# Elastics in orthodontics and comparsion of heavy and medium elastics and the force degredation at different time intervals

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## Abstract

**Introduction**: Objective of the study is to compare heavy elastics and medium elastics at specific time intervals and there force degredation value and comparison of four different brands force degradation value at different intervals of time.

**Methods**: For this study four different brands of elastics are chosen and 10 different size 1/8-inch (2 oz); 1/8-inch (3.5 oz); 3/16-inch (2 oz); 3/16-inch (3.5 oz); 1/4-inch (2 oz); 1/4-inch (3.5 oz); 5/16-inch (2 oz); 5/16-inch (3.5 oz); 3/8-inch (2 oz); and 3/8-inch (3.5 oz). of elastics are chosen randomly for comparison of heavy and medium elastics at different interval of time with force application of 60 gm and the force loss calculated at specific time interval and force degredation value of four brands of elastics . Ten volunteers (aged 17-24 years) were selected for

this study who were undergoing orthodontic treatment in there final settling stage.1 way ANOVA and T –Test were used to identify statistical significance (P \0.05).

**Results**: Force degradation increases with time, Fifty percent of the force was lost after 3.9 hours for the medium elastics and after 4.9 hours for the heavy elastics. A constant significant force reduction in all elastics at every time intervals (P\0.05, P\0.001). There was greater force loss in the heavy elastics compared with the medium elastics at all time intervals (P\0.001); the rates of force loss, however, were similar. Throughout the first hour, the extension rate of all elastics reduce greatly about 13.16%-18.79%, then the rate of force degradation reduces sharply. The degradation of initial force was about 29.35%-39.94% after 48 hours. The 2.0-oz elastics' extension range shrank less than the 3.5-oz elastics'. Elastics with larger inner diameters dropped more slowly than smaller elastics at the same period and with the same beginning force (P /0.05).

**Conclusion**: In the first hour, the force value of the orthodontic latex elastics significantly dropped. The force decayed more slowly with increasing inner diameter and decreasing setting force value. In the first 4 to 5 hours, 50% of force depreciation took place. Orthodontic elastics should be adjusted everyday to prevent breakage and to maintain oral cleanliness.

**KEY WORDS: Force degradation, elastics, force decay ,force loss, heavy elastics and medium elastics**

## INTRODUCTION

Elastics are an essential part of orthodontic treatment which is supported with patients cooperation.

They are worn for rectification of anteroposterior and vertical discrepancies, there are many types of elastics placement in relation with treatment condition. Elastics can be classified in different types :

As stated the material, their availability, their uses, and force. Elastomer is a common term that surrounds materials that, after substantial deformation, rapidly return back to their original proportion. The earliest known elastomeric material was natural rubber, which the ancient Incan and Mayan civilizations used. The term "synthetic rubber" refers to rubber-like substances created using chemicals with the intention of replacing natural rubber. Orthodontic therapy frequently includes the active use of elastics and elastomeric materials. For many years, elastics have been a useful addition to all orthodontic treatments. Their use, combined with good patient cooperation provides the clinician with the ability to correct both anteroposterior and vertical discrepancies.Both natural rubber and synthetic elastomers are widely used in orthodontic therapy. The Begg technique uses naturally occurring latex elastics to create intramaxillary stresses and intermaxillary traction. Edgewise mechanics, which moves the teeth along the arch wire, is where synthetic elastomeric materials in the form of chains are most often used. Chain

elastomers replace metal as the ligating force holding the arch wire to the teeth because the chain links fit snugly under the wings of an edgewise bracket. The chains typically stay in place until the orthodontist replaces them at the patient's next appointment because they are so positively situated on the brackets. This routine differs from that usually followed for latex elastics, which are changed by the patient every 1 or 2 days.1,2The use of latex elastics in clinical practice is predicted on force extension values given by the makers for different sizes of elastics. Elastics will apply the force specified on the package at three times the original lumen size, according to the standard force index used by suppliers. To get the most out of these polymers, from the perspective of a doctor, it would be essential to understand not just the clinical side of these elastics but also their fundamental properties of polymer. 2,3

