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IARA REGINA SERRA CAMPOS

COMPARAÇÃO *IN VITRO* DA DEGRADAÇÃO DAS FORÇAS DOS ELÁSTICOS ORTODÔNTICOS DE LÁTEX EM TEMPO REAL

São Luís - MA

2015

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Dissertação apresentada ao Programa de Mestrado Acadêmico em Odontologia Área de Concentração Odontologia Integrada, da Universidade CEUMA, para obtenção do título de Mestre em Odontologia.

Orientador: Prof. Dr. Fausto Silva Bramante

Co-orientador: Prof. Dr. Rudys Rodolfo De Jesus Tavarez

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Campos, Iara Regina Serra Campos

Comparação da Degradação das Forças dos Elásticos Ortodônticos de

Látex em Tempo Real.

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Iara Regina Serra Campos

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A Comissão Julgadora de Defesa do Trabalho Final de Mestrado em Odontologia, em sessão pública realizada no dia / / , considerou a candidata:

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1) Examinador _____
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DADOS CURRICULARES

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A **Deus,** ao meu amado esposo, Frank Leonardo, aos meus filhos Frank Júnior e Rebeca Adler, aos meus pais e irmãos, a todos os meus amigos em especial, Larissa Freitas e ao meu orientador Fausto Silva Bramante e co-orientador Rudys Tavarez.

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“Que os vossos esforços desafiem as impossibilidades, lembrai-vos de que as grandes coisas do homem foram conquistadas do que parecia impossível”.

SUMÁRIO

CAMPOS, IARA REGINA SERRA. COMPARAÇÃO IN VITRO DA DEGRADAÇÃO DAS FORÇAS DOS ELÁSTICOS ORTODÔNTICOS DE LÁTEX EM TEMPO REAL. 45 F. DISSERTAÇÃO (MESTRADO) – UNIVERSIDADE CEUMA - UNICEUMA. SÃO LUÍS. 2015

RESUMO

O objetivo deste trabalho foi avaliar *in vitro*, a degradação de magnitude das forças em tempo real de elásticos ortodônticos de látex. Foram testados elásticos de látex ¼ de polegada de força média de quatro marcas: Tecnident (TC), Morelli (MO), Orthometric (OR) e TP *Orthodontics (TP)*, sendo 10 elásticos de cada marca. Foi utilizado um dinamômetro digital para medir as forças dos elásticos nos tempos 0, 8, 16, 24, 32, 40 e 48 horas. Avaliou o efeito do tempo na degradação dos elásticos intragrupo e as médias das forças entre os tipos de elásticos intergrupos. Avaliou-se também a força média ao início e ao final em relação ao padrão médio de 113 g. Os resultados demonstraram que, todos os elásticos estudados tiveram perdas acentuadas estatisticamente significantes na magnitude de força em todos os tempos avaliados, ou seja, desde 8 até 48 horas. Também, verificou-se diferenças estatisticamente significantes entre as marcas comerciais nos tempos aferidos, sendo que apenas OR e TP tiveram valores semelhantes. Todos os grupos iniciaram com valores acima da média, sendo que o TC e o MO finalizaram as 48 horas acima dessa força média e os grupos OR e TP abaixo. Os grupos OR e TP foram os que mais perderam suas magnitudes de forças. Os resultados dessa pesquisa mostraram que após o intervalo nas primeiras 8h a marca Tecnident foi a que menos perdeu força, com apenas 3,65% de degradação, Morelli e Orthometric tiveram perdas iguais com valor de 6,5% e a marca TP Orhodontics foi a que mais se degradou com 13,9% de perda da sua força inicial.

Descritores: Látex, Elastômeros, Ortodontia.

CAMPOS, IARA REGINA SERRA. COMPARAÇÃO IN VITRO DA DEGRADAÇÃO DAS FORÇAS DOS ELÁSTICOS ORTODÔNTICOS DE LÁTEX EM TEMPO REAL. 45 F. DISSERTAÇÃO (MESTRADO) – UNIVERSIDADE CEUMA - UNICEUMA. SÃO LUIS. 2015.

