A dual-arch protocol with accelerated movement and less discomfort

Drs. George Schudy and Larry White discuss a way patients can have less pain with their gain

Educational aims and objectives

This article aims to discuss a dual-arch protocol that can accelerate tooth movement and decrease discomfort.

Expected outcomes

Orthodontic Practice US subscribers can answer the CE questions on page XX to earn 2 hours of CE from reading this article. Correctly answering the questions will demonstrate the reader can:

- Identify some reasons for posttreatment discomfort.
- Realize how prostaglandins play an important role in the production of inflammatory pain.
- See the role of antihistamines and steroids in inflammation reduction.
- Realize some effects of various arch wires on discomfort.
- Recognize the possibility for accelerated movement and reduced discomfort as a result of the dual-arch wire protocol.

Introduction

Many times when searching for one effect, investigators will serendipitously discover another; e.g., Alexander Fleming who intended to study characteristics of staphylococci and ended up discovering penicillin. The current presentation offers a similar instructive for orthodontic clinicians. The original intention was to reduce patient discomfort by inserting two initial arch wires (Figure 1), one an annealed wire that would exert minimal tooth movement, and another small, round NiTi wire whose effectiveness would be partially or totally negated by the annealed wire. Patients did experience a dramatic reduction in post-bonding discomfort, but upon the removal of the force-limiting annealed wire, tooth movement accelerated in a remarkable manner, and alignment occurred more rapidly than expected.

The orthodontist against pain

The English author Horace Walpole coined the word serendipity from the ancient name for Sri Lanka, *Serendip.* He explained that this name was part of the title of a fairy tale, called *The Three Princes of Serendip.* As the three princes traveled, they continually made discoveries of things that they had no intention of finding. The accidental detection of accelerated tooth movement in an effort to reduce patient discomfort both surprised and delighted, but that effect never entered the original equation.

Orthodontists generally assume that patients will have a certain level of post-treatment discomfort that will diminish after a day or two — while true for some patients, others continue to suffer chronically, and this affects their cooperation throughout therapy.

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Figure 1

Some have sought to blame patients' attitudinal traits for this lack of compliance,[1-3] but more recent research indicates that genetic predisposition for sensitivity may play a large role in patients' reluctance to help with their treatment.[4-8]

Prostaglandins play an important role in the production of inflammatory pain and occur in almost all human tissues. They were first discovered in high concentrations in the prostate glands of sheep, and this accounts for their name. They are biologically unusual because of their ubiquity, their broad spectrum of physiological action, their high potency, their variety of form, and their short life span.[9-11] The release of prostaglandins greatly enhances the transmission of painful stimuli because they biochemically mediate the amount of cyclic AMP (adenosine monophosphate), which modulates norepinephrine at the neural synapse.[12] The localized effect of prostaglandins explains why some analgesic drugs, such as aspirin, indomethacin, ibuprofen, phenylbutazone, and extracts of aloe effectively combat prostaglandin-induced pain.

Although antihistamines and steroids can reduce inflammation, they do not reduce the accompanying pain and often produce undesirable systemic side effects. All of the non-steroidal anti-inflammatory agents (NSAIDs) inhibit prostaglandin synthesis via acetylation and inactivation of the enzyme cyclooxygenase.[13] However, chronic reliance on NSAIDs will curtail bone metabolism and subsequently slow the movement of teeth.[14-17]

The stasis of capillary blood flow contributes to post-adjustment discomfort by producing arachidonic acid, which makes tissues hyperalgesic, and some researchers have suggested that chewing on hard food could quell posttreatment discomfort by exercising the periodontal membrane and encouraging capillary vitality.[18] Another went so far as to develop a plastic bite wafer that patients could chew on after orthodontic adjustments.[19] While we have only empirical evidence that bite wafers benefit patients, many doctors and patients have enthusiastically endorsed their use.[20]

Arch wire placement

Several researchers have sought to evaluate the effect of various arch wires on orthodontics patients, e.g., stainless steel, NiTi, thermal NiTi, etc.,[21-27] while others have sought to measure patients' psychosocial adjustments.[28-31]

Figure 2: A maxillary arch with only the dead soft wire in place. This wire usually extends to the first bicuspids

Figures 3A and 3B

Recently researchers[32-34] observed the discomfort of patients and the movement acceleration after using a low-level laser applied to the gingiva overlying teeth, while another group[35] studied the effect of vibration of the teeth as a pain reliever. All of these studies confirmed the obvious, i.e., that the initial pain started a few hours after arch wire placement and abated over the next 3-to-4 days. None of the investigations have concerned themselves with the remedial effect of an annealed wire much less one combined with an active NiTi wire.

Maxillary and mandibular arch wire techniques

A .014 annealed stainless steel arch wire was placed within the maxillary brackets and pressed lingually at each interproximal to assure pacificity (Figure 2). A .014 NiTi arch wire (Figure 3A) is layered over the first wire and ligated with elastomers with the hope that the annealed wire would negate the energy of the active NiTi wire. Since the mandibular teeth have smaller roots, the dead soft wire was an annealed .012 stainless steel arch wire that was adapted as with the maxillary dead soft wire, and a .012 NiTi arch wire was overlaid and ligated with elastomers (Figure 3B). Presumably, the combination of wires would decrease the force on the teeth and subsequently decrease patient discomfort, which in fact, did occur.

