STEP an Evolved Straight Wire Technique Philosophy: The Motives and Reasons of a Choice and its Ten Years of Evolution

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In the year when Italy celebrated its 150th anniversary of its unification, I too together with Leone celebrated our 10th year anniversary of an “idea,” the Italian Straight Wire (SW) treatment system. It is important to note that the Step system was derived after years of working with Richard McLaughlin and from many years of using the Vector 3 system and then the so-called MBT system. Therefore it clearly has American roots and could not be interpreted in ways other than the USA being the cradle of biomechanics.

The considerations and indications that gave birth to the Step system derived from the clinical applications and the numerous treated cases with the above mentioned systems. The Step system is characterized by biomechanical flexibility while emphasizing the “logical” simplification of the therapeutic method naturally leading from a plan of the required clinical steps to the resolution of the case. Practically, at least at the start, nothing had been invented. However the original system was optimized with the objective to realize a reproducible technique even in the hands of non-experts. Today, according to the feedback from numerous Italian and foreign clinicians using our system, we have confirmation of having developed, also for less trained dentists, a method that, starting from the appliance planning, leading to a “schematization” of the treatment steps and consequently to predictable results.

An evolution in the design of mini-screws. Introducing the new Leone mini-expansor screw. The new Stealth™ Slender Expansor® Screw is very compact with design innovations that make it ideal for smaller palates where application size and versatility are top priorities. Competing products simply do not measure up; they tend to be larger with more cumbersome mechanics and inferior construction techniques that become plaque traps. The Steath™ Slender Expansor® Screw is a superior product with many advanced features:

SEE PAGES 14-15

New Catalogue Available

SEE PAGES 2-18
The use of the Step technique, thanks to the “logical” versatility of the system, allows for utilizing different levels of friction, permitting to finish cases within the predicted length of treatment time and costs. In fact today we must refer this technique to a Step “system” of which there are several parts, or steps. These include specific brackets (metallic and esthetic), specific sequence of wires (divided into phases and according to their necessity), auxiliary appliances (from elastic tie-backs, height templates to mini-implants) and finally, the possibility of transforming the system to a low friction appliance by using the uniquely designed Slide* ligatures.

In retrospect when we look back at these past 10 years of treating patients with the Step philosophy, we often return to its origins, to the initial motives leading us to choose the materials that are the components of the system in use today. Therefore we will review and clarify the important points of these choices and of the fascinating orthodontic adventure.

The Conception of the Bracket and of the Step Technique

During the beginning months of the new millennium, Alessandro Pozzi, owner and head of Leone, asked Dr. Massimo Lupoli and me to collaborate in the creation of a SW system that could be a Leone trademark. We were approached to develop this new product since we both had many years of experience using Vector-3 brackets followed by using the MBT system all the while sharing clinical experiences with Dr. Richard McLaughlin.

It was with great enthusiasm that we started proposing improvements that derived from the appliances that we were using. The basic principle was, and still is, that the biomechanical efficiency of a bracket derives, for more general aspects, from its dimension and its shape, and, for the specific tooth position, from the torque, angulation and in-out measurement data. Based on these concepts and sharing them with Leone engineers, we developed a series of brackets with ideal shapes, dimensions and pre-adjusted values.

Analyzing our past cases where we used Vector-3 and MBT brackets, we chose to go back to a greater mesio-distal dimension to allow for improved biomechanical efficiency. With respect to the rhomboidal shape, that was developed to facilitate the correct positioning but did not convince us, we decided to change the bracket to a more classic shape, maintaining the torque prescription at its base.

In fact it must be underlined that the larger dimension and the particular shape are absolutely critical in the correct positioning of the brackets. This is of great benefit especially since correct bracket placement on a tooth is a fundamental clinical aspect in the straight wire technique.

For the prescription values, typical of any straight wire system, we decided to increase the tip for the canines, similar to the Roth prescription, because we did not see any improvements in the decreased tip found in the MBT brackets.

