Rapid Palatal Expansion with the Keles Keyless Expander

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Rapid palatal expansion (RPE) is commonly used in orthodontic treatment to correct maxillary transverse deficiency, increase arch length, indirectly widen the mandibular arch in some cases, and move the maxilla downward and forward.[1-5] Maxillary transverse deficiency is usually accompanied by posterior crossbite, unless there is constriction or lingual tipping of the mandibular teeth. Posterior crossbite occurs in about 7.1% of American children in the mixed dentition, and it usually does not self-correct as the patient transitions into the permanent dentition.[6] The Keles Keyless Expander* (KKE) offers an efficient new method to address the maxillary transverse deficiency issue.

Rapid palatal expanders can be divided into three categories: tissue-toothborne, toothborne, and boneborne.[1] The activation component typically consists of a jackscrew in the midpalatal region and a separate activation key. With each turn of the jackscrew, two metal or acrylic blocks move in opposite directions and exert force through the teeth and palatal structures to separate the midpalatal suture and expand the palate.[1] To properly activate the expander, however, the patient or parent must insert the key precisely into the jackscrew hole and turn the screw posteriorly toward the throat. The hole, which is less than 1mm in diameter, is sometimes difficult to locate in the mouth, and food debris exacerbates the challenge. Furthermore, if the user fails to make a complete turn of the screw with the key, the next hole will not appear. Other risks include injuries to the palate from insertion or swallowing of the key.[7-9]

The KKE eliminates these disadvantages of traditional expanders. The KKE is used primarily

*U.S. patent pending, Inviodent, Boston, MA; www.inviodent.com.

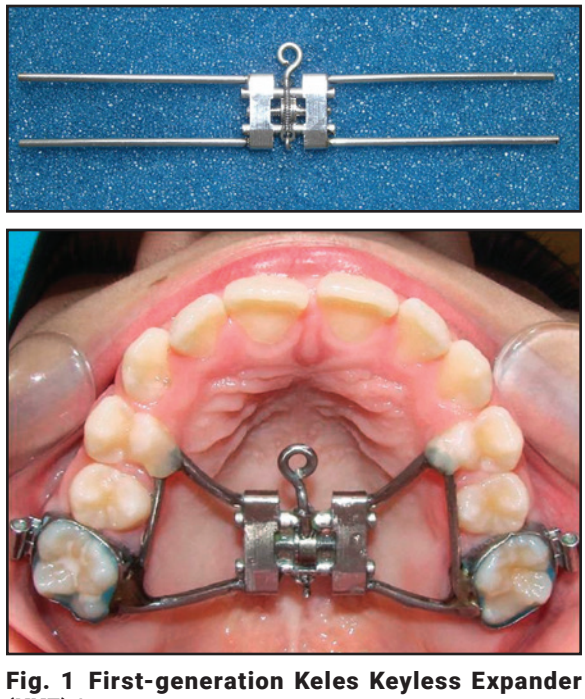

Fig. 1 First-generation Keles Keyless Expander (KKE).*

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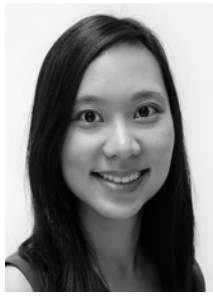

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for rapid maxillary expansion, but can also be used in conjunction with removable appliances. Its integrated activation arm is operated with a finger, eliminating the need for a separate key. As the activation arm is pushed backward, the two adjacent metal portions are moved laterally to initiate the same expansion mechanism as with conventional devices. The activation arm then springs back without unwinding the screw and is ready for the next activation.

The first generation of the KKE was introduced in 2008 (Fig. 1).[10] A new, second-generation design combines a smaller midpalatal screw with a sturdier activation arm, which works as a unidirectional ratchet and includes a locking mechanism to prevent unwinding of the screw (Fig. 2). A stopper prevents the activation arm from being pushed up toward the palate during the passive swing back after each turn, so that the screw will not unwind and the patient can easily grab the arm for the next turn.

The smaller, second-generation KKE can be used in a patient with a high palatal vault or a narrow palate. It can be fabricated with two support arms for a patient in the mixed dentition or with four support arms for enhanced stability in the permanent dentition (Fig. 3). It can be attached either with bands on the first molars or as a bonded acrylic expander.