REAL TIME *IN VITRO* COMPARISONS OF LATEX ORTHODONTICS ELASTICS STRENGTH DEGRADATION

ABSTRACT

The objective of this paper was to evaluate in vitro the magnitude degradation of strengths in latex orthodontic elastics. It was tested four brands of ¼ inch latex elastics of average strength of: Tecnident (CT), Morelli (MO) Orthometric (OR) and TP Orthodontics (TP), being 10 elastics of each brand. A digital dynamometer was used to measure the elastic strengths in the following periods: 0, 8, 16, 24, 32, 40 and 48 hours. It was evaluated the effect of time on the degradation of intragroup elastics and the average of strengths between the types of intergroup elastics. The average strength at the beginning and at the end in relation to the average standard of 113g was also evaluated. The results showed that all elastics studied had statistically significant losses in strength magnitude in all periods assessed, from 8 to 48 hours. Also, it was observed statistically significant differences between the brands in the measured time, and only OR and TP had similar values. All groups started with above average values, and the TC and the MO finalized 48 hours above this average strength and the OR and TP group below the average. The OR and TP were the groups that lost their strength magnitudes the most. The results of this research showed that after the break in the first 8 hours, the Tecnident brand was the least weakened, with only 3.65% degradation, Morelli and Orthometric had equal losses in the amount of 6.5% and TP Orhodontics brand was the most deteriorated with 13.9% of loss from its initial strength.

Key words: Latex, Elastomers, Orthodontics.

LISTA DE ABREVIATURAS E SIGLAS

T 0 - Início da aferição

T 1 - 1º Momento depois de 8h de teste

T 2 - 2º Momento da aferição 16h de teste

T 3 - 3 º Momento da aferição 24h de teste

T 4 - 4º Momento da aferição 32h de teste

T 5 - 5º Momento da aferição 40h de teste

T 6 - 6º Momento da aferição 48h de teste

Abreviatura das marcas de elásticos estudadas:

TC - Tecnident

MO - Morelli

OR - Orthometric

TP - Tp Orthodontics

1 INTRODUÇÃO FUNDAMENTADA

É na cavidade bucal que se concentra grande parte da comunicação facial e o sorriso é o protagonista na aparência e na expressão. A procura para harmonizar a aparência dos dentes é o que impulsiona os indivíduos a buscar tratamento ortodôntico em prol de um sorriso agradável[1.]

E a Ortodontia utiliza-se de vários recursos, dentre eles, o uso de aparelhos fixos associados a elásticos intrabucais. Que são utilizados para diversos tipos de tratamento, como por exemplo: correção de linha média, correção da relação ântero-posterior, intercuspidação, dentre outros.[2]

Os elásticos são dispositivos auxiliares da mecânica ortodôntica e minimizam o tempo de tratamento ortodôntico e assim possibilitam ao profissional maior controle de sua mecanoterapia, dentro dos objetivos propostos pelos aparelhos utilizados.[3]

Boa parte dos elásticos ortodônticos encontrados no mercado tem como principal componente o látex. Contudo, com o aperfeiçoamento da indústria e também com a hipersensibilidade de alguns pacientes a produtos a base do látex, optou-se pela produção dos elásticos sintéticos que, assim como os de látex, possuem desempenho que variam de fabricante para fabricante.[4]

As principais vantagens apresentadas pelos elásticos a base de látex incluem o fácil manuseio, o baixo custo, a boa tolerância por parte dos pacientes, fácil higienização e a grande flexibilidade no estabelecimento da mecânica permitindo combinações quanto aos pontos de aplicações de forças, além de possibilitar ancoragem de acordo com as necessidades das fases do tratamento ortodôntico.[5]

Os elásticos ortodônticos de látex são produzidos a partir do poliuretano e apresentam características tanto de borracha como de plástico. A elasticidade é sua principal característica, além de ser determinante para sua efetividade no tratamento ortodôntico. Depois de sofrer uma deformação, a elasticidade é a propriedade que permite ao material recuperar suas dimensões originais, o que justifica a larga escala de utilização e industrialização. No entanto, pode ser contraindicado em caso de alergia apresentada pelo paciente.[6]

Apesar dessa larga utilização e das vantagens mencionadas, os elásticos possuem algumas desvantagens. O látex sofre uma fadiga ao receber forças além

do seu limite, provocando uma decadência de sua resistência, o que é denominado como degradação da força, o que pode ser um fator limitante no tratamento ortodôntico.

