Comparison of the treatment of maxillary hypoplasia between patients with Down syndrome and patients without any type of syndrome, by using ALT-RAMEC Protocol plus a facial mask

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Abstract:

Objective: To determine if there is any significant difference between patients with maxillary hypoplasia and Down syndrome and patients without any type of syndrome, regarding the changes obtained by applying the same expansion-constriction protocol (Alt-Ramec) plus the use of a facial mask. ***Materials and method:*** A non-randomized non-controlled clinical trial, with the same treatment for both groups, using a protocol of expansion-constriction of the upper jaw for 5 weeks, followed by the use of the facial mask for an average period of 1 year of treatment. All participants started and finished the treatment in a cervical maturation stage before the growth peak, and a convenience sampling was done, with a total sample of 10 patients with Down syndrome and 10 patients without syndrome. ***Results:*** When individually analyzing the groups, the following was found: In the group with Down syndrome (DS) the statistically significant results were in the angle of facial convexity, SNB, ANB and palatal plane perpendicular to Frankfort. In the group without syndrome (NDS), statistically significant differences were found in the angle of facial convexity, SNA, SNB, ANB, point A perpendicular to Frankfort, maxillary length and mandibular length. When analyzing the results between groups, no statistically significant differences were found. ***Conclusions:*** Patients with Down syndrome, despite having many functional and endocrine compromises, presenting lower bone density and having their growth reported as slower, among others, show similar results when compared with children without any syndrome and when applying the same expansion-constriction orthopedic therapy (Alt-Ramec) plus the use of facial masks. This does not mean that there are no differences between the groups, but a larger sample is required to determine if there are really statistically significant differences.

Introduction

Down syndrome (DS) is a genetic disorder caused by the presence of an extra copy of chromosome 21, and it is characterized by the presence of a variable degree of cognitive disability and some distinctive physical features. The incidence of this anomaly is 1 in 600 births;[1] the development of medical advances in this subject has allowed these children to have a higher life expectancy, which has resulted in more frequent consultations by parents to the dentistry service, specifically orthodontics, since these children show apparent signs of malocclusion.[2]

This genetic disposition affects many aspects of the child's development, since in addition to mental retardation they have special morphological features, as well as cardiovascular, skeletal and nervous abnormalities. Many of the clinical signs are related to the retarded growth that these children present at a general level.[3] These signs are also due to the compromise of endocrine disorders such as thyroid dysfunction, low bone density, diabetes, short height or overweight. These conditions, associated with environmental factors such as low calcium and lack of vitamin D, plus muscle hypotonia, are risk factors for bone health of these patients, which result in the retardation of both growth and bone maturity.[4] [5]

The anatomical and functional characteristics of Down syndrome have direct repercussions on the normal growth of facial structures, since they affect neuromotor control and cause respiratory disturbances, muscle weakness and dental anomalies.[6] Anatomically, there is little development of the middle facial third, while the jaw continues its normal development; the musculature in general is hypotonic, including the tongue, which gives the impression of being abnormally long due to muscle weakness and to its anterior position in the mouth (relative macroglossia). These alterations result in poor facial aesthetics, as well as in an alteration in feeding and swallowing, which leads to the occurrence of medical and social consequences in these patients that it is important to prevent from very early stages in the development of these individuals.[7]

There are several features associated with the soft and hard tissues of these patients: The deep and V-shaped palate is due to a poor development of the middle third; the palate is affected in length, height and depth but keeps the normal width. Perioral musculature is affected by muscular hypotonia, which leads to a lip position where the upper lip is raised and the lower one is backtracked, while the tongue is protruding. Lingual protrusion, accompanied by oral breathing plus a forward tilt of the head, is the result of upper airway obstruction;[8] lingual protrusion plus oral breathing can cause chronic periodontitis, xerostomia, indentations on the lateral edge of the tongue, tongue and lip fissures and improper inclinations of the anterior teeth.[9]

Skeletal morphology is characterized by a short cranial base, and there is a lack of growth in both jaws, being the lack of growth of the upper jaw more significant;[10]

the gonial angle is normal. Kissiling reported that patients with Down syndrome showed a 69% overjet, 54% open bite, 97% cross bite, 65% class III malocclusion and dental biprotrusion.[9 11]

Some studies conducted with the expansion-constriction protocol in patients without Down syndrome (NDS) show favorable results [6 7 8] in the treatment of class III malocclusion with maxillary hypoplasia. To date we have not found in literature any reports of treatments that apply in patients with DS protocols similar to those commonly applied in NDS children who have deficiency of the middle facial third.

Because this type of class III malocclusion is a characteristic of patients with Down syndrome (DS), [3 5] the one with the highest incidence (65%), [1] in addition to functional alterations, delayed growth, low bone density and endocrine and muscular problems, the decision was made of comparing whether there are differences between these two groups regarding the results obtained with this protocol plus the use of a facial mask.

