How to avoid extractions when treating malocclusions using MRC’s Bent Wire System and Trainer System for arch development

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Abstract
Maxillary and mandibular expansion has been proposed to increase the arch perimeter and to avoid extractions during orthodontic treatment. Although controversy has persisted over the stability of expansion techniques, there is an increasing trend toward “non-extraction.”

This paper describes a novel method to produce expansion of the dental arches, and at the same time, to treat muscular dysfunctions that may be the etiological factor of the malocclusion. The system has been developed by Myofunctional Research Co. (MRC), Queensland, Australia, as a simpler method of phase one expansion, which may produce improved stability because of simultaneous habit correction in selected cases. Two cases treated with the Farrell Bent Wire System™ (BWS™) are described and the advantage of this method of treatment is discussed.

Introduction
Expansion of the jaws has been increasingly performed in orthodontics to achieve better occlusal and maxillary relationship and, in doing so, improving oral functions. Maxillary and mandibular expansion has been proposed since Edward Angle to avoid extractions (Dewel, 1964). This paper presents a novel method to produce dental arch development in the maxilla and the mandible, while at the same time correcting or maintaining the inter-maxillary relationship either if a sagittal and/or vertical problem exists or a Class I malocclusion with normal overjet and overbite is present at the beginning of treatment.

There is a controversy regarding the ideal time for performing the expansion. Sari and co-workers reported that rapid maxillary expansion by means of a fixed screw (e.g. Hyrax) produces better results when it is performed in the early permanent dentition (Sari, 2003). Although this statement appears to be supported by other studies (Chung, Housley, 2003; Spillane, 1995), maxillary expansion may also be successfully done in older adolescents and adults (Stuart, 2003; Iseri, 2004; Lima, 2000). In the maxilla, rapid and semi-rapid expansion produce an increase of the lower nasal and maxillary base widths, with the maxilla moving forward and downward (Chung, 2004; Sari, 2003; Iseri, 2004).

These changes in the maxilla produced by the expansion are accompanied by a spontaneous mandibular response, which increases the dental arch perimeter (Lima, 2004; McNamara, 2003) and rotates the mandible posteriorly (Sari, 2003; Chung, 2004). Mandibular displacement is associated with an increase in facial height (Sari, 2003, Chung, 2004).

Net gain in the arch perimeter may be calculated accordingly with the expansion performed. Motoyoshi and co-workers reported that 1 mm increase in arch width results in an increase in arch perimeter of 0.37 mm (Motoyoshi, 2002). Akkaya and collaborators determined that arch perimeter gain through expansion could be predicted as 0.65 times the amount of the posterior expansion when treatment is performed with rapid maxillary expansion, and 0.60 times the amount of posterior expansion when treatment is performed with semi-rapid maxillary expansion (Akkaya, 1998). This is also supported by Adkins and co-workers, who determined that arch perimeter may increase 0.7 times the expansion produced at the premolars.

An expected relapse in the amount of expansion has been reported by some authors (Hime, 1990; Housley, 2003), which appears to be the result of that pressure delivered by the cheeks on the maxillary arch and the resistance to deformation of maxillary sutures and surrounding tissues to maxillary expansion. Nevertheless, maxillary and mandibular expansion rises up as one of the important phases of orthodontic treatment, producing arch perimeter increase, and thus, avoiding extraction of teeth. Increasing numbers of multi-banded techniques using passive self-ligating brackets have become popular, but few address the challenges of adapting the soft tissues to this new dental position. Long-term retention is the recommended solution to stability. Thus, the aim...
of the current paper is to present a new method to produce maxillary and mandibular expansion and, at the same time, to treat the soft-tissue dysfunction that may be responsible for treatment relapse (Ramirez-Yañez, 2005). Two example cases treated with the BWS Orthodontic System developed by Myofunctional Research Co (MRC) in Australia are presented to explain the proposed treatment.

The BWS Orthodontic System

The BWS Orthodontic System discussed in this article is composed of two different appliances: the Trainer and the BWS. These two appliances combined may simultaneously produce arch development and treat poor myofunctional habits. The Trainer, a prefabricated functional appliance, has amply demonstrated an ability to relocate the mandible (Louis, 2004) to correct improper forces produced by the muscles of the cheek and lips (Quatrelli, Ramirez-Yañez, 2005a) and to change the dimensions of the dental arches (Ramirez-Yañez, 2005b).

Further research (Yagi, 2011) showed that treatment using the Trainer produced a positive influence on the masticatory and peri-oral musculature.

However, in those cases where more maxillary and mandibular expansion is required to avoid teeth extractions, the Trainer alone combined with the BWS produces higher amounts of expansion and, therefore, a higher increase in arch perimeter. It is also proposed that by utilizing the Trainer in conjunction with the arch expansion, the force of the tongue activates further alveolar changes that other techniques may not achieve because of the bulk of the appliance being located in the palate where the tongue should naturally position.