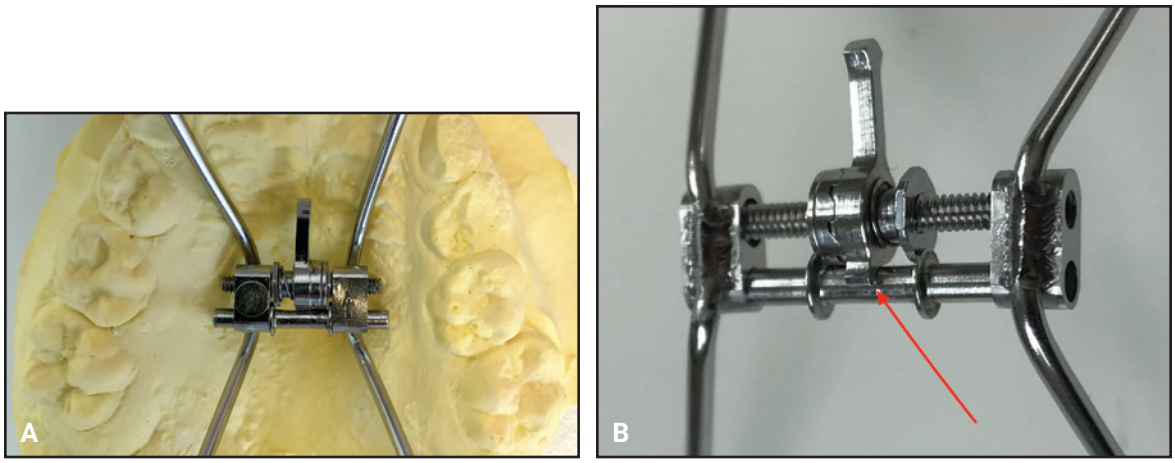

Fig. 2 A. Second-generation KKE with unidirectional wheel design and activation arm mechanism. B. Activation arm of second-generation KKE (arrow indicates stopper preventing overextension of arm toward palate).

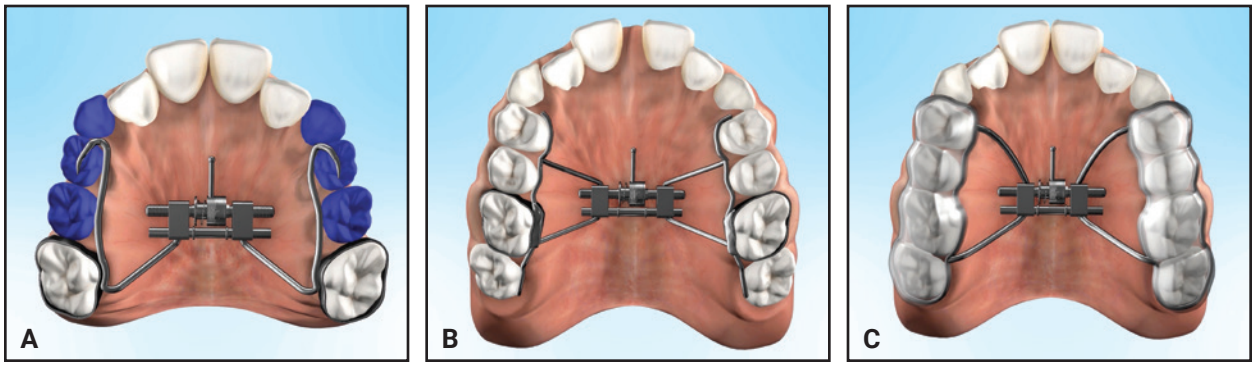

Fig. 3 A. KKE with two support arms. B. KKE with four support arms. C. Bonded KKE.

Fig. 4 14-year-old female patient with ectopic upper canines, Class I molar relationship, and severe upper and lower crowding before treatment.

Case Report

A 14-year-old female presented with the chief complaints of crowded teeth and ectopic upper canines (Fig. 4). She exhibited a straight facial profile, a slightly retrusive and thin upper lip, excessive gingival display in the upper anterior region when smiling, and a mild chin deviation toward the left side. Intraoral examination found a constricted maxilla, lingually tipped lower posterior teeth, a posterior crossbite on the right side, severe upper and lower crowding, and buccally displaced upper canines, with a 2mm overjet and 30% overbite. Molar relationships were Class I. The upper midline was coincident with the facial midline, and the lower midline was deviated 2mm to the left.

Comprehensive nonextraction treatment was planned. After the KKE was used to develop the maxillary arch, correct the crossbite, and gain space for the ectopic upper canines, we would proceed with fixed preadjusted appliances to achieve bilateral Class I canine relationships, normal overbite and overjet, and an ideal occlusion.