Materials and methods:

A non-randomized non-controlled clinical trial was carried out, with the approval by the ethics committee of CES University in Medellín, Colombia. The sample of the patients included in the study was obtained from the private practice of two operators.

Two groups with the same orthopedic treatment were analyzed in an observation period of one year. A convenience sampling was done, with a total simple of 20 patients, 10 with syndrome (DS) and 10 without syndrome (NDS).

Informed consent was taken from parents, after explaining what the treatment was and what its benefits were. Likewise, the assent was taken from those children patients who were able to understand what the study was about.

The treatment therapy performed was the expansion-constriction protocol proposed by Franchi et al. [12], which consists of placing a McNamara Hyrax (see Figure 1); it was cemented with glass Inomer and the protocol was applied, consisting of two quarters of a turn every day for a week, then alternated the next week and the screw being closed until completing the second week and so on, until completing the fifth week (see Table 1).

Subsequently, the facial mask was placed, worn with 14 oz. 5/16 ”elastics which produce approximately 400 g of force per side, in forward and downward direction 30º from the occlusal plane, [12] for 12 hours a day. The success criterion that indicated the end of the use of the mask was to wear it until an overcorrection of class III malocclusion was achieved, or for 1 year of treatment (see Figure 2).

Figure 1. McNamara type expander with the expansion-constriction protocol (Alt-Ramec) with hooks to protract the maxilla.

Table 1. Modified expansion-constriction protocol proposed by Franchi.

Week	1	2	3	4	5	6
Screw opening 2/4 of a turn per day	x		x		x	
Screw closure 2/4 of a turn per day		x		x		
Facial mask placement						x

Figure 2. A patient with Down syndrome. After performing the expansion-constriction protocol (Alt-Ramec) for 5 weeks, a facial mask is placed until overcorrection is achieved, or for 1 year of treatment.

Two samples of both genders with ages between 6 and 11 years were included, which showed morphophysiological characteristics of class III malocclusion due to maxillary hypoplasia. Cephalometric inclusion criteria were: ANB> 2 °, Co-A> 82, negative Witts and prepubertal stage of skeletal maturation according to cervical vertebrae (CVM 1-3). [13]

The information was collected through the Cephalic diagnostic aids, panoramic before and after with the same magnification. Dental models and intraoral and extra oral photographs before and after orthopedic treatment were also taken by the same radiological center, which is standardized for taking photographs.

The tracing and overlapping of cephalic X-rays was performed by the same expert operator, and it was gauged with an intra-class correlation coefficient >0.9; on the other hand, the operator was not aware of the investigation.

The quantitative variables that were used to assess cephalometric changes were: facial convexity angle, SNA, SNB, ANB, A perpendicular to Nasion (ApN), Pogonion perpendicular to Nasion (PpN), Frankfort-mandibular plane angle (FHMA), Frankfort-Palatal plane (FHPP), wits, maxillary length (Co-A), mandibular length (Co-B), Upper incisor to Sella-Nasion (UISN), Upper incisor to Frankfort (UIFH), Lower incisor to mandibular plane (LIMP) and the qualitative variable of the subjective assessment of facial profile (VAS) (see Table 2).

Table 2. Descriptive summary of cephalometric variables before and after treatment, compared in each group with their *p*-values.

	Base line				After to treatment			
	Down S. T1(n=9)	Normal T1(n=7)	Dif. T2-T1	*t student* Valor p	Down S T2(n=9)	Normal T2(n=7)	Dif. T2-T1	*t student* Valor p
	$\bar{X} \pm DE$	$\bar{X} \pm DE$	$\bar{X} \pm DE$		$\bar{X} \pm DE$	$\bar{X} \pm DE$	$\bar{X} \pm DE$	
ACF	-0,1±2,1	1,3±2,4	-1,4±1,1	0,245	2,4±2,6	3,7±1,7	-1,3±1,1	0,264
SNA	78,7±3,6	79,5±3,1	-0,8±1,7	0,663	79,9±5.1	81,5±4,2	-1,6±2,4	0,527
SNB	80,2±3,6	78,9±4,1	1,3±1,9	0,513	78,6±3,6	78,2±4,5	0,4±2,0	0,858

