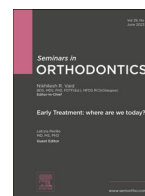


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Everybody gets an expander

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ABSTRACT

Seemingly every preadolescent patient that presents for an orthodontic consultation is prescribed rapid maxillary expansion (RME) treatment. Parents are forewarned of premolar extractions, lateral incisor root resorption from ectopic canines, or obstructive sleep apnea if they delay treatment. Are we exaggerating the need for Phase I RME in pursuit of two-phase treatment and increased revenue? Let's take a closer look at the history, trends, expectations, and proper timing of RME, with an emphasis on Phase I treatment.

RME was invented by Emerson Angell in 1860.¹ His case report was published in the *Dental Cosmos*, the first national journal for the dental profession. Angell's patient was a 14-year-old girl fitted with a transpalatal appliance that featured two counter-rotating screws. After two weeks of turning the screws on her own, she returned to his office with her crossbite corrected and a small midline diastema. Angell concluded that the palatal bones must have separated. Unfortunately, his theory was rejected by his contemporaries, which resulted in a clinical moratorium for the appliance for nearly a century.²

In the 1950s, RME reemerged with Andy Haas.³ The Haas-type expander (1956) featured a modern jackscrew, made by Dentaurum, with a tooth- and tissue-borne framework. As RME became more commonplace, other variations of expanders with different frameworks were introduced, such as the Hyrax (1968), Bonded (1973), Fan-type (1996), Miniscrew-supported (2004), and Laser sintered (2017). Today, the expander is the most common fixed laboratory orthodontic appliance, and it is usually applied during Phase I treatment.

Phase I RME movement

The exponential growth of Phase I RME over the last 50 years has coincided with the general shift in the U.S. toward non-extraction treatment.⁴ This approach gained momentum in the 1980s during the reign of John Witzig and his baseless accusations that premolar extractions caused “craniomandibular disorders,” as well as with the landmark court case, *Brimm v. Malloy* (1987). Extraction rates peaked in the mid-1960's at about 75%, plummeted in the 1980s to about 20% and they have steadily declined ever since.^{4,5} This trend has increased the appeal of providing Phase I RME under the premise of avoiding extractions.

Several other factors have also influenced the growth of Phase I RME and non-extraction treatment, including the inappropriate marketing by self-ligating bracket companies in the early 2000's, the popularity of Invisalign Teen

in the 2010's, and the current hysteria over obstructive sleep apnea. Additionally, a growing number of pediatric dentists and general dentists are attending weekend continuing education courses on orthodontics, which are rife with misinformation. These dentists may pressure orthodontists to treat their mutual patients with non-extraction methods at all costs.

Posterior crowding

The problem is that Phase I RME tends to bind the orthodontist into a Phase II non-extraction treatment plan. Many patients that would have benefited from Phase II extractions finish with dental protrusion and second molar impaction, referred to as posterior crowding.⁶⁻⁹ Understandably, there is a positive correlation between the increase in Phase I RME and the emergence of second molar pericoronitis. Having an oral surgeon extract the third molars and remove the opercula over the second molars does not resolve the tooth-size-arch-length insufficiency, so the tissue regrows and the pericoronitis returns.

Unfortunately, posterior crowding is challenging to predict during preadolescence. It is usually diagnosed during adolescence on a panoramic radiograph. The maxillary second molars will appear angulated at 45-degrees within the tuberosity, while the mandibular second molars will appear mesio-angular or impacted vertically under the anterior ramus. Intraorally, the second molars will erupt partially, with only their mesial cusps visible. During preadolescence, superior positioning of the mandibular third molar buds over the crowns of the developing second molars may forewarn of potential posterior crowding.¹⁰

Therefore, if Phase I RME is recommended, the orthodontist must clarify in the consultation that the objective is to intercept an immediate problem—such as a unilateral posterior crossbite—and not to obviate the need for extractions, which will be determined later. All too often, orthodontists push the urgency of Phase I RME by appealing to parents' emotions regarding pulling teeth. I prefer to tell parents that the necessity for

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extractions has little to do with my skill or the appliances that I use; it is simply a math problem involving the widths of teeth, the lengths of the jaws, and the amount of expansion that we can safely achieve.

