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Difference in Long Protrusion Face Mask before or after Rapid Palatal Expansion in Skeletal Class III Children: A Preliminary Study

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Abstract Introduction Go to ▸

Treatment of Class III malocclusions often presents a challenge for orthodontists. Skeletal deficiency is often associated with dental malocclusion. There are several therapeutic choices, including the use in growing children of orthopedic protraction face mask, which is recommended for the correction of anterior maxillary transverse deficiency before face mask (FM). The purpose of the study is to verify whether there are significant differences in the treatment outcomes in the case of use of a face mask followed by a palatal expander (FM-RPE) versus the use of a face mask preceded by a palatal expander (RPE-FM). Methods: Twelve both male and 12 females, individual-data group (n = 24), about whose organic records the age of extracted tractive first and first the dispenser, and those with an inverted sequence in group B. Some cephalometric measurements were performed on lateral cephalograms taken before treatment (T1), after the end of therapy (T2). Results: Considering the T1–T0 of group A (therapy with FM-RPE), comparison of the evaluation of the results obtained in this work allows us to observe how within group A there is a significant improvement in SNA, SNB, and Angle convexity. Considering the T2–T1 of group B (therapy with palatal dispenser expander followed by traction with Delaire's mask), observed a significant improvement in ANB, SNB, and Angle convexity. Also, the two groups were comparable, and no statistically significant differences were found. Conclusion: The use of a face mask with a long protrusion and the use of a rapid palatal expander and face mask is effective. There is no statistically significant difference in the two groups who performed the therapy in mixed dentition. This suggests that the clinician should choose the protocol that is more suitable for the patient, based on the patient's needs and the clinician's experience. Conclusion: Early diagnosis of third skeletal classes with rapid expansion using a rapid palatal expander can be performed earlier or later than protractor anterior traction with a Delaire mask.

Keywords: skeletal class, rapid palatal expansion, palatal expansion, early treatment

1. Introduction Go to ▸

The definition of malocclusion was first introduced by Angle in 1899 and referred to the relationship between the teeth and the dental arches, the relative position of the dental arches and the relationship between the jaws. Angle's classification is based on the sagittal relationship of the first molars, which is not always correct. Skeletal class III is defined as a condition of disproportionate frontal mandibular growth in relation to cranial growth. In 1966, Tweed divided the third class into two subtypes, type A, characterized by a normal maxillary bone and type B, characterized by dental growth of the maxilla or an associated mandible. [1] Malocclusions with a prognathic mandible and a retrusive maxilla are a challenge for orthodontists, as the treatment is often with non-surgical means.[2,3]

Isaksson observed that 42.4% of class III cases had a normal positional mandible and an advanced mandible, while retrusive maxillary retrusion with a normal positional mandible was present in about 23% of cases. The remaining 32.6% of cases were divided between anterior position of both bones but dental malocclusion or combination of mandibular hypertrophy and maxillary hypotrophy.[4]

The most skeletal class III malocclusion components of mandibular prognathism and have a mediocrebrial strategy with a prognathic appearance but that is also an anteriorization of the maxilla.[5,6]

A recent meta-analysis reports that the genetic factors were involved in the genesis of the skeletal class III malocclusion, and the heritability of the skeletal class III was 0.73 for the mandible, 0.71 for the maxilla, 0.67 for ANB, 0.67 for SNA, 0.67 for ANB/SNB, and 0.66 for SNB.[7] Genetic factors are the most important primary factors in the study, and the authors conclude that skeletal class III is defined as a condition of disproportionate frontal mandibular growth in relation to cranial growth. In 1966, Tweed divided the third class into two subtypes, type A, characterized by a normal maxillary bone and type B, characterized by dental growth of the maxilla or an associated mandible.[1] Malocclusions with a prognathic mandible and a retrusive maxilla are a challenge for orthodontists, as the treatment is often with non-surgical means.[2,3]

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Starting from the assumption that about one third of patients with skeletal class III malocclusion have a deficit of the upper jaw and supported by studies on the mobilization of the circum-maxillary sutures, we aimed in this study to identify if there was an advantage in performing transverse maxillary orthopedics followed by rapid palatal expansion of the reverse sequence dispensed the rapid or better skeletal results.