In the anterior region, being aware of the inevitable loss of real torque due to the play between the “.022” slot and the various rectangular archwires, we reached anterior torque values (bigger than in the Roth technique), and typical of the Vector-3 and then MBT.
The same prescriptions were transferred to the line of ceramic esthetic brackets that combined the same biomechanical efficiency with esthetics.

**From the Technique to the Step System**

Ergonomics and efficiency: this is what a biomechanical system should provide to be able to address the challenges that the profession is faced with. With these goals clearly in mind we “assembled” the appliance that gave origin to a truly and appropriate therapeutic system.

Soon enough, the Step System became a treatment method, a systematic approach, resolved to obtain the maximum efficiency in as little time possible and with predictable results.

The Step System appliances achieve aspects that, in our opinion, are fundamental objectives of a treatment:
1. Increasing control and quality
2. Increasing comfort and therefore collaboration
3. Decreasing the number and time of each clinical appointment while extending the interval between appointments
4. Reducing the full treatment time

The Step System is based on its use of optimized brackets, in shape and torque and tip values together with a set of archwires selected according to the therapeutical step. These wires allow, through the use of innovative low friction Slide* ligatures, to modulate the friction generated at the level of the bracket-wire interface. The interaction of these two components allows creating the ideal biomechanics for each specific case improving the therapeutic times and the necessity of extractions.

The ergonomics and efficiency of the sequence of archwires came about from the simplification of the number and type of wires needed (a maximum of 9 wires, including the optional ones), from a wide range of options of materials and wires. In the sequence, first the high-tech modern Nickel Titanium (NiTi) archwire, a superelastic material, releasing a constant and biologically low force is used. Then Australian steel wires and posts are used as working arches, while the intermediate elastic properties inherent in the titanium-molybdenum alloy wires are employed during the detailing phase, taking full advantage of its properties for maximum 3-D control.

After years of use and hundreds of successfully treated cases, we are able to claim with certainty that our system’s sequence of archwires have given truly maximum control during each phase of treatment.

**The Era of Low Friction**

A few years after the introduction of the Step System, the most popular orthodontic words became “low friction”. The person championing this biomechanical philosophy was Dr. Dwight Damon who had the merits to straightening and mainly divulging the advantages of diminishing the tight binding at the wire/bracket interface. In fact, at the annual S.I.D.O. meeting in Rimini in 2003, my colleagues and I were impressed by his clinical results. From that moment on we tried to understand the mechanism for which low friction could reduce, at least according to Dr. Damon, the biomechanical force, decrease treatment time, reduce the number of extractions and increase the outcome predictability and the comfort for the patient. Many were the considerations, the hypothesis that we took into consideration to arrive to the following conclusion: in a few cases and/or therapeutic phases, the use of low friction, especially with round NiTi archwires, which release constant forces, is an advantage, since it favors a "functional" type of movement, in other words, less induced than with the classical methods. On the other hand, the assertion that low friction is the panacea to all ills is absolutely wrong because knowledge of biomechanics, in particular the low friction one, limits its use only to selected cases and in the phases where it is truly advantageous.
The Step and Slide System

Thinking about whether low friction techniques were efficient or not, and more specifically about the self-ligating brackets, were an enormous stimulus for the development of the Step System. When it was first conceived, it could not benefit from the advantages of low friction. The self-ligating idea was discarded because of its difficulty and its low versatility. Instead we concentrated on transforming our 3-walled bracket (the slot of our Step System) to a 4-walled bracket (similar to a tube), adding a removable flap, resulting in generating the famous, non-conventional ligature tie, eliciting low friction, called Slide*. There were many advantages that appeared immediately by using Slide, including not having to change our way of handling our brackets, both when positioning and in their clinical management.

The low friction Slide* ligatures have therefore become “small door” of the Step technique: the bracket, by simply changing the type of ligature behaves either as a tight frictional system or as a low friction system. Practically, our Step System together with the Slide ligatures has become a versatile biomechanical system: i.e. one that allows the management of friction.

