dimension and the correction of class II malocclusion was described in 1971 by Reichenbach and Taatz that prove the relationship between the improvement in transverse palatal diameter and the correction of sagittal intermaxillary relationships [14]. In 1889, Kingsley underlined this phenomenon, pointing out how the transverse expansion could favor mandible advancement [15]. This example allows to understand how palatal transverse expansion solves spontaneous mandible repositioning in a forward position, solving or improving sagittal malocclusion. Some authors underlined that in comparing skeletal class I patients with skeletal class II division II patients who have not been orthodontically treated, the second group presents a maxillary and mandible transverse diameter reduction [16].

Many authors observed that maxillary expansion has different effects in class I, II, and III malocclusions [3,17-22]. In the retrospective studies of Farronato et al. on 15 growing subjects with maxillary hypoplasia, the effects of RME in the three planes of space were investigated. The cephalometric tracings were analyzed before and after treatment and at the end of the retention period. The results of their study confirmed widening of the maxilla in the transverse plane and an increase in the floor of the nose. In the sagittal plane, different effects were observed in class I, II, and III subjects [23,24]. In class I patients, ANB angle was slightly affected, while in all class II subjects, it decreased due to forwarding positioning of the mandible, confirming that orthopedic force to the maxillary complex during the early phase of growth can contribute to the correction of class II malocclusions.

The aim of this retrospective study was to cephalometrically evaluate the skeletal and dental effects of the transverse sagittal maxillary expander (TSME), for the correction of sagittal and transverse maxillary deficiency in class I, II, and III malocclusions [25].

## Methods

The sample for this retrospective study included 45 patients (mean age, 8.4 years; 26 females, 19 males; 15 skeletal class I subjects, 15 skeletal class II subjects, and 15 skeletal class III subjects) with maxillary bilateral cross-bite in mixed or permanent dentition.

The inclusion criteria were as follows:

- Caucasian ethnicity;
- No history of orthodontic treatment;
- Growing patients;
- Pretreatment and posttreatment lateral X-ray with excellent contrast;
- Transverse maxillary deficiency (at least 8 mm);
- Sagittal maxillary hypoplasia
- Presence of bilateral posterior cross-bite.

Exclusion criteria were as follows:

- Congenital anomalies;
- Previous orthodontic treatment;
- Dental anomalies

Lateral cephalograms were taken by the same technician [C.R.] with the same machine and manually traced by one operator [L.G.] and verified for landmark location and anatomic contours by a second operator [C.M.]. Any disagreements were solved by retracing the landmark or structure to the mutual satisfaction of both operators.

To exclude intra-operator error, each measurement was repeated by the same operator after a period of 7 days.

The method error was determined using Dahlberg's formula $ME = \sqrt{\sum d^2/2n}$, where $n$ is the number of subjects and $d$ is the difference between the two measures. The method error did not exceed 0.1 mm for the linear measurements and 0.2° for angular measurements.

Lateral cephalograms were traced by using acetate papers. A lateral cephalogram was taken before treatment (T0) and a second one was taken after retention (T1).

The assessment of the skeletal relationship was based on SNA-SNB, ANB SN^SNP.SNA, SN^GO.GN, S^GO, SNP.SNA^GO.GN, I^SN, and I^FH angles. N-Me and SNP-A were also analyzed.

Class I patients were considered if their ANB angles were between 0° and 4°, class II patients were considered if their ANB angles were greater than 4°, and class III patients were considered if their ANB angles were less than 0°.

All the patients were treated by a TSME (Figure 1), a modification of the Hyrax RME, to correct the transverse and sagittal dimensions [25].

The TSME is a fixed device designed to develop arch form in patients with constricted dental arches. It is specifically designed for transverse and anteroposterior arch development. The TSME consists of two bands cemented to the right and left I maxillary molars, a Hyrax-type transverse expansion screw, two .045′′ stainless steel wires extending to the palatal surfaces of the central incisors, and two 8-mm Hyrax-type screws attached to these wires between the molar bands and the incisors. The appliance may also be worn in association with extraoral devices.

The appliance was worn from 8 to 12 months. The protocol of activation consisted in the first phase of activation of the transverse screw one quarter turn twice a day until the desired amount of transverse diameter was obtained. In the second phase, the sagittal screws were activated one quarter turn every 15 days for 6 to 8 months. Then, the appliance was left in place for 4 months of passive retention.