Rapid maxillary expansion has earned an important role in modern orthodontics as a secure, predictable, and efficient method for correcting transverse maxillary deficiency in a wide array of clinical conditions. From a biological point of view, rapid maxillary expansion, which separates the right and left halves of the maxilla at the midpalatal suture, is effective during development. Article to be continued on page 2.

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:
When the suture is rarely interdigitated (Melsen, 1972). Therefore, in the context of human development, rapid palatal expansion is a genuine orthopedic technique. In order to achieve rapid maxillary expansion, appliances are attached to dental elements using bands or resin bonding. Over the past century, many different types of expanders have been introduced, including the most recent models that incorporate hygienic rapid expansion screws. In addition, various operating protocols have been introduced allowing for the utilization of classic rapid expansion or a method of alternating rapid expansion and protraction to activate the peri-maxillary tissue sutures. (Liou 2005, Liou e Tsai 2005). The latter protocol is particularly effective in amplifying the orthopedic effects of head gear in the distal-mesial movement of maxillary teeth. However, regardless of which protocol is utilized, rapid palatal expanders are subjected to an intense amount of mechanical stress during the expansion of the upper jaw. An example of such elevated transverse force (between 7 and 16 kg) occurs when separating the two horizontal plates of the palatal bone at the level of the median suture (Isaac and Ingram, 1964, Zimring and Isaazson, 1965).

Achieving this goal requires the use of rigid devices that conform to specific biomechanical needs. Moreover, when applying short term forces in maxillary expansion, the device should be as rigid as possible to transmit orthopedic forces directly to the mid-palatal suture with a minimal loss of force in order to avoid collateral and undesirable affects (ie. dental tipping, etc.) (Fürthauerand Droschl, 1981; Timms, 1981). The goal of this in-vitro study was to measure the development of force in rapid expanders upon each activation of the central screw. The study also sought to determine how much force was required to permanently deform an expander (at either the arm or body level). Additionally, quantifying the rigidity of each rapid expander was a particularly important goal.
Methods & Materials

Three different rapid expansion screws were analyzed for rigidity.
1. Leone A2620 ZoomRax™
2. Dentaurum Hyrax 10 (fig. 2)
3. Forestadent anatomic expander (fig. 3)

All of the examined screws were 10mm long, with one complete revolution corresponding to 0.8 mm of expansion. To evaluate the rigidity of the system, the three expansion screws were adapted onto a standard model, with the expander arms bent as to keep the expander body positioned at a unvarying distance from the palate and with the ends of the arms passing through the first molars and first premolars.

Fig. 4 A standard model was used to position the body of the screw so that it remained the same distance from the palate (traverse view)
Fig. 5 A standard model on which the ends of the arms pass through the first molars and first premolars (occlusal view)
Fig. 6 Instron 3365 (Instron Corp, Canton, MA, USA) with a load cell capacity up to 5kN
Fig. 7 Detail of the Instron during screw activation with a key
Fig. 8 The activations were performed until deformation of the activation key

The arms of each of the three expanders measured between 1.4 - 1.5 mm in diameter. An Instron 3365 (Instron Corp, Canton, MA, USA) with a load cell capacity up to 5kN, was used to evaluate the rigidity of the expanders.

Activation Procedure Of The Expander

The expander is positioned on the Instron, with the machine’s top and bottom forceps clasping the expander arms, thus keeping the expander as vertically aligned as possible (fig. 1, 2, 3);
- Once the device is positioned, the screw is activated with a ¼ turn (corresponding to 0.2 mm of expansion for all the screws analyzed) and the resultant compression force is measured (fig. 7);
- Activations were conducted until deformation of the activation key (fig. 8). 10 trials were conducted for every type of expander, with a total of 30 tests. After every trial (from activation to deformation) the tested expander was replaced with new one.
**Statistical Analysis**

Statistical comparisons were made between the forces developed after 1, 5, 10, 15, and 20 activations (every activation corresponding with a ¼ turn of the screw). Comparisons were made by means of nonparametric tests that contrasted the compressive forces recorded between different activations of the same expander (test by Friedman, post-hoc test by Tukey) as well as between the results of the three different expanders (test by Kruskal-Wallis, post-hoc test by Tukey) (SigmaStat 3.5, Systat Software Inc., Point Richmond, CA, USA).