Changing the Name to Step Logic Line

The growing success of the Step and Slide system brought about in 2008 an improvement in the brackets with a restyling of its slot opening to better accommodate the Slide ligatures with greater stability. This small but important change in design was made due to some practitioners saying that the ligatures were sometimes difficult to tie or they would very easily come off. To highlight this change, the Leone Company added LogicLine to the Step System, so to indicate “logical” use of friction.

It has been well documented in the literature the necessity to use “hybrid” or versatile systems, by which it is possible to modulate in different fashion the friction levels in the two arches or even in different segments within the same arch: even today it turns out that this ability to adjust the friction is absolutely fundamental based on the publication on this topic in 2007 by Richuse e Miles in the ADJOLO. This system, seems today the most versatile commercially available, mainly because it is based on the logical use (and quite simple) of two types of ligatures (elastic modules or Slide).

We have also in the last years published at length on the topic of differential friction and of the versatility of the LogicLine system.

Figure 14. In 2005, Leone patented the low friction Slide ligatures

Figure 15. Note the anterior slot of proper shape to accommodate the Slide ligatures. Shape, dimension, and slot of the bracket are the same.

Figure 16. Comparison between Step System brackets and the new LogicLine ones, with respect both to the normal friction systems and to the low friction Slide ligatures.

Figure 17. AJO-DO 2007 and JCO 2008: Hybrid systems and differential friction. Step System and Slide ligatures in the spotlight!
With time and with the improved use of these Step brackets coupled with the different types of ligatures (elastic modules for higher friction levels, Slide ligatures for low friction) we defined in a precise manner the fundamental benefit of a versatile system, and have found therefore its application both in appropriate clinical situations and in specific and determined phases of the treatment.

In fact, today, the Step Logic system is used for example in:

- controlling anterior torque during reduction of overjet
- differential biomechanics in contiguous teeth
- differential biomechanics in the two arches
- control of tip and rotations during low friction biomechanics
- combined treatment in mixed and/or deciduous dentitions

As a final noteworthy point, the new esthetic ceramic brackets of this system have maintained the same characteristics of the metallic ones (shape, dimensions, prescriptions, adhesion) and they have the same possibility to work in a low friction system, when used together with the super esthetic dedicated Slide ligatures guaranteeing the required chromatic result.
Didactic Work and the Scientific Validation

The Step System over time continues to appear not only efficient and efficacious in its clinical use but also for its simplicity, easily conveyed and easily learned, by those dentists who attended our courses.

Today the Step system has been more validated by numerous scientific evidences which attest the correctness of our decision of bringing together the research of the materials with their clinical application. This continuous research and the treatment of innumerable clinical cases with the Step System brought, on one hand, a draft of a book that is the optimal example of the possibility to use the system in any clinic situation, on the other hand, the continued success of the annual course “Ortodonzia Pratica,” that starting from the basis of the technique, leads the participant to progressively master and to be able, later on, finish even the most complicated cases.

Along with its growth during these years, the system has finally become a global philosophy of treatment that allows us to work in a simple manner, efficaciously, efficiently, reliably, and consequently of having the added value of predictability of results.

It is truly interesting and exciting observing the predictability which is the result, on one side, obviously, of an accurate diagnosis, on the other side, of the efficiency of the appliances, and, lastly, of the time that we spend so that the appliances can perform the information within.

The Biomechanical Efficiency of the Technique

The assessment of the settling that happens in our treatments during the retainer period is the best example of our recommendations: efficient materials, selected, time, resulting in a final product that improves in the long run.

I would like to underline another fundamental characteristic of the Step System: it doesn’t only consist of appliances used in SW biomechanics (brackets, bands, tubes, archwires, low friction Slide ligatures, accessories like tie-back elastics, etc.), but it can improve the use of other appliances that have been added over the years (from mini-implants for extra-dental anchorage to First Class distalizing appliances, to the simplified lingual Idea-L system).
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[Step System with low friction Slide ligatures in the upper arch, normal friction system in the lower arch. Logical use of the system.]

