

Force Decay of Thermoset Elastomeric Chains Pretreated With Low Temperature

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INTRODUCTION

In orthodontics the need for constant, light, continuous force is essential. This need has caused product manufacturers to create many products, such as orthodontic thermoset elastomeric chains (OTEC's). Studies illustrate that force decay has been consistently problematic amongst all types of OEC's. This force decay may be susceptible to manipulation by changing the OTEC at the molecular level in order to decrease and stabilize the force decay rate. Further knowledge will benefit our orthodontic community – both clinicians and patients, if the OTEC force decay rate can be reduced and sustained for a longer time interval. Elastomeric orthodontic chains have been observed to lose majority of their force within two time points: 1 hour and 24 hours. 1 hour being the greatest loss.

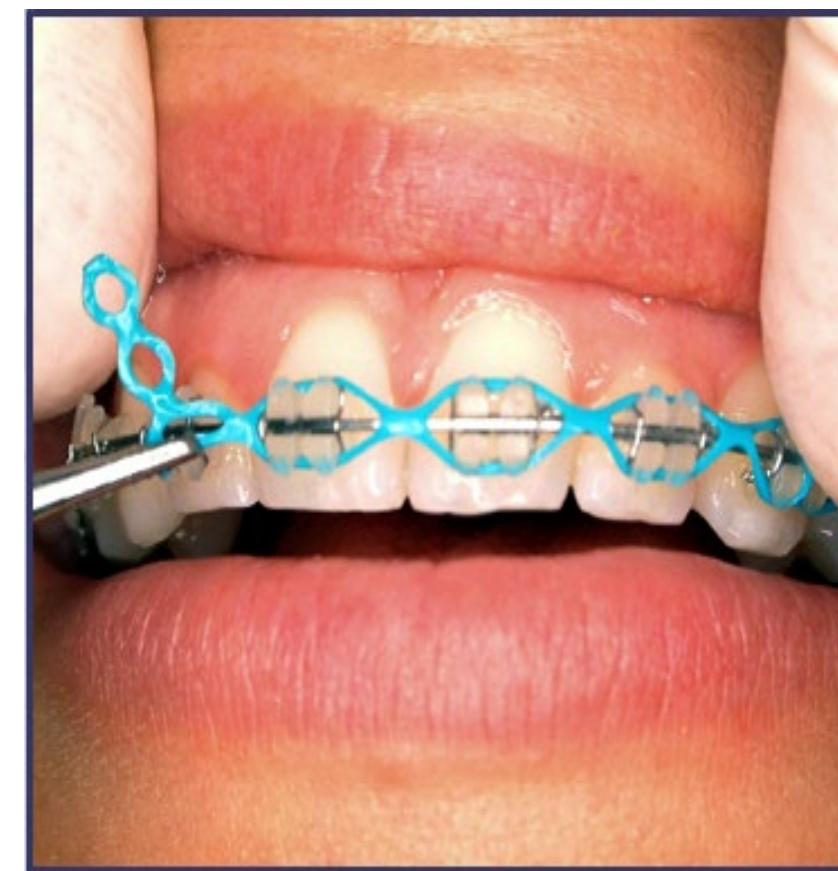


Fig. 1 Using OEC is a common technique to close spaces between teeth

RESEARCH DESIGN AND SAMPLE

- *In vitro* experimental laboratory study
- Clear, closed Rocky Mountain Orthodontics Energy Chain™ (RMO, Denver, Colo)
- Samples cut in lengths of 6 loops with the 4 middle loops actively utilized in experimentation to avoid possible damage to actively tested chain loops

Table 1. Groups Selected, Pre-Treatment Condition and Number of Samples		
Group	Pre-treated Condition	Number of Samples
Control Group	Room Temperature	30
Experimental 1	4 Degrees Celsius	30
Experimental 2	-23 Degrees Celsius	30
Experimental 3	-80 Degrees Celsius	30