**Results**

Descriptive and comparative statistics of the forces generated by the three types of expanders during the tests are presented in the table (fig. 9). Regarding the performance of a single expander over the series of activations (represented in the columns of the table), in all of the three expanders, the forces recorded after 20 activations were significantly greater than the forces recorded after 5 and 10 activations. Significant changes were not observed in the forces generated between 15 and 20 activations of the same expander.

In regard to the comparisons made between different expanders (statistical data represented in the rows of the table), after 1 activation, the Leone expander generated significantly greater force than the Forestadent while there were no significant differences between the Leone vs. Dentaurum and the Dentaurum vs. Forestadent. At 5, 10, 15 and 20 activations, the Leone and Dentaurum expanders generated significantly more force than the Forestadent expander.

**Discussion**

The protocol proposed by Liou (Liou, 2005; Liou and Tsai, 2005) for the treatment of patients affected by cleft lip/palate, or in cases of Class III malocclusion, requires the utilization of alternating forces of expansion and protraction. Therefore, from a mechanical point of view, expanding devices need to be rigid.

The greater the rigidity of the expander (represented in the slope of the curve, screw activations/force) (fig. 9), the greater the development of force after each activation. While force development also depends greatly on the rigidity of real constraints in clinical cases, i.e. the mid-palatal suture is significantly more malleable than the Instron, the fact remains that, given the constraints and characteristics of the mid-palatal suture, a more rigid device will produce greater force. The results clearly demonstrate that all three types of rapid expanders provide sufficient force to cause separation of the mid-palatal suture. The Leone and Dentaurum expanders reached a peak application force of over 20 kg while the Forestadent expander reached around 16 kg of force. Therefore, the analyzed expanders exhibited sufficient force to achieve their designed purpose. Moreover, a very low performance variability was found between different tests of the same type expander, indicating that a
Discussion

A high standard of quality was maintained in the production of the tested devices. A statistical comparison between the data sets demonstrated that the Leone and Dentaurum expanders were significantly more rigid than the Forestadent expander. The results also demonstrated that these more rigid expanders transferred more force to the teeth and, subsequently, to the bone structure, thus reducing the risk of tipping.

The force-activation curve of each expander had a similar trend, exhibiting an almost linear shape during the first 10 activations, followed by a marked decline and decrease to zero force development after the maximum number of activations had been performed. The Leone and Dentaurum expanders exhibited an increasing trend of developmental force after every activation until the 18th - 20th activation, at which point a plateau was reached, whereas the Forestadent expander demonstrated steady growth until the 24th activation (fig. 9).

The similarities and differences between the rates of force growth and decay in rapid palatal expanders are evidently related to the technical characteristics of the expanders themselves and, in particular, are dependent on the method utilized in soldering the expander’s arms to its body; the arms of the Leone (fig. 10) and Dentaurum (fig. 11) devices are soldered parallel with the body of the expander while the arms of the Forestadent (fig. 12) device are soldered perpendicularly to the body, thereby lengthening the arm and reducing the rigidity of the system.

The expanders demonstrated significant structural failure around the 22nd to 25th activation, at which point the Leone screws exerted 22 kg of force, the Dentaurum exerted around 20.5 kg of force, and the Forestadent exerted 17.5 kg of force. However, it should be emphasized that these figures would be impossible to reproduce clinically, as around 16 kg of force correlates with activation key failure (fig. 8).

1,5,10... activations

Significant comparisons (p<0.05, Friedman test) Significant comparisons (p<0.05, Kruskal-Wallis test)

| Table- Statistical comparisons between the different rapid expansion screws and the different quantities of activation force (each activation corresponds with a ¼ turn). Quantities are expressed in Newtons. Med.: median; 25%: twenty-fifth percentile; 75%: seventy-fifth percentile |

Conclusion

The results of this in vitro study demonstrate that the tested expanders have the capacity to develop around 16-20 kg of force, enough to achieve rapid maxillary expansion. This level of force is also sufficient for the utilization of alternating activations of expansion and protraction.

The devices showed structural failure only at high levels of force (around 22 kg) that are impossible to duplicate in a clinical setting as the activation key is distorted when subjected to around 16 kg of force.

It was also determined that the Leone and Dentaurum screws demonstrated a superior level of rigidity with respect to the Forestadent rapid palatal expander.
Some comments about
My Friend Tiziano

There is a certain order to life. A baby is born. He learns to walk and talk. He grows through childhood and adolescence under the guidance of a loving father, doting mother and caring grandparents, becoming the person he was meant to be. And then he becomes a loving father himself as he progresses to early middle age, making a career for himself in his chosen profession.

