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KELES KEYLESS EXPANDER: A NEW APPROACH FOR RAPID PALATAL EXPANSION

Maxillary transverse constriction is among the most common malformations in orthodontics. Treatment usually requires rapid palatal expansion with banded or bonded expanders after eruption of the maxillary first molars. The history of palatal expansion goes back nearly 150 years and has retained its popularity ever since. However, patient/guardian compliance in activating the screw with a key is required. Because it is difficult to see the hole on the screw, it is hard to insert the key through the hole. Furthermore, the chance of injuring the palatal mucosa with the pointed wire key and the risk of swallowing or aspirating the key are common undesired outcomes, and both occur in daily orthodontic practice. To overcome these unwanted incidences and make palatal expanders more patient-friendly, a new design of palatal expander has to be developed for a safe, rapid, and effective expansion with minimum patient cooperation. A newly developed keyless expander has a built-in activation arm, which patients can activate themselves. In all 4 treated cases with a keyless expander, expansion was effectively achieved in a short period of time. World J Orthod 2008;9:407–411.

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Rapid palatal expansion (RPE) dates to 1860 when Dr Angell placed a screw appliance between the maxillary premolars of a 14.5-year-old girl and widened her arch a quarter of an inch in 2 weeks.¹ The patient was provided a key and instructed to keep the shaft as uniformly tight as possible. At the end of 2 weeks, the jaw was widened enough to leave a space between the 2 central incisors. This finding cannot be supported with radiographs, as X-rays had yet to be discovered. The mechanism of action of RPE was clarified in 1950s studies on cats, pigs, and monkeys.^{2–4} These studies showed that a midpalatal

suture was opened using this technique's application of intermittent force.

These studies were later supported by Biederman,⁵ Brossman et al,⁶ Chaconas and Caputo,⁷ Tanne et al,⁸ Melsen,^{9,10} and Murray and Cleall¹¹ who performed studies on dry skulls and human cadavers that indicated that age is an important factor when considering the effect of RPE on craniofacial structures.

Within the past 10 years, 2 types of RPE appliances have been used in orthodontic practice: bonded-type acrylic cap splint RPE and the banded-type (banding the first molars and premolars) RPE appliance. In both cases, a key is required to activate

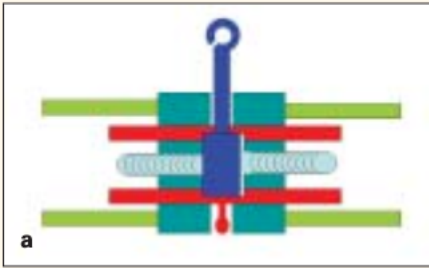


Fig 1a Design of the keyless expander, front view.

Fig 1b Design of the keyless expander, side view.

Fig 1c Keyless expander, front view.

Fig 1d Keyless expander, back view.



Fig 2a Appliance cemented in the mouth.

Fig 2b A patient activates the screw with a fingertip.



the appliance. The key has either a plastic handle to ease the activation process or a short wire key with a piece of dental floss attached to prevent the patient swallowing or aspirating it.¹² Nevertheless, accidental swallowing of the key is still reported,^{13,14} which, among other things, creates liability issues. There is a desperate need for a safe, patient-friendly expander to reduce treatment time and increase treatment efficiency.

APPLIANCE DESIGN

The appliance consists of a variety of components (US patent no. US 7,074,036 B1). Instead of using a key to turn the screw, the screw accommodates a wheel with a built-in, ratchet-like activation arm (Figs 1a to 1d). The arm automatically springs backward with the help of a nickel-titanium spring mechanism after a finger press. The wheel's housing consists of 3 quartocircular indents and accommodates a pin that actively turns the screw in a uni-directional fashion and passively springs back. The patient is instructed to push the arm backward once a day (Figs 2a and 2b), and each turn applies 0.2 mm of expansion. Based on the amount of expansion needed, the patient is instructed to turn the arm for a certain number of days.

CASE 1

A female 14 years 6 months of age in the permanent dentition was diagnosed with a bilateral maxillary constriction of 5 mm. She required an RPE appliance to resolve a skeletal and dental transverse discrepancy. We banded the maxillary first molars and premolars and took impressions for construction of a keyless expander. The appliance was cemented in place and the patient instructed to turn it once a day. She was seen 22 days later to monitor the expansion. The results are presented in Figs 3a and 3b and Figs 4a and 4b.

CASE 2

A female 13 years 5 months of age in permanent dentition was diagnosed with a bilateral maxillary constriction of 4.5 mm. She required an RPE appliance to resolve a skeletal and dental transverse discrepancy. We banded the maxillary first molars and bonded to the first premolars. The patient was instructed to turn it once a day and seen 20 days later to monitor the expansion. The results are presented in Figs 5a and 5b and Figs 6a and 6b.

Fig 3a Case 1, initial frontal view.



Fig 3b Case 1, initial occlusal view.



Fig 4a Case 1, midtreatment frontal view (note the central diastema).



Fig 4b Case 1, midtreatment occlusal view.



Fig 5a Case 2, initial frontal view.



Fig 5b Case 2, initial occlusal view.



Fig 6a Case 2, midtreatment frontal view (note the correction of the posterior crossbite in the molar region).



Fig 6b Case 2, midtreatment occlusal view.





Fig 7a Case 3, initial frontal view.

Fig 7b Case 3, initial occlusal view.



Fig 8a Case 3, midtreatment frontal view (note the midline diastema and correction of the crossbite in the right molar region).

Fig 8b Case 3, midtreatment occlusal view (note the improvement of the arch symmetry).



Fig 9a Case 4, initial frontal view.

Fig 9b Case 4, initial occlusal view.



Fig 10a Case 4, midtreatment frontal view (note the midline diastema and correction of the crossbite in the molar region).

Fig 10b Case 4, midtreatment occlusal view.

CASE 3

A female 14 years 1 month of age in permanent dentition was diagnosed with unilateral maxillary constriction of 7 mm. She required an RPE appliance to resolve a skeletal and dental transverse discrepancy. We banded her maxillary first molars and took impressions for construction of a keyless expander. The appliance is cemented on the first molar and bonded to the first premolar. The patient was instructed to turn the screw once a day and was seen 24 days later to monitor the expansion. The results are presented in Figs 7a and 7b and Figs 8a and 8b.

CASE 4

A female 12 years 6 months old in permanent dentition was diagnosed with a bilateral maxillary constriction of 5 mm. She required an RPE appliance to resolve a skeletal and dental transverse discrepancy. We banded the maxillary first molars and took impressions for the construction of the newly developed expander. The appliance is cemented on the first premolars and bonded to the first premolars. The patient was instructed to turn the screw once a day and was seen 14 days later to monitor the expansion. The results are presented in Figs 9a and 9b and Figs 10a and 10b.

CONCLUSION

The results of the above cases show that the keyless expander is an effective means to achieve maxillary expansion with minimum patient cooperation. The conventional expanders require a key for activation; if you do not complete the one-quarter turn, the next hole on the screw does not appear, thereby making it impossible for the patient to proceed activation. The keyless expander does not require a key, and the patient needs only turn the arm once a day with a finger tip. The other advantage is that after completion, the screw does not unwind because of its design. The built-in arm allows for easy activation of the screw without the risk of dropping the key down a patient's throat or activating the patient's gag reflex. The risks of aspiration, swallowing, and injuring the palate have been eliminated. In this case report, the first phase (expansion) treatment was completed in an average of 3 weeks, enabling the second phase to begin without delay.

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