The fact that the force levels drop over time is one of the fundamental drawbacks of elastic materials.This property is termed "force decay."[4] Elastics are said to exert the reported force at an extension of

300% of their diameter, but the validity of this claim has been seriously questioned, and the force levels may vary with the size and force level of the elastic.5,6

## MATERIAL AND METHODS

For this study four different brands of elastics are chosen and 10 different size 1/8-inch (2 oz); 1/8-inch (3.5 oz); 3/16-inch (2 oz); 3/16-inch (3.5 oz); 1/4-inch (2 oz); 1/4-inch (3.5 oz); 5/16-inch (2 oz); 5/16-inch (3.5 oz); 3/8-inch (2 oz); and 3/8-inch (3.5 oz).of elastics are chosen randomly for comparison of heavy and medium elastics at different interval of time with force application of 60 gm and the force loss calculated at specific time interval and force degredation value of four brands of elastics . 50 volunteers (aged 17-24 years) were selected for this study who were undergoing orthodontic treatment in there final settling stage. T -Test

were used to identify statistical significance (P \0.05).

The patients wore fixed mechanotherapy with mbt appliance (0.022-in slot). The patients used Class II elastics on 0.019 X 0.025 stainless steel wires as part of their treatment.

The following measurements were made.

1. Distance from the maxillary canine to the mandibular molar on the same side in centric occlusion (DCO). The measurement was performed from the cusp tip of the maxillary canine to the tip of the mesiobuccal cusp of the mandibular first molar.
2. Maximum mouth opening measured from the incisal edge of the maxillary central incisors to the incisal edge of the mandibular central incisors (MMO).
3. The distance from the cusp tip of the maxillary canine to the mesiobuccal cusp of the mandibular first molar on the same side in maximum mouth opening (MMOLat).
4. The rubber bands' breakage rates over time and their color changes.

A millimetric stainless steel ruler was used to measure these distances to the nearest 0.5 mm.

A set of tubes contained the premeasured medium elastics. Each tube was marked with the patient's name, type of elastic, and one of the following time intervals: 0, 1, 3, 6, 12, 18, 24, or 48

hours. All participants also received a set of seven tubes with thick elastics that were comparable. The elastics were to be worn by the participants at the designated intervals indicated on the tubes, as advised. They were told to place the elastic back in its tube at the conclusion of each interval. The tubes were gathered in no more than two or three hours.

The force delivered by the elastics was then remeasured 3, and the mean of the readings was recorded. Before each elastic was worn by the patients, the force delivered by the elastic was measured using a force gauge. The three readings' average force was recorded. Each elastic was stretched using a force gauge attached to a 1.5 mm thick pin that was mounted to a specially designed acrylic base, with a ruler on the side to measure the stretching distance. To enable precise stretching of the elastics, a groove was constructed along the ruler. Each patient's elastics were stretched to the same length as the intraoral measurement from the canine to the first molar tip in centric occlusion for each participant.

Force extension was measured in a Tensil Strenght testing machine (load sensor 500G/5N, accuracy of 0.01 mm; PACORR MODEL PCTTM-1). For each elastic, tensile readings in grammes of force were taken over the course of 10 seconds. In order to enter the elastics for their expansion, two hooks were attached to the device, one at the upper connection point and the other at the bottom. The setting force's duration (60 g of force)

