

# The Wave Spring

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**T**he major disadvantage of using stainless steel ligatures for space closure is that their force dissipates almost immediately, requiring frequent reactivation. Elastic chain or thread demonstrates fatigue over a relatively short period, causing permanent deformation and consequent force degradation. On the other hand, metal springs need less frequent reactivation and replacement, thus reducing patient visits and chairtime.

Although looped wires and cantilever springs are sometimes used, the closed-coil spring is the most common space-closing auxiliary. Nickel titanium is generally more effective as a spring material than stainless steel because it can be activated further before permanent deformation occurs. Nickel titanium also produces a more constant force level over its activation range. This allows the teeth to move farther

before the spring force diminishes below the threshold level, so that the time between reactivations can be extended.

## Wave Spring Design

The Wave Spring\* is a new type of orthodontic retraction spring that takes the shape of a wave when extended (Fig. 1). A superelastic nickel titanium alloy delivers a relatively large amount of activation—about 90g of force—from an extremely compact spring—only 6mm long in its resting state. Even when activated to more than three times its resting length, the Wave Spring returns to its original shape without permanent deformation.

When a closed-coil spring is activated, the

\*Trademark of Ultimate Wireforms, Inc., 200 Central Ave., Bristol, CT 06010.

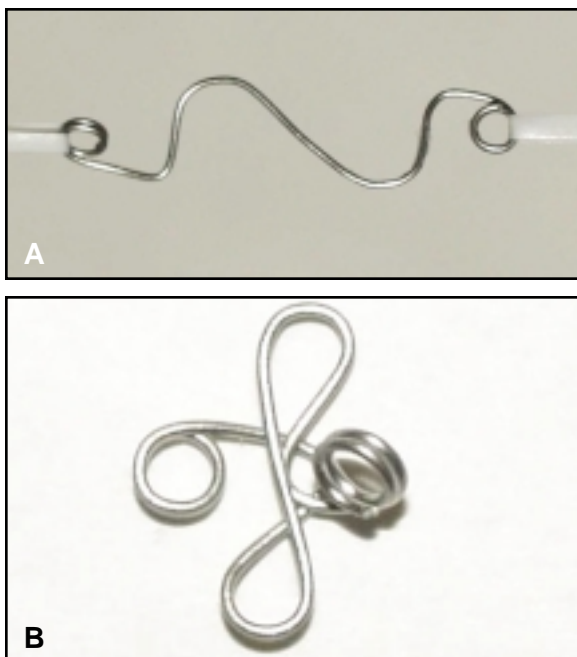


Fig. 1 A. Wave Spring activated. B. Wave Spring in resting state.



Fig. 2 Wave Spring used for maxillary canine retraction.



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ends of the spring twist in opposite directions; as the spring returns to its resting state, it unwinds, creating torque on the attached teeth. The Wave Spring stretches in a linear direction and thus produces no unwinding torque. Because the spring has no coils, it lies flat instead of protruding into the buccal vestibule, making it more comfortable and hygienic. Also, its attachment eyelets are integral to the spring, which eliminates the problem of the eyelets loosening and falling off.

The Wave Spring can be used in any situation where a closed-coil spring would be appropriate for retraction (Fig. 2). If more force is desired, the springs can be doubled up without becoming bulky (Fig. 3).

### Forced Eruption

The Wave Spring's greatest attribute is its

ability to fit into a small space yet remain active over a long distance. Because it has no coils, it excels in the extrusion of impacted teeth, using either an open or a closed technique.