2. Materials and Methods Go to ▸

In this preliminary study, orthodontic changes obtained in two groups of skeletal class III patients were compared and treated in the early stages of mixed dentition with a face mask and RPE anchored to the upper dentition. Twenty-four patients (12 boys and 12 girls) were consecutively selected to verify whether the different modalities lead to statistically significant orthodontic changes in the upper jaw, best clinical outcomes. The two groups were both made up of 12 patients subdivided into group A, those who underwent treatment with a face mask followed by a palatal expander (FM-RPE), and group B, those who underwent treatment with a palatal expander (Hyrax) followed by a face mask and 3 females, as reported in Table 1.

Table 1

Distribution by age and dispersion of the sample groups.

	Sex	Mean	SD	CI95%
GROUP A	Male	7.9	0.9	7.4–8.4
	Female	8.0	0.9	7.4–8.6
	Total	7.9	0.9	7.4–8.4
GROUP B	Male	7.9	0.9	7.4–8.4
	Female	8.0	0.9	7.4–8.6
	Total	7.9	0.9	7.4–8.4
Total	Male	7.9	0.9	7.4–8.4
	Female	8.0	0.9	7.4–8.6
	Total	7.9	0.9	7.4–8.4

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The same table shows the distribution by skeletal divergence of patients, assuming 27 ± 2° as the normo-divergence reference.

The overall duration of treatment was 1 year and 2 months +/− 4 months for group A and 1 year 3 months +/− 4 months for group B (Table 2). The average age of the patients at the beginning of the treatment was a maximum age of patients in 50 boys 8 years 8 months, in 50% the ending by age of the sample of children treated with RPE and then Delaire facial mask (6 years 11months +/− 10 months) and with Delaire facial mask and RPE (5 years 3 months +/− 7 months).

Table 2

Treatment timing.

	Mean	SD	CI95%
GROUP A	1 Y 2 M	4 M	1 Y 2 M–1 Y 6 M
GROUP B	1 Y 3 M	4 M	1 Y 3 M–1 Y 7 M
T (GROUP A – GROUP B)	0 M	0 M	0 M–0 M

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The criteria for inclusion in the experimental group were the presence of mandibular slipping or centric occlusion–centric relation discrepancy and the presence of at least one of the following characteristics: anterior crossbite, Class III molar relation, Class III canine relation, and anterior crowding. The criteria for patients were treated exclusively by the same operator using Hyrax rapid palatal expander and anterior maxillary traction with Delaire's mask anchored to upper dentition based on the several decisions molars.

All the patients protractor was anchored on bands cemented to the upper deciduous second molars and instead of in the first permanent molars, and the extraoral traction coupling sphere were both with 1.1 mm wire, with a force of 400 g per side, and with a force vector of 30° to the occlusal plane and 10° to the upper dentition. The activation of the palatal screw of the palate took place starting from the same day in which the appliance was cemented, making the patients perform 10 to 20 a turn a day, and the activation of the protractor was performed with a force of 400 g per side, and the patients were asked to wear the face mask for an almost fixed-to-fixed interocclusion.

The orthopedic traction was turned twice by the little patient for the which night and four times during the day. However, patient compliance was only achieved by the parents. The activation of the maxillary traction was achieved by using two 7–7.5 Oz elastics pulled with a forward and slightly downward direction, angled about 30° with respect to the occlusal plane, and a developed force of about 350 g each.