What to expect from RME

To determine the amount of space that we can gain with RME, we must first understand the expander's jackscrew, which consists of four components: a perforated cylinder, a lead screw, supporting guide pins, and a platform. The cylinder is seated around the lead screw and turned with a key to provide palatal expansion. It has four holes, so each key turn is a quarter turn. Depending on the manufacturer of the jackscrew, each quarter turn of the cylinder provides either 0.2 mm or 0.25 mm of expansion. Therefore, one full-cycle of the cylinder—or four turns—equals either 0.8 mm or 1.0 mm of expansion.¹¹

The length of the lead screw determines the maximum amount of expansion. The typical lead screw on a bonded or banded expander achieves 10 mm of maximum expansion. Removable expanders have smaller lead screws that achieve less expansion, usually 3 to 7 mm. The length of the lead screw is etched on the jackscrew's platform as a number, referred to as the *nominal size*, along with an arrow that indicates the direction of key turning. For example, a nominal size of 10 could achieve 10 mm of maximum expansion, or 40 to 50 key turns depending on the manufacturer.

How much space can we gain with RME? The amount is less than you might think. The ratio of arch perimeter gained / premolar expansion is 0.7.¹² Therefore, 30 turns of a jackscrew equal 7.5 mm of inter-premolar expansion, which equates to 5.25 mm of arch perimeter gained. Essentially, RME can provide only 5-6 mm of additional arch perimeter, approximately the width of a mandibular incisor; any additional anterior crowding would have to be resolved by incisor proclination. Theoretically, a Miniscrew-supported expander may achieve a slightly greater arch perimeter, depending on the patient's age.

Timing of RME

RME is typically recommended around age 8. By this age, most of the maxillary transverse growth has completed, and the permanent incisors and first molars have erupted to establish the occlusal plane. Additionally, the child's physical size is large enough to adapt to the appliance. While RME achieves greater skeletal effects at younger ages, the mid-palatal suture does not fuse until late adolescence.¹³ Of particular concern is an uncorrected unilateral posterior crossbite with a functional shift that could result in asymmetrical mandibular growth.¹⁴ In such a case, RME should begin before puberty when the mandible's growth potential is greatest.

If the maxillary permanent canines are ectopic in the absence of a unilateral posterior crossbite, the most streamlined approach is to extract the deciduous canines. If this is performed early before the canines cross over the roots of the lateral incisors, autonomous correction occurs approximately 80% of the time.¹⁵ This percentage increases if both the deciduous canines and first molars are extracted by allowing the first premolar to erupt early and out from underneath the permanent canines.¹⁶ This option may cause the patient greater anxiety, so it should be reserved for when the ectopia is severe.

When RME is performed as an alternative to deciduous tooth extractions, there is a tendency to place the expander too early, before the maxillary canines have erupted into the "funnel" between the lateral incisor and first premolar roots, which necessitates a second Phase I expander. Therefore, consider the following protocol: for impacted laterals, provide RME at ages 7-8; for impacted canines, provide RME at ages 8-9; and for a unilateral posterior crossbite, provide RME at ages 10-11 as part of comprehensive treatment. In summary, be more proactive with deciduous tooth extractions and exercise restraint with RME.

Obstructive sleep apnea

Even so, orthodontists who inappropriately tout "airway-friendly" services tend to encourage RME as early as possible, even as young as 3 years

of age. If a child presents with any degree of arch constriction or bruxism, a CT scan is taken to evaluate the oropharyngeal area, followed by the inevitable diagnosis of pediatric obstructive sleep apnea (OSA). The parent is informed of the child's purported high palatal vault, low tongue position, drooping eyes, ankyloglossia, and forward head posture, and then RME is recommended as the panacea. This form of treatment is a retrogression from proven research¹⁷ on OSA and mimics the pseudoscience of "orthotropics" usually provided by pediatric and general dentists.

Interestingly, the outspoken "airway-friendly" orthodontists of today are strikingly like the "TMJ-friendly" orthodontists during the 1980s and 1990s, pushing non-extraction methods and practicing outside the boundaries of evidence-based treatment. According to the research, RME is not recommended for the treatment of pediatric OSA,¹⁷⁻¹⁹ though it has shown some benefit in increasing nasal volume and reducing nasal airway resistance.^{20,21} Watchful waiting appears to be just as effective as RME.¹⁷ In other words, all orthodontists are "airway-friendly," even those that do not recommend unnecessary treatment.

Conclusion

Phase I RME is likely overprescribed because it is relatively innocuous. Ethical concerns arise when parents are provided misinformation regarding the immediate necessity of treatment. Phase I RME does not obviate the need for extractions or cure sleep apnea. Rather, it should be prescribed primarily for transverse skeletal constriction, a unilateral posterior crossbite with a functional shift, or ectopic canines when deciduous tooth extraction proves insufficient. Often, the gains that are achieved with Phase I RME could have been achieved during a single phase of treatment at a later time, saving the patient and the parent unnecessary distress and expense.

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Patient consent was obtained.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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