The BWS is typically composed of a lingual arch, which follows the lingual surfaces of the teeth crowns at the gingival third and ends in a loop at the interproximal space between the second premolar and the first molar on both sides. The distal end engages a tube (0.025 barrel tube by MRC) welded to a cemented band on the first molars (Fig. 1). Additionally, the BWS is maintained in place, facing the gingival third of teeth’s crown, by two bogen premolar brackets cemented on the first premolars with the slot directed toward gingival or alternately composite stops bonded to the premolar or anterior dentition (Fig. 2). The wire component is 0.025 mm spring wire and is fabricated to the arch form of the starting models either by the laboratory or the orthodontist.

The simple nature of the BWS makes it possible to assemble in-house, avoiding the fees that accompany laboratory-constructed appliances.

An advantage of this system is that it does not involve using acrylic in the palatal vault. A functional appliance designed with acrylic on the palate and that is not properly built may lower the tongue, encouraging tongue thrusting, and, thus, either worsening the malocclusion or producing a relapse (Fig. 3). The Trainer is a prefabricated functional appliance, which means no laboratory involvement, and the BWS can be entirely constructed “in office.” The BWS is made of acrylic; nor does it occupy the palate. It allows the tongue to position correctly and the patient to speak normally.

The BWS is also suitable for use in the lower arch. Typical treatment tends to use only upper expansion for three to four months, after which time the wire component of the BWS is removed (the bands are kept for later use of the BWS). The i-2 Trainer (with the inner-cage that produces arch expansion) is then used to maintain the initial arch expansion gained using the BWS. Lower alignment is re-evaluated throughout this stage of i-2 Trainer use. Often, as can be demonstrated in cases selected, lower alignment and arch form improves because of the maxillary expansion and peri-oral musculature functional improvement (Fig. 4). The BWS is held in place using standard ligatures placed around the BWS tube as pictured (Fig. 5).

The following two cases show the effect of the BWS Orthodontic System on arch development.

**Case No. 1**

This 10-year-old female patient consulted because of a crowded dentition involving unusually misaligned upper central incisors with a midline shift of 10 mm and with lost “c” space on the lower left side. The parents requested that the treatment be non-extraction, although they had previously been advised that future orthodontic treatment might require this option (Fig. 6).

The occlusion was classified as Class I with normal slight overjet and with normal overbite. No skeletal alteration was found on cephalometric measurements and analysis of cast models reported a lack of arch development. This case was diagnosed as a Class I malocclusion with underdevelopment of both dental arches. Midline shift was primarily as a result of the lost lower “c” space. Soft-tissue analysis showed a mouth-open posture and hypertensive peri-oral musculature. It was considered the myofunctional habits were a contributing factor to the malocclusion and, thus, a suitable case for the BWS and Trainer combination prior to fixed appliances as the permanent dentition was fully erupted.

The plan of treatment involved a first phase with a BWS for the upper arch combined with an i-2 Trainer — “n” for no core or cage for increased flexibility and use with the BWS. The i-2 Trainer was used one hour daily plus overnight while sleeping. Monthly adjustment to the activating loops of the BWS were made in increments of 0.5 mm per month. This treatment was continued for four months, after which time the upper BWS was removed and i-2 Trainer was used to maintain the expansion achieved by the BWS. The i-2 Trainer also encouraged the tongue to assist in maintaining the maxillary expansion without retainers. At this stage, the lower arch form and dental alignment was assessed and showed considerable improvement. It was noted the space for the lower left permanent canine had increased — an effect thought to be produced by the combination of maxillary arch expansion and correction of myofunctional habits. The midlines were also self-correcting.

Space for the lower canines was ultimately achieved with lower BWS. The case is further improved by continued use of the i-2 Trainer and the Myobrace Regular to exploit the eruption stage prior to treatment finalization with fixed appliances as required.

The observation of the effects and benefits of the BWS Orthodontic System are evident from this case, and the concepts are not new to orthodontics. Maxillary expansion tends to also improve the lower arch length and assists the orthodontist in achieving non-extraction outcomes with more stable results because of simultaneous correction of tongue position and retraining of the peri-oral musculature. The second phase of treatment did not require the BWS on the lower arch as arch development during the treatment period sufficiently opened the space for the lower permanent canine.

The lower anterior teeth were also considerably crowded, and it would regularly be justified in extracting the first four premolar teeth and going into upper and lower straight wire fixed appliance therapy.

It could be argued that treating non-extraction will prolong the treatment and certainly incur greater expense on the parent. However, demand from parents who have had extraction orthodontics in the past...