ANB	-1,6±2,0	0,5±2,3	-2,1±1,1	0,083	1,4±2,3	3,3±1,4	-1,9±1,0	0,079
ApN	-0,9±5,1	-2,2±3,6	1,2±2,3	0,603	2,5±5,6	1,3±2,5	1,2±2,3	0,625
PpN	-1,8± 8,6	-6,6±6,3	4,9±3,9	0,232	0,4±7,4	-4,4±4,8	4,8±3,3	0,165
FHMP	22,4±6,3	-426,7±8,7	-4,2±3,7	0,281	20,9±4,6	27,6±4,5	-6,6±2,2	0,011
PPFH	0,3±4,3	0,5±3,9	-021±2,0	0,923	-2,9±4,5	-2,3±2,5	-0,6±1,9	0,752
Wits	-7,3±3,3	-7,9±1,5	0,6±1,4	0,648	-5,0±3,9	-5,5±3,4	0,4±1,9	0,823
CoA	77,9±3,1	78,6±3,8	-0,7±1,7	0,697	80,2±2,9	82,8±5,0	-2,6±1,9	0,203
CoB	103,3±2,8	102,6±7,5	0,7±2,7	0,806	104,9±4,8	105,4±8,2	-0,5±3,3	0,880
UISN	109,4±11,3	95,3±5,4	14,1±4,2	0,006	108,9±9,4	99,5±4,4	9,3±3,9	0,029
UIFH	119,8±9,8	103,6±5,4	16,3±4,1	0,001	121,8±7,7	109,6±5,8	12,2±3,5	0,003
LIMP	95,3±8,8	86,5±5,6	8,7±3,8	0,038	91,3±5,6	84,5±2,9	6,9±2,2	0,007

**p*=<0.05 Statistically significant changes

An exploratory statistical analysis was carried out with the IBM-SPSS program (SPSS Inc, Chicago, II statistic version 21); the normality of the cephalometric variables was evaluated by the Shapiro Wilk test, determining that the data showed a normal distribution at the beginning and at the end of the treatment; the Student *t* test for paired samples and the Student *t* test for independent samples were performed, in order to compare intra and intergroup changes respectively (see Tables 2 and 3),

Results

The same treatment was performed for both groups: an expansion-constriction protocol of the upper jaw for 5 weeks followed by the use of the facial mask for an average period of 1 year of treatment. All participants started and finished the treatment in a stage of cervical maturation before the growth peak. A convenience sampling was done, with a total sample of 20 patients, 10 with Down syndrome (DS) and 10 without syndrome (NDS). Some patients withdrew from the investigation due to their lack of collaboration, then remaining a total sample of 9 DS and 7 NDS.

Table 3 shows the descriptive and comparative results of cephalometric variables both intra and intergroup, before and after treatment. Tables 4 and 5 show the changes in the subjective assessment of the profile (VAS) in patients with Down syndrome and without syndrome, respectively.

Patients with Down syndrome: DS

When the individual results of the cephalic variables are compared in each group, it is shown that in the group of patients with Down syndrome there is no significant difference in most of the variables, except in the angle of facial convexity, SNB, ANB and Palatal plane perpendicular to Frankfort.

An improvement of the angle can be observed in the measures of the facial convexity angle, that is, a more convex profile was achieved; this is consistent with the subjective assessment of the profile shown in Table 4, where 89% of the patients improved their profile. The profile change is also confirmed by the results of SNA and SNB obtained; as for the palatal plane perpendicular to Frankfort (PPFH), it rotated counterclockwise, T1 to T2 (see Tables 3 and 4).

As for the other measures that did not show a significant difference, it should be noted that the SNA improved (1.3°), the point A perpendicular to Nasion moved forward on average (3.4mm), the perpendicular palatal plane to Frankfort (PPFH) rotated counterclockwise (-2.9°), there was an counterclockwise rotation of the mandibular plane (-1.5°), the wits improved (2.3mm), the maxillary size increased (2.3mm), the upper incisors were vestibularized and the lower ones were lingualized after treatment (see Table 3 and Figures 3, 4 and 5).

  

Figure 3. Cephalic, picture of facial profile and frontal occlusion of a girl with Down syndrome, before and after treatment.