Discomfort measurements

A clinical investigation gauged the effect of the dual wire system on patients' discomfort. Thirty randomly selected patients participated in the study and were bonded with identical Bi-Metric Appliances (American Orthodontics) that uses .016 slots on the anterior teeth and .018 slots on the posterior teeth. Fifteen of the patients received only a maxillary .014 NiTi wire, while 15 other patients received the dual-wires of a .014 annealed stainless steel with an overlay of a .014 NiTi. As with any subjective assessment of pain, clinicians have trouble obtaining objective measurements. But since pain is such an individual experience, researchers have an obligation to accept as true a patient's evaluation regarding the intensity of the event. Figure 4 shows the pain sensations of the .014 NiTi only group, and Figure 5 shows the pain sensations of the dual-wire group.

Figure 4: Pain Report Cards

Upper .014 NiTi Only					
Quite Bad	3, 8, 14	15	15		
Not Too Bad	2, 4, 11	2, 3, 5, 6, 11, 14	9, 11	6, 9, 15	9, 15
Noticeable	1, 5, 6, 7, 9, 10, 12, 13, 15	1, 4, 7, 8, 9, 10, 12	4, 6, 7, 10	2, 7	6
Not Significant		13	1, 2, 3, 5, 8, 12, 13, 14	1, 3, 4, 5, 8, 10, 11, 12, 13, 14	1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14
Days	1	2	3	4	5

Figure 5: Pain Report Cards

Upper .014 NiTi Over Preconditioning					
Quite Bad					
Not Too Bad	12	7			
Noticeable	1, 2, 6, 7, 14	1, 5, 12	7	6,7	
Not Significant	3, 4, 5, 8, 9, 10, 11, 13, 15	2, 3, 4, 8, 9, 10, 11, 13, 14, 15	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
Days	1	2	3	4	5

Five of the patients in the NiTi only group had severe pain that endured 3 days. No patients in this category had insignificant pain. In contrast, no patient in the dual-wire group suffered severe pain and nine patients testified to having insignificant discomfort. Only two of the dual-wire patients admitted to pain that was "not too bad." Nine dual-wire patients reported insignificant pain, whereas only one patient in the NiTi group reported insignificant pain.

Rapid movement

This protocol obviously produces significantly more friction and binding than ordinary arch wires since the slot was smaller (.016) and the annealed wire may touch the surfaces of the bracket slot, the wings (when present) and even the labial surfaces of some teeth. This procedure was developed simply as an effort to provide patient comfort. Little movement was expected with the annealed wire in place but, interestingly, even with the frictional resistance plus the force-diminishing effects of the annealed wire, the .014 NiTi in the maxillary arch (Figures 6A and

6B) and the .012 NiTi in the mandibular arch (Figures 7A and 7B) still had enough force to achieve measurable movement with the two wires in place. After various weeks of the initial dual-arch wires, the annealed wires were removed, and the active NiTi wires were then free to work alone, and they achieved alignments quickly.

These representative patients treated with this dual-arch therapy illustrate the accelerated movement achieved with this protocol. The patient in Figure 6 used the dual-wires for 28 days (Figures 6A and 6B), and the NiTi wire then worked alone for 15 days (Figure 6C). The incisal irregularity initially measured 11 mm. The therapy resulted in an average of 7.3 mm of movement per month. The patient in Figure 7 wore the dual-arch wires for 30 days (Figures 7A and 7B), and the NiTi wire worked alone for 26 days (Figure 7C). The incisal irregularity initially measured 13 mm, and the rate of movement averaged 6.5 mm per month. A previous publication[36] concluded that an average movement of 3-4.9 mm per month constituted a fast rate of movement.

Figure 6A-6C: Patient age 11-years old. Incisal irregularity initially measured 11.0 mm. Treatment time 44 days (1.5 months). Movement 7.3 mm per month.

Figure 7A-7C: Incisal irregularity initially measured 13.0 mm. Treatment time 56 days (2.0 months). Movement 6.5 mm per month. Total movement 13.0 mm

Summary

At this point, one can only conjecture why such accelerated movement occurs with the dual-arch wire protocol. Perhaps a critical mass of osteocytic metabolism is marshaled but remains subdued until removal of the annealed wire. Regardless of the reason for rapid tooth movement, patients experienced significantly less clinical discomfort, and that was the primary objective.

No one has described the experience of clinical pain better than Dr. Welden Bell,[37] and he sums up the problem succinctly, "As a clinical symptom, pain is an experience that cannot be shared. It is wholly personal, belonging to the sufferer alone. Different individuals sensing identical noxious stimulation feel pain in different ways and react at different levels of suffering. It is impossible for one person to sense exactly what another feels."

Since pain remains such a personal affair, orthodontic clinicians should not expect any particular remedy to have an unlimited successful application, but whenever, however, and with whomever, they can alleviate patient anguish, they should avail themselves of any and all correctives available. This dual-wire, force-modulating technique does decrease pain significantly, while at the same time greatly enhancing alignment. OP

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