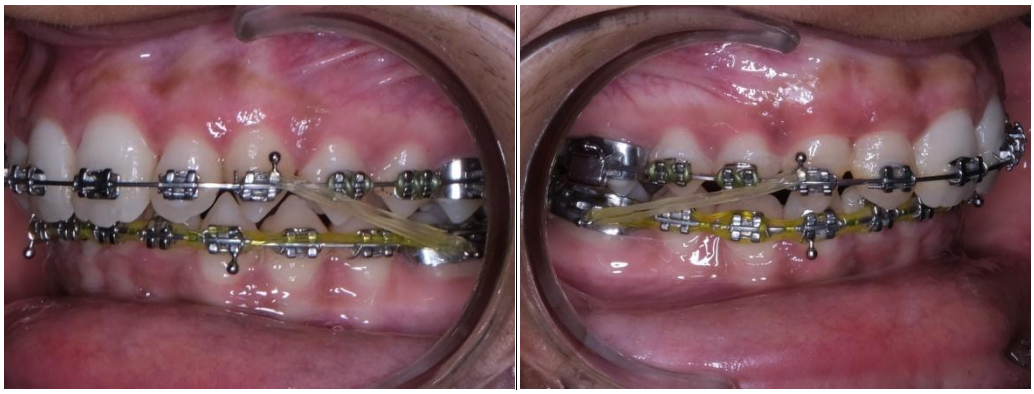
## Statistical analysis

The Statistical Package for Social Science programme was used to analyse the data (version 17.0; SPSS).

We employed descriptive statistics (means, standard deviations, and percentages of force loss). The effects of duration, extension distance, and elastic type were examined using a general linear model with repeated-measures analysis. Each group's average force degradation was calculated, and the data were analysed using a 1-way ANOVA of variance and the t test (P 0.05). Force losses for medium and heavy elastics across various time periods and over all intraorally measured distances. Additionally, a linear regression analysis was done to see how the recorded distances affected the deterioration of force.

# RESULTS

The force value revealed a declining tendency over time in the curve extension of the orthodontic latex fixed in various conditions.The average degradations of the 1/4-inch (2 oz and 3.5 oz) elastic force after 48 hours (33.83% and 36.94%) . Continuously significant decreases in elastic force were observed for latex elastics at all time intervals (P 0.05), with the exception of the period between 0 and 1 hours for 1/4-inch (2 oz and 3.5 oz) elastics. After an hour, the elastic force's deterioration rate was 13.16–18.79%. The deterioration of force value then gradually diminished. After 48 hours, the latex elastics' rate of force degradation ranged from 29.35% to 39.94%. At the same time, it was discovered that elastics with smaller diameters (3/8-inch5/16-inch1/4-inch3/16-inch1/8-inch) degraded more quickly than latex with larger diameters under the same force value parameters (60 g of force).



Comparisons were made between elastic force degradation at the same diameter and various beginning force values. Elastic degradation rates for 3.5-oz groups with 1/8-inch, 3/16-inch, 1/4-inch, 5/16-inch, and 3/8-inch diameters were 32.89%–39.94% at the same time span, which was higher than degradation rates for 2-oz groups (29.35%–34.97%) (see Table 1).

**TABLE 1 -COMPARISON OF FORCE DEGREDATION IN PERCENTAGE % OF DIFFERENT BRANDS AT SPECIFIC TIME INTERVALS**

| TIME INTERVAL (HRS) | BRAND NAMES | | | | | SIZE (OZ) |
|---|---|---|---|---|---|---|
| | MEAN VALUE | orthomatrix | koden | Orthocare | JJ | |
| **0** | 0+/-0 | 58.92+/- 3.4 | 57.99+/- 2.58 | 60.62+/- 3.26 | 61.34+/- 1.80 | 1/8’’2 |
| **1** | 14.18+/-15.62 | 47.75+/-1.46 | 48.72+/-2.19 | 50.48+/-1.77 | 51.48+/-1.46 | 3/16’’2 |
| **3** | 18.88+/-22.90 | 45.33+/-1.47 | 46.13+/-1.97 | 48.50+/-1.82 | 49.79+/-1.47 | 1/4’’ 2 |
| **6** | 20.94+/-25.71 | 43.68+/-1.23 | 43.97+/-2.18 | 46.88+/-1.64 | 47.81+/-1.23 | 5/16 ‘’2 |
| **9** | 24.19+/-28.05 | 42.28+/-1.05 | 42.70+/-2.20 | 45.48+/-1.45 | 46.62+/-1.05 | 3/8’’ 2 |
| **12** | 24.72+/-29.74 | 41.29+/-1.10 | 41.90+/-2.35 | 45.83+/-1.83 | 45.83+/-1.10 | 1/8’’ 3.5 |
| **18** | 26.80+/-31.28 | 40.39+/-1.47 | 40.92+/-2.23 | 41.98+/-1.74 | 44.92+/-1.47 | 3/16’’ 3.5 |
| **24** | 27.78+/-32.65 | 39.59+/-1.56 | 40.06+/-0.97 | 41.83+/-1.83 | 44.33+/-1.56 | 1/4’’ 3.5 |
| **36** | 29.08+/-33.79 | 39.92+/-1.58 | 64.42+/-2.00 | 41.07+/-1.60 | 43.52+/-1.58 | 5/16’’ 3.5 |
| **48** | 29.35+/-34.97 | 38.22+/-1.51 | 38.07+/-1.89 | 40.06+/-1.50 | 42.41+/-1.51 | 3/8’’3.5 |

