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Research Article

Change in Nasal Airflow, Associated with the Treatment of Rapid Maxillary Expansion in Children with Maxillary Compression

Hilda H Torre-Martínez*, Alejandra Zertuche de la Fuente, Roberto José Carrillo González, María del Carmen Theriot Girón, Sandra N González Díaz and Alfredo Arias Cruz

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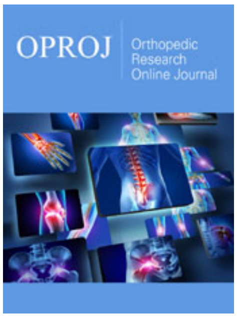

***[1]Corresponding author:** Hilda H Torre-Martinez, Investigación Clínica, Mexico

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Summary

Purpose: To determine the change of nasal airflow (ANF) in children with maxillary compression after performing rapid expansion treatment.

Materials and methods: The sample consisted of 30 patients who attended the Orthodontics Post-graduate Program of the Autonomous University of Nuevo Leon (UANL). They underwent clinical history, study models, lateral cephalogram and orthopantomography. Those who presented maxillary compression were referred to the Regional Center of Allergy and Clinical Immunology (CRAIC) of the University Hospital, UANL., Where a rhinomanometry (T1) was performed to know the values of nasal airflow (NAD) and nasal resistance (RN). before starting the maxillary expansion treatment (ERM). ERM was performed with a Hyrax type expansion screw. Three subsequent registrations were performed with rhinomanometry, the first was one month after starting the ERM (T2), the second to the third month (T3) and the third to the ninth month (T4). Changes in the nasal airflow were compared after of the maxillary rapid expansion, with the student's t test, with p≤0.05, for related samples.

Results: The values of the FAN increased as the measurements were made, on the other hand, the RN decreased progressively. The results were not statistically significant from one time to another. We did not find a statistically significant difference in relation to gender, nor to the present symptomatology. The group of 9 to 10 years was especially favored in relation to the two groups of greater age.

Conclusion: The treatment of MRS is an effective treatment to relieve maxillary compression, helps improve nasal capacity, increasing FAN and decreasing the NR; however, it is not recommended in order to improve nasal permeability exclusively.

Introduction

Maxillary compression malocclusion in horizontal or transverse plane, is in early age, of multifactorial origin, due to the lack of development of the maxilla. It is one of the most common malformations in orthodontics [1-3]. The average transpalatal length of the maxillary arch is 36 to 39mm, in this we find a dentition of average size without crowding or diastemas in some occasions. The deficiency of the transversal length of the maxilla is a primary factor where dental crowding usually occurs. The dental arches with less than 31mm of transverse length, may present crowding; in them it will be necessary to perform maxillary orthopedics or surgically assisted expansion for its treatment [4].

The compression of the upper jaw is due to a low position of the tongue, as well as decompensated forces of compression on the vestibular segments of said arch; it can affect the dental arch and the bone base; it is rare to find the pure presence of any of these [5]. The incidence of maxillary compression increases among young people due to respiratory problems, food, habits, etc. [6,7].

Rapid expansion of the maxilla (ERM) is the orthopedic procedure most used in patients suffering from maxillary compression, which requires expansion of the superior arch [8,9]. MRS results in the separation of palatal and premaxilla structures, because the structures develop bilaterally, joining together in a medial suture. An opposing force is applied to the teeth, to the palatal mucosa, or to both, commonly the force varies from 3 to 10 pounds [10-12].

Nasal airflow

It is the amount of air inspired by living beings, which is limited by the shape and diameter of the nostrils. The most common causes that increase the nasal airflow resistance are nasal obstruction and oral respiration that can be caused by hypertrophic adenoids, allergic rhinitis, nasal trauma, genetic deformity, foreign body and tumors [13].

Computerized rhinomanometry (RAA)

It is an objective exploratory technique for the study of the air resistance in the nasal structures to the passage of air in inspiration and expiration, registers the nasal air flow and the pressure difference in each nostril, one at a time. The rhinomanometer can be used in two ways, dynamic or static, in the dynamic it is required to actively breathe the patient and in the static, a certain flow is passed through the nostril at a certain pressure, holding the breath. Requires an operator, equipment that is not portable, is more expensive, requires patient cooperation for clinical measurement visits.

