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[Intervention Review]

# Initial arch wires used in orthodontic treatment with fixed appliances

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## ABSTRACT

### Background

Initial arch wires are the first arch wires to be inserted into the fixed appliance at the beginning of orthodontic treatment and are used mainly for the alignment of teeth by correcting crowding and rotations. With a number of different types of orthodontic arch wires available for initial tooth alignment, it is important to understand which wire is most efficient, as well as which wires cause least amount of root resorption and pain during the initial aligning stage of treatment. This is an update of the review entitled *Initial arch wires for alignment of crooked teeth with fixed orthodontic braces*, which was first published in 2010.

### Objectives

To assess the effects of initial arch wires for the alignment of teeth with fixed orthodontic braces, in terms of the rate of tooth alignment, amount of root resorption accompanying tooth movement, and intensity of pain experienced by patients during the initial alignment stage of treatment.

### Search methods

Cochrane Oral Health's Information Specialist searched the following databases: Cochrane Oral Health's Trials Register (to 5 October 2017), the Cochrane Central Register of Controlled Trials (CENTRAL) (the Cochrane Library, 2017, Issue 9), MEDLINE Ovid (1946 to 5 October 2017), and Embase Ovid (1980 to 5 October 2017). The US National Institutes of Health Trials Registry (ClinicalTrials.gov) and the World Health Organization International Clinical Trials Registry Platform were searched for ongoing trials. No restrictions were placed on the language or date of publication when searching the electronic databases.

### Selection criteria

We included randomised controlled trials (RCTs) of initial arch wires to align teeth with fixed orthodontic braces. We included only studies involving participants with upper or lower, or both, full arch fixed orthodontic appliances.

### Data collection and analysis

Two review authors were responsible for study selection, 'Risk of bias' assessment and data extraction. We resolved disagreements by discussion between the review authors. We contacted corresponding authors of included studies to obtain missing information. We assessed the quality of the evidence for each comparison and outcome as high, moderate, low or very low, according to GRADE criteria.

## Main results

For this update, we found three new RCTs (228 participants), bringing the total to 12 RCTs with 799 participants. We judged three studies to be at high risk of bias, and three to be at low risk of bias; six were unclear. None of the studies reported the adverse outcome of root resorption. The review assessed six comparisons.

1. Multistrand stainless steel versus superelastic nickel-titanium (NiTi) arch wires. There were five studies in this group and it was appropriate to undertake a meta-analysis of two of them. There is insufficient evidence from these studies to determine whether there is a difference in rate of alignment between multistrand stainless steel and superelastic NiTi arch wires (mean difference (MD) -7.5 mm per month, 95% confidence interval (CI) -26.27 to 11.27; 1 study, 48 participants; low-quality evidence). The findings for pain at day 1 as measured on a 100 mm visual analogue scale suggested that there was no meaningful difference between the interventions (MD -2.68 mm, 95% CI -6.75 to 1.38; 2 studies, 127 participants; moderate-quality evidence).
2. Multistrand stainless steel versus thermoelastic NiTi arch wires. There were two studies in this group, but it was not appropriate to undertake a meta-analysis of the data. There is insufficient evidence from the studies to determine whether there is a difference in rate of alignment between multistrand stainless steel and thermoelastic NiTi arch wires (low-quality evidence). Pain was not measured.
3. Conventional NiTi versus superelastic NiTi arch wires. There were three studies in this group, but it was not appropriate to undertake a meta-analysis of the data. There is insufficient evidence from these studies to determine whether there is any difference between conventional and superelastic NiTi arch wires with regard to either alignment or pain (low- to very low-quality evidence).
4. Conventional NiTi versus thermoelastic NiTi arch wires. There were two studies in this group, but it was not appropriate to undertake a meta-analysis of the data. There is insufficient evidence from these studies to determine whether there is a difference in alignment between conventional and thermoelastic NiTi arch wires (low-quality evidence). Pain was not measured.
5. Single-strand superelastic NiTi versus coaxial superelastic NiTi arch wires. There was only one study (24 participants) in this group. There is moderate-quality evidence that coaxial superelastic NiTi can produce greater tooth movement over 12 weeks (MD -6.76 mm, 95% CI -7.98 to -5.55). Pain was not measured.
6. Superelastic NiTi versus thermoelastic NiTi arch wires. There were three studies in this group, but it was not appropriate to undertake a meta-analysis of the data. There is insufficient evidence from these studies to determine whether there is a difference in alignment or pain between superelastic and thermoelastic NiTi arch wires (low-quality evidence).

