But I’ve Always Done It That Way!

We do many things the way we do, in both our personal and professional lives, for no other reason than we were taught to do them that way. I heard a charming illustration of this maxim at a banquet during the 2007 European Orthodontic Society Congress in Berlin. It went something like this:

A young bride was preparing supper for her new husband. Just before placing the sausages in the frying pan, she cut off both ends. When her groom asked her why, she replied, “My mother taught me that if you cut off the ends of the sausages before you fry them, you will have a delicious meal. That is how I have always done it.” This explanation didn’t really satisfy the husband, so the next time he saw her mother-in-law, he asked her about it. Her reply was the same as her daughter’s: “My mother taught me that if you cut off the ends of the sausages before you fry them, you will have a delicious meal. That is how I have always done it, and that is how I will always do it.” Still skeptical, the husband sought out his bride’s grandmother and asked her about it. The elderly lady looked puzzled, then chuckled. She led the young man back to his apartment, where she questioned her granddaughter. “You are still cutting the ends off the sausages? Why?” “Because that’s the way the women in our family have always done it,” her granddaughter replied. “May I see the pan you are using?” the old woman asked. As the young lady brought out her frying pan for her grandmother’s inspection, the old lady roared with laughter. “Oh, my goodness! You are still using my tiny old pan!”

Of course, the only reason the grandmother had ever cut off the ends of the sausages was that she didn’t have a big enough frying pan. It had no effect on the flavor of the outcome.

Once in a while, I find myself doing something in my orthodontic practice simply because “that’s how I’ve always done it”. Take, for example, the exercise of sealing or tying off the jackscrew of a rapid palatal expander (RPE) after the expansion has been completed and transverse treatment goals have been realized. Most of us were taught...
that if we didn’t do that, the expansion screw would “back off” and some of our meticulous expansion would be lost. I know I have followed this protocol for years, ever since the completion of my graduate training, without ever questioning whether there was any evidence to support it.

As it turns out, there is none. In this issue of JCO, Drs. Luis Tomas Huanca Ghislanzoni, Lorenzo Franchi, and the late Tiziano Baccetti present a well-conceived clinical study that tests the old paradigm of sealing off the expansion screw in a simple yet elegant manner. Forty-eight consecutive cases were treated with an RPE. Following active expansion, the twice-daily turns of the screw were discontinued and the appliance was left in place, with no mechanism applied to prevent the screw from backing off. Not wanting to spoil the surprise, I’ll leave it to you to read the entire article for the thrilling conclusion—and a well-thought-out theoretical explanation of why things turned out the way they did. Suffice to say, the results did not concur with the way we were all taught.

While evidence-based decision making has its detractors, it has gradually become the law of the land in dentistry. There’s a lot to be said for track record, but cold, hard, objective evidence wins the contest every time. “That’s how I’ve always done it” or “That’s how I was taught to do it” is no longer a good enough rationale for any clinical procedure. In this month’s article, Dr. Huanca and colleagues call into question a time-honored, widely accepted “way of doing things” and demonstrate convincingly that conventional wisdom isn’t always correct. Based on their findings, I’m going to take a good look at the way I’m doing everything in my practice and make sure there is cold, hard evidence to support my “paradigms”. You can bet that I will not be cutting the ends off my sausages.

RGK
The rapid palatal expander (RPE) is widely used to correct maxillary constriction. Clinically, there are only a few differences among the various expansion protocols, including the number and frequency of turns (activation rate) of the midline jackscrew for rapid or slow expansion,\textsuperscript{1,2} the attachment method (banded or bonded acrylic),\textsuperscript{3} and the decision whether to use deciduous or permanent teeth for anchorage.\textsuperscript{4}

The screw of an RPE is commonly blocked with composite or a stainless steel ligature after the desired expansion has been achieved, the objective being to prevent relapse due either to the forces generated by stretched tissues of the enlarged maxillary bone trying to return to their previous state\textsuperscript{5} or to back-turning from manipulation by the tongue.\textsuperscript{6} Little research has been published, however, that might confirm such relapse.

We used a prospective clinical trial and a theoretical approach to investigate whether it is necessary to lock the screw after active expansion.

Materials and Methods
The prospective clinical trial was performed in Dr. Huanca Ghislanzoni’s private practice. Because a statistical power greater than .9 was desired, a sample size of at least 45 subjects was needed. Forty-eight consecutive patients (21 males and 27 females) presenting with maxillary deficiency, as indicated by a unilateral or bilateral crossbite, were chosen for treatment with rapid palatal expansion. The mean age at the start of treatment was \(7.8 \pm 1.2\) years.

A Hyrax expansion screw\textsuperscript{*} coated with a...
friction agent was cemented to the first molars of each patient (Fig. 1). A full turn of the screw provided .8mm of expansion. The treatment protocol was the same for each patient: two quarter-turns per day (.4mm of expansion), with weekly visits to note progress. The active expansion phase lasted a mean 15 ± 3 days. In each case, when the amount of expansion was judged satisfactory, with a slight overcorrection, a notch was carved with a diamond bur into the lingual surface of the screw spindle (Fig. 2). The notch served as an unambiguous reference point for any backward movement of the screw components, since such movement would cause a displacement of the notch. The screws were not blocked with composite or ligatures.

After an average 5.5 months of retention with passive expanders, the appliances were removed. At the debanding appointment, each screw’s notch position was checked, and the number of reverse turns needed to deactivate the screw was counted to verify that none of the screws had reversed by exactly one or more full turns, which might have created an illusion of stability.

Results

All 48 patients completed the treatment. An average 30 quarter-turns were made, resulting in an average screw opening of 6.1 ± 1.2mm. None of the notches was found to be displaced, and the number of “deactivation” turns matched the number of activations in each subject. Since there had been no relapse in any of the patients, no further statistical analysis of the results was required.

