

# STEP: Optimizing a well-known technique

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For almost 20 years, we have been using the Straight Wire Technique, invented and developed in the mid 1970's by Dr. Lawrence Andrews.

With time, the biomechanical properties characterizing each individual bracket underwent changes. These changes require a careful review of the problems related to the control of dental movement during the clinical use of the brackets.

Most important changes were introduced at first by Dr. Roth, then by Dr's. Bennett and McLaughlin. Their prescriptions are the origin of modern techniques developed from the original technique.

Our ten year relationship with Dr. Richard McLaughlin has inspired our treatment approach and enabled us to work closely with LEONE and Dr. McLaughlin to carry out studies about the efficiency of different brackets on our patients who do not match the North American ethnic standard used as a base for many other studies.

Along with the R&D department at Leone we developed a new set of preformed brackets, first during the design and biomechanical analysis steps, then - and just as importantly - during the clinical evaluation phase. This way, we seized the opportunity to propose some significant changes in the design and technique in order to solve some biomechanical problems we met during our many-years of clinical practice.

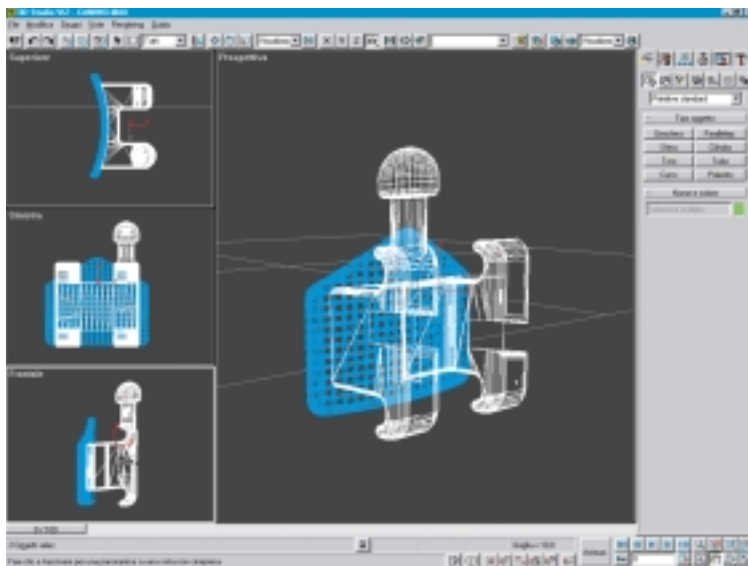


Fig. 1 - Computer-assisted design.

## DESIGN AND MANUFACTURING

The new STEP brackets, acronym for Straight Technique Evolved Philosophy, are designed through a computer assisted procedure and manufactured by the MIM (Metal Injection Molding) technique (fig. 1).

This technique is the state-of-the-art for producing precise mechanical parts including rounded surfaces, with good dimensional stability.

When we first discussed the STEP bracket, the first question to emerge was the shape and size we should give it.

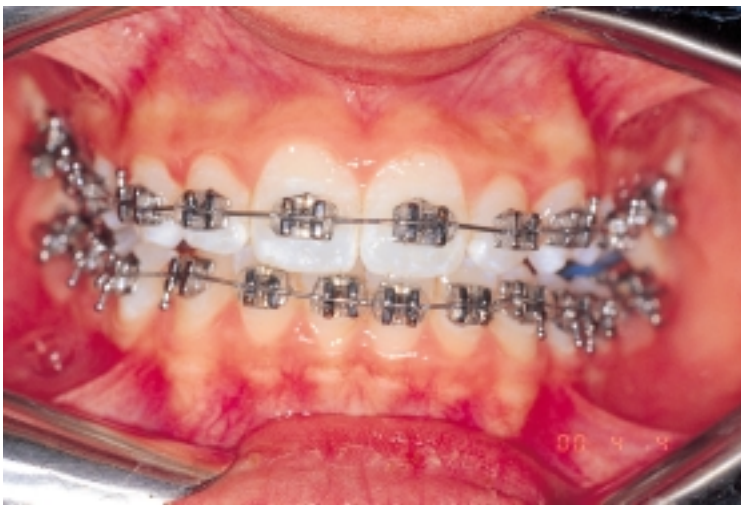
We remembered all past discussions and arguments about the ideal shape and size a bracket for the Straight Wire Technique should have; we took into consideration the universal use of Nickel-Titanium wires (shape-memory or thermo-activated) which, thanks to their outstanding elasticity, don't ask for a wide interbracket distance to increase the flexibility of the archwire, (fig. 2 and 3).