Acoustic rinometry

It is a non-invasive and easy to perform test, it allows the knowledge of the geometry of the nasal passages, defines the volume of the cavities and the variations in the nasal mucosa. It is based on sound reflection, providing a calculation of the transverse area of the nostril. The main advantages are that it is a non-invasive, fast method, and the space of the device is reduced, it does not require patient collaboration, so the handling of the information is easy [14-18].

The effects of a partial obstruction of the airways are of great importance especially for the orthodontist, because it causes lack of growth and craniofacial development, causing decrease in the transverse dimension of the upper jaw and maxilla, causing crossbite, reduction of both jaws , decreased mandibular length and open bite by a postero-rotation of the jaw, when performing breathing orally, there is also a decrease in the antero posterior size of the neurocraneo and the nasal complex, changes found in the human being with mouth breathing [19].

Material and Method

Children aged 8 to 15 years who attended the orthodontics graduate of the U.A.N.L., the total sample was 30 children (17 women and 13 men).

The inclusion criteria were the following:

a) 8 to 15 years old.

b) Both genres.

c) Maxillary compression according to the Pont index.

d) Where the ERM treatment is indicated.

e) Informed written consent from the parent or guardian.

The exclusion criteria for the study were patients with the following characteristics:

a) Skeletal asymmetry of the upper or lower jaw.

b) Indication of orthognathic surgery.

c) Upper first molars bent vestibularly.

d) Patients with advanced periodontal disease.

e) Septal deviation.

f) Skull-facial malformations.

g) Adenoid hypertrophy.

h) Tumors in the oral cavity.

i) Nasal polyp.

j) Upper airway infections.

k) Patients undergoing immunotherapy treatment for more than one year, including the last 12 months before the assessment.

l) Patient who for any reason could not attend the scheduled study visits.

The size of the sample was made by means of the following formula, according to the number of patients admitted annually in the postgraduate program in orthodontics of the U.A.N.L.

Medical and dental clinical history, clinical review, as well as the own studies for the orthodontic evaluation (study models, lateral cephalogram and orthopantomography), the maxillary dimension were evaluated, those diagnosed with maxillary compression according to the Pont index, were sent to the CRAIC, where the first Rinomanometry was performed (T1), after carrying out the medical history of the department. The rhinomanometry was performed by the same doctor with the patient sitting in a comfortable position, at the same temperature (20-25 °C) between 4:00 and 6:00pm of the scheduled visits to the CRAIC. The patient remained at rest for 30 minutes, sitting in a comfortable position, at the same temperature (20-25 °C), before each measurement the rhinomanometer was calibrated, the mask was placed (Rhino Lab brand GMBLT®) on the patient's face, covering the nose and mouth, avoiding deforming the facial structures at the time of performing the procedure. Five measurements of each nostril were made to each patient, the measurements of greater and lesser flow were eliminated, the 3rests were used to determine the average flow and pressure of each nostril; the measurements were made in a time no longer than 10 minutes.

The expansion devices were manufactured and controlled by two students of the second year of the postgraduate program in orthodontics. The Hyrax type expansion apparatus was cemented in the upper first molars with powder glass ionomer (AquaCem®Dentsply De Trey). Two activation per day, one quarter turn in the morning and one quarter turn in the evening were indicated; each revolution equals 0.25mm expansion.

The evaluation was weekly, until the maxillary expansion was completed, which took 15 to 20 days. One month after the expansion began, the patient went to the CRAIC for a second study of rhinomanometry (T2) and physical examination; These same procedures were performed at 3 (T3) and 9 months (T4) of having started the ERM. On the second and third month they went to a control appointment in orthodontics to assess the correct fixation and record any discomfort that may occur. On the fourth month of retention, the device was removed.

Different study groups were formed for the analysis of the information, after having studied the total sample without subgroups. The first subdivision was according to the patient's gender, in female and male.

The second subdivision was classified according to age, dividing the size of the total sample into three groups according to age, group 1 (n = 10) included those patients of 9 and 10 years of age, group 2 (n = 13) those from 11 to 13 years of age, and group 3 (n = 7) children of 14 and 15 years of age.

The last subdivision of the study was carried out according to the nasal symptomatology: absent (group 1) or present (group 2).

Statistic analysis

To compare changes in nasal airflow after rapid maxillary expansion in patients with maxillary compression; the test of t, with a value of $p \leq 0.05$, was used for related samples, as well as for the groups formed by gender, age and the nasal symptomatology present. The changes of the RN and FAN were evaluated in each of the pits, as well as to compare the values from one determined time to another.

