

Beyond Edgewise - The Triamond™ Appliance: Biomechanics and Protocol

The goal of the Wedgewise technique is to achieve treatment objectives without the complications built into all the variants of Edgewise. This new category of orthodontic device is rooted in the principle of uniform force distribution along the dental root within the framework of a light wire technique.¹ In this way, Wedgewise can more predictably create tooth movement without the deterrents which occur in Edgewise and serve to slow orthodontic treatment. It is the logical successor to Edgewise.

The unique arch wire slot design of the Triamond™ bracket together with the self-ligating clip mechanism act to maintain the full-fit of the arch wire in all dimensions within the slot. This characteristic eliminates any “play” between the arch wire and bracket slot, which is inherent to Edgewise. Therefore, moments of couples (rather than forces) are produced without binding at the bracket corners which occurs with rectangular slots and undersized wires, i.e. Edgewise (Fig 1).

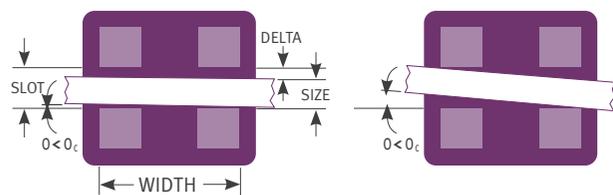


Fig. 1: Profile view of Triamond™ bracket engaging the Wedgewise wire. Note the corresponding fit between the slot and the arch wire as opposed to an Edgewise bracket.

This also eliminates the alternating crown (tipping) then root (uprighting) movements that the latter employs during tooth movement (Fig. 2a-c).

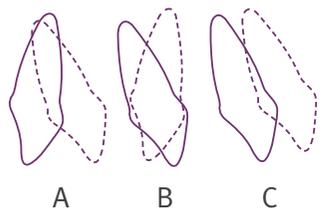


Fig 2: Description of actual tooth movement during bodily movement. (A) Initial crown tipping proportionate to “play” in slot – uncontrolled tipping, (B) Root upright occurring with wire binding at bracket corners (moment-of-the-force), (C) resultant tooth movement appearing to be translational (A+B=C).

The implications of these differences are that less friction is created by Triamond™ brackets under conditions of malalignment as well as with larger sized finishing wires (Fig. 3),² the efficiency of tooth movement is improved since wire binding is avoided, and lower forces need to be applied.

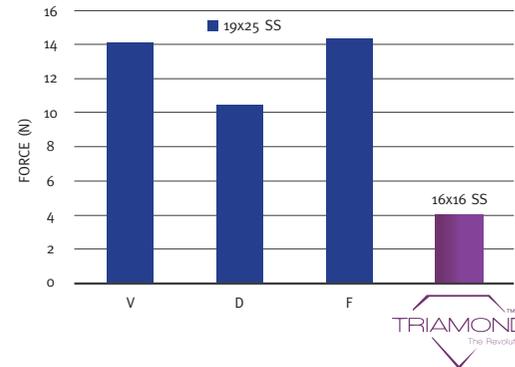


Fig. 3: Comparison of frictional forces generated by displacing a 0.195”x0.025” wire through a straight 5-bracket segment of 3 different Edgewise brackets, and a Wedgewise wire through an analogous Triamond configuration. Note the 2.5-3.5x greater friction caused by Edgewise variants.

Biomechanics

Wedgewise vs. Edgewise

Major differentiating characteristics of Wedgewise are found in the biomechanical responses as expressed by the Triamond™ appliance. For example, comparing biomechanical behaviors in resolving crowded mandibular incisors, specifically, the most lingually/occlusally displaced such tooth. When an Edgewise appliance, regardless of method of ligation, is used to correct this malocclusion, the aforementioned tooth has expressed on it labially and apically directed forces.

This results in labial movement of the crown due to a horizontal force in this direction and the vertical force directed apically and forward of the center of resistance which creates a moment to rotate the tooth labially. These forces also cause lingual movement of the root apex. Taken together, this distribution of forces improves the alignment of the dental crown, but causes uncontrolled tipping (Fig 4a,b).

