Original Article

Perceived pain during rapid maxillary expansion in children with different expanders: *A prospective study*

Marília Carolina de Araújo[a]; Jessica Rico Bocato[a]; Sandrine Bittencourt Berger[b]; Paula Vanessa Pedron Oltramari[b]; Ana Cláudia de Castro Ferreira Conti[b]; Marcio Rodrigues de Almeida[b]; Thais Maria Freire Fernandes[b]

ABSTRACT

Objectives: To evaluate and compare the intensity of pain caused by rapid maxillary expansion (RME) with two expanders: Hyrax and Haas type, in growing patients.

Materials and Methods: Thirty-nine patients (23 girls and 16 boys) with an average age of 9.3 years (SD = 1.39 years) were randomized into two groups and treated with Hyrax- and Haas-type expanders. In both groups, initial activation of the expander screw was one full turn on the first day followed by 2/4 of a turn two times a day (morning and night) for 7 days. Inclusion criteria were patients presenting with a posterior crossbite or maxillary atresia between 7 and 12 years old. To evaluate the intensity of pain during the active phase of the treatment, a combination of the Numerical Rating Scale and Wong-Baker Faces Pain Scale was used. Mann-Whitney test was used to compare the two treatment groups.

Results: There was significant inverse correlation between days following insertion and pain. During the expansion period, 100% of the children reported some pain. Hyrax expander subjects reported greater pain than those treated with the Haas-type expander only on the first day. The level of pain remained greater in girls throughout treatment.

Conclusions: Pain was reported regardless of the type of expander and was higher in the Hyrax group only on the first day of activation. (*Angle Orthod.* 2021;91:484–489.)

KEY WORDS: Pain; Maxillary expansion; Pain scale

INTRODUCTION

Rapid maxillary expansion (RME) is the elected treatment for the correction of transverse deficiencies found in the maxilla and has been routinely used in cases of actual maxillary deficiency. The aim is to increase the width of the upper arch by separating the midpalatal suture with the use of an expander. The separation occurs as a result of the perpendicular relationship of the expander screw to the suture and the mode of activation of the appliance. Activation is quick and aims to accumulate a certain amount of force to break the resistance of the midpalatal suture.[1–3]

Among the most commonly used expanders are the Haas (tooth-tissue-borne) and Hyrax (tooth-borne) types, with the design as the main difference.[1,2] The Haas-type expander has two acrylic pads connected by a stainless-steel frame and is defined as a maximally anchored appliance with the palate, fibers of the periodontal ligament, and buccal bone plate as the areas of force distribution. The support mechanism for the bands of the anchoring teeth in the Hyrax appliance is a rigid structure of stainless steel, transmitting its force directly to the periodontium.[3]

As the result of some factors, such as greater bone elasticity, less resistance to expansion, and consequently less painful symptomatology, early treatment is indicated in the mixed dentition phase.[3] However,

[a] PhD student, Department of Dentistry, University of Northern Parana (UNOPAR), Brazil.

[b] Professor, Department of Dentistry, University of Northern Parana (UNOPAR), Brazil.

Corresponding author: Dr Thais Maria Freire Fernandes, Department of Dentistry, University of Northern Parana (UNOPAR), 183 Marselha Street, Jd Piza, Londrina, Parana 86041-140, Brazil
(e-mail: thaismaria@hotmail.com)

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patient reports of painful sensations during the expansion phase are well known to professionals.[4–6] The initial pain is reported in the form of pressure on the anchoring teeth and alveolar process. With the continuation of treatment, the pain moves to the bones and further sutures.[1,2] The pain peak is reached immediately after each activation and declines abruptly, minutes later. As suture opening occurs, symptomatology decreases noticeably.[6]

Pain may vary based on some factors such as age, sex, stress, individual pain threshold and cultural differences, as well as the magnitude of the applied force.[6] The inflammatory reaction during sutural opening and compression of the periodontal ligament may contribute to the pain experienced during RME.[7] Several studies have been performed that evaluated the intensity of pain concerning fixed orthodontic treatment,[8–10] but few have analyzed pain during the RME treatment. Most of the reports found cited pain as one the side effects when comparing different protocols of expansion.[6,11–13] However, there have been no studies evaluating the pain associated with RME treatment comparing the most commonly used expanders. Therefore, the objective of this study was to compare the intensity of pain caused by RME between two types of expanders: Haas and Hyrax type, in patients during the growth stage. The null hypothesis was that there would be no difference in pain intensity between the appliances during expansion.

MATERIALS AND METHODS

Study Group, Procedure, and Data Collection

This study was approved by the Research Ethics Committee of the University of Northern Parana (UNOPAR)/Plataforma Brasil 2.008.872 and registered on the Brazilian clinical trials register site (U1111-1185-7694). Parents of patients signed the informed consent form before the intervention.