**Case No. 2**

This 12-year-old female patient consulted because of very underveloped maxillary arch form and ectopic erupting canines (Fig. 8). This is far from an ideal stage to be considered for extraction treatment; however, the parent insisted that the case was attempted non-extraction. The lower anterior teeth were also considerably crowded, and it would regularly be justified in extracting the first four premolar teeth and going into upper and lower straight wire fixed appliance therapy.

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avoid this approach for their children. Therefore, the BWS Orthodontic System can be a beneficial technique that the orthodontist can use in these exceptional cases.

Treatment was similar to case 1. An upper BWS was fitted and combined with the use of the i-2n Trainer initially for four months, after which time the BWS wire was removed, leaving the molar bands in place. The i-2 Trainer was introduced at this stage for a further three months to maintain the expansion prior to a second phase of treatment using the BWS and i-2 Trainer for three months (as mentioned earlier in this article).

This allows the dentition to “catch up” and prevents excessive tooth mobility. It is thought that much of the expansion achieved by this system is dentoalveolar rather than sutural, as with a rapid maxillary expander and other acrylic expanders. Also, there is more development in the anterior arch form, which is an effect previously found in the research on the Trainer (Ramirez-Yañez, 2005b).

The difficulty in cases like this, requiring large amounts of expansion to achieve a non-extraction result, is a tendency to create an open bite. Although this occurs to some extent, the BWS Orthodontic System does not open the bite as much as more conventional techniques because the tongue position is favorably altered by use of the Trainer. This conjecture may require further investigation to ratify.

Once again, spontaneous alignment of the lower anterior dentition has occurred without the requirement for an additional BWS for the lower arch. This effect is not just restricted to these two cases but is a routine observation of the BWS Orthodontic System. This case also illustrates the stability achieved in the lower dentition as no retainers were used apart from night use of the Trainer.

Although this patient is not at the ideal age, the pictures show that it was possible to obtain space for all permanent canines, without extractions and with good stability. The bite opening is minimal and tends to decrease with further dental development. Although this case was finalized
with the Myobrace Regular™ from MRC, fixed appliances on the upper arch would possibly have delivered quicker results following the BWS Orthodontic System. The assistance of correcting the forces delivered by the muscles of the cheek (buccinator and temporalis) at swallowing cannot be ignored and is a key part of the modus operandi of this expansion system.

After two years of treatment and observation, along with night-time retention using the i-2 Trainer for 12 months after treatment, the BWS produced enough upper arch development to not only accommodate the erupting canines, but also achieve lower anterior alignment with minimal intervention and minimal retention (Fig. 9). This case was a more extreme example that orthodontists will face in the future as more parents demand the non-extraction option with minimal use of multi-bracket systems.

Conclusions

Maxillary and mandibular expansion has been shown to be an excellent alternative to increase the arch perimeter and, thus, to avoid the need for extractions to properly align teeth. This paper has presented two cases treated using the BWS Orthodontic System, which involves the combination of two appliance systems: the Trainer, a pre-fabricated functional appliance; and the BWS.

Both appliances, Trainer and BWS, have to be used in order to get the results reported in this paper. The BWS Orthodontic System showed in these two cases and in many cases treated by the authors is an excellent means to produce arch development in both upper and lower dental arches in a short time.

The effect of the BWS Orthodontic System on arch development does not change the inter-maxillary relationship when a Class I occlusion exists at the beginning of treatment. However, when a Class II malocclusion associated to a crowded dentition is present the BWS Orthodontic System produces arch development and, at the same time, the mandibular relocation effect is produced by the Trainer (Usumiez, 2004; Ramirez-Yañez, 2005a; Quadrelli, 2002), which treats the distal position of the mandible.

Additionally, the BWS Orthodontic System has shown to improve the overjet and overbite but to maintain them when they are correct at the beginning of treatment. This system treats muscular dysfunctions that may be the cause of crowding and malocclusion and may cause relapse after treatment is finished.

Thus, the BWS Orthodontic System may be proposed as an excellent alternative form of treatment in those cases where arch development is required to align teeth, patients want to minimize or even avoid brackets and extractions, the mandible needs to be relocated, soft tissue dysfunction is present and treatment needs to be performed in a reasonable period of time.

References


About the authors

CHRIS FARRELL, BDS, graduated from Sydney University in 1973 with a comprehensive knowledge of traditional orthodontics using the BEGC technique. Through clinical experience, he took an interest in TMJ/TMD disorder and, after further research, Farrell discovered that the etiology of malocclusion and TMJ disorder was myofunctional, contradicting the current views of his profession. Farrell founded Myofunctional Research Co. (MRC) in 1989 and has become the leading designer of intra-oral appliances for orthodontics, TMJ and sports mouthguards.

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