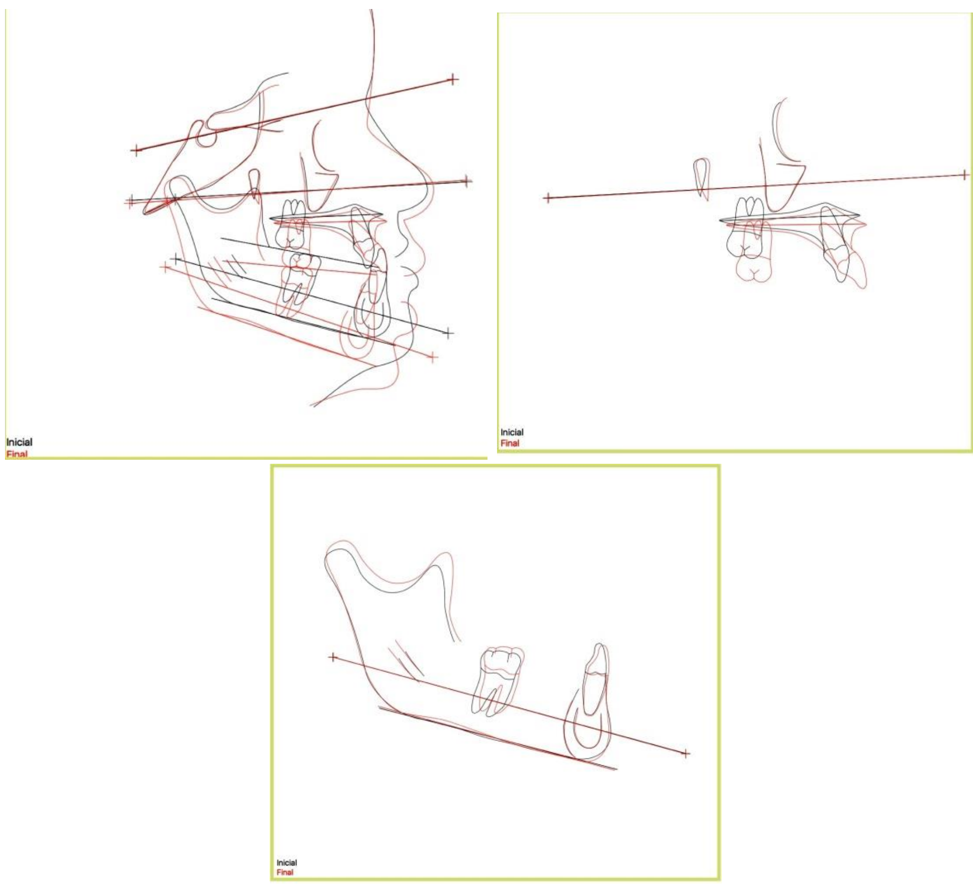

Figure 4. General, regional maxillary and mandibular overlap of the female patient from 6 to 7 years old, where facial, skeletal and growth changes can be observed.

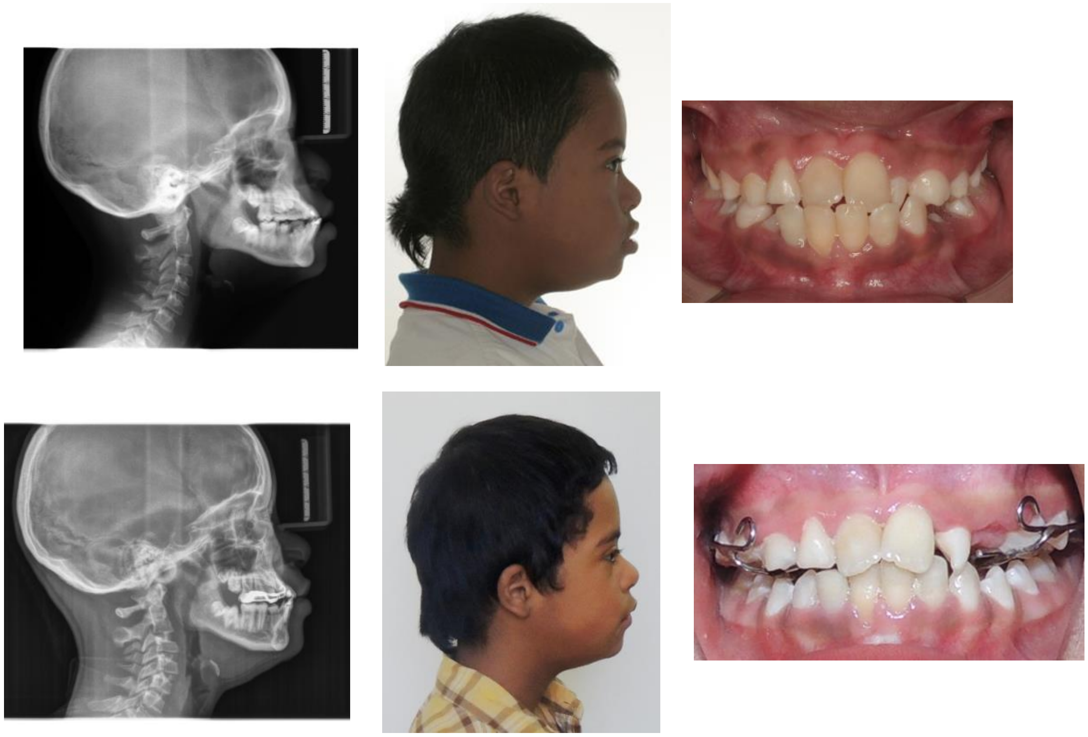

Figure 5. Cephalic X-ray, picture of facial profile and frontal occlusion of a boy with Down syndrome, before and after treatment.

Patients without Down syndrome: NDS

More quantitative variables were found In the Group of SSD children, with statistically significant differences such as the facial convexity angle, SNA, SNB, ANB, point A perpendicular to Frankfort, maxillary length and mandibular length. In facial convexity angle, this became a more convex angle: When compared with the subjective assessment of the profile (VAS), this group showed a profile improvement in 100% of the patients (see Table 5). The SNA increased (2.1°), the SNB had a setback (-0.8), which once again contributes to profile improvement; point A perpendicular to Nasion was projected forward (3.5mm), the palatal plane perpendicular to Frankfort (PPFH) rotated counterclockwise (-2.3°), the maxillary and mandibular length increased 4.3mm and 2.9 mm respectively, which goes against treatment, since growth control would be expected as a result of the treatment with a facial mask (see Table 3 and Figures 6, 7 and 8).

