Frictional Resistance of Aesthetic Orthodontic Archwires Compared to Traditional Arch Wires Before and After Toothbrush Abrasion

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ABSTRACT

Introduction: Our objective was to compare frictional resistance evident in aesthetic archwires to traditional (non-aesthetic) archwires.

Methods: Archwires ligated with elastics to fixed brackets were pulled through these brackets while frictional resistance (in lbf) was measured.

Results: There were no confirmed significant differences between the frictional resistance of the aesthetic arch wires compared to the traditional non-coated wires for all wire sizes tested.

Conclusions: Our data suggests that a sacrifice of clinical performance with these aesthetic archwires as compared to traditional archwires is not likely.

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INTRODUCTION

Aesthetically pleasing appliances are one of the most desired aspects of orthodontic treatment for patients today. With the introduction of clear aligners for orthodontic purposes the public perception is that traditional appliances should be clear also. Clear brackets are currently produced and used with great regularity. The only remaining piece to the orthodontic fixed appliance therapy that has a metal appearance is the orthodontic arch wire. Within the last five years numerous wires have been produced with different types of wire coatings to match tooth colors. Almost every manufacturer now offers these aesthetic wires but usually at a higher cost. However these wires are not routinely incorporated in treatment due to both a lack of evidence-based research and practitioner familiarity. Very few published studies regarding different characteristics of aesthetic arch wires have been reported and there are no research reports describing the effects of tooth brush abrasion and frictional resistance associated with these wires.

STUDY DESIGN

This study measured resistance in a control group and three treatment groups. The control was comprised of non-coated wires. The treatment groups were comprised of different types of aesthetic (coated orthodontic archwires: 1) polymer coated, 2) epoxy coated, and 3) palladium coated (Jinsung). Within each of the three treatment groups there will be seven different (4 NiTi and 3 SS) wires of various sizes that will be tested. The seven different wires will consist of the following: NiTi (.016 in, .018 in, .017*.025 in and .019*.025 in) and stainless steel (.018 in, .017*.025 in and .010*.025). After obtaining baseline resistance levels, the treatment groups underwent 2, 4, and 8 minutes of toothbrush abrasion using a Phillips sonicare HX6690 toothbrush and the abrasion testing jig (figures 1.4) with subsequent resistance testing. To measure frictional resistance a testing apparatus was designed to represent a buccal segment and was modeled after Becetti and Franchi1 (figures 2,3).

LIMITATIONS

Human error was a significant limitation in data collection and durability observations.

According to Swartz2 a more accurate term for friction in orthodontics is “resistance to sliding”, which encompasses a frictional component as well as factors such as biomechanical dynamics, the binding of the archwire to the bracket complex, and the release of that friction between the wire and the brackets align, the relative amount of archwire-bracket binding changes. It cannot be assumed that the amount of friction is constant. Our study has measured resistance to sliding using a steady-state laboratory model. The archwire and the brackets are in constant contact as the wire is drawn through and the force is measured. Thus, this test design measures the frictional component of resistance to sliding between the archwire and the brackets during continuous binding. It does not allow for movement of the brackets or archwire (lateral excursion).

RESULTS/DISCUSSION

There were no confirmed significant differences between the frictional resistance of the aesthetic arch wires compared to the traditional non-coated wires for all wire sizes tested. For most of the aesthetic wires, no matter what type of coating, there seems to be a slight decrease in frictional resistance. Abrasion, for 2, 4, and 8 minutes seemed to have minimal effect on increasing or decreasing the frictional resistance of the selected types of coatings. There were mild variants for each time interval but when observed from the 8 min endpoint no significant increase or decrease was observed. There were no significant differences in wear resistance among the three different coatings or within each coating type at the three different abrasion intervals.

Subsequent statistical analysis will be conducted. The distribution of data will be determined with one-way analysis of variance (ANOVA) followed by Holm-Sidak post hoc test for multiple comparisons (level of significance, P<.05) (Charts 1,2,3 represent future graphic depiction of results).

CONCLUSIONS

The additional cost and not clinical performance are the only major consideration in choosing among the three types of aesthetic wire tested. This could allow a complete aesthetic experience for dental patients without sacrificing treatment efficiency and positive outcomes. Further research is needed to evaluate the potential additional clinical implications of frictional resistance in aesthetic orthodontic archwires.

REFERENCES


INTRODUCTION

PURPOSE OF THE STUDY

The purpose of this research project is to 1) investigate the degree of frictional resistance associated with selected aesthetic arch wires compared to the traditional arch wires; 2) investigate differences in frictional resistance among three different types of aesthetic arch wires and 3) determine differences in the functional durability of the wire coatings tested after toothbrush abrasion. Wire characteristics to be tested in this study are frictional resistance, wear resistance and functional durability.