

Longitudinal Stability of Rapid and Slow Maxillary Expansion: A Systematic Review

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ABSTRACT

Aim and objective: To review the long-term stability of slow maxillary expansion (SME) and rapid maxillary expansion (RME).

Materials and methods: A systematic review of literature was carried out on the principal medical databases. Cephalometric studies, measurements on the dental casts, retrospective, cohort studies were kept as inclusion criteria. Last 20 years articles were included in the study. The studies where expansion had been performed by any one of the methods of expansion; that is, SME and RME were accepted. Studies where posttreatment follow-up had been performed were included. Selected articles were independently evaluated by three researchers. Discrepancies were resolved by discussion to reach a common consensus.

Results: Total of 151 articles were first shown as relevant articles but after sorting the article according to relevancy in a stepwise manner 12 articles fulfilled the inclusion criteria and were incorporated in the study finally. In the study, nine prospective and three retrospective studies which had followed patients after maxillary expansion from 2 to 15 years were included.

Conclusion: Correction with slow and rapid palatal expansion appears to be stable in the long-term when followed for extended periods after expansion treatment.

Clinical significance: The article clearly describes the effectiveness of the expansion treatment and its longitudinal stability in terms of relapse by providing various evidences from the literature which were sought after systematically searching the different electronic databases.

Keywords: Constricted maxilla, Crossbite, Palatal expansion, Rapid maxillary expansion.

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INTRODUCTION

Palatal expansion has been a popular and proven technique for the correction of transverse discrepancies used in orthodontics since long. There are many available types of maxillary expansion appliances and different expansion rates in rapid maxillary expansion (RME) or slow maxillary expansion (SME). Using jackscrew expanders, RME can be usually defined as two turns per day, while SME uses one turn after every second day or greater interval. Both treatment modalities (RME or SME) have their own advantages and disadvantages.

The short-term effectiveness of the technique is understood, yet some dilemma regarding the long-term stability still exists. Rapid palatal expansion is a treatment procedure that aims at enlarging the maxillary dental arch and the palate and is indicated when the upper jaw is too narrow compared to the lower jaw. Narrow jaws can often limit the airway and expansion helps to improve the airflow and allows the patient to breathe more normally through the nose. Studies assessing long-term stability of rapid palatal expansion have shown mixed reviews.¹⁻⁷

Posterior crossbite should be treated with maxillary expansion as early as possible. Overcorrection has to be performed in order to enhance the treatment stability. It has been reported that almost one-third of the expansion performed is lost posttreatment. The aim of the study was to collect evidence from the literature for long-term stability after slow and rapid maxillary treatment.

MATERIALS AND METHODS

A systematic review of literature was performed on the principal medical databases: PubMed (Medline), Medline In-Process, LILACS (Latin American and Caribbean Health Sciences Literature),

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Google Scholar, Web of Science, Cochrane Library, and EBSCO. The present study was undertaken in the department of orthodontic of Narsinhbhai Patel Dental College and Hospital in Gujrat. Keywords used were rapid maxillary expansion and long-term stability palatal expansion. Cephalometric studies, measurements on the dental casts, retrospective studies, and cohort studies were kept as inclusion criteria. Twenty-year articles (January 1, 1997 to December 31, 2017) were included in the study. Articles older than 1997 were not considered (Table 1). The studies where expansion had been performed by any one of the methods of expansion; that is, SME, RME, or expansions by the inner bow of the headgear were accepted. Only studies where some form of posttreatment follow-up had been performed were included. Studies without follow-up were rejected. Selected articles were independently evaluated by three researchers. Discrepancies were resolved by

discussion to reach a common consensus. Articles in language other than English were not included in the study. The articles were searched according to population, intervention, control, outcome (PICO) protocol as given in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines 2009. The analysis method and inclusion criteria have been specified in detail and documented in a protocol in order to restrict the likelihood of selection bias.

