash which is prepared from *Salvadora persica* extract and its efficacy in improving gingival health and lowering carriage rate of cariogenic bacteria has been demonstrated [18]. All these antimicrobial agents can be beneficial in inhibiting salivary MS levels and reducing gingivitis therefore improving oral hygiene in orthodontic patients [19]. However, mouthwashes are chemicals that can change the pH of oral environment and affect the orthodontic appliances. Several studies have addressed the force decay of orthodontic ECs, among them the effect of pH changes [20], different types of artificial saliva [21], temperature, bleaching agents [10] and sodium fluoride [22], have been studied.

This study was conducted with the aim of comparing the effects of three different mouthwashes including persica, chlorhexidine, sodium fluoride (NaF) and the combination of chlorhexidine and sodium fluoride on the force decay of orthodontic elastomeric chains in in vitro conditions.

2. Materials and methods

In this experimental in vitro study, 315 pieces of elastomeric chains with the length of 24 mm, all of them clear and without intermodular link, (American Orthodontics) were selected. The specimens were divided into five groups: control group, persica, chlorhexidine 0.2%, sodium fluoride 0.2% and the combination of chlorhexidine and sodium fluoride — each containing about 15 pieces of chain.

A custom made device was designed to hold the chain stretched at the length of 24 mm. This length demonstrates the average distance between the mid-buccal point of the upper canine crown and the buccal groove of the first upper molar. The initial length of samples was so that they exert about 200 gr force at the length of 24 mm since the acceptable force for average orthodontic tooth movements is mentioned to be about 200 gr [23]. The test specimens were cut so that one extra loop was remained on each side to avoid any damage on terminal loops.

Five devices were fabricated for the five study groups. A number of round cross sectional rods were made of stainless steel and were inserted in a plexiglass plate. (Fig. 1). In order to

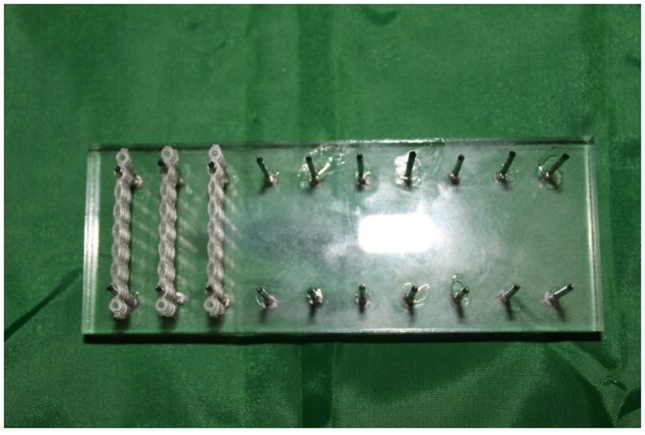


Fig. 1 – Fabricated device made of stainless steel rods to hold the chains stretched at the length of 24mm.

Please cite this article in press as: A.H. Mirhashemi, et al., Effect of four different mouthwashes on force-degradation pattern of orthodontic elastomeric chains, Orthod Waves (2016), http://dx.doi.org/10.1016/j.odw.2016.11.007