The active phase of treatment ended when a significant overcorrection in the sagittal plane and class II molar relationship was achieved. The patients underwent a period of retention of 6 months, during which the occlusions of interest were monitored by about one month, the overcorrection was achieved, the presence of posterior and downward displacement produced by the chin size of the mouth. For this reason, in group B, the Delaire face mask was used for a period of 6 months, during which the patients underwent a period of retention. After the expansion of the palate, the patients underwent a period of retention of 6 months, during which the stabilizing the occlusal relationships in "centric relationship". Even in group A (Delaire + RPE), the end of treatment exchanges was performed on average 6 months after blocking the activation of the palatal screw.

On the patients of both groups, two lateral X-rays of the skull were performed in the usual occlusion position and natural head position (Harvard-Dolphin) in the following measurements. At the start of the treatment and T1 to have stabilization after the two orthopedic phases.

A cephalometric trace was performed on each X-ray by the same operator, identifying the measurements shown in Table 3.

Table 3

Skeletal and dental relationship evaluated in the study.

Angular Skeletal Relations	SNA	Position of the Maxilla
	SNB	Position of the mandible
	ANB	Intermaxillary sagittal relation
	SN/GoMe	Skeletal mandibular body relation
	SN/Ptg	Skeletal convexity
	ANB/SN	Skeletal relationship of the vertical plane
	Ngo-Me/Ptg	Skeletal relationship of the mandibular plane
Dental Relations	Ptg-Pm	Soft tissue anterior projection
	Incisor/SN	Dentoalveolar incisors
	Incisor/Ptg	Intermaxillary relationship
Dental	1+/Ptg	Upper incisor inclination
	1-/GoMe	Lower incisor inclination

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For each measurement, the mean and standard deviation within the sample were calculated. For each therapeutic interval, the Student's test was then calculated for paired data. The two groups were then compared using the Student's test for independent data. The error of the method was then calculated using the Dahlberg formula, requiring 12 measurements to first patients one week after the first measurement. An SDE of 0.847 was obtained, which was well below the limit of 0.25.

3. Results Go to ▸

The results of the study are shown in Table 4, Table 5 and Table 6.

Table 4

Study results for the sample A – Hyrax + face mask.

	T0		T1		T1–T0	
	AVERAGE	SD	AVERAGE	SD	AVERAGE	SD	T
SNA	80.5	3.1	80.8	3.1	0.3	0.5	2.2*
SNB	80.0	3	78.9	3.0	−1.0	0.9	−4*
ANB	0.5	1.9	1.9	1.9	1.4	0.7	6.9*
SN/GoMe	32.8	5.1	32.8	5.1	0.0	0.0	0.0
SpP/Ptg	1.9	3.2	1.5	3.3	−0.4	1	−1
Ngo-Me/Ptg	2.1	3.2	1.7	3.3	−0.4	1	−1
PM/Ptg	0.4	3.4	0.8	2.8	0.4	1.4	1*
ap/Ptg	0.9	2.7	1.1	2.7	0.2	0.8	1
1-/SPP	62.1	8.9	63.9	8.9	1.7	9.3	ns
1-/GoMe	90.1	7.1	92.8	7.1	2.7	4.9	2.7*
1+/Ptg	28.8	5.6	30.4	4.7	1.6	3.8	1.4
1+/SPP	112.6	10.7	113.6	6.3	1.1	10.02	ns
1+/SN	107.7	8.7	107.1	7.1	−0.6	5.9	ns
6-1-1	17.9	0.1	17.9	0.5	−1.9*	1.5	ns
6-1-1/Ptg	17.9	0.1	17.9	0.5	−1.9*	1.5	ns

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* p value < 0.05, * p value < 0.01.

Table 5

Study results for the sample B – Delaire + face mask.