A deformação dos elásticos pode ser definida de duas formas: elástica e plástica. A elástica, ocorre quando a forças aplicadas ao material tem sua forma alterada, contudo, quando a força deixa de ser exercida ele retorna à sua forma original, e plástica quando a força empregada é maior que seu limite e quando essa força é cessada o material não retorna a sua forma original.[7]

É evidente que o profissional deve considerar que existem diferenças entre as mudanças de ambientes e da degradação do material estudado, e que elas são divergentes ao se comparar as pesquisas clínicas e *in vitro.* Dessa forma, existem variáveis inseridas no uso dos elásticos e dúvidas que permeiam essa prática, como se os elásticos exercem a força esperada quando submetidos a diferentes fatores, e se atendem a expectativa do tratamento.[8]

Transpondo assim, esses conhecimentos para os elásticos ortodônticos, surge o desafio de estudarmos o comportamento desses, já que, buscamos materiais que tenham perda controlada ou insignificante da magnitude de suas forças durante o tempo do tratamento ortodôntico.

Assim, esse estudo teve como finalidade, analisar os níveis de forças exercidas pelos elásticos de látex em período pré-determinado e verificar se as forças estão de acordo com a proposta ortodôntica, assim como observar a degradação ocorrida com estes durante 48 horas de uso.

Dessa forma, teremos um conhecimento pautado pela ciência, que poderá ser mais preciso quanto a utilização dos elásticos com suas características mais detalhadas, tornando a mecanoterapia ortodôntica mais eficiente e segura.

2 PROPOSIÇÃO

Avaliar *in vitro*, a degradação das forças dos elásticos ortodônticos de látex em tempo real e comparar as diferenças da perda da magnitude de forças entre os diferentes grupos estudados.

3 CAPÍTULO 1

COMPARAÇÃO *IN VITRO* DA DEGRADAÇÃO DAS FORÇAS DOS ELÁSTICOS ORTODÔNTICOS DE LÁTEX EM TEMPO REAL

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ABSTRACT

REAL TIME *IN VITRO* COMPARISONS OF LATEX ORTHODONTICS ELASTICS STRENGTH DEGRADATION

ABSTRACT

The objective of this paper was to evaluate in vitro the magnitude degradation of strengths in latex orthodontic elastics. It was tested four brands of ¼ inch latex elastics of average strength of: Tecnident (CT), Morelli (MO) Orthometric (OR) and TP Orthodontics (TP), being 10 elastics of each brand. A digital dynamometer was used to measure the elastic strengths in the following periods: 0, 8, 16, 24, 32, 40 and 48 hours. It was evaluated the effect of time on the degradation of intragroup elastics and the average of strengths between the types of intergroup elastics. The average strength at the beginning and at the end in relation to the average standard of 113g was also evaluated. The results showed that all elastics studied had statistically significant losses in strength magnitude in all periods assessed, from 8 to 48 hours. Also, it was observed statistically significant differences between the brands in the measured time, and only OR and TP had similar values. All groups started with above average values, and the TC and the MO finalized 48 hours above this average strength and the OR and TP group below the average. The OR and TP were the groups that lost their strength magnitudes the most. The results of this research showed that after the break in the first 8 hours, the Tecnident brand was the least weakened, with only 3.65% degradation, Morelli and Orthometric had equal losses in the amount of 6.5% and TP Orhodontics brand was the most deteriorated with 13.9% of loss from its initial strength.

Key words: Latex, Elastomers, Orthodontics.

INTRODUCTION

It is in the mouth cavity that most of facial communication is present and the smile is the protagonist in appearance and expression. The demand to harmonize the appearance of teeth is what drives individuals to seek orthodontic treatment in favor of a pleasant smile[1].