To know the statistical significance of the study group, in relation to all times, it was performed in ANOVA statistical analysis, where the value of $p \leq 0.05$.

Results

The nasal airflow (FAN) and nasal resistance (RN) changes were evaluated; no statistically significant difference was found in the total sample in any of the variables. However, when analyzing the changes in the different times of the study, from T1 to T2 (5033.32cm^3/Pa-3215.83cm^3/Pa), a statistically significant difference was observed in the value of the nasal resistance -RN- in the right fossa, representatively diminishing its value from one time to another. The change was observed similar when studying the values of, T1-T3 (5033.32cm^3/Pa -2556.25cm^3/Pa) and T1-T4 (5033.32cm^3/Pa-2997.82cm^3/Pa). However, these data were evaluated from one time to another, in the order of the event they did not show statistical significance, when they were evaluated with the ANOVA analysis.

In the left fossa, significant changes were observed in nasal resistance, -RN- between times 2 and 3 (4934.78cm^3/Pa-3773.22cm^3/Pa), nasal resistance decreased clinically improving nasal airflow. Classification according to gender. The sample was divided into two groups according to gender, group 1 (n=17) corresponded to that of the girls and group 2 (n=13), to that of the children. It was observed that RN in the left fossa was lower in group 1, when evaluated from T1-T3. The values shown by group 1 when measuring the RN, in the mentioned pit of T1 6261.57cm^3/Pa-T3 4519.21cm^3/Pa respectively, also increased the nasal air flow from T1 to T3 (70.69cm^3/sec/Pa-109.53cm^3/sec/Pa). When evaluating the variables at different times, no statistically significant difference was observed between the groups.

Classification according to nasal symptomatology. Two groups were formed according to the present symptomatology. In group 1 (n=9) those children who did not present any symptom of nasal affection were included, and in group 2 (n=21) those with nasal symptoms such as sneezing, pruritus, nasal obstruction and / or rhinorrhea.

When comparing the changes of T1-T3 of the two groups, we found a greater increase in FDER in group 1 (t1 135.13cm^3/sec/Pa-173.75cm^3/sec/Pa), compared to group 2 (t1 84.29cm^3/sec/Pa-t3 119.85cm^3/sec/ Pa) where the value of $p < 0.05$. In both groups the nasal resistance decreased as the measurements were made (tables 14 and 15), except for the RDER value T4, it was higher at T3 in both groups. (Group 1 T3 1644.25cm^3/Pa-T4 2491.00cm^3/Pa, group 2 T3 2961.72cm^3/Pa-T4 3234.33cm^3/Pa).

A progressive increase in nasal airflow was recorded in both groups, as well as in the right and left fossa, from T1 to T4. Classification according to age. The size of the total sample was divided into three groups according to age, group 1 (n=10) included those patients of 9 and 10 years of age, group 2 (n=13) those of 11 to 13 years of age, and group 3 (n=7) children of 14 and 15 years of age.

T1-T2. Group 1 recorded a greater increase in FDER (t1 60.90cm^3/sec/Pa-t3 83.20cm^3/sec/Pa), FIZQ (t1 23.70cm^3/sec/Pa-t2 59.90cm^3/sec /Pa) compared with group 2 where FDER (t1 127.54cm^3/sec/Pa-t2 120.15cm^3/sec/Pa), FIZQ (t1 105.92cm^3/sec/Pa-t2 133.77cm^3/sec/Pa). The nasal resistance was lower in RIZQ in group 1 (t1 10,764.17cm^3/Pa-t2 7,288.22cm^3/Pa) when compared with group 2 (t1 3,013.75cm^3 / Pa-t2 3,447.85cm^3/Pa) see tables 24-25.

When comparing group 1 with group 3, the changes in FIZQ and RIZQ were significantly favorable for the group of younger age. The values of FIZQ for group 1 (t1 23.70cm^3/sec/Pa-t2 59.90cm^3/sec/Pa), for group 3 (t1 121.83cm^3/sec/Pa-t2 136.17cm^3/sec/Pa). The values for RIZQ of group 1 (t1 10,764.17cm^3/Pa-t2 7,288.22cm^3/Pa) and group 3 (t1 2550.00cm^3/Pa-t2 3811.60cm^3/Pa).

