Original Article / Özgün Araştırma

Evaluation of Soft Tissue Projection on Axial Cone Beam Computed Tomography Images After Surgically Assisted Rapid Maxillary Expansion

Cerrahi Destekli Hızlı Üst Çene Genişletmesi Sonrası Yumuşak Doku Değişikliklerinin Aksiyal Konik Işınlı Bilgisayarlı Tomografi Görüntüleri Üzerinde Değerlendirilmesi

Delal Dara Kılınç[1], Emrah Dilaver[2]

[1]Bahçeşehir University Faculty of Dentistry, Department of Orthodontics, İstanbul, Turkey
[2]İstanbul Medipol University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, İstanbul, Turkey

Keywords
SARME, soft tissue projection, CBCT, orthodontics, oral surgery

Anahtar Kelimeler
SARME, yumuşak doku projeksiyonu, CBCT, ortodonti, çene cerrahisi

Received/Geliş Tarihi : 28.11.2020
Accepted/Kabul Tarihi : 31.12.2020

doi:10.4274/meandros.galenos.2020.57625

Address for Correspondence/Yazışma Adresi:
Assoc. Prof. Dr. Delal Dara Kılınç,
Bahçeşehir University Faculty of Dentistry,
Department of Orthodontics, İstanbul, Turkey
Phone : +90 506 459 97 71
E-mail : delaldara.kilinc@dent.bau.edu.tr
ORCID ID: orcid.org/0000-0001-9009-6218

Abstract

Objective: Surgically assisted rapid maxillary expansion (SARME) is one of the major treatment objectives in orthodontics. It is very obvious that SARME has non-negligible clinical impacts on the facial soft tissues of patients. This study aimed to investigate the correlation between hard tissue expansion and soft tissue projection after SARME on axial cone beam computed tomography (CBCT).

Materials and Methods: Sixteen patients (9 women, 7 men) with a mean age of 22.18±1.64 years and having a transverse maxillary deficiency were enrolled in this retrospective study. A tooth borne Hyrax maxillary expander was applied to the patients and CBCT images were taken before (T0) and 6 months after (T1) SARME. Soft and hard tissue changes were superimposed and evaluated digitally on pre-surgical and post-surgical axial CBCT images by using *In Vivo* Dental Software.

Results: The mean value of the hard tissue expansion was 4.50±1.38 mm for the anterior region and 3.92±1.31 mm for the posterior region. The difference between these values was not significant ($p>0.05$). There was no correlation between soft tissue projections ($p=0.509$; $r=0.178$) and anterior and posterior hard tissue expansion values ($p=0.424$; $r=0.102$) on both sides.

Conclusion: There was no correlation between soft tissue projection and hard tissue expansion values after SARME. In addition, the difference between the anterior and posterior hard tissue expansion values was not statistically significant.

Öz

Amaç: Cerrahi destekli hızlı üst çene genişletmesi (SARME) (surgically assisted rapid maxillary expansion) ortodontide ana tedavi seçeneklerinden biridir. SARME'nin hastaların yüzleri ve yumuşak dokuları üzerinde göz ardı edilemeyecek klinik etkileri olduğu ortadadır. Bu çalışmanın amacı, konik ışınlı bilgisayarlı tomografinin (KIBT) aksiyel görüntülerinde SARME sonrası elde edilen sert doku genişlemesi ve yumuşak doku projeksiyonu arasındaki korelasyonu incelemektir.

Gereç ve Yöntemler: Bu retrospektif çalışmaya transvers maksiller yetmezliği olan ve yaş ortalaması 22,18±1,64 yıl olan 16 hasta (9 kadın, 7 erkek) alındı. Hastalara

Hyrax maksiller ekspansiyon apare uygulandı ve KIBT görüntüleri SARME öncesi (T0) ve 6 ay sonra (T1) olacak şekilde çekildi. Yumuşak ve sert doku değişiklikleri, *In Vivo* Dental Yazılımı kullanılarak cerrahi öncesi ve cerrahi sonrası aksiyel KIBT görüntülerinde dijital olarak değerlendirildi.

Bulgular: Sert doku genişlemesinin ortalama değeri ön bölge için 4,50±1,38 mm ve arka bölge için 3,92±1,31 mm idi. Bu değerler arasındaki fark anlamlı değildi (p>0,05). Her iki tarafta yumuşak doku projeksiyonları ile ön ve arka sert doku genişleme değerleri arasında korelasyon yoktu (p=0,509; r=0,178) (p=0,424; r=0,102).