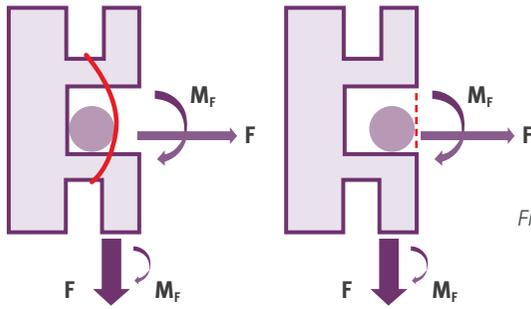


Fig 4: Force diagram as expressed on an elastomeric/steel ligature ligated (a), and self-ligating (b), alignment wire in an Edgewise bracket.

In contrast, the same conditions treated with the Wedgewise / Triamond™ appliance generates different more beneficial force vectors (Fig 5).

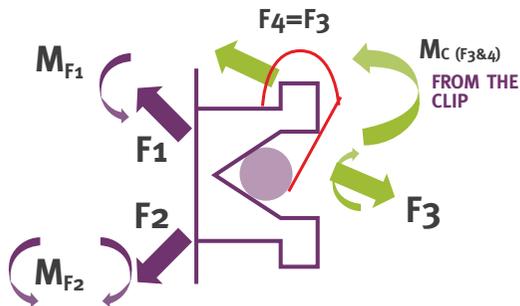


Fig 5: Forces (F1-3), associated moments (M1-3) and Moment of the Couple (MC) generated by engaging an alignment arch wire into an extruded and lingually displaced lower incisor during leveling and alignment.

Firstly, the two angulated walls with the arch wire held against them produce divergent forces with their corresponding opposing moments. Secondly, the unique design and interplay of the self-ligating non-locking and non-rigid clip which counters the forces caused by the arch wire, comprises a third-class lever. This produces a moment in the opposite direction of that generated by the labial/intrusive forces caused by the arch wire, therefore, uncontrolled tipping to this tooth is reduced or eliminated. Taking into account the lack of binding at the slot edges and the differential forces created by the clip and unique slot geometry, as well as a reduction of uncontrolled tipping, a reduction of overall treatment duration can be expected. This is not just another self-ligating bracket!

Protocol

Only 2 sets of arch wires

The geometry of the Triamond™ bracket slot coupled with the properties of the self-ligating clip mechanism imbibe the Wedgewise appliance with unique capabilities and utilization. Whereas Edgewise consists of three essential stages; leveling and aligning, then working, then finishing, Wedgewise is comprised of two, since working and finishing are performed simultaneously. The former requires 3-6/7 pairs of arch wires to complete, however, Wedgewise is administered with only two pairs of arch wires.

Bonding without compensations

Firstly, the preferred course of diagnosis and treatment planning is carried out. Wedgewise does not dictate one type of treatment preference. Secondly, bracket placement is performed without any compensations for side effects experienced in Edgewise (i.e. for bite opening/closing, prevention of collapse into an extraction site, etc.). Leveling and alignment are accomplished using a 0.016" nickel titanium arch wire. Should the calibrated self-ligating clip mechanism not be able to be nearly or fully closed, it can be done so at only one corner with full engagement planned for the ensuing appointment (Fig. 6). Alternatively, a 0.014" nickel titanium wire can be used.



Fig 6: Following initial Triamond™ bracket bonding and insertion of a 0.016" nickel titanium arch wire. The severity of the rotation of the maxillary right second premolar precluded full arch wire insertion, therefore, the clip was utilized to engage it only on its distal corner. Full engagement was possible at the next appointment.

Simple, reliable contributory self-ligation

The clip is best opened and closed using the accompanying tool (Fig. 7).



Fig 7: Here is pictured the accompanying Triamond™ opening/closing tool. A close up of the tip of the tool is provided.

It has a tip that exactly fits the purchase point in the center of the clip and is engaged by orienting the handle of the tool horizontal to the occlusal plane either from the mesial or distal. All that is required to either close or open the clip is to roll the handle of the tool between the thumb and forefinger a fraction of a turn with little effort. The clip has been designed and tested to maintain its integrity and undergo this function well beyond its dependable clinical use. It has not been shown to fail or become difficult to manipulate under any conditions of oral hygiene (i.e. calculus build up etc.).

