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An evaluation and comparison of force degradation of orthodontic elastics from two different manufacturers – An in vivo study

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Abstract

Objective: This study was designed to evaluate and compare the characteristics of force degradation of latex elastics from 2 different manufacturers.

Methods: Out of a sample size of 24 sites, 12 sites (right or left) were assigned as Group A (American Orthodontics elastics) or Group B (Ormco elastics). Force levels were measured at the time of elastic placement, after 24 hours, and after 48 hours with the help of Dontrix gauge.

Result: At baseline, there was an insignificant difference in force between the two groups (p = 0.063). After 24 hours, Group A had a significantly higher force compared to Group B (p=0.018).After 48 hours, Group A still maintained a significantly higher force compared to Group B (p=0.008). Force degradation was higher in Group B with a significance value of p=0.039. **Conclusion:** Group A elastics should be changed daily. Because of higher rates of force loss that continued throughout testing, it is more important that Group B

elastics be changed at regular intervals not exceeding 10-12 hours.

Keywords: Orthodontic elastics, Intermaxillary Elastics, Elastic Force Degradation.

Introduction

Elastics are defined as During certain stages of treatment, small elastics or rubber bands are worn to provide individual tooth movement or jaw alignment.[1]They are used to apply force on the teeth. Patients can easily wear the elastics on their own and keep up with proper oral hygiene.

They can be given intra- arch or inter- arch as per needed. Inter- maxillary elastics are given between a point on maxillary arch and a point on mandibular arch.[2] Inter-maxillary elastics were mentioned by Calvin S. Case at the Columbia Dental Congress in 1893; Edward Angle described the technique before the New York Institute of Stomatology in 1902.

It has been frequently observed that rubber elastics lose their initial force after being placed in mouth due to regular oral activities (such as chewing and speaking) and after being exposed to various oral conditions (eg, saliva, oral temperature, foods, and drinks with different acidity and alkalinity).[1]Additionally, the force delivery over time changed depending on the manufacturer.

This study was designed and implemented to evaluate and compare the characteristics of force degradation of latex elastics from 2 different manufacturers.

Materials:

1. 3/16-inch elastics (American Orthodontics) (fig 1)
2. 3/16-inch elastics (ORMCO elastics) (fig 2)
3. Dontrix guage (MORELLI ORTHODONTIA) (fig 3)
4. Tweezers (fig 4)

Fig.1: 3/16-inch (AO) elastic

Fig. 2: 3/16-inch (ORMCO) elastic

Fig. 3: Dontrix guage

Fig. 4: Tweezer

Inclusion criteria

- Patients who are undergoing fixed orthodontic treatment (0.022 * 0.028 slot metal bracket) at the Department of Orthodontics and Dentofacial

Orthopedics, Manubhai Patel Dental College, Hospital & O.R.I., Vadodara will be considered for this study.

- Patients whose treatment needed intermaxillary class 2 elastics.

Exclusion criteria

- Periodontally compromised patients.
- Patient allergic to latex
- Patients having habit of smoking

Methodology

- In this split-mouth in vivo study, 12 patients who were undergoing orthodontic treatment with a 0.22 slot MBT bracket system with rectangular stainless-steel wire, and who fulfill all inclusion criteria have been selected for the study.
- Group A – American Orthodontics elastics
- Group B – Ormco elastics
- Participants were allocated into 2 sides; right and left side allocated in group A and group B randomly.
- Before the tests, the position, and the distance of stretching was determined and the traction hooks (upper canine and lower 1st molar) were placed on the brackets.
- The distance of intermaxillary traction between the two hooks was determined while the subjects were in dental interdigitation. (fig 5)
- The subjects required to wear the elastics for 48 hours without exchanging them.
- Force measurements made at 3 intervals, at the time of elastic delivery, 24 hours, and 48 hours. (fig 6)
- At each interval, force was measured by Dontrix gauge in subjects' mouth.
- The tensile readings were recorded in grams.
- To ensure the consistency of the tests, all measurements were performed by one person.
- The author had advised the patient to restart wearing the elastics on both sides if any breakage of elastic during treatment occurs.

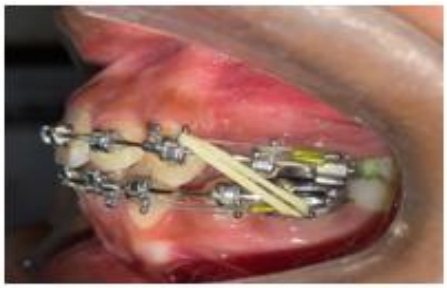

Fig. 5: Intermaxillary Elastic

Fig. 6: Dontrix gauge used to measure force levels

Sample Size

Considering the mean difference in force over time by 0.08 with SD 0.06, a minimum of 24 sites (12 per group) require to achieve 95% confidence and 90% power.

Reference: Tong Wang, et.al. 2007, Angle Orthodontist.

Statistical Plan

- Descriptive statistics like frequency, percentage, mean and SD
- Independent t-test to compare mean values between two groups.

