Effects of surgically assisted rapid maxillary expansion on nasal patency

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Abstract
The aims of this study were to evaluate and compare nasal width and nasal permeability changes in surgically assisted rapid maxillary expansion (SARME) patients, using posteroanterior (PA) radiographs and active anterior rhinomanometry (AAR).

Methods: Fifteen patients (average age 22.7 years) underwent PA radiographs and AAR tests before (T0) and 6 months after (T1) SARME. A Hyrax type expander was used on all of them. The nasal width was measured in the most external points of the nasal cavity. A control group of ten patients (average age 22.3 years) underwent two AAR tests in a time interval of six months. Total nasal resistance (TNR) was calculated in the two measurements performed in both groups. The data obtained were analysed using SPSS® v.24.0.

Results: There was an increase of the nasal width between T0 and T1 in the SARME group. Comparing data of AAR between the two groups (study and control), significant differences were found in nasal permeability. There were no changes in TNR median values between the first and second rhinomanometry measurements in the control group. The median value of TNR in the study group ranged from 0.24 Pa/cm³ to 0.19 Pa/cm³ before SARME to 0.19 Pa/cm³ after SARME.

There was a statistically significant change (p = 0.002) in the sense of decreasing TNR after SARME.

Conclusions: The results support the initial hypothesis that SARME has a positive action on nasal cavities width and reduces resistance to air passage.

Introduction
Surgically assisted rapid maxillary expansion (SARME) associates a surgical procedure with orthodontic treatment. It is frequently used to treat skeletal transverse maxillary deficiencies (TMJ) in skeletal and non-growing individuals. Several studies have shown that maxillary expansion leads to changes in the transverse dimension of the maxilla and nasal cavity, providing an improvement in the patient's breathing. The nasal patency can be assessed objectively using rhinomanometry, a test which simultaneously measures flow and nasal pressure. The etiology of transverse maxillary deficiency is multifactorial, including congenital, developmental, traumatic and some types of treatment (such as left palate). There are several clinical indicators of TMJ, namely, unilaterally or bilaterally, where the anterior end of the inferior turbinate is crowded, rotated or displaced palate or buccal teeth (Figure 1), a narrow maxillary arch, a low palate, and an increase of vestibular corridors, forming non-esthetic black spaces in the corner of the mouth.

Material and methods
Patients
Fifteen patients (7 male and 8 female) with a mean age of 22.7 years where allocated in the study group. The control group consists of ten patients (4 female and 6 male) with a mean age of 22.3 years. All patients were treated with a Hyrax type of maxillary expander banded to the maxillary first premolars and first molars. The placement of the device preceded the surgery between one and four days.

Study design
This longitudinal study was conducted in two stages: T0 and T1. For the study group, T0 is the time before surgery and T1 is the time (six months) after surgery. In these two periods, postero-anterior (PA) radiographs and active anterior rhinomanometry (AAR) were performed. The control group T0 means the time of the first AAR and T1 the time of the second, six months later.

Nasal width was measured before and after surgery at the most external points of the nasal cavity, using PA radiographs.

Surgical technique
All patients underwent SARME under general anesthesia with nasotracheal intubation. The pterygoid plates were separated from the tuberosity. All of the patients were operated by the same surgical team.

Expansion protocol
The first activation of the device was done during surgery. After a 5-day latency period, the patient was instructed to activate the appliance one quarter-turn in the morning and one quarter-turn in the evening in a total of 0.5 mm per day until the intended expansion was achieved. There was no overexpansion. The appliance was kept in place for a possible containment for about 12 months.

Rhinomanometry
The AAR exams were performed at the Pulmonology Department of the hospital where the study was conducted, all of them by the same radiology technician. The examinations were carried out according to the protocol issued by the ICRH in 1983. A nasal decanister, syringe and tubing with a Harvard, 1 mg/ml nasal drops, was used. Measurements of nasal resistance on inspiration were performed at 150 Pa, alternatively in the right and left nostrils.

Cephalometric evaluation
Radiographs taken at all patients throughout the study were performed by the same radiology technician. Orthopantomography XGplus Sirona® orthopantomograph was used in all patients (Figure 3). The width of the nasal cavity was calculated by linear measurement of the NC-CN points of the Ricketts frontal cephalogram. Measurements were done on posteroanterior cephalograms at T0 and at T1 for each patient.

Table I

<table>
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<th>Study Group</th>
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Figure 1 – Intraoral photographs showing unilateral and bilateral cross bites

Figure 2 – Surgical procedure and hyrax activation

Figure 3 – Posteroanterior (PA) radiographs (from left to right): T0 (pre-surgery); intermediate phase (maximal expansion); T1 (6 months after surgery)

Discussion
In our study the SARME group presented a reduction in total nasal resistance, in contrast with the control group that showed no variation between T0 and T1. The results of rhinomanometry show that there was an effective decrease in total nasal resistance after surgery.

Conclusions
It is possible to conclude that there was an increase in nasal cavity width and that there was a decrease in total nasal resistance six months after SARME. The results support the initial hypothesis that SARME has, in addition to other effects, a positive action on nasal cavities, reducing resistance to air passage. It was not possible, however, to establish a direct correlation between increased nasal width and decreased nasal resistance. It would be desirable to develop further studies in this field with a larger sample size in order to obtain a better understanding of the consequences of SARME on nasal cavities in general and nasal permeability in particular.

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