Figure 6. Cephalic X-ray, picture of facial profile picture and frontal occlusion of a girl without Down syndrome, before and after treatment.

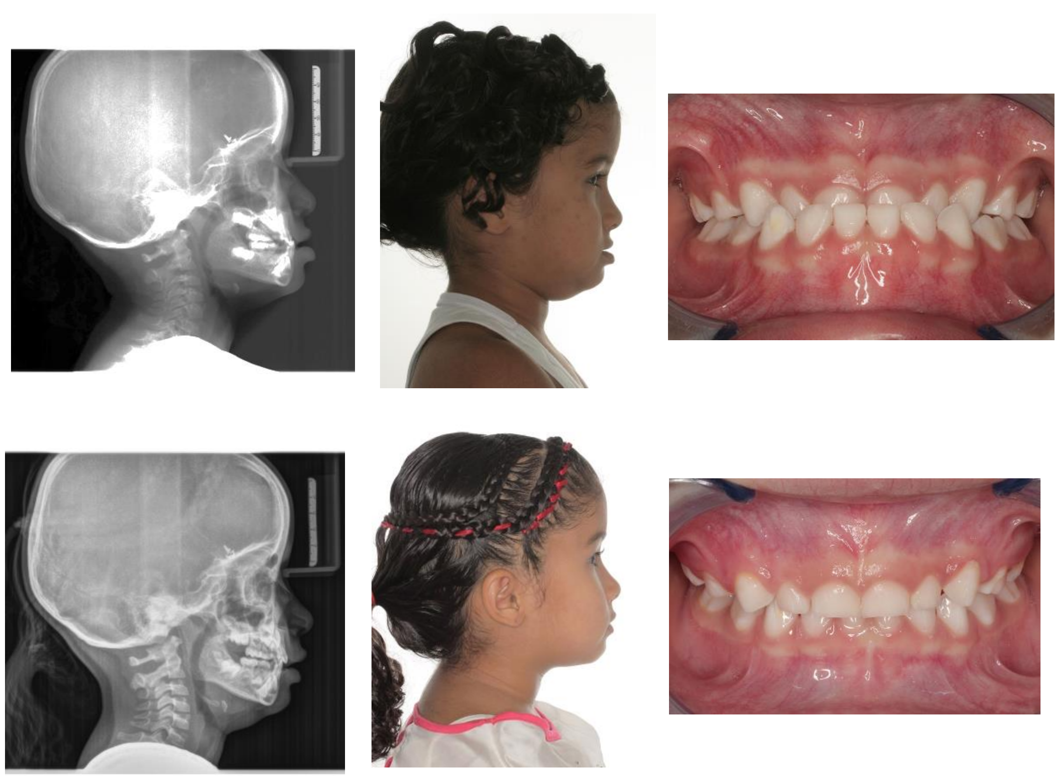

Figure 7. Cephalic X-ray, picture of facial profile picture and frontal occlusion of a girl without Down syndrome, before and after treatment.