Sonuç: SARME sonrasında yumuşak doku projeksiyonu ile sert doku genişleme miktarları arasında bir ilişki yoktu. Ayrıca ön ve arka sert doku genişleme miktarları arasındaki fark istatistiksel olarak anlamlı değildi.

Introduction

Transverse deficiency of the maxilla is a major problem in treatment of some types of malocclusions. Palatal expansion is the most preferred method for transversal advancement of the maxilla (1). The most used methods for palatal expansion are: rapid maxillary expansion (RME), slow maxillary expansion (SME) and surgically assisted rapid maxillary expansion (SARME). RME and SME are generally applied in growing patients while SARME is preferred for non-growing or adult patients (2). Skeletally mature patients with a narrow maxilla need separation of mid-palatal suture most often with SARME or Le Fort I surgery (3-5). Skeletal and dental outcomes of maxillary expansion is comprehensively presented in the literature (6). Koudstaal et al. (3) presented that besides the lack of the consensus in the literature regarding the surgical technique and the type of the distractor used (tooth-borne or bone-borne), surgically assisted maxillary expansion is found to be more stable than orthodontic RME.

Surgical procedures for management of skeletal anomalies may affect the shape and position of the overlying soft tissues (7). Orthopedic effects of RME and SARME have previously been investigated in various studies with lateral cephalograms and cone beam computed tomography (CBCT) images (3,7-10).

In some of the previous studies soft tissue responses to skeletal effects were evaluated on two-dimensional data (11-13). Lateral cephalograms can be used to assess the sagittal and vertical soft and hard tissue changes but can not be used to investigate the transversal changes (14). For an optimum treatment planning and treatment prediction, it is required to evaluate the soft tissue response to underlying skeletal movement precisely. Visualization of the post-operative (post-op) 3D model predictions can help orthodontists and surgeons to make better treatment plannings (15).

Nevertheless, advantages of CBCT enables the clinicians to visualize the craniofacial complex in three dimensional images without any image superposition or size distortion (16,17). There are many studies which evaluated the facial soft and skeletal tissue changes on 3D CBCT images (14,18,19). The aim of this study was to investigate the relationship between the amount of hard tissue expansion and soft tissue projection; and to examine whether there was a correlation between these parameters after SARME on axial CBCT. The null hypothesis was, there was no correlation between hard tissue expansion amounts and soft tissue projection amounts after SARME.

Materials and Methods

Ethical approval of the study was given by İstanbul Medipol University Non-Interventional Clinical Research Ethics Committee (decision no: 10840098-604.01.01-E.28865, date: 23.08.2017).

CBCT images were collected from the pool of the Medipol University Dental Hospital. CBCTs were taken for other dental and maxillofacial purposes previously before SARME (T0) and at least 6 months after SARME (T1). Sixteen patients (9 females and 7 males) who had SARME because of transverse maxillary deficiency, aged from 20 to 24 with a mean age of 22.18±1.64 were enrolled in the study. Written informed consents were taken from all of the patients. Inclusion criteria were: similar orthodontic anomaly and presence of bilateral posterior cross-bite with transverse maxillary deficiency. Exclusion criteria were: previous orthodontic treatment and congenital malformations.

All of the patients were applied a tooth-borne, 4-banded Hyrax (Hyrax, 10 mm., Dentaurum, Ispringen, Germany) appliance, that included first premolars and first molars, 1 day before surgery. All of the patients had the same type of appliance, same activation procedure and same retention time. The expansion screw was activated two turns a day for 14

days beginning from the operation. The first two turns were activated by the orthodontist in the operation room for the first day. Patient was told to activate the screw two turns a day for the remaining 13 days. The post-activation retention time was 6 months.

Pre-operative (pre-op) and post-operative CBCT slices which were reconstructed at nasal floor base level were superimposed (Figure 1). The area between apex of left and right maxillary canines and point subnasale on both sides was defined as peri-alar region and the area between canines and first molars on both sides was defined as malar region (Figure 2). To evaluate the soft tissue projection changes in peri-alar region and malar region, the areal spatial amount of projection was calculated in (mm^2) on superimposed axial images (Figure 2). For evaluation of the linear transversal maxillary hard tissue expansion amount in anterior segment; linear differences (mm) between the pre-op and post-op locations of the apices of the right and left canine were used. For evaluation of the linear transversal maxillary hard tissue expansion amount in posterior segment; linear differences (mm) between the pre-op and post-op locations of the apices of the right and left molar teeth's palatal root were used. Superimpositions and all of the measurements were done by using Invivo 5 Software (ver. 5.2, Anatomage Dental, San Jose, CA, USA).