Table I displays the means and standard deviations of the force loss resulting from the medium and heavy elastics at the measured time intervals. The numbers demonstrate how both medium and heavy elastics gradually lose force over time.

During the first several hours, there was a quick reduction of force, followed by a more gradual decline. After 3.9 hours for the medium elastics and 4.9 hours for the heavy elastics, 50% of the forces were lost. For the medium and heavy elastics, substantial reductions in elastic force were seen continuously at all time intervals (P 0.05, P 0.001), with the exception of the interval between the 6 and medium elastics should be stored between 1 and 3 hours apart, while heavy elastics should be stored every 12 hours. At all time periods, the heavy elastics had more force loss than the medium elastics (P 0.001) However, in the medium and heavy elastics, the percentages of force loss from the initial values at each time period were comparable.

Means and standard deviations for DCO were 24.1 and 6.2 mm, MMO were 47.4 and 6.1 mm, and for MMOLat, 46.5 6 6.7 mm, and. The force decay was somewhat influenced by DCO, which stands for the stretching distance of elastics, but not significantly (P 5 0.06).

However, the general linear model indicated that the maximal mouth opening anteriorly had a significant influence (P0.05). Changes in force were unaffected by MMOL at.

The levels of force loss at the various time points and DCO had a good correlation

**TABLE 2 -COMPARISON OF HEAVY ELASTICS AND MEDIUM ELASTICS AT SPECIFIC TIME INTERVALS**

| | **HEAVY ELASTICS** | | | MEDIUM ELASTICS | | |
|---|---|---|---|---|---|---|
| **TIME INTERVAL(HRS)** | MEAN VALUE | FORCE APPLIED(G) | FORCE LOSS | MEAN VALUE | FORCE APPLIED | FORCE LOSS |
| **0** | 36.45+/-23 | 60 | 11.9 | 21.7+/-2.3 | 60 | 11.9 |
| **1** | 38.2+/-14.0 | 60 | 12.0 | 26.3+/-8.6 | 60 | 13.4 |
| **3** | 42.0+/-12.6 | 60 | 13.8 | 31.7+/-9.5 | 60 | 15.7 |
| **6** | 52.3+/-12.3 | 60 | 16.9 | 37.8+/-10.9 | 60 | 18.5 |
| **9** | 56.7+/-1.45 | 60 | 18.8 | 39.8+/-11.0 | 60 | 19.1 |
| **12** | 59.5+/-13.9 | 60 | 19.2 | 46.4+/-10.8 | 60 | 19.9 |
| **18** | 65.8+/-16.6 | 60 | 21.1 | 59.4+/-17.3 | 60 | 22.2 |
| **24** | 85.7+/-21.1 | 60 | 26.8 | 66.0+/-17.9 | 60 | 28.2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **36** | 89.92+/-4.67 | 60 | 28.9 | 66.9+/-20.07 | 60 | 29.7 |
| **48** | 98.7+/-25.6 | 60 | 30.2 | 69.89+/-1.2 | 60 | 30.9 |

## DISCUSSION

At the following intervals: 1, 3, 6, 12, 18, 24, and 48 hours, all elastic samples underwent testing. In a number of experiments, the first three periods reflected the time of a significant initial force decline. While other investigations discovered force depreciation in the first hour, some studies observed steep gradients in force degradation in the first 3 to 5 hours. [7,9,11,14]

For the remainder of the day, the following three time intervals revealed slower but ongoing force decrease.