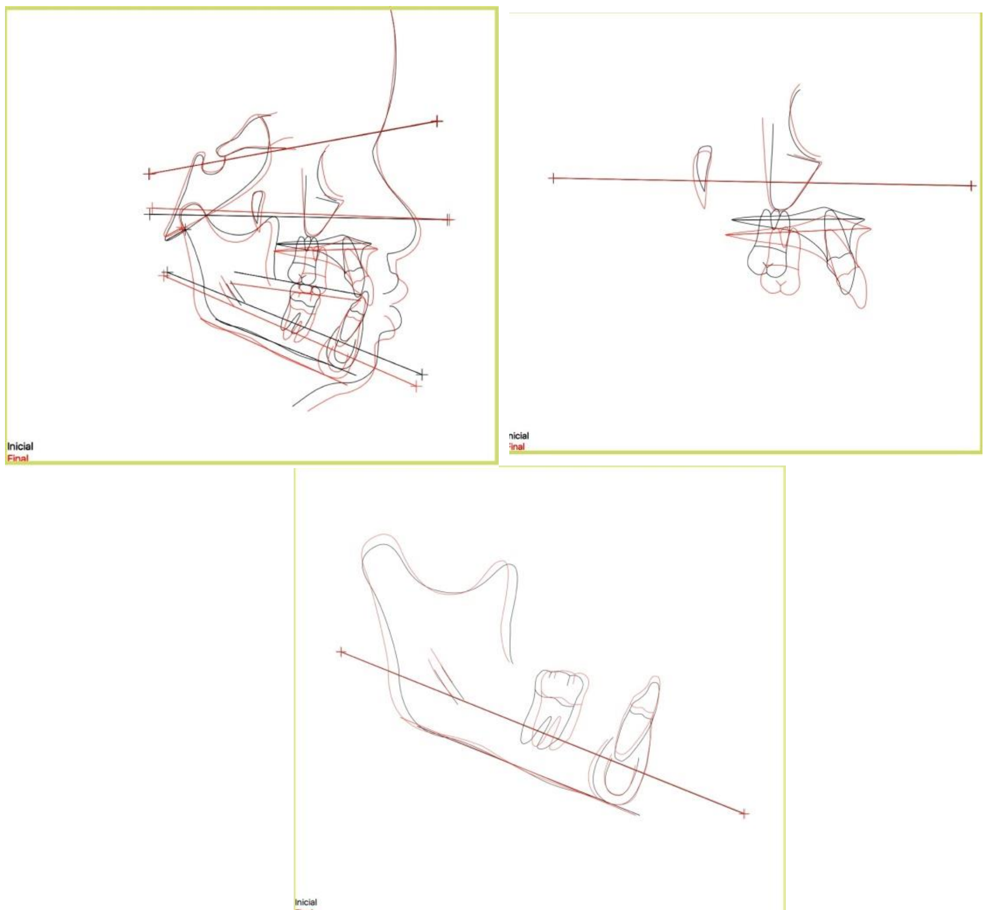

Figure 8. General, maxillary and mandibular regional overlap of the female patient from 4 to 5 years old, where facial, skeletal and growth changes can be observed.

Intergroup results: DS vs NDS

When carrying out the comparison between groups after treatment with Alt-Ramec plus the use of a facial mask, no significant difference was found between them; however, the results achieved in both groups are positive and lead to the improvement of intermaxillary and occlusion relationships. The difference that stands out is that in the patients with DS the mandibular plane showed a counterclockwise rotation, while in the NDS patients t rotated clockwise. Another expected result was the inclination of upper incisors, which was vestibularized in the two groups as an effect of the protraction of the maxilla, and the lower incisors were lingualized in both groups in terms of the measures obtained (see Table 3).

Table 3. Descriptive and comparative summary of the cephalometric variables intra and intergroup, before and after treatment.

	DS (n=9)				NDS (n=7)				Changes in T2 DS-N	
	T1	T2	Dif. T2-T1	*p*-value	T1	T2	Dif. T2-T1	*p*-value	Dif. SD-N	*p*-value
	$\bar{X} \pm DE$	$\bar{X} \pm DE$	$\bar{X} \pm DE$		$\bar{X} \pm DE$	$\bar{X} \pm DE$	$\bar{X} \pm DE$		$\bar{X} \pm DE$	
ACF	-0,1±2,1	2,4±2,6	2,5±3,1	**0,043***	1,3±2,4	3,7±1,7	2,4±1,5	**0,005***	0,1±1,3	0,952
SNA	78,7±3,6	79,9±5.1	1,3±2,9	0,242	79,5±3,1	81,5±4,2	2,1±2,0	**0,033***	-0,8±1,3	0,549
SNB	80,2±3,6	78,6±3,6	-1,7±1,7	**0,020***	78,9±4,1	78,2±4,5	-0,8±1,2	0,130	-0,9±0,8	0,239
ANB	-1,6±2,0	1,4±2,3	2,9±2,7	**0,011***	0,5±2,3	3,3±1,4	2,8±1,7	**0,004***	0,2±1,2	0,892
ApN	-0,9±5,1	2,5±5,6	3,4±5,1	0,085	-2,2±3,6	1,3±2,5	3,5±2,3	**0,007***	-0,1±2,1	0,977
PpN	-1,8± 8,6	0,4±7,4	2,2±8,8	0,493	-6,6±6,3	-4,4±4,8	2,3±4,3	0,216	-0,1±3,4	0,975
FHMP	22,4±6,3	20,9±4,6	-1,5±3,7	0,266	26,7±8,7	27,6±4,5	0.9±4,7	0,614	-2,4±2,1	0,268
PPFH	0,3±4,3	-2,9±4,5	-3,1±3,2	**0,020***	0,5±3,9	-2,3±2,5	-2,7±2,3	**0,019***	-0,4±1,4	0,782
Wits	-7,3±3,3	-5,0±3,9	2,3±3,6	0,101	-7,9±1,5	-5,5±3,4	2,5±3,5	0,110	-0,2±1,8	0,913
CoA	77,9±3,1	80,2±2,9	2,3±4,3	0,144	78,6±3,8	82,8±5,0	4,3±2,6	**0,005***	-1,9±1,8	0,310
CoB	103,3±2,8	104,9±4,8	-1,7±4,8	0,323	102,6±7,5	105,4±8,2	2,9±1,6	**0,003***	-1,2±1,9	0,542
UISN	109,4±11,3	108,9±9,4	-0,6±6,5	0,794	95,3±5,4	99,5±4,4	4,2±5,8	0,102	-4,8±3,1	0,151
UIFH	119,8±9,8	121,8±7,7	2,4±5,8	0,320	103,6±5,4	109,6±5,8	6,1±4,6	0,013	-4,0±2,7	0,154
LIMP	95,3±8,8	91,3±5,6	-3,9±6,0	0,084	86,5±5,6	84,5±2,9	-2,1±3,8	0,196	-1,9±2,5	0,463