Due to the full expression of the prescription delivered by the Triamond™ appliance, it is recommended that once the alignment stage arch wire has become passive, that tooth positions be evaluated and any needed bracket re-positioning be done. The alignment arch wire(s) should then be re-engaged to complete this stage of treatment. In Wedgewise this will eliminate or significantly reduce any wire bending that would otherwise be necessary during both the working and finishing stages of Edgewise.

Elastics from day 1

In yet another deviation from Edgewise, a consequence of the Wedgewise mechanism is that intra/inter elastic forces can be applied from the initial alignment wire. Meaning, that elastic chains, Class II/III elastics can be applied together already with the alignment wire. Since higher force levels required in Edgewise preclude this option, these supplemental forces are not delivered prior to the working stage, whereas in Wedgewise lighter forces can be applied earlier in treatment. Meaning, that when 0.014" and 0.016" nickel titanium arch wires are used, 2- or 4-ounce elastics, respectively, are appropriate. Depending on the thickness of the elastic products to be used, simultaneous use of elastic chain(s) with intermaxillary elastics often requires engagement of the chain only around the incisal wings of the given bracket where said intermaxillary elastics will also be engaged (Fig. 8).



Fig 8: Clinical presentation of a patient in the working/finishing stage of treatment where space closure is being performed in the maxillary arch using an elastomeric chain which bi-passes the clip of the canine to permit easier engagement of a Class II elastic to this tooth.

Under these conditions, it should be anticipated that a half-cusp Class II canine relationship be resolved to a Class I within 1-2 appointments, given patient cooperation.

6 weeks between appointments

It is recommended that patients be seen every 6 weeks for adjustments. These appointments should be comprised of either replacement or provision of elastic products, bracket repositioning, or progressing to the second and final stage of treatment, working/finishing, by changing to the 0.016" square stainless-steel Wedgewise

arch wires. This arch wire can be adjusted/bent/detailed using the Wedgewise plier whose beak/tip mimics the slot of the Triamond™ bracket (Fig. 9).

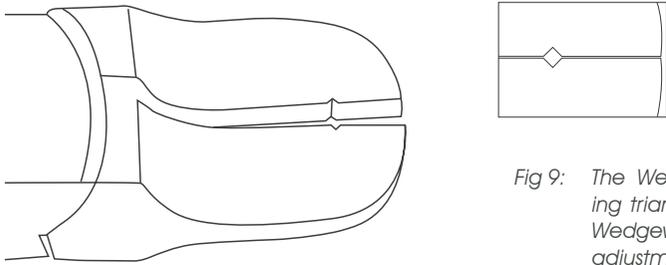


Fig 9: The Wedgewise plier. Note the opposing triangular grooves in its tip where the Wedgewise wire is to be held during its adjustment(s).

This provides a positive non-crushing hold of the arch wire so that it cannot twist or slip as when adjusting Edgewise wires. Furthermore, as opposed to Edgewise, where there is always play between the arch wire and bracket slot requiring overestimation of any detail bends needed, in Wedgewise these conditions have been eliminated and only the required detailing should be performed.

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Conclusions – Patient/Doctor Benefits

Wedgewise is a light wire technique combining a unique geometry and interplay of the Triamond™ bracket arch wire slot, the Wedgewise wire and the force-vector enhancing characteristics of the self-ligating clip. These components facilitate orthodontic tooth movements and treatment in less time than Edgewise because it does not superimpose the side effects nor require the higher levels of force inherent to the older method. Clinical trials have typically resulted in treatment duration occurring in 40-60% less time than previously experienced with Edgewise.

Furthermore, fewer tasks using a smaller armamentarium are required to accomplish each patient visit. We can report finding a 30% increase in practice efficiency as determined by comparing patients treated within a fixed schedule. These properties are tailor-made for the modern orthodontic team practice where the use of a quickly mastered and simple to use fixed appliance is more intuitively managed to provide predictably excellent clinical outcomes.

Welcome to the Triamond™ revolution.

REFERENCES

1. Consolaro A. Force distribution is more important than intensity!. Dental Press J. Orthod. vol.19 no.1 Maringá Jan./Feb. 2014.
2. Michailidis, Panagiotis. "Comparative study of frictional forces generated by a bracket with a unique slot geometry vs. Victory, Damon 3 and Flair brackets", Master's Thesis, Goldschlager School of Dental Medicine, Tel-Aviv University, 2019.