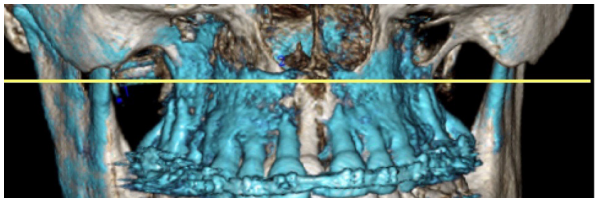

Figure 1. The illustration showing the evaluation level of axial cone beam computed tomography

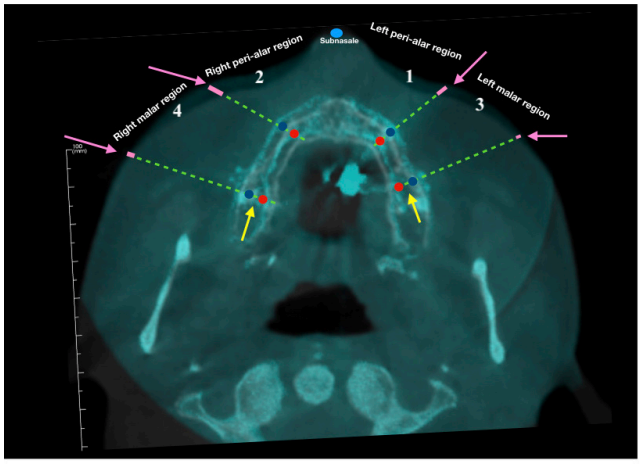

Figure 2. Superimposition of pre-expansion and post-expansion cone-beam computed tomography images

Sn: Subnasale, 1,2: Peri-alar region areal soft tissue projections; 3,4: Malar region areal soft tissue projections; Yellow arrows: Hard tissue expansion regions; Pink arrows: Soft tissue projection regions

I-CAT Imaging System was used for the study (i-CAT 17-19, Imaging Sciences International Inc., Hattfield, Pa, USA). Every CBCT image was obtained by a strict, standardized scanning protocol. Patients were seated in a vertical position in front of the CBCT machine, stabilized with head support, strap and chin cup when occlusal plane was oriented horizontally to the ground. The patients were monitored to ensure that they remained motionless throughout the duration of scanning (8.9 seconds). The images were taken by the same technician in the same conditions while the patients' head positions were oriented in perspective of Frankfort Horizontal Plane to ensure their accurate and repeatable positioning. All images were recorded at 120 kVp and 20.27 mAs using a 16x6 cm field of view and 0.30 voxels. The kV and mA parameters were automatically determined from scout views obtained from the i-CAT Imaging System.

Surgical Technique

Following nasotracheal intubation, infiltration of anesthetic solution containing 2% lidocaine and epinephrine 1:1,000,000 IU was made vestibular sulcus of the maxilla. Vestibular incision was performed from first premolar to contralateral first premolar. After incision, the anterior nasal spina and maxillary surface below the infraorbital foramen were exposed. Buccal corticotomy was performed from the priform aperture to the pterygoid fissure. Maxillary separation was achieved by decortication by a thin osteotome at the level of the anterior nasal spine and by separation of pterygoids on both sides.

Statistical Analysis

Data were analyzed with IBM SPSS V23 (SPSS for Windows, version 23.0, SPSS Inc., Chicago, IL, USA). The Paired sample t-test was used to compare the data which comply with normal distribution. Pearson correlation analysis was used for the relationship between variables. Data with normal distribution were presented as mean ± standard deviation. The significance level was taken as ($p<0.05$).

Results

Out of 16 patients, the proportion of females was 56.3% and of males was 43.7%. The mean value of the anterior hard tissue expansion was 4.50±1.38 mm and the mean value of posterior hard tissue expansion was 3.92±1.31 mm. The difference between anterior and posterior hard tissue expansion values was not statistically significant (p=0.173) (Table 1).

Total peri-alar region projection was measured as 94.23±26.6 mm^2. Total malar region projection was 103.21±32.8 mm^2. There was a statistically significant difference between total peri-alar and malar areal projection values (p<0.05) (Table 2).

The mean value of right soft tissue peri-alar region projection was 57.8±16.6 mm^2 while the left peri-alar region projection at same level was 36.4±10.7 mm^2. There was a statistically significant difference between right and left expansion values (p<0.05). The mean malar region expansion was 57.61±22.3 mm^2 for right side and 45.6±12.5 mm^2 for left side. There was a statistically significant difference between right and left expansion values (p<0.05) (Table 3).