A total of 39 patients between 7 and 12 years old, presenting with posterior crossbite or maxillary atresia, were included in this study (16 boys and 23 girls, average age of 9.34 $\pm$ 1.39 years). Inclusion criteria were patients with posterior crossbite or maxillary atresia between 7 and 12 years old. Exclusion criteria were syndromes, periodontal disease, agenesis and supernumerary teeth, anterior crossbite, open bite, permanent tooth loss, extensive caries, and previous orthodontic treatment. The children were randomly divided into two experimental groups using a simple random number table in the Excel program (Microsoft Corporation, Redmond, Wash) prepared by an investigator with no clinical involvement in judgment.

According to previously published effect sizes for the variable pain,[14,15] the test power indicated that 16 patients were necessary per group to achieve an alpha value of .05 and power of 95%.

All participants were treated with RME at the University of Northern Parana (UNOPAR) by two specialists in orthodontics and supervised by a professional with more than 10 years of experience. The anchorage of the appliances was provided by bands adapted to the upper first permanent molars, and circumferential clasps were attached to the upper deciduous canines or to the permanent canines when they appeared in the arch. Participants were randomly divided into two groups and treated with two types of expanders: Hyrax and Haas type. In both groups, the initial activation of the expander screw was one full turn on the first day followed by 2/4 of a turn per day (one in the morning and one at night) until the screw opening reached 7 mm.

Verbal instructions were given to the child and parent about how to use the pain scale to assess pain. Patients were asked to rate their pain severity.[6,16,17] The first expansion was performed at the dental clinic, and the children were asked to classify their pain, 15 minutes after the expansion was performed, using a combination of a Numerical Rating Scale (NRS) and Wong-Baker Faces Pain Scale (FPS)[6,16,17] (Figure 1).

Parents or guardians were instructed to repeat the expansion procedure at home and measure the pain and necessity of analgesics after the activation. The child's pain response, 15 minutes after each screw rotation, was recorded on the evaluation scale for the entire expansion phase.

Statistical Analysis

Distributions were summarized as percentages for discrete variables or as averages and standard deviations (SDs) for continuous variables.

The variables of primary interest for the study such as days of active treatment (days of activations) and pain reported during treatment were also summarized as averages and SDs and compared between the two treatment groups using the Mann-Whitney test. Secondary, sex-related analyses were also performed using a graph and the Mann-Whitney test.

The level of significance for all analyses was .05. Analysis was performed with IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY) and Minitab 17 Statistical Software (Minitab Inc, State College, Penn).

RESULTS

The characteristics of the 39 patients in the two treatment groups are shown in Table 1. The Pearson chi-square test confirmed there was no significant

