# Effects of surgically assisted rapid maxillary expansion on nasal patency

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Abstract

**Introduction**: 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 (T1) after SARME. A Hyrax type expander was used on all of them. The nasal width was measured in the outermost 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 analyzed 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 ranges from 0.24 Pa/cm2/s before SARME to 0.19 Pa/cm2/s 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 (TMD) in skeletally mature and non-growing individuals.[1] Several studies [2-5] 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 side effects of some types of treatment (such as cleft palate).7 There are several clinical indicators of TMD, namely, unilateral or bilateral cross bite, crowded, rotated or displaced palatine or buccal teeth (figure 1), a narrow maxillary arch, a narrow palate[6], and an increase of vestibular corridors, forming non-esthetic black spaces in the corner of the mouth.[7]

Figure 1 – Intraoral photographs showing unilateral and bilateral cross bites

The option for surgery in a TMD requires the determination of the severity of the maxillomandibular discrepancy and the differential diagnosis between skeletal, dental or mixed transverse anomalies in different degrees of participation.

SARME is a procedure that combines bone distraction with the controlled expansion of soft tissues.12

The nasal valve is the narrowest region of the airway and extends from the caudal end of the upper lateral cartilage to the anterior end of the inferior turbinate.15 It is responsible for about 50% of the total airflow resistance from the nostrils to the alveoli.16

# 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 devices 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 rhinomanometries (AAR) were performed. For 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 outermost 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.

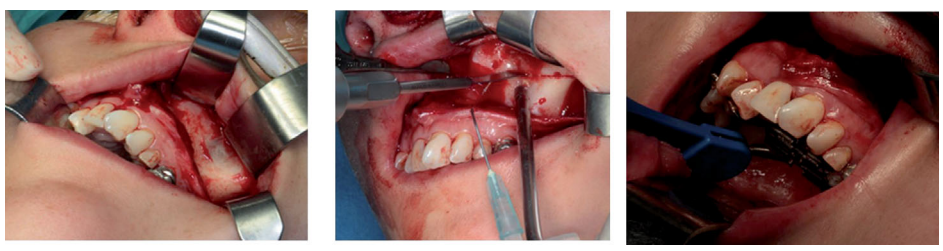

Figure 2 – Surgical procedure and hyrax activation

**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 as a passive containment for about 12 months.

**Rhinomanometry**

The AAR exams were performed at the Pneumology Department of the hospital where the study was conducted, all of them by the same operator with MasterScreen Body Jaeger®.

The examinations were carried out according to the protocol issued by the ICSR in 1983.20

A nasal decongestant, xylometazoline hydrochloride, 1 mg/ml, nasal drops, was used.

Measurements of nasal resistance on inspiration were performed at 150 Pa, alternately in the right and left nasal cavities.

**Cephalometric evaluation**

Radiographs taken on all patients throughout the study were performed by the same radiology technician. Orthophos 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.

**Statistical analysis**

The analysis was performed using the statistical analysis program SPSS® v.24.0

# Results

**Table I** - Association between measurements at different "times" (T0 and T1) in the study group

| | Min | P 25 | Median | P 75 | Max | n | p-value[1] |
|---|---|---|---|---|---|---|---|
| resist1_total_150 | **,15** | ,20 | ,24 | ,31 | ,62 | 15 | 0,002 |
| resist2_total_150 | ,15 | ,16 | ,19 | ,24 | 0,44 | 15 | |
| Nasal widht_mm_inic | 25.08 | 30.71 | 32.76 | 34.40 | 37.47 | 15 | 0,001 |
| Nasal widht_mm_fin | 26.00 | 31.74 | 33.99 | 35.63 | 38.29 | 15 | |

1 – Wilcoxon Test

resist 1_total 150 - total nasal resistance at 150 Pa in T0; resist2_total_150 - total nasal resistance at 150 Pa in T1; nasal widht_mm_inic- initial nasal width in millimeters at T0; nasal widht_mm_fin - final nasal width in millimeters on T1; Min - minimum; P 25 - 25th percentile; P 75 - 75th percentile; n - absolute frequency; T0 - the moment before surgery; T1 - 6 months after surgery

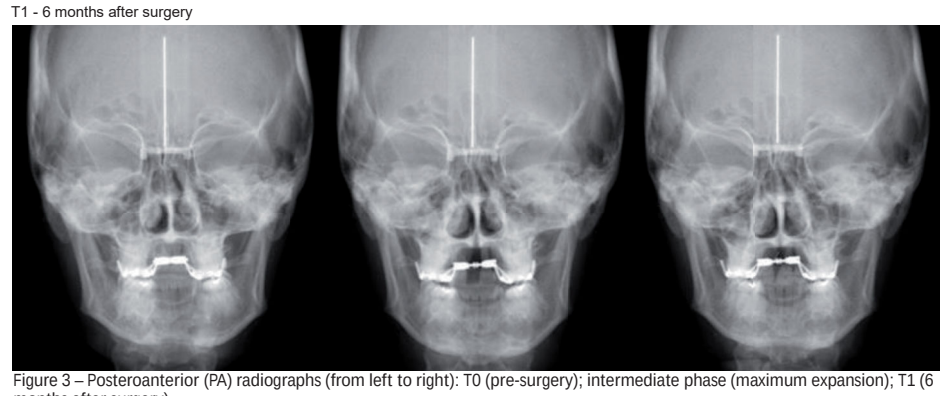

Figure 3 – Posteroanterior (PA) radiographs (from left to right): T0 (pre-surgery); intermediate phase (maximum expansion); T1 (6 months after surgery)

Figure 4 – Intraoral photographs showing the expansion movement; frontal view (from left to right): placement of the expansion device, maximum expansion moment and containment period; occlusal view (from left to right): cementation of the Hyrax type expander and moment of maximum expansion (when the screw is blocked)

# Discussion

In our study the SARME group presented a reduction in total nasal resistance, in contrast with the control group that shown 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 and with a larger sample size in order to obtain a better understanding of the consequences of SARME over nasal cavities in general and nasal permeability in particular.

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