Fig. 2 - Treatment with Mini Diagonali brackets

We made an evaluation of the shape, dimension and quality of the retention bases and we performed a statistical analysis on anatomical data, trying to meet high expectations regarding clinical use, hygiene and resistance to treatment and masticatory forces combined.

Starting from a statistical study on tooth sizes Dr. McLaughlin recently published in the JCO, we built a positioning chart for the brackets, in order to optimize the mechanical properties built in their slots.



*Fig. 3 - Treatment with STEP brackets*

We are now able to compare the features and benefits of diagonal and classical brackets; we selected the latter, for - according to our clinical experience - they are easier to position and more therapeutically efficient.

All the reasons allowed for a determination of the shape, the size, the degrees of torque and angulation, the in-out value, the material and the manufacturing process for the new bracket, which special features are:

- a) increased mesio-distal dimension in order to optimize the application of forces regardless of the tooth.
- b) Enlarged bonding base, curved mesio-distally and occlusogingivally to reduce the thickness of the adhesive and optimize the bond strength.
- c) Easy positioning, thanks to the rectangular design of the body of the bracket, to the pentagonal base with its upper angle and to the laser marking between the tie wings. STEP brackets feature an average of 10% higher bond strength, because of the “arrow” of the pentagon. In-vitro bond strength tests were performed and demonstrated that this additional surface is giving the base a bond strength which, being oriented in the same direction as masticatory forces, resists to normal stress and absorbs any additional stress that would encompass the limitations of a normal bonding base.
- d) .022” slot, torque-in-base, tip-in-slot, in-out, all these values were respected through the use of leading-edge technologies for designing and manufacturing the brackets.

## POSITIONING

This step is critical for achieving good treatment results, essentially with a fully preinformed technique as STEP. The specific “arrow-like” shape of the base and the laser etched line in the middle of the bracket allow for a better visual assessment of the main frame of the bracket and facilitate its positioning along the long axis of the tooth (fig. 4). Mesial and distal edges of the base are parallel and make mesio-distal positioning easier.

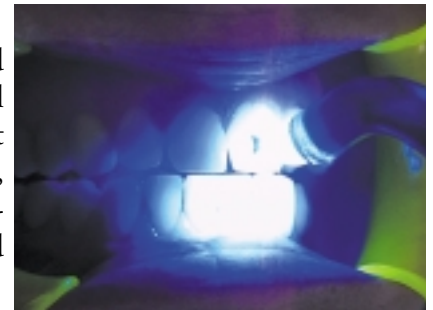
The laser marking on the base with the FDI identification number of the tooth enables a precise identification of the individual bracket and suppresses any risk of misplacement. Our experience led us to advise the use of a color-coded



*Fig. 4 - Correct positioning of STEP brackets*

aluminum height gauge for setting the bracket at the proper height. In addition, the light-cured bonding agent was very useful to settle the bracket position without any concern about setting time (fig 5 and 6).

The round and individually anatomical shaped base makes positioning in the center of tooth long axis correct. The 80 gauge mesh and the optimized anatomical design of the base warrant an optimal bond strength, as the quantity of composite between the base and the enamel is minimal.



*Fig. 5 & 6 - Using a light-cured bonding allows for a precise positioning of the bracket*



## BIOMECHANIQUE

The mesio-distal dimension is slightly higher in STEP brackets, this is intended to improve the tridimensional biomechanical control of the tooth and to facilitate the alignment of the crowns and, mostly, of the roots.

The antero-posterior thickness of the bracket was increased and the tie-wings were redesigned in order to respect the proper in-out value for each individual tooth.

The resulting higher ligating space allows for the use of accessory ligature, tie-backs and lace-backs, all these being essential for our treatment approach, but sometimes difficult to use with a mini-bracket.

Thanks to these features and to the rounded and smoothed surfaces of the STEP brackets, enforcing a good oral hygiene is easier at any step or the orthodontic treatment (fig. 7).



*Fig. 7 - STEP bracket and lace-back*

Torque-in-base directly transmit the forces to the center of the clinical crown, ensuring the proper torque to be achieved (fig. 8).

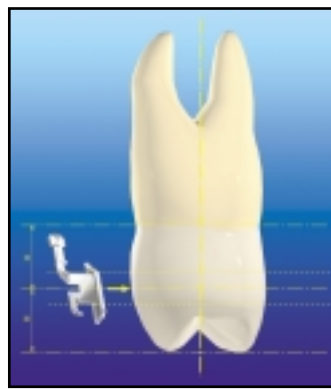
Torque is positive on maxillary incisors and negative on all other teeth.

The teaching of Dr. McLaughlin led us to keep torque values similar to those he chose. So far the clinical response for our patients has not shown any problem related to the torque values of this prescription.