RESULTS

Searching of article from January 1, 1997 to December 31, 2017 resulted in the identification of 12 articles which fulfilled the inclusion criteria.⁸⁻¹⁹ Details of the included article are provided in the master table (Table 2). Maximum period of follow-up was performed by Fenderson et al. for 15 years (Fig. 1).¹⁵ Maximum numbers of subjects were studied by Huynh et al. that is 312 subjects (Fig. 2). There were nine prospective clinical trials^{6,9,11,14-19} and three

retrospective studies.^{8,10,13} We also found a systematic review but it was not included in our study as we focused mainly on primary studies.¹² Total of 151 articles were first shown as relevant articles but after eliminating the duplicates and sorting the article according to relevancy in a stepwise manner 12 articles were identified (Flowchart 1) out of which 9 studies used rapid palatal expansion whereas 3 used slow expansion.

DISCUSSION

Generally, maxillary expansion changes are reasonably stable and only a small amount of relapse is seen in the long-term follow-up.^{1,3,5} Krebs²⁰ in his study with implants has reported a decrease in maxillary bone width of just 0.5 mm right after the completion of maxillary expansion. The outcome of these former studies commensurate with studies included in this systematic review which also state that correction performed after expansion are mostly stable in the long-term. Various authors have studied subjects who were treated with RME for varied period of times and provide sufficient evidence that posttreatment corrections are stable longitudinally. At the close of 20 years of follow-up, Haas⁵ reported slight decrease in the width of the maxillary base in 10 of his cases. Cameron et al.³ reported an overall enlargement of 2 mm in maxillary bone width compared to a control group when followed for 6 years post-orthodontic treatment. In contrast to the skeletal changes, dental arch transverse width has a marked relapse rate according to few longitudinal studies, retaining about 40% of initial molar expansion.²⁻⁶

Treatment performed by slow expansion also showed good longitudinal stability when achieved in the mixed and permanent dentitions.²¹⁻²⁷ The probable reason for good stability of RME might

Table 1: Exclusion and inclusion criteria of the included studies

	<i>Inclusion criteria</i>	<i>Exclusion criteria</i>
1	Cephalometric studies, measurements on the dental casts, retrospective, cohort studies	Articles older than 1997 were not considered
2	Slow maxillary expansion, rapid maxillary expansion, or expansion by the inner bow of the headgear	Articles in language other than English were not included in the study
3	Posttreatment follow-up performed	Studies without follow-up were rejected

Table 2: Various parameters analyzed of the included studies

	<i>Authors</i>	<i>Type of study</i>	<i>Population</i>	<i>Intervention</i>	<i>Outcome</i>	<i>Follow-up</i>
1	Pinheiro et al. ⁸	Retrospective cohort study	90 adolescent patients (age 10–19 years) with narrow maxilla and posterior crossbite	Expansion with HASS appliance	Stable correction	5 years
2	McNamara et al. ⁶	Prospective study	112 patients with narrow maxilla	Expansion with HASS appliance	Stable correction	6 years
3	Gurel et al. ⁹	Prospective study	41 patients with narrow maxilla	Expansion with Hyrax appliance	Unstable correction	5 years
4	Huynh et al. ¹⁰	Retrospective study	312	Hyrax HASS Quad helix	Stable	2 years
5	Masucci et al. ¹¹	Prospective	22 patients with class III malocclusion	Hyrax with face mask	Stable	8.5 years
6	Lima et al. ¹³	Retrospective study	30 patients with class I malocclusion	HASS appliance	Stable	4 years
7	Mohan et al. ¹⁴	Prospective study	54 patients	HASS appliance	Stable	6 years
8	Fenderson et al. ¹⁵	Prospective study	102	HASS appliance and inner bow of cervical headgear	Stable	15 years
9	Lima Filho and de Oliveira Ruellas ¹⁶	Prospective study	70	HASS appliance and inner bow of cervical headgear	Stable	10 years
10	Lima Filho and Ruellas ¹⁷	Prospective study	70	HASS appliance and inner bow of cervical headgear	Stable	10 years
11	Matsumoto et al. ¹⁸	Prospective	27	Hyrax	Stable	30 months
12	Chang et al. ¹⁹	Prospective	25	Hyrax	Stable	6 years