	T0		T1		T1–T0		
	AVERAGE	SD	AVERAGE	SD	AVERAGE	SD	T
SNA	79.4	3.1	79.4	3.1	0.0	0.0	0.0
SNB	78.9	3.2	79	3.0	−0.0	1.7	ns
ANB	0.5	1.9	0.4	1.9	−0.1	1.4	ns
SN/GoMe	32.8	5.1	32.8	5.1	0.0	0.0	0.0
SpP/Ptg	1.9	3.2	1.5	3.3	−0.4	1	−1
Ngo-Me/Ptg	2.1	3.2	1.7	3.3	−0.4	1	−1
PM/Ptg	0.4	3.4	0.8	2.8	0.4	1.4	1
ap/Ptg	0.9	2.7	1.1	2.7	0.2	0.8	1
1-/SPP	62.1	8.9	63.9	8.9	1.7	9.3	ns
1-/GoMe	90.1	7.1	92.8	7.1	2.7	4.9	2.7*
1+/Ptg	28.8	5.6	30.4	4.7	1.6	3.8	1.4
1+/SPP	112.6	10.7	113.6	6.3	1.1	10.02	ns
1+/SN	107.7	8.7	107.1	7.1	−0.6	5.9	ns
6-1-1	17.9	0.1	17.9	0.5	−1.9*	1.5	ns
6-1-1/Ptg	17.9	0.1	17.9	0.5	−1.9*	1.5	ns

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* p value < 0.05.

Table 6

Results of the comparison between the two groups covered by the study and statistical significance.

	T0		T1–T0	
	A	B	A	B
SNA	80.5	79.4	0.3	0.0
SNB	80.0	78.9	−1.0	−0.0
ANB	0.5	0.5	1.4	−0.1
SN/GoMe	32.8	32.8	0.0	0.0
SpP/Ptg	1.9	1.9	−0.4	−0.4
Ngo-Me/Ptg	2.1	2.1	−0.4	−0.4
PM/Ptg	0.4	0.4	0.4	0.4
ap/Ptg	0.9	0.9	0.2	0.2
1-/SPP	62.1	62.1	1.7	1.7
1-/GoMe	90.1	90.1	2.7	2.7
1+/Ptg	28.8	28.8	1.6	1.6
1+/SPP	112.6	112.6	1.1	1.1
1+/SN	107.7	107.7	−0.6	−0.6
6-1-1	17.9	17.9	−1.9*	−1.9*
6-1-1/Ptg	17.9	17.9	−1.9*	−1.9*

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* p value < 0.05.

As shown in Table 4, considering the T1–T0 of Group A (therapy with FM-RPE), the results obtained in this work allows us to observe how within group A there is a significant improvement in the Wits and Angle indices following treatment, an index of the differential advancement of the two jaws. The SNA and SNB values have shown a significant improvement, and the maxillary and mandibular plane on the skull base. The convexity index also appears to be statistically significantly improved.

Group B treated with the palatal dispenser sequence followed by traction with Delaire's mask showed a significant improvement in ANB, in SnB, and Angle convexity. Also, there was a significant increase in the advancement of the upper jaw following the therapy. On the other hand, no significant increase in skeletal divergence was observed during orthodontic treatment. The results are reported in Table 5.

In Table 6, a statistical comparison of the two groups in the study shows the values of the two groups at T0 and the variations between the two groups. The two groups were comparable at T0 for ANB, ANBp, SCT, so, that means that the two groups were comparable, and no statistically significant difference was highlighted.

The data were analyzed with the software package SYGNUS 10 (Cellinger Software, TX, USA).

4. Discussion Go to ▸

The treatment of the skeletal class III represents in many cases a challenge for the orthodontist, as the treatment of the malocclusion is linked to the reproducible growth of the bone bases. In particular the mandibular one.

The literature agrees that among the malocclusions, the third class is the least widespread,[1,2] However, this occurs predominantly in the Asian population.[3,4] The skeletal class III can present as a true class III or as a characteristic white pathological or syndromic pictures: in the case of patients with cleft lip and palate, this type of malocclusion is present in 15–17 of the children treated.[5,6]

In a recent study, it was observed that 68.1% of patients with craniosynostosis have a skeletal class III and 31.9% have a class II, with a prevalence of 1.9% depending on the case, with orthognathic surgery, orthopedic orthodontics or orthopedic surgery.

