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ORIGINAL ARTICLE

Evaluation of the fit of preformed nickel titanium arch wires on normal occlusion dental arches

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KEYWORDS

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Abstract *Aim:* To determine the fits of preformed nickel titanium (NiTi) archwires on dental arches with normal occlusion.

Methods: Forty sets of upper and lower plaster models were obtained from men and women with Class I occlusions. Preformed $0.016'' \times 0.022''$ NiTi archwires from Rocky Mountain Orthodontics (RMO), 3 M Unitek, Ormco, and Dentaurum were evaluated in terms of their fits on dental arches from male, female, and combined cases. Data were analyzed by using fourth- and sixth-order polynomial equations, analysis of variance (ANOVA), and the Duncan post hoc test.

Results: In the upper arches, the best fit and least error were obtained with RMO Ovoid and Ormco Orthos Large archwires for male cases, but with 3 M Orthoform LA archwires for female and combined cases. In the lower arches, the best fit and least error were obtained with Ormco Orthos Large for male cases, with 3 M Orthoform LA and RMO Normal for female cases, and with 3 M Orthoform LA, RMO Normal, Ormco Orthos Large, and Ormco Orthos Small for combined cases. When both dental arches were matched, Ormco Orthos Large was the best wire for male cases. 3 M Orthoform LA was the best wire for female and combined cases.

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Conclusions: Using an archwire form with the best fit to the dental arch should produce minimal changes in the dental arch form when NiTi wires are used and require less customization when stainless-steel wires are used.

1. Introduction

Achieving a stable, functional, and esthetic arch has long been the primary objective of orthodontic treatment. A key aspect in achieving these goals is the identification of a suitable arch form for each case. Preservation of the original arch form and size plays an important role in ensuring the long-term stability of orthodontic treatment results (Shapiro, 1974; Felton et al., 1987; DeLa Cruz et al., 1995). Felton et al. (1987) examined pretreatment, posttreatment, and postretention dental casts of 15 Class I and 15 Class II nonextraction orthodontically treated patients. When orthodontic treatment changed the arch form, the results frequently were unstable and relapsed to the pretreatment state. They concluded that in many cases, arch forms must be customized to obtain long-term stability (Felton et al., 1987). DeLa Cruz et al. (1995) examined the casts of 45 Class I and 42 Class II Division 1 malocclusion cases. Patients underwent extraction of the four first premolars and were followed for at least 10 years after retention. The arch form rounded during treatment, followed by a change to a more tapered form during the postretention period. They concluded that the arch form tends to return to the pretreatment shape after retention.

When a preformed archwire is used in orthodontic treatment, the form of the treated dental arch is altered to match the form of the wire. However, because of the wide variation in arch forms among humans, there is no consensus on the optimal dental arch form to be achieved as the result of treatment. Hence, it is critical to select the appropriate archwire form for each case. An important issue that arises in orthodontic practice regards the selection of the appropriate form from different archwire blanks. Modern orthodontic mechanics consists of archwires of various types, shapes, and sizes according to different manufacturer specifications. With the advent of highly elastic preformed nickel titanium (NiTi) wires, clinicians began to introduce large cross-section archwires in the early stages of orthodontic treatment.

Braun et al. (1999) superimposed 33 popular NiTi preformed archwire and bracket assemblies on maxillary and mandibular normal occlusion arch forms with the use of the Beta function. They found that the forms of the preformed wires did not emulate the natural human arch form. Specifically, all of the arch widths (measured at the canines and first molars) determined by the preformed wires were greater than the arch widths of the natural human arch form (Braun et al., 1999).

It would be beneficial to have archwires with a limited number of forms and sizes that resemble most patient arches. This scenario would enable the original arch form to be preserved as much as possible during the initial stages of treatment when NiTi wires are used, and would minimize the need for wire customization in the final stages of treatment when large stainless-steel (SS) wires are introduced. The aim of this study was to evaluate the fits of various commercially available preformed archwire designs in Saudi men and women having normal occlusion arches.

2. Materials and methods

2.1. Study sample

Upper and lower plaster dental models were obtained for 40 adult Saudi subjects (20 men, 20 women; age: 18–25 years) with Class I normal occlusion. Male samples were obtained from cadets at King Abdulaziz Military Academy. Female samples were obtained from female dental students and interns at King Saud University, College of Dentistry. Subjects with Class I occlusion were chosen because the preponderance of malocclusions is corrected to this Angle classification. Class I occlusion was defined as the presence of bilateral Class I molar and canine relations, overbite/overjet between 2 and 4 mm, no crowding or spacing exceeding 2 mm, no rotated teeth, and no anterior or lateral cross-bite (Ferrario et al., 1997, 1999). Subjects were excluded if they had undergone previous orthodontic or prosthetic treatment, proximal or extensive occlusal restorations involving the cusp tips, or if they had obvious incisal or cuspal attrition, tooth fracture, ectopically erupted or supernumerary teeth, deciduous teeth, congenitally missing teeth, or extracted teeth (excluding third molars) (Ferrario et al., 1997, 1999).

Preformed 0.016" × 0.022" NiTi archwires of four popular brands were evaluated in terms of their arch form and size on a normal occlusion sample. The archwires tested were as follows:

(1) Rocky Mountain Orthodontics (RMO) pentamorphic system: Normal, Tapered, Ovoid, Narrow Tapered, and Narrow Ovoid.
(2) 3 M Unitek (3 M): Orthoform I (tapered), Orthoform II (square), Orthoform III (ovoid), Orthoform LA, and Standard.
(3) Ormco: Broad Large, Broad Small, Orthos Large, Orthos Small, Tru-Arch Medium, and Tru-Arch Small.
(4) Dentaurum: Normal and American.

2.2. Model/wire digitization and curve fitting

Imaging methods and digitization software were developed and tested in a previous study (Al-Harbi et al., 2008). Because the main objective of the current study was to compare preformed archwires to dental arch forms, the arch forms were defined according to the respective bracket positions on the teeth. Clinically, brackets are positioned on teeth according to a defined midpoint on the facial axis of the clinical crowns (FA point). The FA point divides the most prominent point of the central lobe of all clinical crowns except the molar teeth.