*p=<0.05 Statistically significant changes

Table 4. Qualitative variable of the facial profile of the group with Down syndrome, before and after treatment. **VAST1 * VAST2**[a]

Count

		VAST2			Total
		Concave	Convex	Straight	
VAST1	Concave	1	1	4	6
	Convex	0	1	0	1
	Straight	0	2	0	2
Total		1	4	4	9

a. Condition = DS

Individuals with no profile improvement (blue)
Individuals with profile improvement (green)

Table 5. Qualitative variable of facial profile in the group without Down syndrome, before and after treatment. **VAST1 * VAST2**[a]

Count

		VAST2			Total
		Concave	Convex	Straight	
VAST1	Concave	0	3	1	4
	Convex	0	0	0	0
	Straight	0	3	0	3
Total		0	6	1	7

a. Condition = NDS

Individuals with no profile improvement (blue)
Individuals with profile improvement (green)

1. Discussion

The most relevant achievement in this study is to be able to observe that children with Down syndrome, despite having many functional compromises and their growth being reported as slower, when compared with children without any syndrome after applying the same expansion-constriction orthopedic therapy (Alt-Ramec) plus the use of a face mask, may show similar results.

No studies were found on cooperation or adherence to interdisciplinary treatments which children with Down syndrome must face throughout their lives. Only one study was found, about the psychological profile of these children that may affect cooperation and collaboration; Troncoso et al. made a description in 2003 of the profile of these children, reporting that they had little initiative, resistance to change and low response capacity, and that they were not inhibited in their expressions; however, and even though it was not one of the objectives of this study, the attitude and high level of collaboration of the children with Down syndrome and their families was excellent in this study, which breaks paradigms to treat these children in the consultation.[14]

There is little evidence of children with Down syndrome treated orthopedically; 65% of these patients present a skeletal class III malocclusion that greatly affects their facial and occlusal harmony.[15] This study may encourage clinicians to treat these type of patients as they would with children without syndrome, since both their collaborative attitude and the results obtained can improve not only their aesthetic condition but also their functional one.

The literature found shows several types of treatment from very early ages, where it is sought to improve the function of perioral muscles, breathing, swallowing and chewing.[16] [17]

There are no studies in patients with Down syndrome with which the results obtained can be compared, except for a case report of a patient with Down syndrome that was part of this same study.[18] For this reason, a future study could compare the results obtained in this study with studies carried out with similar techniques, and compare it with the Gold standard for the treatment of this type of malocclusion, based on the use of rapid palatal expansion with the facial mask.

The fact of not finding significant differences between the groups in this study does not mean that they do not really exist. The sample is too small to make inference, therefore a larger sample will be required in the future in order to be able to determine if there really are significant differences.

When analyzing the differences in the variables at the beginning and at the end of the treatment, significant differences are observed in some measures between the groups; among them are the angle of upper incisors with respect to Sella - Nasion (ISSN), upper incisors with respect to Frankfort (UIFH) and lower incisors with respect to mandibular plane (LIPM), which were always found more vestibularized at the beginning and at the end of treatment in patients with DS. Additionally, a different response was observed in the rotation of the mandibular plane after treatment, where children with DS presented a counterclockwise rotation of the mandibular while the NDS children had a clockwise rotation, as it has been observed to occur in most studies in which maxillary protraction is used by means of the facial mask; these results may be caused by the functional characteristics of lingual force, interposition and protrusion in patients with DS (see Table 2).

Another important finding, and despite the fact that no significant differences between the groups were evidenced, is that when analyzing the variables with significant intragroup results at the end of the treatment it can be observed that the NDS group exhibits more significant results than the patients with DS; this means that the changes obtained in some variables were greater in the NDS patients. The variables with significant results in the NDS patients were: ACF (2.4 ± 1.5), SNA (2.1 ± 2.0), ANB (2.8 ± 1.7), ApN (3.5 ± 2.3), PPFH (-2.7 ± 2.3), CoA (4.3 ± 2.6), CoB (2.9 ± 1.6), while the variables in DS patients were few: ACFs (2.5 ± 3.1), SNB (-1.7 ± 1.7), ANB (2.9 ± 2.7), PPFH (-3.1 ± 3.2) (see Table 3).

The technique used in this study was the one proposed by Franchi, which is a variation of the original one proposed by Liou.[19] The modification consists in using a McNamara Hyrax with a expansion-constriction protocol for 5 weeks (see Table 1) plus the use of a facial mask for 1 year of treatment in patients who are at the stage before the growth peak.