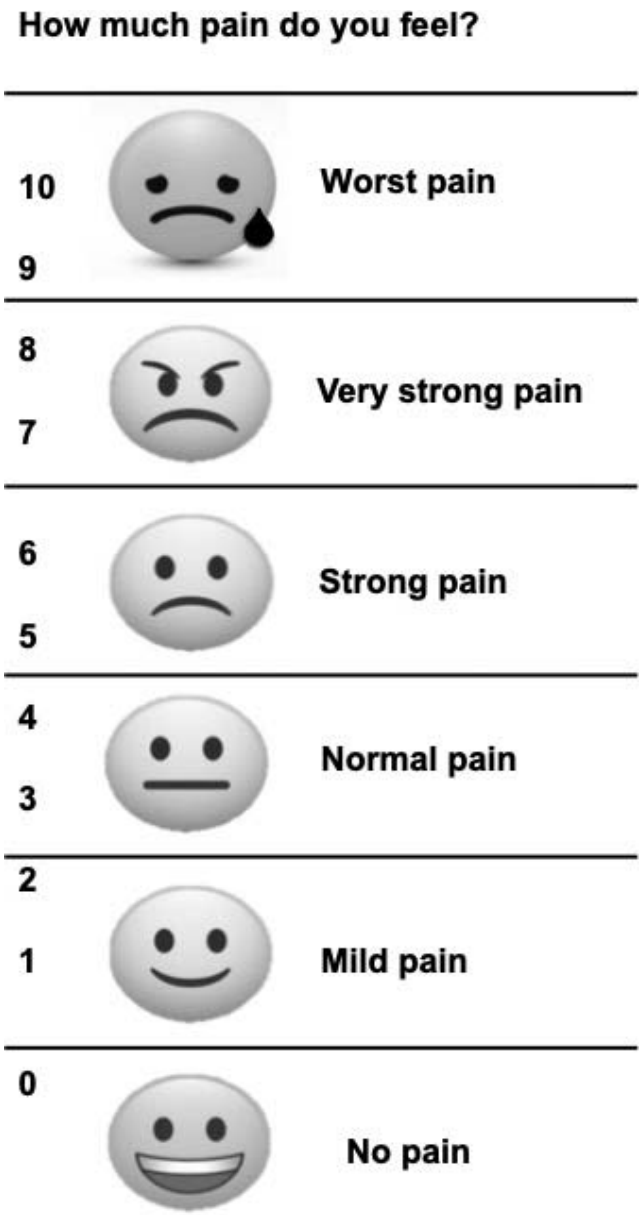

Figure 1. The Numeric Rating Scale (NRS) and Faces Pain Scale (FPS) used for pain evaluation.

difference in the makeup of the two groups. Similarly, age was, on average, not significantly different between the two treatment groups.

Throughout the expansion period, 100% (39/39) of the children reported some pain. Regardless of the type of expander used, all values in the pain scores were reported in the study. The use of analgesics during the active expansion phase was not reported. There was an opening of a midline diastema and disjunction confirmed by occlusal radiographs for all patients.

There was a statistically significant inverse correlation between days from insertion and pain (Table 2). In both groups, pain was considered moderate or strong on the first 2 or 3 days of activation and decreased with time (Figure 2).

Table 1. Characteristics of the Study Sample (χ^2 Test)

Variable	Hyrax Group, n = 20	Haas Group, n = 19	Total, N = 39
Sex, n (%)			
Female	13 (56.5)	10 (43.5)	23
Male	7 (43.7)	9 (56.3)	16
Age, y, mean (SD)	9.56 (1.60)	9.13 (1.11)	9.35 (1.37)

Individuals who were treated with the Hyrax expander reported significantly greater pain than subjects treated with the Haas type on the first day. Pain intensity, regardless of the appliance, was reported to be higher in the first days of activation. With the exception of the first day, the type of device did not significantly influence perceived pain during RME (Figure 3).

In the comparison between the sexes, the level of pain remained greater in girls throughout the course of treatment (Figure 4), and 43.47% of the girls reported "the worst pain" at least once during the activation period, in contrast to boys, in whom only 18.75% reported this type of pain (Figure 5).

DISCUSSION

This study evaluated two maxillary expanders, Hyrax and Haas type, used to treat individuals with posterior crossbites during the growth stage, to analyze the intensity of pain during RME using daily reported pain values and to determine if there was a difference between the appliances. Several studies have assessed the pain associated with other types of orthodontic treatments,[10,16] although most of the reports of RME found in the literature cited pain based on the side effects reported when analyzing different expansion protocols.[6,11–13,18,19] There were no studies that evaluated the pain associated with RME, comparing

Table 2. Treatment Results According to Expander Type

	Hyrax Group, n = 20		Haas Group, n = 19		
Variable	Mean	SD	Mean	SD	*P* Value
Pain during treatment					
Day 1	2.64	1.62	1.47	1.41	.002*
Day 2	2.20	1.54	2.16	1.5	.963
Day 3	2.45	1.72	1.97	1.42	.204
Day 4	2.22	1.69	1.97	1.61	.544
Day 5	1.97	1.66	1.79	1.51	.680
Day 6	1.67	1.44	1.80	1.72	.894
Day 7	1.29	1.43	1.92	1.57	.070
Day 8	1.19	1.51	1.88	1.53	.058

* Statistically insignificant difference ($P > .05$).

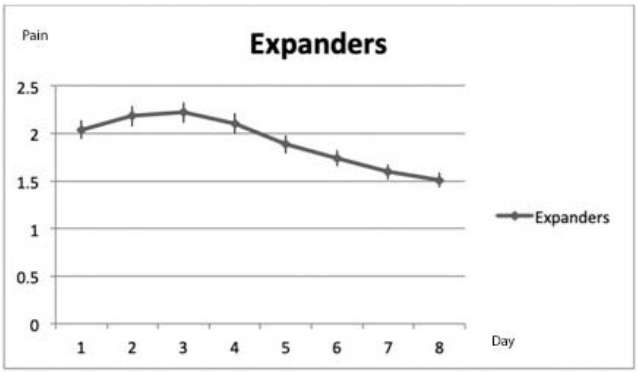

Figure 2. Pain intensity during the active expansion phase.