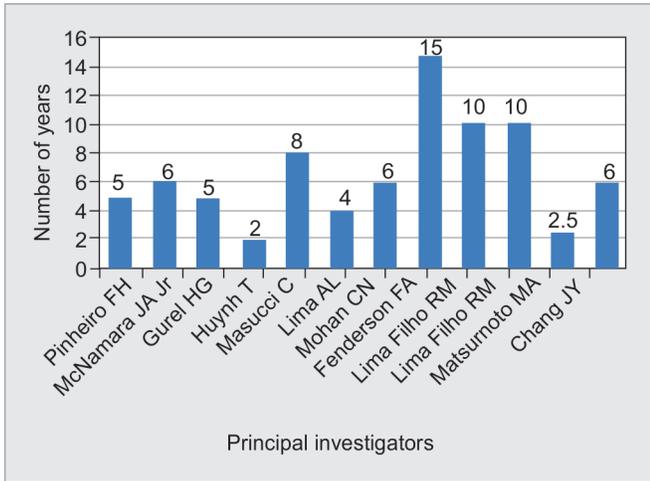


Fig. 1: Maximum period of follow-up

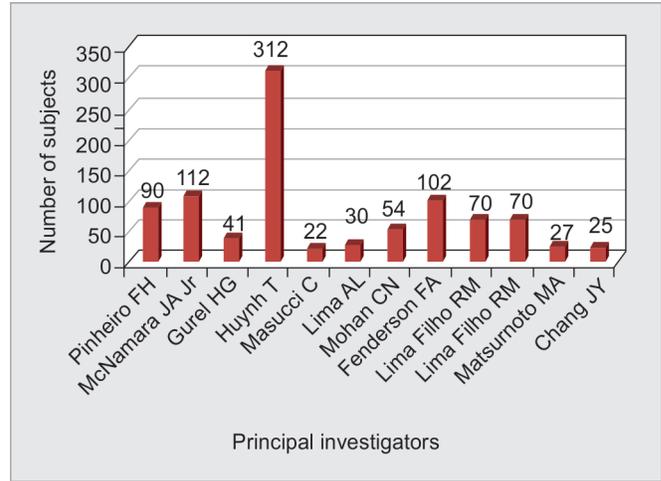
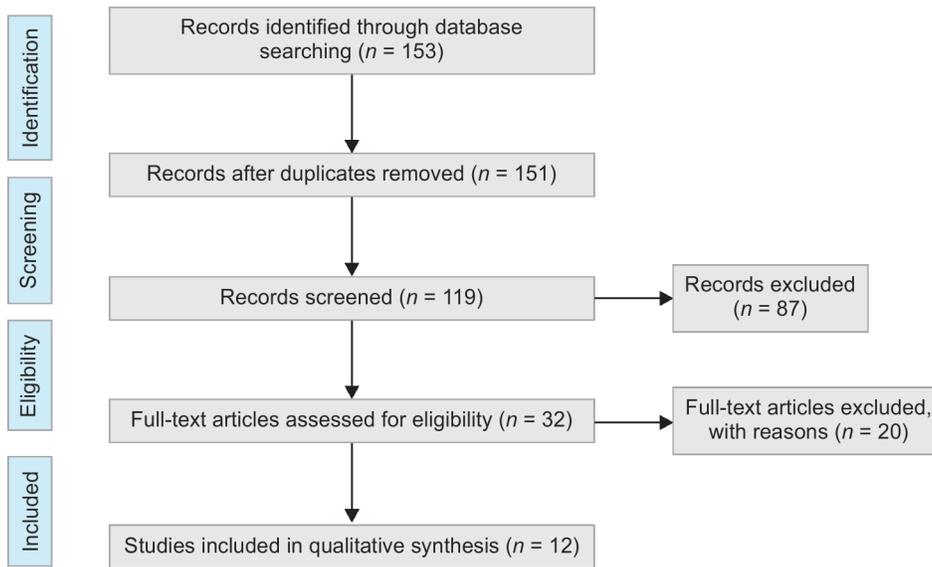


