# Comparative Study of NiTi Orthodontic Wires

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## Introduction

Superelastic nickel-titanium orthodontic wires enable the creation, transmission and control of light and continuous forces that allow tooth movement, which leads to the correction of tooth position. Despite characteristics like high yield strength, low elastic modulus and high resilience, the clinical interest of these wires lies in their superelastic behavior. In this study, the determination of phase transformation temperatures along with the identification of predominant phase at room and intraoral temperatures were accomplished through DSC analysis; superelastic behavior were analyzed through tensile tests. Due to intraoral conditions and specificity of orthodontic fixed appliances, a new approach is presented for the 3-point bending tests which included brackets in their settings in order to compare orthodontic wires performances. Wire slippage inside the brackets and friction due to wire-bracket-ligature combinations on bending and pulling tests, respectively, are also discussed.

## Materials and Methods

Superelastic Ni-Ti orthodontic wires from two commercial brands Dentaurum and Ormco, with a 0.46 x 0.64 $mm^2$ rectangular cross-section.

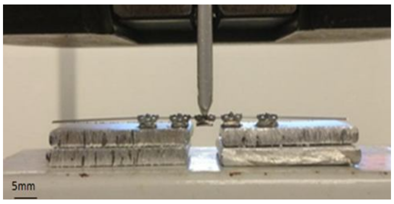
**DSC thermal analysis (DSC 204 F1 Phoenix model from Netzsch)**

Heating and cooling rate of 10˚C/min.

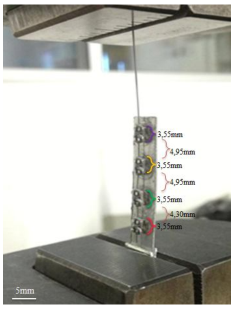
**Tensile testing (Shimadzu AG 50kNG)**

Gauge length 26 mm; stroke speed: 3mm/min; maximum strain 8%.

During orthodontic treatment, the wire is placed along the brackets. Wire-bracket connection is made through elastomeric ligature.



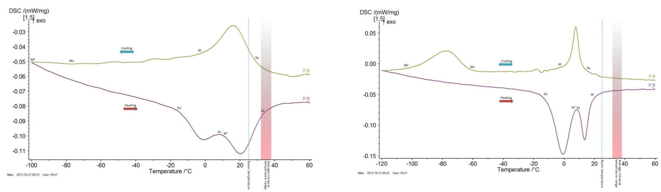

Mounting consists in 2 sets of aluminum plates placed 6.4 mm apart; 1 row of 4 Dentaurum brackets was attached. Wire-bracket connection is made through Morelli elastomeric ligatures. Load is applied on bracket positioned at the midpoint.



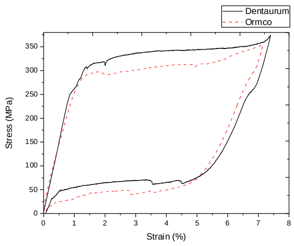

The wire, which is attached to the upper grip, is pulled across 4 Morelli brackets glued to an aluminum plate attached to the lower grip. Morelli and Dentaurum elastomeric ligatures were used.

## Results

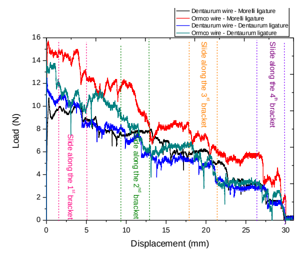
### DSC Analysis



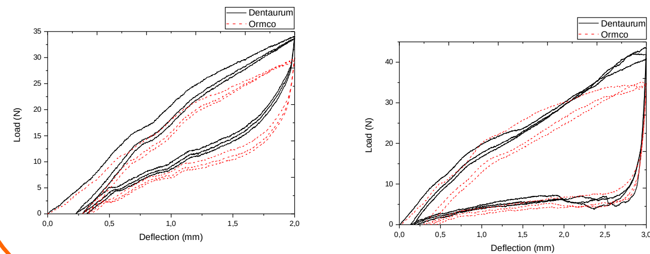

### Tensile Tests




### Pulling Tests




### Modified 3-Point Bending Tests




## Conclusions

DSC results showed that Dentaurum wire had, at room temperature, a predominance of austenitic phase with some residual R-phase, being fully austenitic at intraoral temperature, while Ormco wire revealed a fully austenitic phase at room and intraoral temperatures. Pulling tests exhibited force fluctuations due to the friction caused by wire-bracket-ligature connection. Both tensile and bending results showed a superelastic behavior; lower forces corresponding to Ormco wires' reverse phase transformation plateau when compared to Dentaurum were exhibited. The wire slippage phenomenon inside the brackets is highlighted by the 3mm deflection tests.

The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.

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## Acknowledgments

Funding by FCT/MEC through PEst-C/CTM/LA0025/2013-14 - Strategic Project - LA 25 - 2013-2014) is acknowledged. Elisabete Martinho, as Ormco sales representative, is also acknowledged for making possible the donation of Ormco *NiTi Preformed Archwires* used in this study.

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