RESULTS

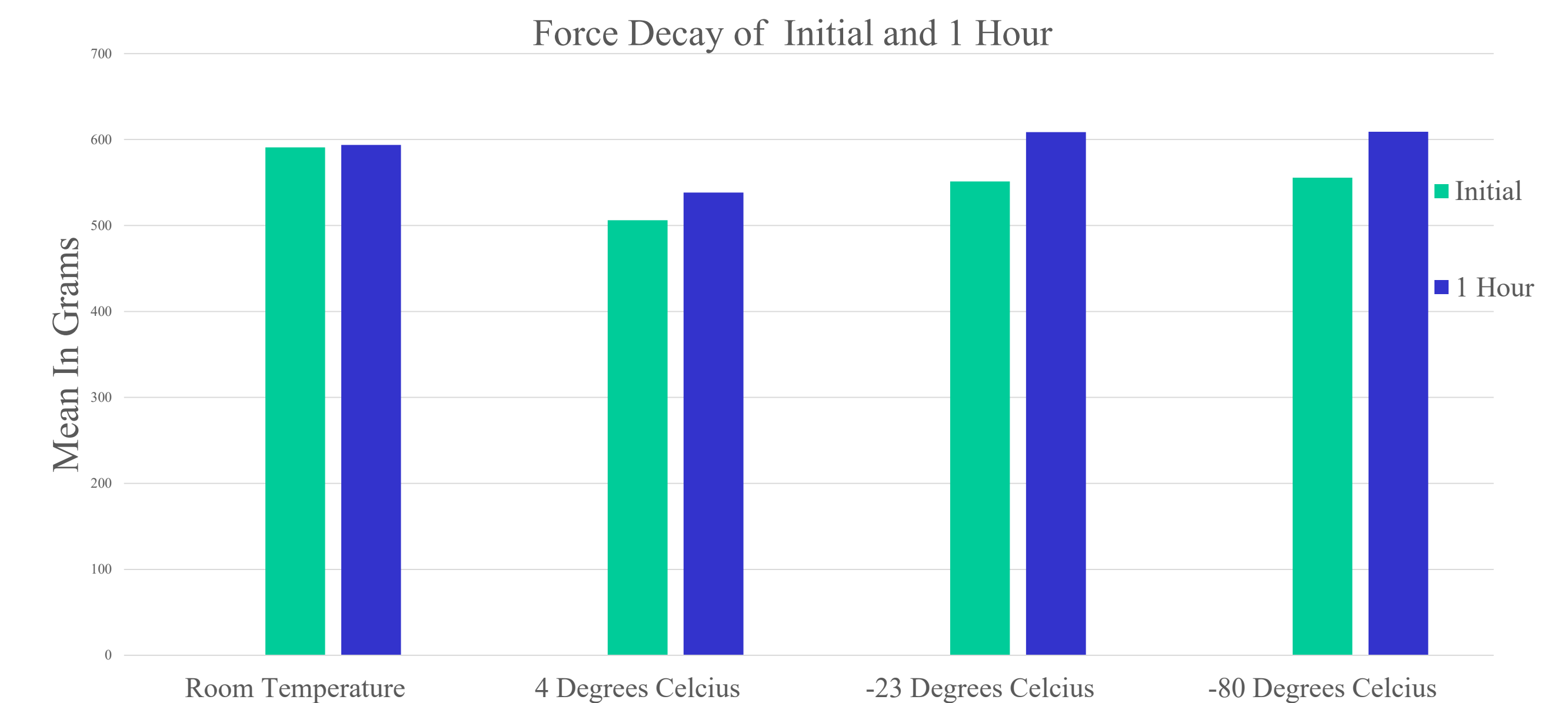


Fig 4 . Graphic Representation of Orthodontic Thermoset Elastomeric Chains Means Force Decay of Initial and 1 Hour

- There was no significant differences between group means at the following time points: 24 Hours, 14 days and 28 days as determined by a one way ANOVA ($p>0.05$)
- There was a significant difference between group means at the following time points: Initial and 1 Hour as determined by a one way ANOVA ($p<0.05$)
- The experimental group that was significant was 4 Degree Celsius for Initial and 1 Hour