Results

Table 1: Grouped data for means (standard deviations) of force over time

Time h	Group A	Group B
Baseline	158.75(21.54)	143.75(15.53)
After 24 hours	137.91(21.36)	117.08(18.64)
After 48 hours	122.91(15.14)	100.41(21.79)

Table 1 depicts the descriptive statistics of force measurements over time for two groups. -Group A and Group B. The data is collected at three different points of

time: Baseline, After 24 hours, and After 48 hours. It appears that both groups started with higher force values at Baseline and experienced a decrease in force over the following 48 hours.

Table 2: Comparison of Force at different time points between the groups

Time h	t	df	P Value	Mean Difference	95% Confidence Interval	
					Lower	Upper
Baseline	1.956	22	.063	15.00000	-.90362	30.90362
After 24 hours	2.545	22	.018	20.83333	3.85619	37.81048
After 48 hours	2.937	22	.008	22.50000	6.61346	38.38654

Table 2 compares the force measurements between the two groups at different time points. At Baseline, there lies insignificant difference in force between the two groups ($p = 0.063$). This suggests that, initially, the groups were similar in terms of force. After 24 hours, there is a statistically significant difference in force between the groups ($p = 0.018$). Group A has a mean force of 20.83 units higher than Group B, with a 95% confidence interval. This indicates that Group A had a significantly higher force after 24 hours compared to Group B. After 48 hours, a similar pattern is observed. There is a statistically significant difference in force ($p = 0.008$), with Group A having a mean force 22.50 units higher than Group B. This suggests that, after 48 hours, Group A still maintains a significantly higher force compared to Group B.

Table 3: Comparison of force degradation between the groups

Group A vs Group B	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Amount of Force Degradation	1.040	22	.039	-7.50000	1.78510	7.44837

Table 3 compares the amount of force degradation between the two groups. The key finding here is that the amount of force degradation is significantly different between the two groups ($p = 0.039$). Group B has, on average, 7.50 units more force degradation than Group A. This indicates that Group B experienced a greater degradation of force compared to Group A.

Discussion

Force decay in orthodontic elastics has been well documented. Bales et al[10] cited Bertram in 1931 as having first reported that one third of an elastic's developed force is lost per day and further suggested that, clinically, elastics should be changed daily. The data from the present study thus support that of Bales et al. as after 1 day force decay was seen with both the groups.

According to Kersey et al (2003) Cyclic testing caused significantly more force loss and this difference occurred primarily within the first 30 minutes.

According to Kapila[11], oxygen concentration and pH changes have no obvious significant effects on force degradation of elastomeric chains.

Ash and Nikolai[12] also suggested that greater force relaxation was observed in water at 37°C compared with air at the same temperature.

In contrast, Bales et al[10] reported no difference between the forces exerted by orthodontic latex elastics in wet and dry environments. In an oft-cited (but never published) pilot study, Andreasen and Bishara[13] found that room temperature water adequately simulated saliva at 37°C for the assessment of latex elastics, but not for polyurethane elastomer chains. Overall, elastics and non-latex chains have been tested at room temperature and at 37°C, in dry air and moist air, in distilled water, normal saline and artificial saliva, and with or without aging.

However, no consensus on the appropriate conditions for the testing of orthodontic elastics has emerged.

According to Russell et al (2001) the GAC non-latex elastics lost more energy and retained lower force values than did the GAC latex; the Masel latex and non-latex elastics over time and would likely become less effective to move teeth. Over 24 hours, there was a decrease in the loads generated by all elastics.

According to Kanchana and Godfrey (2000) there were significant differences in force extension and force degradation characteristics between different extensions and force magnitudes for the elastics of the different manufacturers. It is suggested that the clinician could use the table of force degradation values for different extensions to select appropriate elastic.

According to Liu Yang et al (2020)the force degradation of latex elastic in vivo is much greater than that in both air and artificial saliva.

In theory, 100- 150 g of force was required on each side of the Intermaxillary mechanics for Class II and III correction.

For example, it could be generated by fixing latex elastic from canine (or traction hook) to the maxillary molar.

The latex elastic was overstretched more than 3 times its deformation, so it could be easily predicted that the degradation of the latex elastics with Intermaxillary traction everyday was much larger than the result of this experiment.

In our study force degradation was more in group B than group A after 24 hrs and 48 hrs. So, they should be changed every day, and even group 2 elastic should be changed after 10-12 hours.

Volunteers with similar diets were tested to avoid the influences of different eating habits and saliva environments on the experiment.

Clinicians should consider choosing suitable elastics with an initial force that is a little higher than required, considering the quick degradation in the first hour.

In clinical practice, to meet the principle of the force extension and ensure that the force value of the latex elastics is relatively stable, it may be necessary to recommend that patients discard the elastics after 1 day. The clinician should rely on reasonable constancy of working properties for any elastic type; this requires quality control in manufacturing.

With the development and research of high polymer chemical materials, a more stable manufacture of orthodontic latex elastic that could supply good quality and stable orthodontic material for orthodontic treatment could be obtained.

Conclusion

1) Company an elastics should be changed on daily bases.
2) Because of higher rates of force loss that continued throughout testing, it is more important that Company O elastics be changed at regular intervals not exceeding 10-12 hours.

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