## Authors' conclusions

Moderate-quality evidence shows that arch wires of coaxial superelastic nickel-titanium (NiTi) can produce greater tooth movement over 12 weeks than arch wires made of single-strand superelastic NiTi. Moderate-quality evidence also suggests there may be no difference in pain at day 1 between multistrand stainless steel arch wires and superelastic NiTi arch wires. Other than these findings, there is insufficient evidence to determine whether any particular arch wire material is superior to any other in terms of alignment rate, time to alignment, pain and root resorption.

## PLAIN LANGUAGE SUMMARY

### What are the best materials to use for the first arch wire in a fixed brace?

#### Review question

We wanted to find out the best kind of wire arches for orthodontists to use when putting braces on people's teeth to make them straighter. Our review evaluated whether different types of initial arch wires result in important differences, such as faster straightening of teeth, reduced pain or reduced side effects, such as the shortening of the tooth root during treatment with braces?

#### Background

Orthodontic treatment is undertaken worldwide to correct crowded, twisted, buried or prominent front teeth. This treatment is normally given in adolescence or adulthood. Fixed orthodontic appliances (braces) consist of brackets bonded to the teeth that are connected by arch wires, which exert forces on the teeth. The first (initial) type of arch wire, inserted at the beginning of treatment, is for correcting crowded and twisted teeth.

Over recent years, a number of new materials (various mixtures ('alloys') of nickel and titanium (NiTi)) have been developed, which show a range of different properties in the laboratory and which manufacturers claim offer benefits in terms of tooth alignment. This is an update of the review entitled *Initial arch wires for alignment of crooked teeth with fixed orthodontic braces*, which was first published in 2010.

#### Study characteristics

We searched for studies on 5 October 2017. We were interested in 'randomised controlled trials' (RCTs), which are studies in which participants are assigned randomly to the interventions being compared. We found 12 RCTs with 799 participants, all of whom had upper or

lower full arch fixed braces, or both. The studies evaluated different initial arch wires, but they were poorly conducted or reported, or both, and their results are likely to be biased. The studies varied in a number of other aspects of orthodontic treatment, compared different types of initial arch wires and reported different outcomes at different times. None of the studies reported both potential benefits (straightening) and harms (pain or side effects such as tooth root shortening).

### **Main results**

We found moderate-quality evidence that coaxial superelastic nickel-titanium (NiTi) can produce greater tooth movement over 12 weeks than single-strand superelastic NiTi. We found moderate-quality evidence that there is no difference in pain at day 1 between multistrand stainless steel versus superelastic NiTi arch wires. There is insufficient evidence from our included studies to know if any other particular initial arch wire material is better or worse than another, or if they function equally well, with regard to speed of straightening, pain or tooth shortening in people undergoing orthodontic treatment.

### **Quality of the evidence**

There was moderate-quality evidence that coaxial superelastic NiTi can produce greater tooth movement than single-strand superelastic NiTi, and that there is no real difference in pain whether whether arch wires are made with multistrand stainless steel or superelastic NiTi. The quality of the evidence for all other comparisons and outcomes was low or very low. Overall, the evidence about initial arch wires in orthodontic treatment is very limited, with comparisons often assessed by one small study with problems in its design. The findings are imprecise and unreliable so more research is needed.