But the order of life has been broken—when I am here today to pay my respects to my friend Tiziano, rather than hopefully many years from now when he should be saying a few nice things about me at my funeral. Today is not the way life should be.

One of the best decisions I ever made occurred in June 1994, when I met two young men from Florence, Tiziano Baccetti and Lorenzo Franchi. I was giving a one-day course in Rome, and unannounced they came to the course and talked their way in, saying they were friends of Alexander Petrovic and Tom Graber. The next day my family and I traveled to Firenze with them, the start of a wonderful relationship among our families that has lasted for 17 years. “Tiziano and Lorenzo” like “pizza and beer,” they go together well. Tee and Ell (as they are known to my grandchildren) are non-biological Siamese twins joined at the intellectual hip.

When they came to Ann Arbor together over the years (Tiziano himself made over 50 trips), they became part of our American family. T and L always were included in our family activities, participating in many functions at home as well as attending Michigan football and basketball games with us. They both were so much part of our family life in Ann Arbor that Tiziano was a reader in the wedding ceremony of my son David five years ago. Both of them worked with many of our residents over the years, helping guide them in their research and becoming part of their lives.

The unexpected death of Tiziano in Prague a few days ago obviously has had a profound impact on his family and friends in Firenze, but the shock of this news has been felt world-wide. Tiziano made friends easily and was the catalyst for creating both professional and personal relationships around the world. In the time since his death, I have received emails of condolence from around the world—not from ten or a hundred people, but literally hundreds of his friends and colleagues. I heard from many of our former orthodontic residents whose lives were touched by him and Lorenzo as well as some of the most well-known clinicians and researchers in our specialty. He was loved and respected by all.

We never will know why Tiziano was taken from us last week, at least not while we are on this earth. So when I get to heaven (hopefully not too soon), the first thing that I am going to ask God is why Tiziano was taken away from us during the prime of his life. Tiziano was not a rising star in orthodontics, he already was a superstar whose impact was felt around the world, not only in Firenze and Ann Arbor, but in Germany, Slovenia, Colombia, Poland, Australia, mainland China, Iceland and Brazil as well as in numerous other places around the globe. Tiziano expanded our visions of the future, pushing us all to be better—from the senior researcher to the under graduate student, from the woman selling him coffee at Starbucks to folks behind the counter at the residents inn where he and Lorenzo stayed so often in Ann Arbor.

What was Tiziano to me? First, he was my son, not in the biological sense but certainly in the intellectual and spiritual sense. He was my colleague for sure, with Tiziano, Lorenzo and Jim becoming a productive research machine in Ann Arbor (Tiziano always would talk about coming to the “gold mine” at the U of M).

Finally, if you ask me for one word that can be associated with my image of Tiziano, the word has three letters—F-U-N, fun. Life with my dear friend Tiziano always was fun. He made our lives richer when he was with us. I miss him greatly during this sad time, as do we all. There forever will be a hole in my heart.
### RPE Series 620

**No Turn Backs!**

Every Leone 620 Expansor features “Muscle Thread™” - a unique process by which the threads are extruded with compression which results in a perfect fit, total surface smoothness, and maximum hardness. Laser Marked to guarantee authenticity! A laser-etched lot number on every 620 Expansor provides a method for the accurate maintenance of patient records. Specially designed activation holes will accept the standard bent arm key, expansor key, or swivel key, and will stop the key from accidentally hitting the soft palate during the activation process. Directional arrows and expansor size are laser etched into the surface of the expansor body. This eliminates the possibility of body compression which can result from mechanical stamping of the information. Laser welding of the extension arms into the body of the expansor is done without the use of solder. This eliminates oxidation and corrosion in the mouth. Special Thermo Insulator Paste (R0227-01) should be used for soldering during the construction of the fixed appliance.

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### RPE Series ZoomRax™ A2620

**Super Sturdy Machine to do the Work**

**No Turn Backs!**

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The MINI and MIDI DIAGONALI® cuspid and bicuspid brackets feature integral ball hooks which are made using MIM® technology. For over 15 years, as a leading company in the orthodontic field, we have manufactured brackets with MIM® technology to guarantee the highest durability of our products.

These unique rhomboid-shaped brackets are laser marked with a midline as well as a distal gingival reference point on the tie wings to facilitate bracket positioning.

