Leveling mechanics is due to the application of:
• adequate inter bracket distance,
• light and elastic force,
• preformed memory arch wire.

One of the advantages of nickel titanium (NiTi) and super elastic arch wire is that we can fill the bracket slot earlier during the course of the treatment plan.

In lingual orthodontics compared to labial orthodontics, rotational movement to level a single rotated tooth is not easy to achieve.1

There are several points to consider:

Movement mechanics of a rotated tooth
The only force system that can produce pure rotation (a moment with no net force) is a couple, which is two equal and opposite and parallel forces, but non-collinear.4

The rotational movement depends on the moment of the forces. The moment of the force is equal to the magnitude of the force applied, multiplied by the perpendicular distance of the line of action to the center of resistance.

These forces applied to the tooth should produce efficient rotation. However, in buccal orthodontics, rotation movement of rotated teeth can be accomplished even without an exact application of this force system.

Memory-shaped pre-formed arches in large cross-sections, filling the slot of the bracket, have good control of the tooth movement and can perform this task within a short amount of time.

In labial orthodontics, leveling seems to be easier and can be resolved in less time. Reference the clinical case (Figs. 1 and 2).

In the lingual technique, the arch wire could move the teeth in the lingual direction.1 That is the reason why some movements are difficult to achieve, as they are in the labial technique.

The problems are:
• During the rotational movement, teeth are moved lingually into a shorter length of the arch, with less space for movement (Fig. 3).
• The small size of the arch and subsequent short inter-bracket distance (Fig. 4).
• Less control of the arch in the bracket slot.

The short inter-bracket distance necessarily means that any moment produced across a given bracket will be decreased due to the short lever-arm to the center of rotation.

This is more significant in the mandibular dental arch because it is more constricted than the maxillary and the incisor mesial-distal width, which is less than the maxillary incisors (Fig. 4b).5

Depending on the available space for de-rotation, it can be necessary to open space as the first step. The second step is the de-rotation.

Slot position
If we consider de-rotation as an isolated step, then we know the power applied works on the horizontal plane. In principle, by all brackets with horizontal slots, the arch wire can slip off (Fig. 5). Two factors can avoid this problem.

The ligature holds the arch wire into the slot. This effect can support the force direction.2

But this effect can be eliminated if the force direction pulls the arch wire out of the slot. This can happen very frequently with the lingual technique.

Using light forces and also small diameter arches make it more difficult and almost impossible to de-rotate a rotated tooth at the moment of leveling.

Contingent on the various force systems, the arch wire can move in the lingual direction.5 That is the reason why some movements are difficult to achieve, as they are in the labial technique.

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action and jacking position of a labial or a lingual arch wire, the position of the bracket slot has different consequences. The horizontal slot makes fewer problems in labial, as in lingual, technique.

Today, the majority of the lingual brackets in the market offer horizontal slots. With this particular orientation of the slot, only the ligature contains the arch. Thus, the points of the applying forces are not firm when elastic ligature is used, even with steel ligation and full engagement of the arch wire in the bracket slot.

Even slight rotations of the tooth are difficult to be solved completely in this way with stainless steel ligature. The use of copper-nickel titanium arch wires will slightly increase the effectiveness because the arch has a tendency of sliding out of the lingual slot.

What is the solution? For de-rotation, the slot needs to be close to force direction (Fig. 6). In principle, a tube would solve all problems. However, to use tubes on all teeth makes it impossible to insert the wire.

When the leveling stage requires de-rotation of a single tooth, the vertical slot is an alternative. During de-rotation, the arch wire is in contact with the bracket body or metallic framework (Figs. 6, 7 and 9). Therefore, the power from the arch wire will transfer completely to the tooth.

However, a vertical slot instead of a horizontal slot is also not enough because some of the movements in this stage (leveling) might be affected, and it may not be very efficient with this orientation of the slot. For example, any vertical movements, especially intrusion movements, are difficult with a vertical slot. In principle, this is the same problem with a horizontal slot and de-rotation as described.

The clever solution
To find a satisfactory reply for the outlined problems, an ideal lingual bracket would need a vertical and a horizontal slot. This is a technical challenge because, on one hand, lingual brackets need to be small in all directions. On the other hand, they should have many features. A good compromise is the magic lingual bracket system.

For front teeth, magic brackets have a horizontal slot (Fig. 8), but the insertion of the arch wire is vertical. When the arch wire is in position, it is held into the horizontal slot and cannot slide in the direction of the force because the metal wall of the bracket body does not allow it (Fig. 9).

This special design will achieve most of the movements that de-rotation requires and is effective in realizing the necessary vertical, in-out and angulations movements that leveling requires. In the posterior teeth, the situation is identical because of the vertical slot design of the brackets (Fig. 7).

These are the advantages of a vertical slot (not only for lingual brackets): better torque control, rotation and "en-masse" retraction. Additionally the arch wire is easy to insert because there is a direct view into the slot.

Effective control with rotation and torque require brackets with a long mesial-distal distance (Fig. 11). Naturally, the issues of a short inter-bracket distance can be solved or minimized with the use of memory-shaped arch wires and, especially, super elastic arches.

In order to accomplish those movements effectively, it is important to consider indirect bonding to place and position lingual brackets. Indirect bonding significantly reduces rotation deviation with irregular proximal contact points.

Conclusion
In comparison to labial orthodontics, rotational movement is difficult to achieve in lingual orthodontics. There are many reasons for this, but one of the most important is the use of brackets designed with a horizontal slot.
The results of this design specific to de-rotation of a single tooth, or a group of teeth, are very poor and require a lot of time.

Magic lingual brackets are designed with a special slot. In these brackets the arch wire will not disengage the slot, and the leveling forces are very effective in achieving all the movements efficiently.

* (Dentaurum, Turnstr. 31, 75228 Heiningen, Germany; www.dentaurum.de)

References

About the author

Dr. Rubens Demicheri received his DDS in 1983 from the Universidad de la Republica (UDELAR) in Uruguay and then went on to complete his postgraduate studies at Nagasaki University in Japan. Demicheri has been an associate professor in the Department of Pediatric Dentistry at UDELAR, a visiting lecturer at the University of Alfonso X el Sabio in Spain and a lecturer on lingual orthodontics in South America and Europe.

Contact him by e-mail at demicheri@odon.edu.uy.