Figure 27, 28. Luca, age 17. Crowding, Discrepancy of midlines
Figure 29. Starting of the treatment
Figure 27, 28. Luca, age 17. Crowding, Discrepancy of midlines
Figure 29. Starting of the treatment

Figure 30, 31. Day of debonding.

Figure 32, 33. 18 months check-up. Notable improvement of the dental relationship due to the progressive settling of the occlusions.
Figure 32, 33. 18 months check-up. Notable improvement of the dental relationship due to the progressive settling of the occlusions.

Figure 34, 35. 36 months check-up. Settling completed with perfect intercuspation and sagittal and vertical relationship in the norm.
Figure 34, 35. 36 months check-up. Settling completed with perfect intercuspation and sagittal and vertical relationship in the norm.

Figure 36. Starting the bonding and progressive settling.
The Step System is continually modernized since we created a method of indirect bonding that allows us to manage, in an appropriate fashion, the vestibular and lingual positionings. This method has given satisfying clinical results and even in the literature it is quoted to have a bigger advantage in achieving excellent results. In fact, it is with great pleasure having seen the publication of this technique in the November 2007 Journal of Clinical Orthodontics issue and, above all, that in the Editor’s Corner of the same issue, Robert Keim wrote indicating his great appreciation for our technique.

**Literary and Scientific Work**

The first scientific contribution was presented in 2000 with a table clinic at the AAO annual meeting in Chicago titled “An Innovative System of Preadjusted Appliance.” During these 10 years we have had the opportunity to divulge this idea in Italy and many other countries. The importance of the biomechanical ideas was confirmed everywhere we presented it and, later on, also the clinical efficacy of the system. All the cases with which I have passed the certification exams, first the Italian Board of Orthodontics then the European Board of Orthodontics, were without question treated with the biomechanical Step System, including all the cases that have been shown at various conferences, reports and communications that I had the honor of presenting at the most important scientific societies. It is with great fondness that we remember the starting point, the first article published in the Journal of Clinical Orthodontics in 2005. And with equal pleasure, I would like to mention the contribution given to the book on low friction edited by the S.I.D.O. in which a chapter was dedicated to the Step-Slide System (All the literature relative to the Step & Slide technique is available on the website www.leone.it).
The answer is very clear: actually there is no scientific evidence that supports the claim of growth of alveolar bone! Therefore is it a functional expansion or simply a change in the inclination and position of the teeth? Teeth go where there is bone, and this in conclusion, is valid both for low friction and for the traditional systems. There is no reason based on evidence to prefer low friction brackets or traditional brackets with the purpose of expanding the arch.

**Figure 45.** Expansion of the upper arch with the low friction Step and Slide System.

**Figure 46, 47.** Note as the changing of the arch shape happens in an equal measure both with the low friction and the traditional systems. In the second case, however, the first premolars have been extracted.

Those are changes at the dento-alveolar level, as we have already documented in a paper published in the AJO-DO in 2006, regarding expansion of the maxilla with the Step-Logic Line.

Other claims were examined in the article, for example if the upper arch expansion is comparable to that obtained with rapid expansion, whether the stability over time is greater when obtained with the low friction system, and, if this method is more efficacious and efficient in the treatment of the malocclusions.

**Figure 48-50.** AJO-DO 2006, evaluation of the low friction effect (with Slide ligatures) on the arc dimension and shape.

We would like to spend some more time explaining the effectiveness and the undeniable superiority of any hybrid system (just like the Step-Logic System), compared to all others.

In fact, regardless of the answer given, with scientific evidence, to the question on the efficacy and efficiency of a self-ligating system compared to a traditional one, the question is obviously absolutely irrelevant to us!!! Will the results show that the low friction systems are more efficient? We are ready with the Slide!

On the contrary, will the results show that the traditional bracket systems are more efficient? We will continue, as always, to use the Step brackets with normal ligatures. I do not believe that anyone can actually take pride of the simplicity and flexibility of a system like our Step-Logic.

Therefore, we can use the same identical image and the same concept if we want to discuss another "claim:” are the mechanical "sliding," phenomena truly related to the low-friction or do they depend on binding and notching?

