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Testing the mechanical properties of titanium molybdenum preformatted orthodontic archwires under tensile stress – A preliminary report

S.Génin[1], P.Laheurte[2], A.Eberhardt[3], MP.Filleul[1]

[1]Faculté de Chirurgie Dentaire de Nancy, [2]Laboratoire d'Etude des Textures et Applications des Matériaux (CNRS-UMR 7078), [3]Laboratoire de Physique et Mécanique des Matériaux (CNRS- UMR 7554)

INTRODUCTION: Orthodontists require a wide variety of metal archwires to optimize treatment procedures.

First introduced by BURSTONE and GOLDBERG in 1979, the original patents for Titanium-Molybdenum archwires have now run out and similar products are freely sold by a number of suppliers.

The elasticity modulus of Titanium Molybdenum archwires is intermediate between those of stainless-steel and Nickel Titanium. The aim of this study is to compare the mechanical properties under tensile stress of several of the various Titanium Molybdenum archwires now available on the market.

METHODS: 10 Orthodontic rectangular (.017 x .025 inch) preformed archwires were obtained from 9 major firms: Beta-Titanium™ (American Orthodontics®), Rematitan® (Dentaurum®), Resolve® (GAC®), BetaBlue™ (Highland Metals®), TMA® et TMA Low Friction® (Ormco®), Beta Plus™ (OrthoPlus®), Bendaloy™ (RMO®), TiMolium™ (TP Orthodontics®), Beta III Titanium™ (Unitek®).

3 wires from each firm were tested under tensile stress with a Zwick machine and the stress/strain curve specific to each brand of wires was plotted.

RESULTS: Variations in the general shape of the curves observed can be summarized in three groups (figure 1: stress/strain curve)

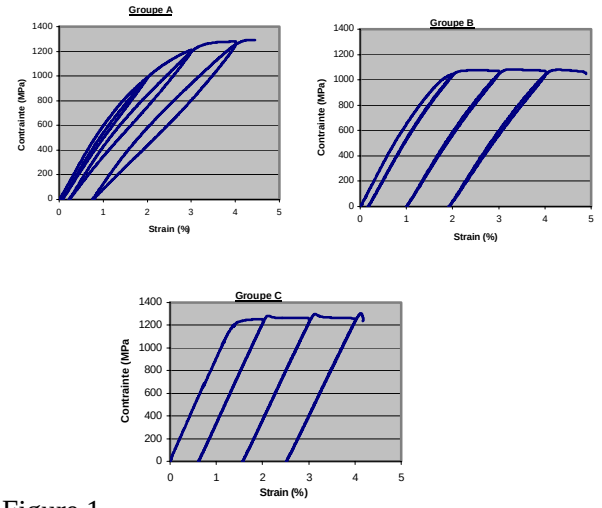

Figure 1

DISCUSSION : The three groups mentioned are :

-Group A:

Namely Beta Titanium™ (American Orthodontics®), Resolve® (GAC®), Beta Plus™ (OrthoPlus®), Beta III Titanium™ (3M Unitek®).

These wires have in common:

- a small amount of plastic deformation when they are subjected to tractions at 2% and 3%
- a degree of stiffness close to 0.38% of the stiffness of stainless steel.

-Group B:

Namely Rematitan® (Dentaurum®), TMA® et TMA low friction® (Ormco®), Bendaloy™ (RMO®), TiMolium™(TP Orthodontics®).

These wires have in common:

- greater plastic deformations, specially for TiMolium™ which is notably more brittle than the others;
- a degree of stiffness ranging from 0.42% to 0.46% of the stiffness of stainless steel TiMolium™s being the stiffest of all wires (approx. 0.58% of stainless steel) .

-Group C:

The archwires of only one firm come into this group : BetaBlue™ (Highland Metals®) with :

- more plastic deformation than any other type of arch-wires;
- a high degree of stiffness (0.55% of stainless steel).

CONCLUSIONS: Mechanical performance varies distinctly from one type of archwire to an other. The amount of plastic deformation is of particular significance since it conditions the elastic properties required for orthodontic tooth-movement.

The degrees of stiffness also vary. The stiffness of the arch-wire conditions the amount of force delivered to the teeth, also of paramount importance in orthodontic treatment.

Testing their behaviour in tension calls for further investigation (in bending and torsion) to complete the comparative study of archwires produced from Titanium Molybdenum.

REFERENCES:[1]BURSTONE C.J., GOLDBERG A.J.:Beta titanium: A new orthodontic alloy. Am.J.Orthod., 77(2): 121-132, 1980