And orthodontics makes use of several resources, including, the utilization of fixed appliances associated with intraoral elastics, which are used for different types of treatment, such as: midline correction, correction of anteroposterior relation, intercuspation, among others.[2]

These devices are auxiliary in orthodontic mechanics and minimize the orthodontic treatment time and thus allow the professional more control of his mechanotherapy, within the objectives proposed by the devices utilized.[3]

A good portion of the orthodontic elastics found in the market has latex as its main component. However, with the industry's improvement and also with hypersensitivity of some patients to latex-based products, it was decided to produce synthetic elastics, which just as the latex ones, the performance varies from manufacturer to manufacturer.[4]

The advantages presented by the latex-based elastic include easy handling, low cost, well tolerated by patients, easy cleaning and great flexibility in the mechanical settings allowing combinations as to the points of strength application.[5]

The latex orthodontic elastics are produced from a polyurethane material with characteristics of both rubber and plastic. Elasticity is its main feature, besides being crucial to effectiveness in orthodontic treatment. After suffering a deformation, the elasticity is the property that allows the material to recover its original dimensions, which explains the wide range of use and industrialization.[6]

Despite this widespread use and advantages mentioned, the elastics possess some disadvantages: latex undergoes a fatigue when receiving forces beyond its limit, causing a decline in their resistance, which is termed as the strength degradation, which can be a limiting factor in orthodontic treatment. Furthermore, the combination with the moist environment of the mouth cavity results in the maximized loss of these strengths.[7]

Clearly, the professional should consider that there are differences in the effect, and that the degradation of existing materials appears differently when evaluating the clinical and in vitro researches. Thus there are many variables inserted in the use of elastics and many questions that permeate this practice, like if the elastic exert the expected strength when subjected to different factors, if they meet the expectation of the treatment.[8]

This study aimed to evaluate in vitro and real time degradation of the strengths produced by the latex type orthodontic elastics and to compare if there are differences

between the commercial brands.

MATERIALS AND METHODS

The sample calculation was performed using the statistics software SAS® version 9.1.3 (SAS Institute Inc., Cary, USA). The following parameters were used: the power of the test 0.8 for variance analysis for repeated measures to detect an effect size of 0.2, with a significance level of 0.5, using 4 groups of 7 repetitions with N = 10, and the standard strength value of the elastics of 113 grams considering catalogs of each brand analyzed and according to Aljhani & Aldrees[9].

It was tested 40 ¼ inches latex elastics, medium strength, from 4 brands, namely: Tecnident (CT) (*São Carlos SP* Brazil Lot No. 118241), Morelli (MO) (*Sorocaba SP* Brazil Lot No. 1837970.), Orthometric (OR) (Supplier: G & H WireCompany, Production:. 2165 Earlywood Dr Franklin, Indiana - USA, Lot No. 281647), TP Orthodontics (TP) (La Porte, Indiana USA Lot nº25513006) and stored under controlled cooling at 16ºC.

For each elastics brand were used four groups (N = 10) and in this period each elastic was observed for 48 hours.

The elastic were positioned on the device when it was already at a 2 cm (centimeters) distance. This measure corresponds to a three times distension of its inner diameter to avoid fatigue and stress of the material. After the insertion it was necessary to wait 10 seconds to only then register the first measurement in T-0 (initial strength), afterwards it was registered in periods of 8, 16, 24, 32, 40 and 48 hours. All measurements and exchanges of elastic were performed by a single trained and calibrated operator.

It was used a DD500 model dynamometer (Instrutherm – *Instrumentos de Medição Ltda, São Paulo,* Brazil) with metal bracket adapted for measuring the strength degradation (Figure 1). The record of the degradation was carried out in real time using infrared camera (INTELBRAS, *São José*) model: EHM, reference 7896637641456, *São José S/C, Brasil* DVR INTELBRAS, RV 316 model, reference 7896637648141, *São José S/C*. Brazil, and internal hard drive (2 OTB), WDAV-GP model, reference WCC4MNSAEZP8 (Canada) for storage of images which have been viewed and stored in the computer (Figure 2), where the operator has manipulated the elastics only in the moment of the insertion of devices, which significantly contributes to the veracity of the results found here.

The study included 80 days of shooting, totaling 1920 recording hours, allowing a real-time in vitro analysis of degradation of the strengths exerted by latex orthodontic elastics. Data were tabulated and defined in KgF (Kilogram-force).