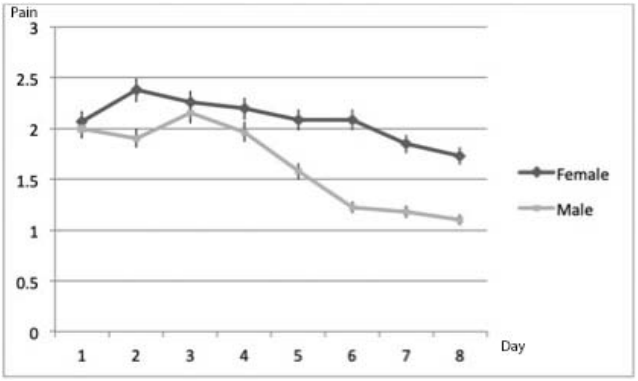

Figure 4. Average level of pain reported over time according to sex.

the two most commonly used appliances for this procedure.

Pain is a complex sensation that varies from one individual to another, so it is difficult to quantify. For pediatric patients, the measurement of pain may be even more difficult, and numerous studies have been carried out with the aim of measuring it.[17,20,21] The subjective report of pain intensity is the most commonly used method to measure pain in pediatric patients. Studies showed that children from the age of 3 years understand the concept of pain and its degrees of intensity, provided they had an appropriate device for reporting it.[17] The current study used a combination of two validated and commonly used scales, the NRS and the FPS, for a correct assessment of pain in children.[6,16] This was based on other studies[6,12] that documented the agreement between the FPS and the standard visual analog scale[22] and used an NRS[13] or combined FPS and the Analog Color Scale.[11]

In the present study, the findings of greater pain intensity during the first days of treatment were consistent with other studies. In fact, most children undergoing RME experience painful sensation, especially during the first few days of expansion.[6,11,23] In both groups, there was a decline in pain sensation as the activations continued, suggesting all children felt some pain, usually during the early phases of expansion.[23] Studies in humans and animals showed that, in the early stages, RME resulted in the creation of a highly vascularized and disorganized connective tissue of an inflammatory nature that resulted in a perception of pain.[6,11] During subsequent activations, there was a decrease in suture separation, which may have explained the decrease in pain reported by children in this study. The trend for decreasing amounts of reported pain over time may also be explained by the fact that children can become more comfortable with the procedure, and thus, the fear and anxiety of activating the appliance may be reduced with each activation.

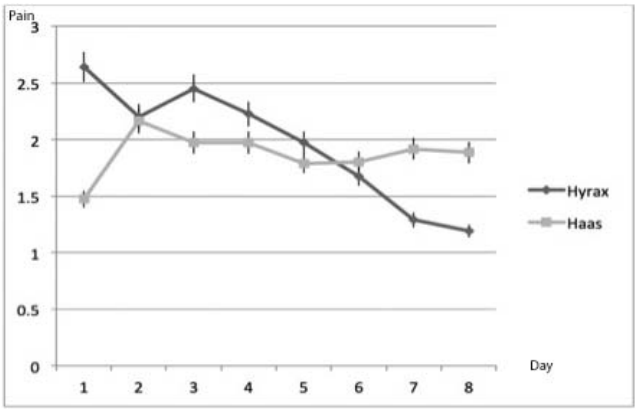

Figure 3. Intergroup comparisons for pain intensity during the active expansion phase.

This study showed that there was a significant difference in pain intensity between the two expanders during the initial phase of activation. The children who used the Hyrax demonstrated a greater intensity of pain on the first day of activation, which could be explained by differences in the design of the expanders. Consequently, different distributions of force on the oral tissues were experienced. In the Hyrax appliance, a rigid structure of stainless steel connects the expansion mechanism to the bands of the anchor teeth, thus concentrating more force on the support teeth. However, in the Haas type, the acrylic pads are connected to the stainless-steel structure. With regard to the biomechanics of RME, according to Braun et al.,[24] expanders with acrylic pads are much less rigid than those constructed exclusively of stainless-steel wire, as in the case of the Hyrax.[24] The Haas expander was defined as a maximally anchored appliance, with the palate, fibers of the periodontal ligament, and buccal bone plate as areas of force distribution, which differs from the Hyrax expander that transmits its force only to the periodontium.[4]

In the comparison between boys and girls, pain levels were higher for girls, which was similar to the

Figure 5. Percentage of boys and girls who reported the type of pain specified at least once.

findings of Baldini et al.[6] and Gecgelen et al.[12] It is believed that women are more sensitive to pain than men, although there are conflicting reports in the literature on this issue.[9,10] In addition, it is believed that women perceive themselves more, are more attentive to changes, and talk more about pain. The perception of pain is not a decisive factor to be used in choosing the type of expander to use, but guidance to those responsible is necessary, as some discomfort will occur, especially in the first days.

CONCLUSIONS

- Pain was reported, regardless of the type of expander.
- Pain was higher in the Hyrax group only on the first day of activation.
- Female patients were more sensitive to the activations, with 43.47% of the girls reporting "the worst pain" at least once during the activation phase.

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