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Comparison of Dental and Bone Devices with Instantaneous Expansion of the Upper Jaw in Young People

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Annotation: Narrowing of the upper jaw is one of the most common anomalies, regardless of the type of dentition studied. They can be treated with either dental or bone dilators, depending on the biological maturation of the patient. Prepubescent treatment has been shown to be successful, but there is evidence of an open seam even in the late stages of adolescence.

Keywords: palatal dilatation apparatus, cone-beam computed tomography, orthodontic fixation procedures, young adult.

Upper jaw constriction is one of the most common anomalies, regardless of the type of dentition studied. This can often be accompanied by posterior crossbite and crowding of teeth. This is a progressive anomaly that tends to increase in young people and may be permanent in adults. Most of these transverse defects are treated with rapid maxillary dilation (RME) using a dental or bone expander. Treatment in patients before the peak of puberty is successful; however, the effectiveness of RME in adults is still a matter of debate. Fusion of the palatine suture at the end in adolescence, orthodontic rupture is almost impossible in young people, which makes surgical treatment necessary. However, this surgical procedure requires: hospitalization of the patient and implies a set of morbidity risks that can affect the patient's quality of life.

It has been shown that the fusion of the palatine suture depends on the patient, and that chronological age is not a reliable method for determining the stage of suture fusion during growth. The cone beam computed tomography (CBCT) was used to classify the morphology of the suture into five stages according to the stage of maturation.

The seams are classified into:

Stage A: high density straight suture line, without or slight interdigitation;

Stage B: jagged appearance of a high-density suture line;

Stage C: Two parallel jagged lines with high density lie close to each other, separated in some areas by small sparsely populated rooms;

Stage D: fusion of the suture at the level of the palatine bone with separation into the maxillary part;

Stage E: Complete fusion of the palatine suture.

Bone RME began to be used when anchor devices were temporarily introduced. However, there is not much evidence of its effect in the treatment of adult patients. On the other hand, most of these studies use only 2D images to obtain data, with the disadvantage of overlaying soft tissues, or through the analysis of training models that only allow the evaluation of dental measurements. Thanks to CBCT, large, reliable images can now be obtained, allowing doctors and researchers to evaluate quantitative changes in bones and teeth in three dimensions with minimal distortion and low radiation doses.

The purpose of this study is to compare the effectiveness of instantaneous bone expansion in young people using CBCT in relation to the device on the teeth in adults suffering from narrowing of the upper jaw.

Materials and methods. A retrospective study was conducted in the regional dental polyclinic of the city of Samarkand in 9 patients (three men, six women) with an average age of 18 ± 5.5 years (range from 13 to 28 years) (Table 1), during 2022-2023. All patients were healthy and gave informed consent. None of the patients had previously received orthodontic treatment. Patients who reached the peak of puberty were included according to the assessment using Baccetti's "Cervical Vertebral Maturation Method" (three patients in stage CS4, two in stage CS5 and four in stage CS6), determined using lateral teleradiography. The diagnosis of narrowing of the upper jaw was made by contour on frontal teleradiographs using the Ricketts method. The analysis was performed by detecting two skeletal points for determining the width of the upper jaw (JL-JR) and two additional points for determining the width of the jaw (AG-GA). The difference between the maxillary and mandibular linear measurement was also obtained in comparison with the average value determined by Ricketts according to the age of the patient. 9 patients were treated with instantaneous expansion of the upper jaw without surgery. Six patients were treated with dentures. (Hyrax type) and three patients with bone transporter of household appliances (MARPE) (Table 1). Data collection: photographic recordings, posterior-anterior and lateral teleradiography and research models of each patient. Additionally, CT was performed before treatment (T1) and after dilation (T2). KLK was performed using ProMax 3D (PlanMeca) with a field of view of 90 mm x 90 mm.

Each subject was asked to sit vertically, Frankfurt horizontally, the plane parallel to the floor. The median palatine suture was assessed by measuring the anterior and posterior sutures, and the transverse size of the fixed bone and dental points. The incisor and molar slopes were estimated using angular measurements in the upper jaw axial plane (Figure 1). All measurements were obtained in T1 and T2. Front transverse dimension. The line between the inflection points of the vestibular cortical bone was traced on both sides, having as an anteroposterior landmark, the inter-root space between the second premolar and the first upper molar.

The molar slope. In the coronal plane, the angle formed by two points and a horizontal link to the software. The palatine point located in the center of the width of the palate at the level of the palatine floor, and the dental point located in the middle of the palatine apex of the first right and left molars. The angle of the molar (right and left) It is formed by the lower line running from the return point above the horizontal software link and the upper line is drawn from the dental link to the median palatine point.

Incisor tilt. For each incisor, an angle was obtained, the sides of which were: a vertical line from the distal amelocemental junction of the incisor with the tip of the root of the same tooth, and a horizontal line to the top of the contralateral incisor. The inner angle of each tooth was measured.