A KKE was fabricated with bands on the upper first molars and two support arms extending to the upper first premolars (Fig. 5A). Because the patient had a narrow palate, the two-arm design allowed higher placement of the screw for improved comfort. The support arms were secured with composite on the lingual surfaces of the upper first premolars to prevent any occlusal interference. The patient was instructed to activate the expander

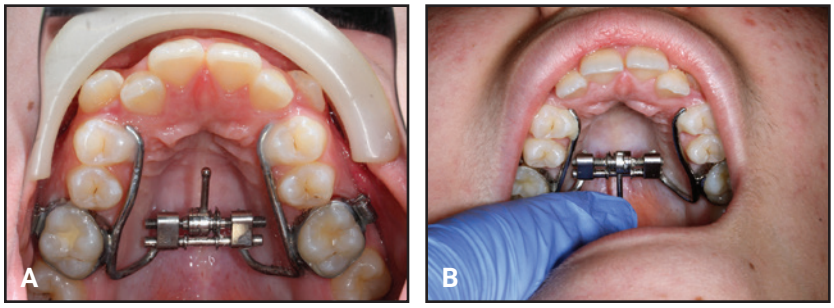

Fig. 5 A. Cementation of KKE with two support arms. B. Activation arm pushed downward and backward to activate expander.

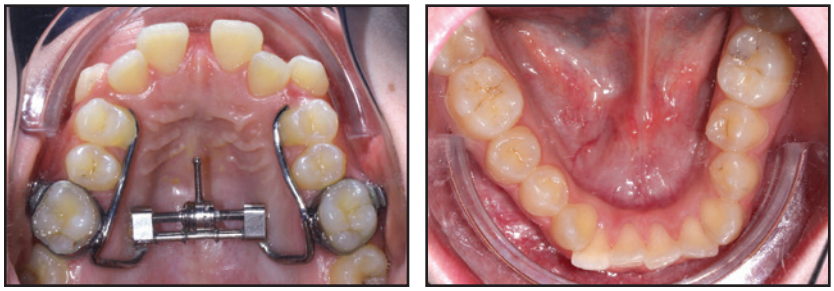

Fig. 6 Expansion complete after KKE activation once per day for 25 days.

by pushing the activation arm downward and backward (Fig. 5B), then gently swinging it back, forward, and upward once per day for 25 days. Each turn opened the expansion screw .3mm.

The maxillary expansion corrected the right posterior crossbite and created a 3mm midline diastema (Fig. 6). The activation arm was then removed with a high-speed bur, and the KKE was left passively in place for three months of retention.

An .018" preadjusted bracket system** was then bonded in both arches. The sequence of archwires was .014" nickel titanium, .016" nickel titanium, .016" stainless steel, .016" × .022" nickel titanium, .016" × .022" stainless steel, .017" × .025" nickel titanium, and .017" × .025" stainless steel.

After a total 23 months of treatment, 3-3 lingual retainers were bonded in both arches (Fig. 7). Upper and lower Essix-type removable retainers were also delivered.

Discussion

Improper management of interceptive treatment prior to conventional full bonding can increase the complexity and length of later orthodontic treatment, as well as the clinician's liability.

Fig. 7 Patient after 23 months of treatment.

The case presented here demonstrates effective and efficient RPE using the second-generation KKE. Successful expansion of the upper arch facilitated a nonextraction treatment plan and avoided exacerbation of a retrusive profile.

The most common problem reported by patients using the Hyrax*** expander is difficulty "finding the hole" of the appliance, according to preliminary results of an ongoing study at the Harvard School of Dental Medicine.[11] This leads to frustration for both patients and parents, missed activation turns, and delayed expansion progress. The KKE eliminates that obstacle. The patient shown here was able to activate the expander completely on her own, without difficulty or assistance from her parents. No injuries, expander breakage, or other complications were reported during the expansion period.

Like the traditional hole-and-key jackscrew, the Keles Keyless screw component can be incorporated into a variety of expander designs, fixed or removable. The second-generation KKE, available in 8mm or 12mm expansion capacities, has been reduced in size to enable its use in patients in the mixed dentition or with narrow palatal vaults.

Further research is needed to explore the potential for incorporating the KKE into tissue-toothborne or boneborne expanders. A joint study is currently being conducted by the Harvard School of Dental Medicine and the Department of Orthodontics, Sydney Dental Hospital, to evaluate the dental and skeletal effects of the KKE.

**American Orthodontics, Sheboygan, WI; www.americanortho.com.
***Registered trademark of Dentaurum, Inc., Newtown, PA; www.dentaurum.com.

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