Statistical analysis

Mean values and standard deviations of the elastics strength were calculated in each evaluation time, as well as the percentage averages of loss for the initial strength during the timeframes evaluated.

The following hypotheses were tested: (1) If there was significant difference of the averages of intragroup and intergroup strengths between the elastics TC, MO, OR and TP in the evaluated times (0h, 8h, 16h, 24h, 32h, 40h and 48h); (2) If there was significant difference between the average values of the elastics strength in each time of evaluation, and regarding the value of standard strength of 113 grams.

To answer the first hypothesis it was employed the ANOVA tests for repeated measurements for two factors with mixed design (intergroup and intragroup), complemented by the Anova One Way test and post hoc of Tukey. The second hypothesis was tested using the T test of Student for one sample.

The significance level adopted was 5% and the statistics software used was SPSS 21.0 (IBM, Armonk, NY, USA).

RESULTS

Table 1 shows the average values and standard deviations of the strength measurements for each type of elastic after each time of evaluation.

The ANOVA test for repeated measurements on intragroup analysis showed that there were statistically significant differences in the average of strengths between all periods evaluated ($p < 0.001$). In addition, the interaction Period X Elastic Brand also presented significant difference ($p < 0.001$). It means the strength decreased differently between the elastic at each assessment time (Table 1). The ANOVA One Way showed that while the elastic TC and MO showed significant difference between them and the other elastics, the OR and TP elastics showed no statistically significant difference ($p > 0.05$) in all evaluated times (except for 8 hours, all were different). The comparison in pairs, through the Tukey test, can be seen in Table 1 through letters.

To answer the second hypothesis, the average values of the elastics at each time of evaluation were compared using the T test of Student for one sample, with the average standard value of 113 grams. Both the elastics TC and MO had significantly higher values than the default value in all periods evaluated ($p < 0.05$). The OR and TP elastics presented values above and significantly different from the default value in the initial assessment (period 0h). However, the TP elastic showed no significant difference in the periods of 8, 16 and 24 hours, while the OR elastic did not presented in periods of 16, 24 and 32 hours (Figure 3, values with filled circles).

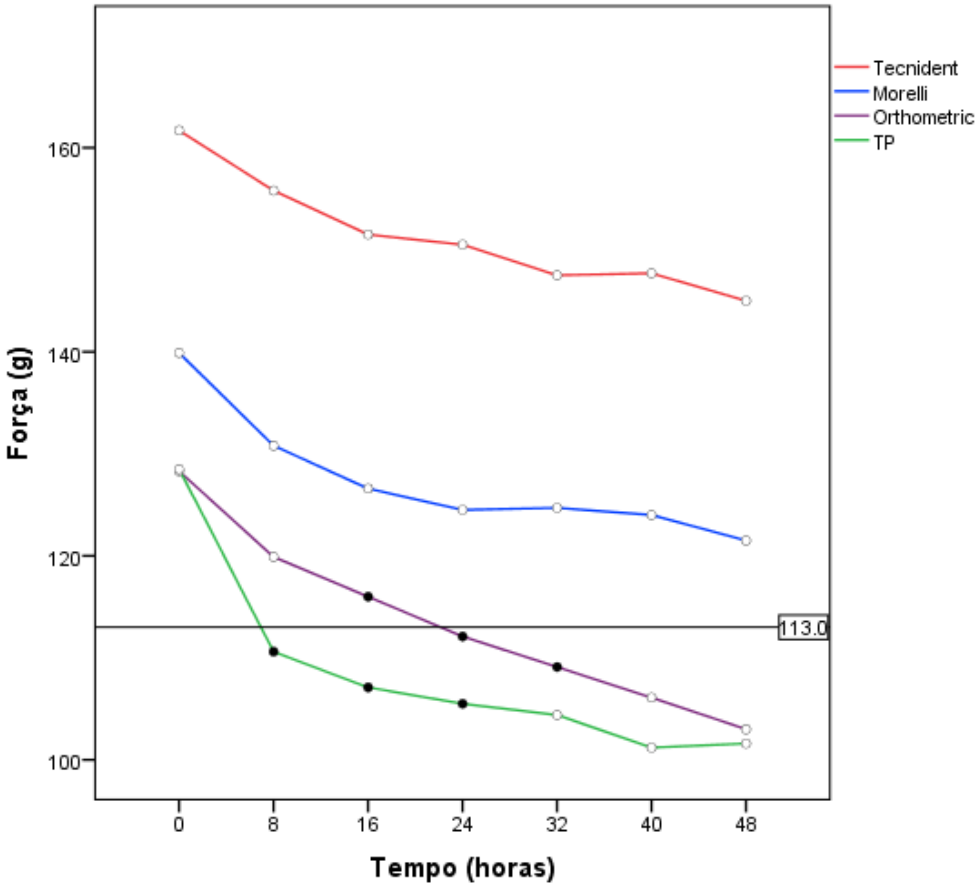
The percentage losses of the elastics strength from the initial values are shown in Figure 4. It is clear that is that TC elastic was the one that had lower loss in all periods of evaluation. The MO and OR elastics had losses of strength magnitude similar, up to 16 hours, while the MO elastic stabilized from this period, the OR elastic continued with a linear loss until 48 hours. The TP elastic was the one that presented the greatest loss in all periods of evaluation, about 15% of the initial value in the first 8 hours (Figure 4).