IMPLICATIONS

Orthodontist

- The doctor can have greater confidence that the forces delivered by the OEC are consistent and optimized to the time interval prescribed and more accurately predict the force levels delivered by the OEC

Patient, parent and orthodontist

- The force decay may be reduced by pre-cooling, thereby increasing the effectiveness of the OEC, resulting in the ability to increase the time interval between visits, benefiting both the patient and the doctor

METHODS

4 specimen groups (-80°C, -23°C, 4°C, 21.5°C,) with a total sample size of 120 six link clear elastomeric chains. Specimens were held on acrylic block jigs 25mm apart. Force measurements were taken at five-time points (initial, 1 hr, 24 hr, 14 d, 28 d) utilizing a Lutron force gauge

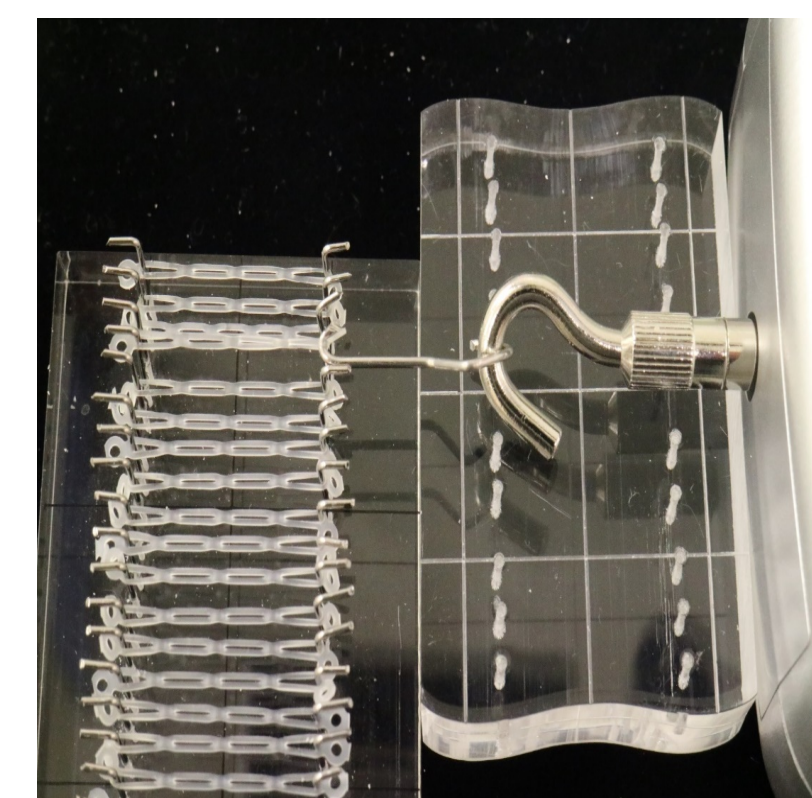


Fig. 2 Acrylic block jig holding OEC 25 mm apart while measuring the force with Lutron Fg 5005 gauge



Fig. 3 Lutron Fg 5005 gauge allows force measurement for quality control

CONCLUSION

- The RMO energy chains that were pre-treated in low temperatures had a lower mean force initially delivered by the three experimental groups (4° C, -23° C, -80° C).
- Pre-treated, cold RMO energy chains when tested in an ambient environment showed very little, if any force decay over time.
- The 4° C RMO energy chains showed a strong statistical significance in most timepoints and amongst all experimental groups.

REFERENCES

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OBJECTIVE

To evaluate the effect of low temperature pre-treatment on the force decay of orthodontic thermoset elastomeric chains

NULL HYPOTHESIS

Orthodontic Thermoset Elastomeric Chains (OTEC) that have been pre-treated in a reduced temperature environment will not display a decreased rate of force decay within the first hour and 24 hours