Several studies used the 24-hour interval as the last time point for their measurements.[7,13] The 48-hour interval represented the longest period that the rubber bands can survive intraorally, and it was used by other studies.[7,8]

The measured distances in the patient's mouth—DCO, MMO, and MMOL at—represented the amounts of stretch of the elastics. DCO is considered as the most reproducible distance to measure.[17,18]

A rapid initial reduction in force was seen in the first few hours of the force degradation pattern, which was followed by a slower decay over the following 48 hours.A similar pattern was reported in other studies but in an ex-vivo setup.[11,14,15] The medium elastics lost 50% of their force about an hour earlier than the heavy elastics.This result was similar to that reported by Gioka et al[11]; most of the elastic relaxation occurred within the first 3 to 5 hours after extension.

Except for between 6 and 12 hours in the case of medium elastics and between 3 and 6 hours in the case of heavy elastics, significant force losses were seen at all time points.This might be because during these time periods the participants had less dynamic oral activities after their lunch.[19]

Fernandes et al[12] reported similar findings. Fifty percent of the force was lost in the medium elastics earlier than the heavy elastics by almost an hour . Russell et al [10] reported faster rates of force loss for heavy elastics in the first few hours compared with medium elastics in some brands, although equal rates of force loss were reported for other brands. In addition, they noted that when compared to their light and heavy counterparts, medium elastics were more homogeneous and displayed less variation within the sample . Therefore, medium elastics were recommended as the clinician's first choice.[14]

In this investigation, heavier elastics showed greater force loss than medium elastics. Contrarily, earlier research on latex elastics suggests that thinner elastics distribute forces more consistently whereas thicker elastics sustain higher forces over time but might be more susceptible to creep and show more force loss over time.[16,20] The percentage of force loss, however, seemed more comparable in both medium and heavy force elastics.

Wong[21] and Taloumis et al[22] reported that the greater the initial force of the rubber band, the greater the amount of force decay, whereas other authors reported that the initial force had no relationship to the amount of force decay.[23,24] Hwang and Cha[25] reported a relationship between the initial force and the amount of force decay but in silicone rubber bands.

Less than 30% of the original elastic force was lost after 24 hours. After that, the further force reduction was relatively lesser. Liu et al[26] confirmed that the force value was remarkably stable after 1 day because the structural changes caused by repeated stretching were not cumulative.

Some studies have recommended that elastics do not need to be replaced so frequently because, after
most of the force decay in the first day, the force could remain relatively constant for a few days.[7,8,27]

However, it is advised to change the elastics every day for oral hygiene reasons and because there is higher elastic breakdown after 24 hours. Clinically, it must be decided whether to begin with more force than is believed required or to reduce it after a little while in the mouth.[19]One study suggested changing the rubber bands twice daily to keep a relatively high level of force.[11]
Other authors suggested that elastic bands with higher force than needed should be used, and they should be prestretched before use to prevent the higher forces in the first few hours.7
Rubber bands had some aesthetic alterations, going from a straw-hued yellow to an off-white tone. They also had a swollen appearance. Similar changes have been observed in other studies.[14]
Maximum mouth opening anteriorly had a significant effect on force decay but not on the lateral distance. There are no reported literature on the effect of maximum mouth opening on the force degradation of elastics either anteriorly or laterally. There was a significantly higher correlation between DCO and force decay. Other studies reported that more elongation of the elastics potentiated an increased force degradation.[11,28]
The effect of maximal mouth opening or the lateral distance at centric occlusion may be affected by a number of variables, including food intake, changes in temperature, and perioral muscular activity. It is impossible to study the effect of each variable alone in the oral environment.[11]
It is essential for manufacturers to accurately document and report the qualities of force degradation of their products, in addition to practitioners having a solid understanding of elastic properties because of the differences in properties of the various brands of elastics.[27]

## CONCLUSIONS

1. Fifty percent of force degradation occurred in the first 4 to 5 hours, followed by continuous and gradual force degradation for the remaining time intervals.
2. Because of breakage and for oral hygiene purposes, orthodontic elastics should be changed every 24 hours. Otherwise, elastics can be used for 48 hours.
3. Force decay of the elastics was correlated with lateral distance between the maxillary canine and the mandibular first molar at centric occlusion.
4. The amount of anterior mouth opening had a significant effect on force degradation of the elastics.

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