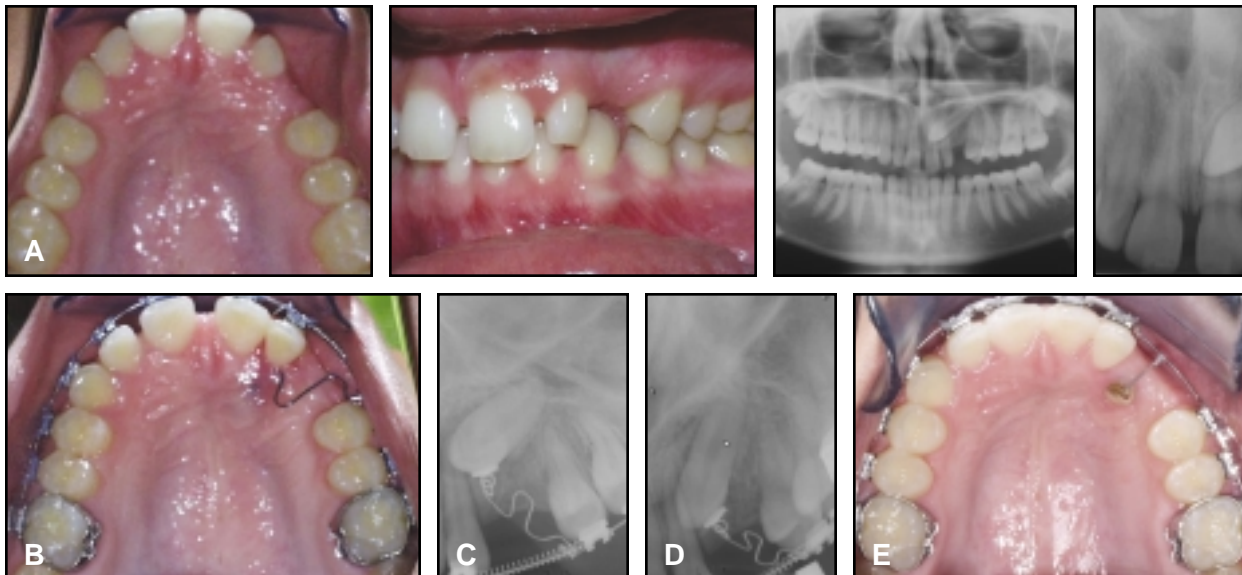
The open method involves surgically exposing the impacted tooth and bonding an attachment (Fig. 4). When the tooth lies above



Fig. 3 Doubled Wave Springs provide twice the force with no significant increase in space.



Fig. 4 A. 16-year-old female patient with Class I occlusion, maxillary spacing, moderate mandibular crowding, and unerupted canines. After leveling and alignment and creation of space for canines, only mandibular right canine had erupted. Patient was referred for exposure of remaining canines. B. Maxillary left canine was most severely impacted and had to be moved farthest. C. Canine after four months of forced eruption with Wave Spring, using open method. Bonded attachment and Wave Spring were then removed, and button was bonded to rotate tooth with elastic thread. D. Canines in position.



**Fig. 5** A. 14-year-old female with Class I occlusion, maxillary spacing, mandibular crowding, and severely impacted maxillary left canine. B. After surgical exposure, lightly activated Wave Spring was connected between bonded attachment on impacted canine and archwire mesial to maxillary left first premolar. C. In three months, palatal soft tissue granulated over canine and attachment. D. As tooth erupted and moved distally, spring was gradually reactivated by attaching it more distally. E. After seven months of eruption, Wave Spring was removed, and canine was tied directly to main archwire with elastic thread.

the mucogingival junction in the maxillary arch or below the mucogingival junction in the mandibular arch, a graft may need to be performed on its buccal or labial surface—if possible, by repositioning the flap tissue apically around the crown. Without the graft, the thin oral mucosa will surround the tooth, and the resulting lack of attached gingiva will make the tooth prone to gingival recession.

If the tooth is severely impacted, the flap may have to be closed after the attachment has been bonded to the tooth. In such a case, the closed method may be healthier for the surrounding periodontium and may result in a more esthetic clinical crown length and better long-term stability.<sup>1,2</sup>

With the closed technique, a gold chain or looped ligature wire is secured to the bonded

attachment on one end, and either an archwire or a lever arm on the other. The tooth is extruded through the tissue by tying an elastomeric ligature to the chain or the ligature wire. Because the elastic fatigues so rapidly, however, this process involves multiple patient visits. If a Wave Spring is used instead of a gold chain, it will not have to be reactivated as often (Figs. 5,6).

#### REFERENCES

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2. Becker, A.; Brin, I.; Ben-Bassat, Y.; Zilberman, Y.; and Chaushu, S.: Closed-eruption surgical technique for impacted incisors: A post-orthodontic periodontal evaluation, *Am. J. Orthod.* 122:9-14, 2002.



**Fig. 6** A. 12-year-old male patient with Class I occlusion, maxillary spacing, mandibular crowding, and horizontally impacted mandibular right second premolar. Impacted tooth could have been extracted and later replaced with crown and implant, but this might have left large periodontal defects mesial and distal to extraction site. Instead, bite was opened and arches leveled. Open-coil spring was then placed to regain space for mandibular right second premolar. B. After surgical exposure, Wave Spring was attached to bonded bracket. Collagen was placed over bracket to promote bone formation, Wave Spring was attached to mandibular archwire, and flap was closed. C. Spring was attached more mesially at five-to-six-week intervals to encourage uprighting. D. After seven months of eruption, spring was removed; button was bonded to premolar and tied to archwire with elastic thread. E. Four months later, bracket was bonded to tooth for final alignment. F. Patient after debonding.