The D.B. Mini and Midi Diagonali® brackets feature 80 mesh bonding bases that are anatomically contoured to the shape of vestibular tooth surfaces. The rounded edges of the tie wings and the smooth polished surfaces facilitate bracket positioning and reduce the thickness of the adhesive layer, an important aid in minimizing the possibility of any bracket detachment during treatment.

The rounded edges of the bracket's smooth polished surfaces facilitate plaque removal and ensure maximum patient comfort.

The MINI and MIDI DIAGONALI® cuspid and bicuspid brackets feature integral ball hooks which are made using MIM® technology. For over 15 years, as a leading company in the orthodontic field, we have manufactured brackets with MIM® technology to guarantee the highest durability of our products.

FDI-System marking

With one single idea, protected by numerous patents throughout the world, Leone has put an end to the possibility of positioning errors. An FDI (Fédération Dentaire Internationale) identification number is laser marked on the mesh pad of every bracket, clearly indicating the tooth to which a specific bracket should be attached. This method identifies each tooth with a two-digit Arabic number: the first digit indicates the quadrant, the second identifies the tooth according to Palmer's notation. The number, permanently etched and free of toxic substances, is immediately recognizable and easily readable without the aid of magnifying lenses.
Optimum bond strength

The brackets are brazed to a 80 mesh sintered base with a special palladium alloy, ensuring strong adhesion to the tooth no matter what adhesive is used. The laser-etched pad with FDI identification also increases the retention of the adhesive. The bases of the bicuspid brackets are extended occlusally to limit interference.

Conveniently packaged

All brackets are exclusively sold in original Leone packaging: kits of 1, 10, 25, 50 cases and refill packages of 10. Each single-case kit is sealed closed, providing a guarantee of hygiene and cleanliness when opened in the presence of the patient. The back label displays the product code, description, lot number and product symbols. The 10-case kits are made with ABS plastic. A large label on the kit cover displays the product code, description and lot number; the same information is also clearly displayed on the front drawers of the conveniently stackable Leone kits. Inside the trays, a clear plastic cover protects the brackets, as well as provides information pertaining to their correct placement.

Dimensions

The product line of the “Diagonali” orthodontic brackets is available in the most popular techniques. The MIDI version ensures a perfect biomechanical control and the MINI version, with its reduced dimensions, combines efficiency with aesthetics and comfort.

Available techniques

MINI DIAGONALI® ROTH, RICKETTS and ANDREWS Systems
MIDI DIAGONALI® ROTH, RICKETTS and ALEXANDER Systems

A timeless classic

All LEONE orthodontic brackets are fully manufactured in our facility in Sesto Fiorentino (Firenze) using the most advanced technologies. The MINI and MIDI DIAGONALI® brackets are two product lines of distinguished excellence, representing the fruit of a meticulous design in combination with applied technologies and advanced production processes during which the product undergoes a rigorous quality control. For over 15 years the MINI and MIDI DIAGONALI® brackets, affectionately known as little “technological jewels”, have represented one of the most effective instruments at the disposition of orthodontists, guaranteeing an excellent clinical process from the beginning of treatment.
All the orthodontic brackets illustrated in this brochure are not intended to be a duplication of any other existing system nor does Leone S.p.A. imply that they are endorsed by the above mentioned doctors or Schools.

**MINI & MIDI DIAGONALI**

**metal brackets**

**with FDI identification** (patented)

---

**MINI & MIDI DIAGONALI**

- **MINI & MIDI DIAGONALI®**
- **MINI & MIDI DIAGONALI® ROTH SYSTEM**
- **MINI & MIDI DIAGONALI® RICKETS SYSTEM**

For further information please refer to our orthodontic catalogue.

**CALL 800-242-9986**

**FOR SPECIAL PRICING AND DETAILS OF CURRENT AVAILABLE PROMOTIONS**

---

**MINI DIAGONALI®** also available for **ANDREWS** .018" and .022"

**MIDI DIAGONALI®** also available for **ALEXANDER** .018" and .022"

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All brackets are available in packages of 10.

---

Brackets not included into kits
Leone buccal tubes are produced in stainless steel with Metal Injection Moulding technology for absolute precision of the slot size and a special bevelled design for maximum patient’s comfort.