Table 1 – Comparisons of strengths degradation between the different elastics and periods analyzed.

	TC	MO	OR	TP
0h	161,70[a] (8,48)	139,90[b] (4,40)	128,30[c] (5,57)	128,50[c] (12,64)
8h	155,80[a] (8,17)	130,80[b] (4,80)	119,90[c] (4,86)	110,60[d] (11,16)
16h	151,50[a] (9,72)	126,60[b] (6,81)	116,00 [c] (4,42)	107,10[c] (10,01)
24h	150,50[a] (8,48)	124,50[b] (6,25)	112,10[c] (4,40)	105,50[c] (10,62)
32h	147,50[a] (9,12)	125,90[b] (5,97)	109,10[c] (5,58)	104,40[c] (10,96)
40h	147,70[a] (1,13)	124,00[b] (5,27)	106,10[c] (5,13)	101,20[c] (11,41)
48h	145,00[a] (10,89)	121,50[b] (5,23)	103,00[c] (5,31)	101,60[c] (10,50)

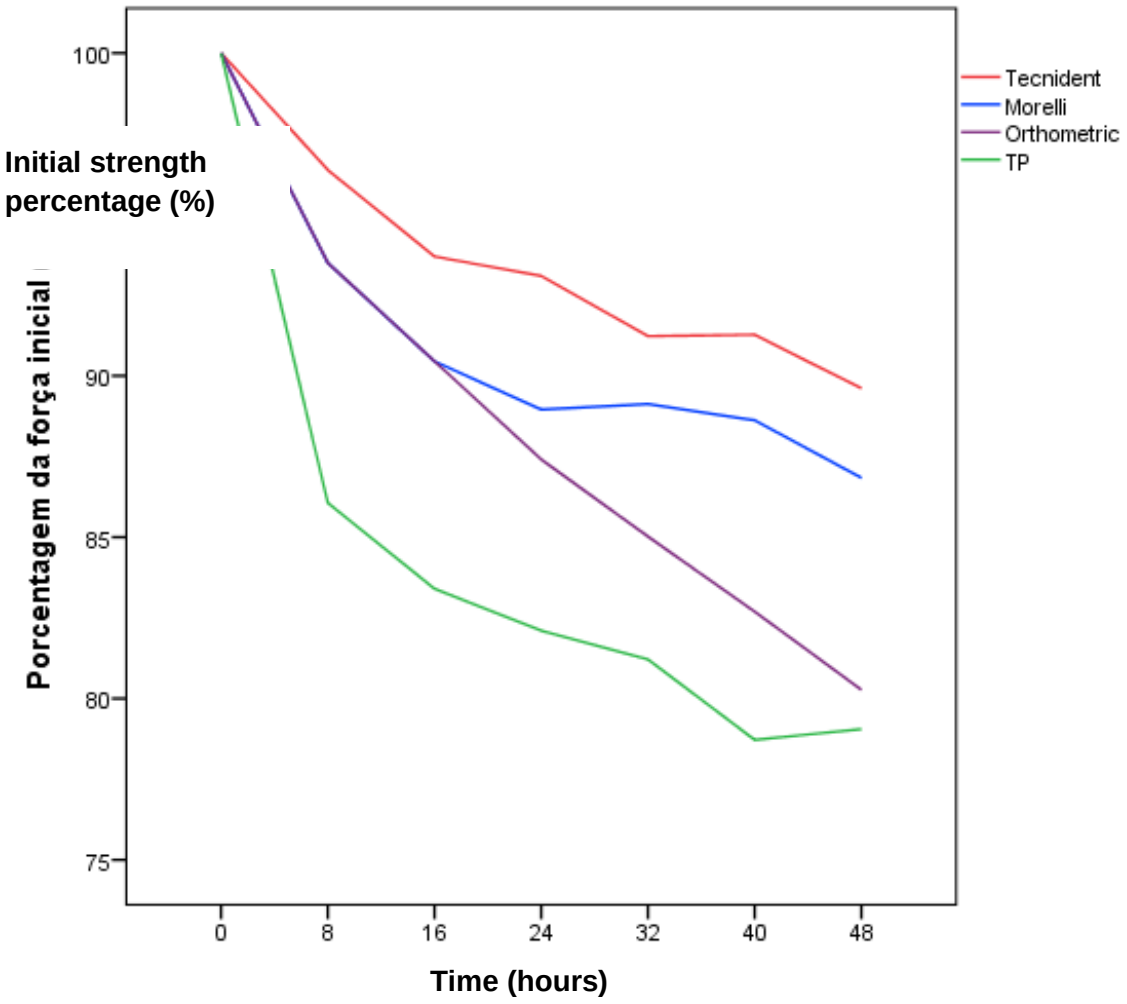
Significant difference between the groups (ANOVA One Way). Different letters in horizontal = significant difference $p<0,05$ (Tukey test).

Figure 3 – Strength reduction between the types of elastics after each period of evaluation. Horizontal line represents the standard value of 113 grams.



Filled Circle = Average values not statistically different from the 113 grams value, p>0,05 (T test of Student for one sample).

Figure 4 – Percentage of loss of initial strength between the types of elastics after each period of evaluation.



DISCUSSION

This study was conducted to aid in the clinical practice of the Orthodontists regarding the period indicated for replacement of ¼ inch latex type orthodontic elastics at the medium setting, regarding the period indicated for, it means, whether they should be changed in 24 or 48 hours. The knowledge of accuracy of the applied strength allows the clinician to be more precise to select elastics that have a particular desired strength to be applied to a tooth or a dental arch.[10]