The study conducted by Masucci et al. in 2014 is similar to this study in terms of morphological variables, treatment time and expansion protocol, but the sample was only made of patients without any syndrome.[21] In this study significant differences were found between the groups, finding greater progress in the Alt-Ramec /Mf group vs ERP/Mf. When comparing the changes found in the cephalometric variables SNA, SNB, ANB and Wits with the ones found in the present study, the Masucci values were higher: SNA (3.1° vs 1.7°), SNB (-1.9° vs -1.2°) ANB (4.9° vs. 2.9°) and the wits (4.2mm vs. 2.4mm). As for the rotation of the palatal and mandibular planes, both planes rotated 1.6° clockwise in the Masucci study, while in this study the palatal plane in both groups rotated counterclockwise -2.9°. Regarding the mandibular plane, the patients with DS had a counterclockwise rotation of -1.5° and the NDS had clockwise rotation of 0.9°. These results may be due to the period of active treatment, since the Masucci study reports a treatment of 7 months more than the present study.

In a subsequent study conducted by some of the same authors Fischer, Massucci et al. in 2018, two groups of patients with a population of 17 subjects per group were compared, using the same treatment protocols analyzed three-dimensionally by means of CBCT. No significant differences were found between the groups; it was determined that the differences obtained between the two studies are due to the difference in the measurement methodology (2D vs. 3D) .[22] The study by Fischer, Massucci et al. in 2018, despite its methodological differences, is consistent with the results of this study.[22]

Isci et al. evaluated the effects of Alt-tamec/Mf and ERP/Mf in two groups of approximately 11-year-old patients with class III malocclusion due to maxillary hypoplasia; protocols similar to the study by Masucci et al. were applied. They found that in the Alt-Ramec group the results of the maxillary advance were better (3.4mm) than those obtained with ERP/Mf (2.2mm);[23] these results also agree with those of Liu et al., where the protocol is different, since the expansion-constriction is for 7 weeks. It was found that the maxillary advance is greater in the protocol of Alt-Ramec /Mf (2.67mm) vs ERP/Mf.(1.9mm)[19]

When evaluating the systematic review of 35 articles carried out by Pithon et al. in 2016, only five were selected which met the important inclusion criteria: subjects in active growth period, with transverse and anteroposterior maxillary deficiency, who used the Alt-Ramec protocol and who had a control group in which the traditional protocol of rapid palatal expansion was used. But when analyzing these five articles they selected, big differences are found that may affect the results, such as the weeks of the expansion-constriction protocol, different devices for maxillary traction, patients with LPH where variations in the protraction effect of the maxilla could occur due to the type of anomaly, among others. The result, according to this systematic review, is that the protraction of the maxilla with the Alt-Ramec protocol is much greater and is carried out in less time and with better results [24], which goes against the findings in the result of this article, where the 16 patients showed effects that were similar to those found in studies conducted with rapid palatal expansion plus the use of the facial mask; this is also evidenced in another recent article from 2017 by Al-Mozany, where the results are very similar to this study, showing positive results but similar to those found with the facial mask.[25]

The same happened in the Canturk study, where they treated 36 patients with class III malocclusion due to maxillary deficiency, on which the intervention was conducted randomly, half with Alt-Ramec for 8 weeks and the other half with rapid palatal expansion. The treatment was started simultaneously, and although the results did not show significant differences between the groups, the changes in the two groups were positive.[26]

The results found among the different studies where the Alt-Ramec therapy plus the use of facial mask is used report a great variability with respect to the other studies or case reports. This corresponds to the lack of homogeneity regarding the protocol used, 5 weeks in some, 7 in others, and 9 in others. As for the design of the device used and the small sample of the studies, they are not consistent either, in terms of age, type of device and hours of use, among others. However, all studies but one have been positive for the improvement of class III malocclusion due to maxillary hypoplasia.

It is important for future research to consider a defined protocol, with large samples, at established ages in patients either without syndrome or with Down syndrome, in order to obtain reliable results on which clinical practice can be based. It is also important to analyze the habits that these clinical characteristics of patients can show, muscle hypotonia and possible early myofacial therapy in this type of patients; it is also important to consider in future studies, even if it is just a clinical assessment, that in patients with DS the resolution of class III malocclusion after this protocol was faster than with the NDS group; this may be due to the low bone density that these patients present at the endocrine level, and possibly to their good collaboration and commitment; however the response in terms of magnitude in some variables was greater in the NDS patients.

CONCLUSIONS

Therapy with the expansion-constriction protocol in patients with or without syndrome in early stages of treatment produces favorable facial and occlusal skeletal effects.

Although children with Down syndrome have a slower growth and development and have functional compromises, they respond in a seemingly similar way to a child without any syndrome.

More research is required on the orthopedic treatment with Alt-Ramec followed by the use of the facial mask, since the few existing studies show that maxillary protraction is more effective with this protocol. However, the results of this study show similar results to those obtained with the use of rapid palatal expansion plus the facial mask.

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