**Figure 51.** An answer to any need.
A great article regarding this topic was published in the AJO-DO in 2009, and the conclusions are summarized in figures 52-55

From over 40 years Leone palatal expanders have been widely used by orthodontists in the world with success. The experience obtained with millions of patients treated with the A0630 Leone expanders has brought us to the manufacture of new versions to satisfy the different clinical demands.

Laser welding of the extension arms into the screw’s body

Laser-etched expansion limit, directional arrow, lot number

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- The rapid expander A2620, more compact, allows high expansion limit with the aid of telescopic guides.
- The anatomical rapid expander A0630 with orthogonal arms allows for the fabrication of devices with small dimensions, high stability, comfort, and safety.
- Micro rapid palatal expanders A0621, with extra-long arms, are characterized by a body significantly smaller than other available expanders.
- The “Ragno” device solves treatment cases where higher expansion in the anterior zone is required.
- The spring activated expander which allows an amortized expansion.

Finally, we can discuss other absolutely advantageous characteristics of the Step-Logic System, such as the smaller dimension of a traditional bracket compared to the systems with flap, the best chance at good hygiene, the most comfort, etc. In conclusion, the plentiful literature confirmed that the “non-conventional ligatures in Slide” produce a very low force level, perfectly identical to those described for the self-ligating brackets.

Therefore there are only advantages in the use of this System that is perfectly, individually, relatively adjustable according to the most varied needs: a true “hybrid.”

Thanks to all who have shared this orthodontic adventure from its beginning that has given and continues to give many gratifications: and therefore, certainly the first, Gabriele Scannapieco, and then the Florence Group, Lorenzo Franchi, Tiziano Baccetti, Fabio Giuntoli, Matteo Camporesi, Giulia Fortini, and also Daniel Celli, Roberto Ferro, Nicola Minutella, the School in Cagliari with Prof. Vincenzo Piras e Raffaello Cortesi, and not to forget anyone, all those who have contributed as authors of prestigious papers, Prof. Felice Festa, Simona Tecco, Ilia Verrochhi, Prof.ssa. Paola Cozza, Prof.ssa. Ersilia Barbato and finally the users who have given us precious help in improving what was possible. Obviously, in a league of their own, the Leone Company and the Pozzi Family, without whose trust nothing would have been possible.
RAPID EXPANDER WITH ORTHOGONAL ARMS

This new Leone anatomical expander is the ideal solution for patients who need an orthopaedic maxillary expansion, as it allows the fabrication of devices with limited dimensions, high stability, comfort, and safety. The small sizes of the body and the orthogonal position of the bending arms allow an optimal positioning of the expander even in case of very narrow palates, thus promoting the biomechanical control of the expansion. The swivel key allows for an easy introral activation by the patient.

Packs of 1

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Key included in the package

- The orthogonal position of the arms reduces the overall size of the device
- The arms are housed within a through-hole into the body and the laser welding makes them to form an integral part of the screw, thus ensuring maximum safety and comfort for the patient.
- Two different placements are possible thanks to the marking of the arrows on both sides of the screw.
- Available in three expansion capacities for every therapeutic needs.
- The ends of the guide pins are micro-machined to provide a mechanical friction throughout treatment.
- The end-stop limits the possibility of over-treatment.

MEMORIA® LEAF SPRING ACTIVATED EXPANDER

This device is an evolution in the design of the previous spring-loaded expander, designed with technical and scientific collaboration of Dr. Claudio Lanteri and Mr. Filippo Francolini. This new expander features a small size body, and it is equipped with two Nickel Titanium MEMORIA® leaf springs allowing the release of calibrated and continuous forces to promote the dental expansion of the maxillary arch. Re-loading is needed when the two opposing leaf springs move apart. The intraoral activation will put the springs in contact again allowing the release of the chosen force.