Fig. 2: Number of subjects studied

Flowchart 1: Flowchart



be attributed to orthopedic effects, whereas few others relate the good stability of slow expansion with the maintenance of sutural unification and stimulation of bone formation.²¹⁻²⁷ However, extensive and substantial literature search the articles published in the last 20 years have focused more on the RME.

Only a scarce number of studies actually compared SME and RME longitudinally.^{15,16,28} Most of them used the expanded inner bow of the face bow assembly as the slow expansion device and the experimental groups did not have posterior crossbite. Expansion was performed to relieve crowding in class I patients²⁸ and decompensate maxillary arch constriction in class II patients prior to facial orthopedics.^{15,16} Herold²⁹ investigated the stability of expansion using Hyrax expander, quad-helix, and removable plate (with coffin springs or expansion screw), in patients presenting with posterior crossbite. After 5 years of follow-up, relapse of posterior crossbite was greater in the quad-helix group compared to Hyrax and removable appliance groups. The variability in the sample characteristics and the diversity in the results of these previous

studies mandate further clarification. This study aimed to evaluate the longitudinal stability of RME and SME by means of assessing samples which were followed from 2 to 15 years after the end of orthodontic treatment.

Rapid maxillary expansion is an effective method of gaining space in the dental arches.³⁰⁻³² Research³⁰ has demonstrated that an increase of a millimeter of transpalatal width results in an increase of 0.7 mm in the maxillary arch. Long-term appraisal of residual gain in arch perimeter is mandatory to assess the success of this treatment approach in reducing the need for the extraction of teeth. Unfortunately, there are few long-term studies that address the stability of RME. The literature reports that the range of the percent of relapse after retention can be from 0 to 45%.^{2,5,33-36} Comparisons among different investigations become complicated and demanding because the clinical studies had different sample sizes and study design.

Rapid maxillary expansion and fixed appliance can easily correct tooth-size/arch-size discrepancies of mild-to-moderate degree. As



reported, 6 mm of long-term net gain in maxillary arch perimeter and 4.5 mm in mandibular arch perimeter can be expected. Rapid maxillary expansion may be particularly helpful in patients who have a narrow maxilla (e.g., 31 mm maxillary intermolar width) in association with an accentuated curve of Wilson, signs of maxillary deficiency syndrome.^{37,38} The studies included in this review showed great heterogeneity in study design as well as treatment modality and follow-up. This was the reason that no meta-analysis could be performed and the results must be interpreted with caution.

CONCLUSION

Many studies of low quality and high heterogeneity were identified showing overall stability of the expansion after the maxillary expansion. Further research is required so that more carefully designed studies are available which will reduce the heterogeneity and improve the quality of evidence. It can be concluded from the present study that correction performed after RME and SME are stable as most of the article included in the study have shown minimal relapse after expansion treatment.

CLINICAL SIGNIFICANCE

The article clearly describes the effectiveness of the expansion treatment and its longitudinal stability in terms of relapse by providing various evidences from the literature which were sought after systematically searching the different electronic databases and will help the clinician in planning the treatment.

DECLARATIONS

Ethics Approval and Consent to Participate

Manuscript does not report on or involve any animals, humans, human data, human tissue, or plants hence ethical approval and consent is "Not applicable".

Consent for Publication

Manuscript does not contain any individual person's data hence this section is "Not applicable".

Availability of Data and Materials

We do not wish to share the data as the master chart for all the included studies and detailed list of referred article has already been included.

AUTHORS' CONTRIBUTIONS

All authors sufficiently contributed in designing, acquiring data, analyzing data, and in drafting the article.

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No special reference has to be made in this segment.

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