GIOKA et al (2006) in his research report two weak points in his experiment, which were flaws in collecting data continuously and excessive manipulation of the material, different from this study is experimental in vitro there were no weaknesses, because through recording and archiving of images, it was possible the continuous visualization of strengths degradation of each elastic in different groups without direct intervention by the researcher in the evaluated periods, with no need to handle the elastics, allowing a reliable analysis in results.[11]

When comparing the results of this work with others in the literature, it was observed that the first hour of experiments they were consistent with the findings of Bishara and Andreasen[12], Hershey and Reynolds[13], Ashe Nikolai[14], Young e Sandrik[15], De Genova,*et al*.[16], Grassi *et al*.[17], Russell *et al*.,[18], e Eliades& Bourauel[19], who demonstrate the high loss of characterized strength by the decline curve.

These results coincide with those of KERSEY et al who also found that initial strengths of latex elastics that showed higher values than those specified by the manufacturers. However, it should be noted that even starting with values above the average strength of 113 grams, for ¼ medium setting elastics, these values are in compliance with the proposed in orthodontic mechanotherapy, which would not damage the dental periodontal conditions.[4]

In the work of Fernandes et al., [20], the brands Morelli and TP Orthodontics presented 221g and 165g of initial strength, respectively. The values are much higher than those announced by the manufacturers, which is in accordance to those found in this study.