The expander is available in two models releasing either 500 g or 800 g

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A0626-11

A0628-11 R

A0629-11 L

BABY RPE EXPANSION SCREW

Developed with the assistance and clinical experience of Prof. Nicola Veltri, the RPE baby expansion screw is intended for the rapid expansion of the palate suture, and is available with either 2 or 4 arms. The model with 4 arms may be an alternative to the expander A0620, while the model with 2 arms may be an alternative to the expander A0621. Packs of 1

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Key with safety ring leash included in the package

A0620-11

A0621-11

A0625-09

RAGNO FAN-TYPE RAPID EXPANDER

Conceived with the cooperation of Dr. Eleonora Schellino and Prof. Remo Modica

Entirely made of biomedical stainless steel. The expanding arms are laser welded to the screw body. Laser engraved directional arrows. It is a device for the rapid expansion of the palate that allows you to get a widening of the single anterior sector of the maxillary arch, still maintaining the expansion at the molar level. Packs of 1

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A0625-09
An evolution in the design of mini-screws. Introducing the new Leone mini-expansor screw. The new Stealth™ Slender Expansor® Screw is very compact with design innovations that make it ideal for smaller palates where application size and versatility are top priorities. Competing products simply do not measure up; they tend to be larger with more cumbersome mechanics and inferior construction techniques that become plaque traps. The Stealth™ Slender Expansor® Screw is a superior product with many advanced features:

- Very compact and strong mechanism, body bulk is minimized
- No external weld marks, will not be a plaque collector.
- Arms are internally attached to resist stress point breakage.
- Internal mechanism absolutely reliable for stability and precision
- Available in two sizes, one size does not fit all.
- Extra long arms to easily form appliances without soldered extensions.
- Packaged with the new Leone Swivel Smart Key™.
- Superior Leone materials and workmanship.

The included Smart Key™ features activation detection. Once the proper revolution of the key has been completed, the gentle clicking movement indicates the turn is complete. It’s so simple even parents can do it.

The included Smart Key™ features activation detection. Once the proper revolution of the key has been completed, the gentle clicking movement indicates the turn is complete. It’s so simple even parents can do it.

**Available in 2 Sizes:**

- **8 & 11 MM**
  - 8 MM: 1.5 MM, 12.5 MM
  - 11 MM: 1.5 MM, 16 MM

**Actual Sizes**

- **For maxillary application you may use position A or B, 8mm or 11mm are suitable for palatal expansion appliances.**

**For mandibular application you may use position B, 8mm is more adequate for lower arch appliances.**

**Comparison and evaluation of the fabrication and device characteristics for each brand was done in Europe and the USA by engineers and experts in these devices. Actual models were built and a detailed evaluation of the fabrication and the material used by each brand was done.**

**Facts**

- **LEONE “STEALTH”**
  - Claimed Maximum Expansion: 8mm
  - Actual Max. Expansion: 10mm
  - Expert Score: 7+/10
  - Screw Width: 14.9mm
  - Direction Height: 5.3mm
  - Body Thickness: 3.9mm
  - Arm Length: 67mm

- **DENTAURUM “VARIETY SP”**
  - Claimed Maximum Expansion: 12mm
  - Actual Max. Expansion: 10mm
  - Expert Score: 7+/10
  - Screw Width: 14.9mm
  - Direction Height: 5.3mm
  - Body Thickness: 3.9mm
  - Arm Length: 67mm

- **DENTAURUM “VARIETY”**
  - Claimed Maximum Expansion: 12mm
  - Actual Max. Expansion: 10mm
  - Expert Score: 7+/10
  - Screw Width: 14.9mm
  - Direction Height: 5.3mm
  - Body Thickness: 3.9mm
  - Arm Length: 67mm

**Conclusion:** The Leone Stealth measurement claims match the actual size and were verified. Leone specifically built a specific triangle body for maximum strength. Leone arms are perfectly housed and laser welded for a smooth final stealthy design, giving maximum patient comfort. Dentaurum’s expansion characteristics do not agree with their specification. The Dentaurum bodies are not anatomically shaped and do not provide a housing to support the arms. Welding is roughly executed and not strong enough. When greater palate splitting force is required, we believe the Leone design to be inadequate.
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