The nasal resistance and nasal airflow in the left fossa of group 3 increased in this measurement time, however the values for group 1 were especially favorable when compared with group 3. T1-T3. The changes were similar to those observed in times 1 and 2. Both for nasal airflow and resistance in both pits when comparing the results of the three groups. T1-T4. In group 1, the increase in nasal airflow in both nostrils was statistically greater, when compared to group 2; no significant differences were observed when comparing with group 3 in this measurement time. The decrease in nasal resistance values was significantly lower in RIZQ of group 1 (t1

10,764.17cm^3/Pa-3,494.89cm^3/Pa), being related to group 2 (t1 3,013cm^3/Pa-4 2,374.45cm^3/Pa). T2-T3. The nasal airflow, in FDER, was significantly higher in group 1 (t2 83.20 cm^3/sec/Pa-t3 100.00cm^3/sec/Pa), when analyzing against the two remaining groups, where the values of group 2 were

Discussion

It was found that the size of the nasal cavity increases after the expansion treatment, either by rapid maxillary expansion or by surgically assisted maxillary rapid expansion (SARPE); due to this, the improvement in nasal breathing problems was achieved, changing in some cases from oral to nasal breathing Basciftci et al. [20]; This improvement was reported in our study, in the same way, in the questionnaires made during the consultations carried out after the expansion began, where patients report ease when breathing through the nose and decrease of obstruction.

In different researches carried out by Doruk [1], Ceroni [21], Enoki[22] & Cappellette [23], in children from 7 to 15 years of age, who underwent ERM treatment for reasons of orthodontic treatment ; the nasal cavity was evaluated by acoustic rhinometry to know the volumetric capacity and the geometry of the nasal cavity. The nasal capacity was increased progressively after treatment; similarly, it increases the volume of this, decreasing nasal resistance to air flow. These studies justify ours, since in an objective way by means of the computerized rhinomanometer we obtained the exact values of the nasal resistance and the nasal airflow of each nostril, individually in the four times of measurement.

When evaluating post-ERM changes in nasal resistance in the short term, according to Oliveira [24], we find that it decreases significantly, remaining stable in the long term. In our study, the decrease in NR was lower in the right fossa when decreasing from T1 (5033.32cm^3/Pa)-T4 (2997.82cm^3/Pa), the left fossa similarly decreased from T1 (4934.78cm^3/Pa)-T4 (3413.12cm^3/Pa); the changes registered were clinically significant.

According to Bicakci [11], the changes found by acoustic rhinometry among patients treated before or after peak pubertal growth were not significant. Similarly, in our study, we found that group 1 (9-10 years of age) was the one that was mainly favored to the treatment of MRE, since it manifested more benefactor changes for the FAN and the RN, at different times measurement.

Palaisa [25], found no relationship between the amount of expansion and the increase in volume of the nasal cavity, in each measurement period [26-35]. The conventional tomography is effective to evaluate the nasal cavity, since it allows the study of transversal, vertical and sagittal form, concluded, the area and volume increases significantly when performing MRS, with stable changes for three months. In our study, we observed a decrease in the NR in both nostrils, decreasing its value gradually, however, from T3-T4 (2556.35cm^3/Pa-2997.82cm^3/Pa) the RN of the right fossa increased, without being statistically significant change [36-52].

Conclusion

After analyzing the results, we formulated the following conclusions:

1. The hypothesis was accepted since the patients included in this study increased the amount of nasal airflow by 10% or more in one or both nostrils.

2. Rapid maxillary expansion treatment is recommended in patients with maxillary compression, being effective in children under 15 years of age.

3. In the total sample nasal airflow increased in the right and left nostrils, the increase was progressive up to T4.

4. Nasal resistance decreased according to the measurements, T3-T4 recurrence was observed in the right fossa.

5. The group of girls revealed greater decrease in nasal resistance, than children in T1-T3. In the remaining variables and measurement times, there was no statistically significant difference when comparing the results in the group of girls with that of boys.

6. The group WITHOUT nasal symptomatology, had greater increase in nasal airflow in the right fossa, than the group WITH symptomatology present in T1-T3.

7. The two groups WITH / WITHOUT symptomatology showed relapse in the right nasal resistance of T3-T4.

8. The group of 9-10 years reflected better values than the older groups, for nasal airflow and nasal resistance in the two pits, in the different measurement times.

There was no significant difference between groups 2 and 3.

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