As well as Morelli and TP Orhodontics, the Tecnident and Orthometric brands also showed higher initial values with 161g and 128g each, but only Orthometric brand presented a value close to that recommended in the literature for average

strength of about 113g, while Tecnident has a closest value to the strength of latex elastics classified as heavy of 170g.[21]

In the intervals of 24 and 48 hours to OR and TP brands differ from those found by Wang et al., [22] where reports that no statistically significant differences were found in these intervals. However, the TP brand demonstrated similarities between them.

The results of this research showed that after the break in first 8h, Tecnident brand was the least weakened, with only 3.65% degradation, Morelli and Orthometric suffered equal losses in the amount of 6.5% and TP Orthodontics was the one which most deteriorated with 13.9% loss of its initial strength.

Bell[23] in a series of tests carried out with elastic samples in vitro constantly stretched for a period of 12 to 24 hours, found that prolonged distension causes 1% or less decrease in strength applied, which goes against the present study that showed values greater than 1 % in all studied brands. However, there are differences in the studied brands (Ortho-Spec, Tru- Elastic, Latex and Unitek) of the elastics and in the methodology employed in the study.

In the study by Fernandes et al., [24] the strength degradation after a 24-hour interval was 19.45% (Morelli) and 20.19% (TP Orthodontics). These results differ from the ones verified in this research that showed loss of 11% (Morelli) and 17.9% (TP Orthodontics) in the same time interval. This difference may be the result of methodological variability, since the study of Fernandes et al., has not been evaluated in real time. Other comparisons become obstructed due to differences in the studies of the brands, compositions, diameters, periods of time and different environments to develop the research.

CONCLUSION

According to the methodology employed and study conditions, we can conclude that:

All the groups (brands) showed statistically significant losses of strength magnitude in all periods evaluated (8, 16, 21, 32, 40 and 48 hours) and there is a significant difference in strengths in all examined brands that can clinically compromise the orthodontic treatment performed.

The loss of the strength magnitude in all groups evaluated was different in the first eight hours of analysis. However, PT and OR brands similarly lost the magnitude of their strength in the subsequent periods (16, 24, 32, 40 and 48 hours), thus it is clinically indicated the exchange of orthodontic elastics OR and TP every 24 after its activation.

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Figure 2. *Image with part of the resources used ; infrared camera , monitor, dynamometer , adapted device , DVR, mouse.*

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4 CONSIDERAÇÕES FINAIS

Considerando todas as marcas analisadas, todas iniciam com valores superiores ao preconizado de 113g.

Com base na estatística empregada, os elásticos OR e TP são os que têm maior proximidade ao valor médio padrão de 113g, e que a indicação de troca poderia ser feita a cada 24 horas. No grupo TC e MO as trocas dos elásticos poderia ser indicada a cada 48 horas, pois, apesar de perdas significativas de suas forças, como iniciam com valores bem acima do padrão, após 48 horas estes ainda liberam forças próximas ao padrão médio de 113g.

Os fabricantes deveriam descrever com maior precisão as forças exercidas por seus produtos, possibilitando assim ao ortodontista uma escolha mais consciente do produto ofertado.

5 CONCLUSÃO

De acordo com a metodologia empregada e condições do estudo, podemos concluir que:

Todos os grupos (marcas) apresentaram perdas significativas em todos os tempos avaliadas (8, 16, 21, 32, 40 e 48 horas).

A perda da magnitude das forças em todos os grupos avaliados foi diferente nas primeiras oito horas de análises, porém, nas marcas OR e TP nas horas subsequentes (16, 24, 32, 40 e 48 horas) perderam de maneira semelhante a magnitude de suas forças.

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ANEXOS

ANEXO 1 - Normas da Revista

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LISTA DE ABREVIATURAS E SIGLAS

T 0 - Início de aferição

T 1 - 1º Momento depois de 8h de teste

T 2 - 2º Momento de aferição 16h de teste

T 3 - 3 º Momento de aferição 24hde teste

T 4 - 4º Momento de aferição 32h de teste

T 5 - 5º Momento de aferição 40h de teste

T 6 - 6º Momento de aferição 48h de teste

Abreviatura das marcas de elásticos estudadas:

TC - Tecnident

MO - Morelli

OR - Orthometric

TP - Tp Orthodontics