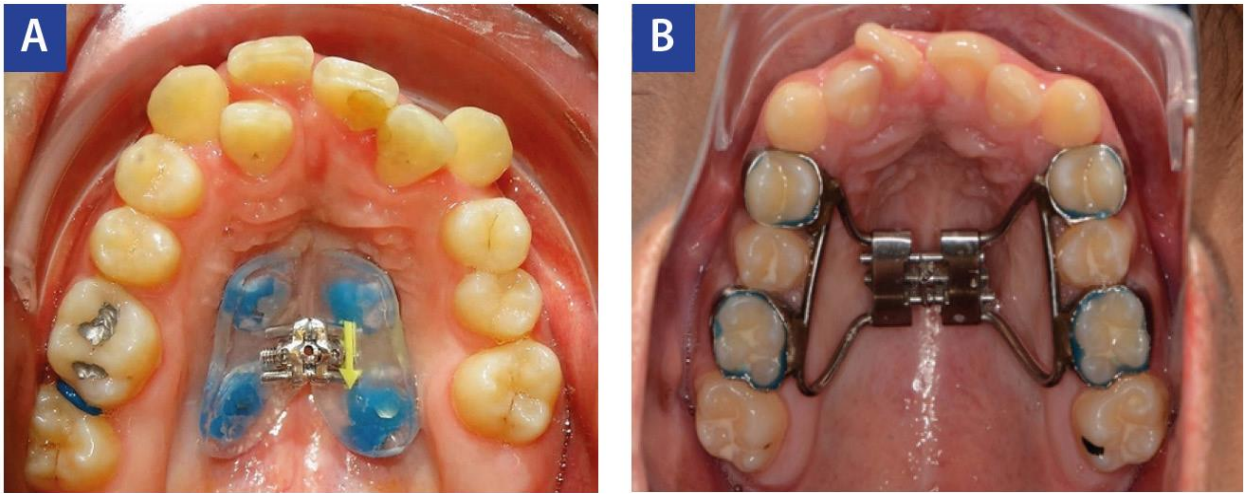
Table 1. Examples of data

The device	Age (years)	Activation (mm)	Activation time (days)	Period of wearing (days)
MARPE (n=3)	17±1.7	7.33±1.52	7.33±1.52	9.67±4.04
HYRAX (n=6)	18±5.5	8.25±3.22	8.17±3.43	6.83±1.83

Clinical protocol A type 2 bone expander described by Lee et al. It has four minimints, two between the canines and the first premolars, and two between the second premolars and the first molars. The mini screws are connected to the expander through an acrylic resin cover.11 Four self-tapping screws and self-tapping screws M.O.S.A.S.

Dewimed, Gac mini screws (Fig. 1) 10 mm long and 1.6 mm in diameter with a transmucosal collar and a soft fabric platform. A Hyrax type toothed expander was used; it has four wire marks, two in the first premolars and two in the first permanent upper molars with central Hyrax molars. An expansion screw with an extension of 11 mm located next to the palatal contour (Fig. 2).

Fig. 1. Angular and linear measurements.



A: Bone expander for rapid expansion of the maxillary bone. B: Dental extender for rapid expansion of the maxillary bone

Fig. 2. Accelerated expander for the upper jaw.

The results obtained. When evaluating the analyzed variables by the CBCT method, from the point of view of linear measurements, an increase in the anterior transverse dimension (ATD) can be observed in 78% of patients, while the posterior transverse dimension (PTD) increased in all patients, regardless of the device used. ATD in the dental group showed an average lift of 1.93 mm ± 2.1 mm, while in the group with mini screws the average lift was 2.1 mm ± 2.6 mm. PTD in the Hyrax group showed an average lift of 1.94 mm ± 1.42 mm, while for the group The average

lift of the mini screws was 2.41 mm ± 0.68 mm. As for angular measurements, the dental molar angle decreases regardless of the expansion of the device used. Patients receiving dental support the device showed an average decrease of 3.43 ° ± 2.52° for the first right molar and 2.78° ± 2.62° for the first left molar, while for patients treated with a bone apparatus, the average decrease for the first right molar was 4.29 ° ± 3.8°, and 2.59 ° ± 1.43 ° for the first left molar. The angle of the incisor inclination gave different results: in the Hyrax group, for the upper right incisor it decreased by 3.62 ° ± 4.79 °, for the upper left incisor it increased by 2.02 ° ± 5.2 °, and for the upper right incisor in the minimint group it increased 1.42 ° ± 3.28 °, and for the upper left incisor it decreased 6.67 ° ± 9.39 °. A diastema has formed between the incisors.the extension of the upper jaw in the group of mini screws, with a separation between the crowns of the central incisors of about 2.54 mm. According to the results of the analysis of the paired t-test in the group of patients treated with the Hyrax device, statistically significant differences were found in the following studied variables: posterior transverse size, molar inclination of tooth 3 and molar inclination of tooth 14. In the group of patients receiving minimints, only a significant difference was statistically found in the posterior transverse measurement. The distribution of the anterior and posterior transverse measurement data for both groups is shown in box diagrams. When examining the presence of a mid-palatal suture dissection and comparing different techniques, X-ray transparency was presented in all patients treated with minimints, and only 50% of patients treated with Hyrax presented this X-ray transparent line.

When comparing the transverse dimensions between patients who achieved X-ray translucency of the suture, the values of the transverse dimensions were higher in patients receiving Dyrax. When analyzing the difference between T1 and T2 according to each device and comparing them between both groups: Hyrax and Miniscrews (unpaired t-test), no statistically significant differences were found.

Conclusion. In all patients treated with bone machines. the transverse diameters and the presence of an X-ray translucent line have increased. When comparing skeletal and dental effects achieved with bone and dental devices, an increase in posterior transverse size was observed in both groups; therefore, with skeletal fixation, the expansion of the upper jaw was more parallel and with more skeletal than dental movements. The expansion of the upper jaw in patients receiving minimints shows results in the posterior transverse dimension, which are significantly larger than in the group receiving Hyrax, moreover, there is a smaller molar slope in the skeleton fixation group. A controlled randomized clinical trial and long-term follow-up should be conducted to assess the stability of distribution in both devices in young people.

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