Putting nickel titanium wire in its place

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The development of highly resilient archwires made of nickel titanium alloys was expected to have a profound impact on orthodontic treatment. These archwires deliver light forces over an extended range, with no deformation of their original shape. And, through much of their range, they can defy Hook's law and deliver forces of a constant magnitude. It would seem such an alloy would be a superb material for orthodontic archwires. Combined with the development of pre-adjusted orthodontic brackets, the so-called straight wire appliance, it appeared that we had the perfect appliance—a bracket requiring no bends with a wire that accepts none.

However, most orthodontic problems resist such simple solutions. Even in a Class I case with deep overbite, precisely placed pre-adjusted appliances with two slot-filling nickel titanium wires may not correct the malocclusion. One reason is that nickel titanium wires that resist deformation also resist the placement of bends. Another problem is that archform cannot be altered in nickel titanium archwires. Figure 1 shows the same preformed nickel titanium wire overlaying two arches. In the small arch, the wire places the upper canines in the anterior segment. In the larger arch, the canines are in the posterior segment. The anterior curvature is under the influence of the perioral muscles and the tongue. The posterior curvature is influenced by the buccal musculature and the muscles of the tongue. The mesial half of the canine is part of the anterior curvature, while the distal half of the labial aspect begins the posterior curvature. The Bonwill-Hawley, a geometric construction of arch form, respects the change in curvature at the middle of the canines. Archwires that cannot be altered in shape may be of limited value in orthodontics.

The best use of nickel titanium archwires may be as initial wires to begin the correction of rotations and to produce initial alignment of brackets so that custom bent steel wires can be used to control archform and allow for more extensive retraction and/or intrusion of teeth.

This notion was tested in a recent survey of 600 orthodontists in North America. The following questions were included: Do you routinely use the newer alloys such as Nitinol, Sentinol, etc? ("Yes"-87%; "No"-13%)

Those who use them were asked: Do you use these wires as initial archwires? ("Usually"-68%; "Sometimes"-27%; "Rarely"-3%; "Never"-2%) Do you use these newer alloys as final archwires? ("Usually"-8%; "Sometimes"-27%; "Rarely"-39%; "Never"-26%)

Ninety-five percent of responding orthodontists reported using nickel titanium archwires in the initial stages of treatment, and 65% rarely or never use them as their final archwire. But even as an initial archwire, nickel titanium has an alternative. Spiral, multiple archwires have just as much springback and will accept adjustments for archform and first and second order bends. These wires also have an irregular surface which discourages sliding out of the tube on the terminal molar—a common experience with nickel titanium wires. Finally, cost is an important factor. Nickel titanium wires typically cost four to six times as much as steel wires.

The next generation of orthodontic archwires will have load-deflection rates similar to nickel titanium, allow the orthodontist to place first and second order bends, be formable to allow custom archform, and will be tooth colored. Current research in composites shows promise in having all of these properties. In the meantime, orthodontists should be aware of nickel titanium wires' limitations, and put them in the proper place.

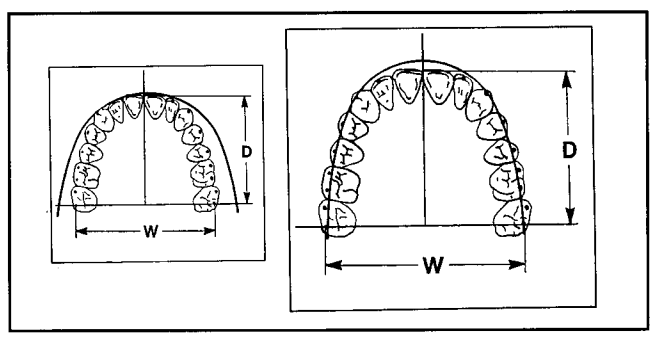

Figure 1
Preformed archwire on a small arch and large arch