Discussion

Locking the jackscrew in place after achieving the desired rapid palatal expansion is a universal clinical management tip that actually appears to have little substantiation. The resistance force of the maxillary tissues against the expander was studied by Isaacson and colleagues in five patients, using a modified RPE with a dynamometer connecting the expansion screw and the bands on one side of the mouth to an acrylic plate placed against the palatal alveolar process of the opposite side. The expansion screw was activated .8mm per complete turn, as in many current RPE designs. In four of the patients, the forces measured by the dynamometer dropped to zero five to seven weeks after the end of active expansion. In the fifth patient, for whom the maximum possible daily activations were performed in the clinic, a drop to zero was noted after only five days. This sudden decrease was attributed to back-turning of the screw, perhaps caused by masticatory function or manipulation by the patient. In a more recent study, Halazonetis and colleagues measured the contribution of the stretched cheeks in resisting maxillary...
expansion; results showed a negligible .6g/cm² per millimeter of expansion.10

Other factors that could be considered potential causes of back-turning are vibrations and lubrication. Vibrations at a particular resonance frequency can cause a screw to unseat. In the mouth, the voice can produce vibrations ranging from 60 to 2,000Hz, with averages of 100Hz for an adult man, 200Hz for an adult woman, and 400Hz for a child.11,12 Although no data have been published on the resonance frequency of an RPE screw system, it seems unlikely that vocal vibrations could affect the stability of expansion treatment.

A lubricant reduces the strength and number of bridges formed between the asperities of sliding surfaces.13 In studies using artificial saliva, friction has been variously found to decrease,14 stay the same,15 or increase16 during orthodontic treatment. Tselepis and colleagues reported a drop in frictional force between stainless steel brackets and archwires of as much as 60% under lubrication with artificial saliva.17 Even this much reduction in static friction would not be enough to allow any screw to turn back, however, as demonstrated by the following theoretical discussion.

Geometrical analysis shows that an RPE screw cannot be unintentionally turned back as long as the slope of each thread does not exceed a critical value of 36.5°. In fact, the slope of the threads is the key factor. Our calculations were based on the specific manufacturing details of the screw used for the present study, but they may be applied to virtually any screw of similar thread pitch and slope.

The Leone A0620 screw has a mean diameter of 1.5mm; a full turn provides .8mm of activation (expansion). Assuming the screw of the RPE is centered symmetrically between two metal blocks moving away from each other, this means that for every full turn, each block moves .4mm away from the center. That value also represents the pitch of the screw—the distance between the centers of two contiguous threads as measured along the long axis (Fig. 3A). The slope of the thread (the angle between the thread and a plane perpendicular to the long axis), can be calculated using the equation:

$$\alpha = \arctan\left( \frac{\text{pitch}}{\pi \times \text{diameter}} \right) \quad (\text{Eq. 1})$$

By applying this equation to the A0620 screw, the thread-slope angle, $\alpha$, is shown to be 4.9°.

The forces from the stretched maxillary tissues, acting parallel to the long axis of the screw, may be broken down into two parts (Fig. 3B): $F_\parallel$ (parallel to the threads) and $F_\perp$ (perpendicular to the threads). $F_\parallel$ alone could theoretically cause the screw to turn back because it acts as a tangential force, creating a moment around the long axis of the screw. $F_\perp$ is assumed to be the force responsible for frictional resistance to turning.

The force of static friction is calculated by multiplying the normal force by the coefficient of friction, which for stainless steel is about .74.18

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**Fig. 3** Screw characteristics and resulting forces. A. Screw pitch and thread slope. B. Direction of forces.
This force, \( F_f \), acts in the same direction as, but in opposition to, \( F_h \). If \( F_h \) is greater than \( F_f \), the screw can turn around its axis; otherwise, it will not move. An angle of 36.5° (the arctangent of .74) is the critical angle at which \( F_h \) is equal to \( F_f \). Under normal conditions, it is impossible for a shallower-threaded screw to turn back, because the frictional forces will always be greater than the parallel forces (Fig. 3B).

Projecting the compression force \( F \) onto a coordinate system parallel to the slope of the threads, \( F \) can now be expressed in terms of components parallel to \( (F_h) \) and perpendicular to \( (F_t) \) the threads:

\[
F_h = F \sin \alpha \quad \text{(a)} \\
F_t = F \cos \alpha \quad \text{(b)} \\
F_f = \mu F \cos \alpha \quad \text{(Eq. 2)}
\]

where \( \alpha \) is the slope of the threads and \( \mu \) is the coefficient of friction. The applied load cannot cause the screw to back out unless the component of the force parallel to the threads is greater than the force of friction:

\[
F_h > F_f \quad \text{(Eq. 3)}
\]

From the identities in Equation 2, it follows that for the screw to back out, the condition

\[
\tan \alpha > \mu \quad \text{(Eq. 4)}
\]

must be met. For \( \mu \) to equal .74, \( \alpha \) must be greater than 36.5°, which is unlikely with any normal thread design. Alternatively, for \( \alpha \) to equal 4.9°, the coefficient of friction would need to be less than .09 in the static case described here.

**Conclusion**

Our prospective clinical trial and theoretical considerations show that locking the expansion screw of an RPE at the end of active expansion is an unnecessary precaution in most situations. The shallow slope of virtually any expansion-screw threads will prevent relapse of the expansion mechanism. Although our clinical study used a screw coated with a friction agent, it appears from our calculations that such coatings, as well as the ratcheting-type mechanisms incorporated in many screws, may be superfluous.

**REFERENCES**