Every MIM® tube and attachment may be pre welded to either CALIBRA® or WEB® bands with free prewelding service or solder-brazed on the D.B. anatomical mesh pad MAXI F2800-00, which is first molar anatomical contoured. Solder-brazing service is free of charge. The connectors for laser welding, under patent pending, represent a good help in the laboratory to perform laser welding of elements with variable thickness. The Leone connectors are manufactured from stainless steel with MIM® technology to get smooth surfaces for the maximum comfort of the patient.

**Notice to the Reader:**
With this section we continue to bring you extracts from the Leone Orthodontic General Catalog so you can see the extensive selection that Leone produces and offers. In the next issue we will feature Elastics & Ligatures, which is the next group of products not yet published.

**MIM® Buccal Tubes**

Every MIM® tube may be pre welded to either CALIBRA® or WEB® bands with free prewelding service or solderbrazed on the D.B. anatomical mesh pad MAXI F2800-00, which is first molar anatomical contoured. Solder-brazing service is free of charge. Also available in the direct bonding version upon request.

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**auxiliary tube .018”x.025”**
**Convertible MIM® Buccal Tubes**

The laser welded convertible cap prevents from any detachment and it is easy removable with the special Leone instrument P1090-00. Every tube is available: in the D.B. version, prewelded to either CALIBRA® or WEB® bands or solder-brazed on the D.B. anatomical mesh pad MAXI F2800-00

Packs of 10
Packs of 100 on request

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**CALL 800-242-9986 FOR SPECIAL PRICING AND DETAILS OF CURRENT AVAILABLE PROMOTIONS**
Convertible MIM® Buccal Tubes Continued

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VISIT US AT THE AMERICAN ASSOCIATION OF ORTHODONTISTS (AAO) MAY 4-7, 2012 HONOLULU, HI. BOOTH #1421

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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.

Available in 2 Sizes:

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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.
**EXPERTS EVALUATION • stealth® vs. VARIETY**

A 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.

### Leone “STEALTH”

**Claimed Screw Width**: 15.0mm  
**Actual Screw Width**: 14.9mm  
**Direction Height**: 5.3mm  
**Claimed Maximum Expansion**: 12mm  
**Actual Max. Expansion**: 10mm  
**Body Thickness**: 3.9mm  
**Arm Length**: 67mm

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

- **For Stealth 8mm & 11mm employed in the lower arch. Use only position A as shown in the above & lower Illustration. 8 mm type is more adequate for lower arch appliances.**

**Expert Score**: 10/10

### Dentaurum “VARIETY SP”

**Claimed Screw Width**: 15.0mm  
**Actual Screw Width**: 14.9mm  
**Direction Height**: 5.3mm  
**Claimed Maximum Expansion**: 12mm  
**Actual Max. Expansion**: 10mm  
**Body Thickness**: 3.9mm  
**Arm Length**: 67mm

**Expert Score**: 7+/10

**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 Dentaurum design to be inadequate.
VISIT US AT THE AMERICAN ASSOCIATION OF ORTHODONTISTS (AAO)
MAY 4-7, 2012 - BOOTH #1421

LEONE INTERNATIONAL COURSES
SEPTEMBER 13 & 14, 2012 FLORENCE, ITALY
COURSES ARE GIVEN IN ENGLISH

DAY 1, September 13, 2012, New Perspectives on Class III treatment

11.15-11.45 Break
11.45-13.00 Hugo De Clerck (Brussels, Belgium): Bone anchored midface protraction in growing Class III patients (video conference)
13.00-14.00 Lunch
15.15-16.00 José Miguel (Rio de Janeiro, Brasil): Surgery-First Orthognatic Approach - Eliminating presurgical orthodontic treatment. (video conference)
16.00-16.30 Break
16.30-17.30 Carlos Villegas (Medellìn, Colombia): Orthognathic surgery in Class III growing patients. New Perspectives. (video conference)

DAY 2, September 14, 2012, New Perspectives on Rapid Maxillary Expansion

11.30-12.00 Break
12.00-13.00 Roberta Lione, Paola Cozza (Rome, Italy): Analysis of potential adverse effects of rapid maxillary expansion in growing subjects.
13.00-14.00 Lunch
14.00-15.00 James McNamara: Can Rapid Maxillary Expansion Be Used in Patients with Excessive Vertical Dimension? (video conference)
15.00-16.00 Jasmina Primozić: Early treatment of unilateral functional crossbite - the impact on facial asymmetry and morphology of the upper jaw
16.00-16.30 Break
16.30-17.30 Maja Ovsneik: Early treatment of unilateral functional crossbite - the role of irregular orofacial functions