At any step of the treatment, these torque values, positive on the upper incisors and negative on all other teeth, facilitate the control of the over-jet and of the overbite, especially in Class II correction.

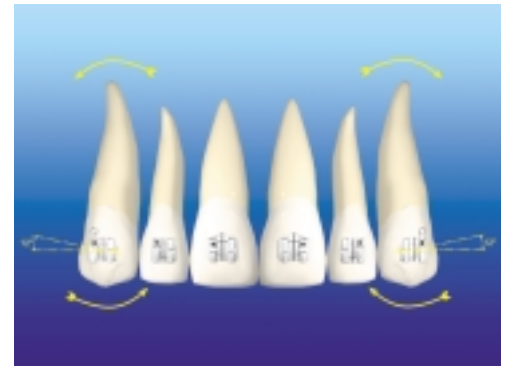
We introduce some changes in tip values, in order to solve some problems we met in controlling the over-jet, in closing extraction spaces and during the retention phase.

In the past few years, when using the most recent brackets, we noticed a consistent loss of torque in the anterior segment in our cases (extraction and non-extraction). Beforehand, this phenomenon was very seldom observed.

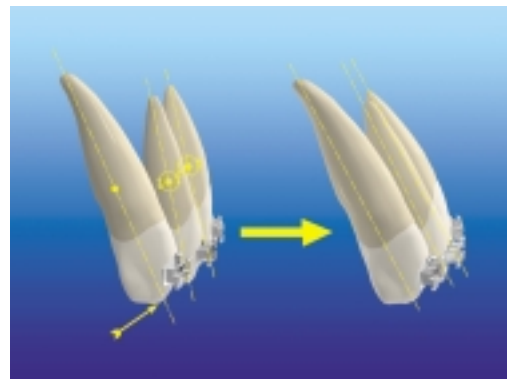


*Fig. 8 - Schematic biomechanics for a torque-in-base bracket*

In our opinion, the problem was the tip on the upper cuspids and bicusps. Using computer software, we simulated the retraction of the anterior segment with a .019" x .025" archwire with hooks and with more tip built in cuspids and bicusps brackets, the results confirmed our assumption. When using this prescription, the crown of the cuspid - with more tip - fills more space on



*Fig. 9, 10  
Increase tip on the cuspid impinges the laterals and centrals towards the midline.*



*Fig. 10*



*Fig. 11  
Pressure from the cuspids and movement guidance from the arch wire increase the torque on the incisors*

the dental arch and "buttresses" the crowns of the lateral and central. The loss of torque is minimized (fig. 9, 10, & 11). In other words, increasing the tip on the anteriors reinforces the anterior torque during the critical levelling and aligning phase, when using round wires: a significant loss of torque is

typically observed during this phase of treatment, this loss is difficult to compensate during the correction of the over-jet and the space closure.

We must say - as any Straight Wire practitioner well knows - that an increased tip calls for more attention to anchorage control, as the appliance will apply a more buccal force on the anterior teeth resulting in possible mesial movement of the posteriors.

Thanks to their precisely cut and smooth slot, that significantly reduces friction, STEP brackets make sliding mechanics easier.

## CONCLUSIONS

When finishing our cases with preinformed appliances, we met frequent problems related to a poor fit between the appliance and the individual patient.

STEP brackets were designed and produced through lead-edge technologies. They demonstrate a good fit to any patient and allow for achieving treatment goals in the most simple and secure way. They also reduce treatment time.

Perfect bracket positioning is one of the key factors in the modern fixed therapy. STEP brackets were designed with this objective in mind. Classic design was adopted because, based upon our clinical experience, we think that the diagonal design is not helpful in order to visualize the mid point of clinical crown. The bracket mesial distal width was increased allowing a perfect orthogonal placement and maximizing the biomechanical control permitting better utilization of the wire properties and shortening treatment time. This encourages the patient's cooperation.

Increase tip value of the cuspid bracket gives more root buccal torsion of the upper incisor avoiding the presence of space among canines and laterals at the end of the treatment. Patient comfort is greatly enhanced by a perfect polishing of the brackets. Treatment results are optimized by all the features a fully preinformed appliance can and should have.

STEP brackets are part of a treatment system specifically designed and developed to maximize the efficiency and predictability of orthodontics.

This system includes bands and specially designed buccal tubes, arch wires with hooks, Memoria and Thermomemoria arches, elastics, elastic ties and other specific products that will allow for a near-to-perfect therapeutic approach.



*For items mentioned in this article please refer to pages 14, 15, 16, 17 and 19.*

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