Class cap was first orthopedic therapy for third skeletal classes. The results in the literature are abundant, and some authors have observed significant results in the treatment of class III malocclusions, the mandible protrusion and limit its growth led to the abandonment of the use of this class cap replaced by the orthopedic protractor face mask (FM).[7,8] The FM has been used to obtain the anterior displacement of maxillary, the forward displacement of mandible by inclusive rotation of the mandibular plane, and counterclockwise rotation of the maxillary plane. A meta-analysis states that orthopedic face mask treatment is beneficial in early, short-term skeletal Class III cases.[9] The results of the study of Kapust [10] are in line with this.

Face orthodontic treatment is the ideal solution when the skeletal problem is absent or minimal. It has a dentoalveolar component determined primarily by means of a lingual inclination of the upper incisors and a proclination of the upper incisors associated or not with the extraction of permanent teeth.[11,12] Many authors have reported that the orthopedic protraction face mask is effective in the treatment of class III malocclusions with a prognathic mandible and a retrusive maxillary phase in dentition or early mixed dentition, followed by an orthodontic phase at the end of the growth.

In some cases, the antagonists of the mandible in the deficit of the upper jaw make it necessary to perform orthognathic surgery in adulthood. Orthodontic treatment in the growing phase can reduce the need for mandibular osteotomies.[13,14] The choice of treatment for the skeletal class III malocclusion must be based on a careful evaluation of the case and an accurate choice of treatment timing.

In the literature, there are studies with conflicting results. Some show an increase in the present analysis the treatment performed with a Delaire mask followed by RPE (group A) leads to a significant improvement in the SNA and SNB angles, the convexity angle, and the angle between the maxillary and mandibular planes.[15,16] Cozza and Lione [17] state that the results differ from the work of Cozza and Lione [18] in that a statistically significant improvement in the ANB angle is not observed.

This is probably linked to the choice of the patients of group A, at the time of the start of treatment with the Delaire mask, the dentition incisors were present in the arch with the crowns of the permanents, so a dentoalveolar component of the orthopedic effect of the face mask could be expected, which is not present in patients who have a deciduous dentition. In the study by Cozza and Lione,[18] the patients with the eruption of the permanent central incisors, part of the lower jaw in the center of the concavity supported by the rest of the permanent incisors.

In group B, a statistically significant increase of ANB, SnBn, and Angle was observed, as reported in the literature. The results of the study confirm that the orthopedic protraction face mask is effective, and it is linked to the fact that the use of a expansion expander before traction can result in an anterior movement of jaw. Compared to group A, on the other hand, no increase in divergence has been observed either mandibular or palatal.

Post-mandibular rotation was not detected, as was also the case in the Mermigkis [19] study According to Cozza et al.,[20] the anterior movement maxillary bone is not accompanied by a downward movement of the maxillary intermaxillary sutures.[21,22] The choice of treatment for the skeletal class III malocclusion must be based on a careful evaluation of the case and an accurate choice of treatment timing.

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5. Conclusion Go to ▸

The treatment of third skeletal classes as an early age is a widely used therapeutic choice in orthodontics. The use of a rapid palate expander combined with a facial mask is an effective and low-contacting dentoskeletal malocclusion. From what emerges from the present study, the therapeutic sequence does not influence the skeletal outcomes of the treatment, which are linked to the clinical based on the dentoskeletal conditions of the individual patient at the start of treatment.

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Declaration of Conflicting Interests Go to ▸

Conceptualization: FL, methodology: FL, software: FL, validation: M.R., formal analysis: FL, investigation: LM, data curation: A.D.S., writing—original draft preparation: F.L., writing—review and editing: M.R.T.M., visualization: F.L., supervision: M.R.T.M., project administration: F.L. Funding acquisition: LM. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement Go to ▸

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethical Committee of the University of Paulo (Protocol No. 1855/2015). 10 September 2015.

Conflicts of Interest Go to ▸

The authors declare no conflict of interest.

Notes Go to ▸

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