There was no correlation between anterior hard tissue expansion values and total peri-alar soft tissue projection values (p=0.509, r=0.178). There was no correlation between posterior hard tissue expansion values and total malar region soft tissue projection values (p=0.424, r=0.102) (Table 4).

Table 1. Comparison between anterior and posterior hard tissue lineer expansion amounts

	Mean ± SD	p
Anterior hard tissue expansion (mm)	4.5±1.38	NS
Posterior hard tissue expansion (mm)	3.92±1.31	

Paired samples t-test, NS: Non-significant, SD: Standard deviation

Table 2. Comparison between total perialar region and malar region soft tissue areal expansion amounts

	Mean ± SD	p
Total perialar region soft tissue projection areal amount t (mm^2)	94.23±26.6	<0.05*
Total malar region soft tissue projection areal amount (mm^2)	103.21±32.8	

Paired samples t-test, SD: Standard deviation, *Statistically significant

Discussion

In the literature, there are studies which evaluated the projection amounts on face after RME and SARME (9,14,18-23). In the present study, the peri-alar and malar projection after SARME was evaluated because, the authors observed clinically that there are non-neglectable changes on the faces of patients after SARME which could be related to the supporting projection of expanded hard tissue.

It was presented that, edema was fully resolved at least 6 months after surgical interventions (24). That's why, patients with second CBCT images which were taken at least 6 months after SARME for other reasons

Table 3. Comparison between right and left soft tissue areal projection amounts

	Right Mean ± SD	Left Mean ± SD	p
Perialar region soft tissue projection amount (mm^2)	57.8±16.6	36.4±10.7	<0.05*
Malar region soft tissue projection amount (mm^2)	57.61±22.3	45.6±12.5	<0.05*

Paired samples t-test, SD: Standard deviation,*Statistically significant

Table 4. Correlation between hard tissue expansion and soft tissue expansion

	Peri-alar region soft tissue projection amount	Malar region soft tissue projection amount
Anterior hard tissue expansion	r=0.178 p=0.509	-
Posterior hard tissue expansion	-	r=0.102 p=0.424

Pearson Correlation test, r: Pearson correlation coefficient, p: p value

were selected form the data pool in this retrospective study.

In the literature there are many studies presenting the relationship between the bony changes and soft tissue changes after SARME (14,19-22). It is emphasized that the ratio of osseous repositioning to soft tissue response for surgical procedures is very important in the treatment planning. The opportunity of predicting the amount of soft tissue movement correlated with hard tissue allows the clinician make more acceptable and aesthetic treatment plans (25). Soft tissue responses to skeletal changes was evaluated on two-dimensional data in the literature previously (9,12,13). It was stated that lateral cephalograms can be used to evaluate the sagittal soft and hard tissue changes but cannot be used to investigate the transversal changes (14). Nonetheless, CBCT enables the clinicians to visualize the craniofacial complex in 3D images without any image superposition or size distortion (5,7).

The amount of the three dimensional changes of the maxillary structures after RME is still contradictious (26). Berger et al. (27) and Pangrazio-Kulbersh et al. (28) presented a 1:1 soft tissue response to the skeletal changes associated with RME while Badreddine et al. (16) gave this ratio as 0.5 mm soft tissue alteration to 1 mm skeletal movement. Nada et al. (14), Torun (23), and Ramieri et al. (29) reported an increase in soft tissue malar projection after maxillary expansion because of the underneath bony expansion. Their results were consistent with our results. In the present study, malar projection after SARME on both left and right sides of samples with a mean value of 57.61±22.3 mm^2 for right and 45.6±12.5 mm^2 for left was found. Moreover, Torun (23) evaluated the malar projection on sagittal plane and reported a significant linear malar projection increase of 1.60 mm on both the right and left sides in pubertal and prepubertal RME patients.

In our study a tooth borne Hyrax expander was applied to the patients. Nada et al. (14) found that the type of the distractor didn't have a significant effect in the changes on the malar region while they stated that using a transpalatal distractor instead of a RME would be effective on the more posterior and less anterior alveolar expansion amounts resulting with the less retraction of the lips.

In some previous CBCT studies, inter molar width expansions were reported to be between 3.6 mm and 4.8 mm (6,30). In our study we determined hard tissue expansion both on the anterior (canine to canine) and posterior (first molar to first molar) regions. The mean value of the anterior inter-canine hard tissue expansion was 4.50±1.38 mm while the mean value of posterior inter-molar hard tissue expansion was 3.92±1.31 mm. The difference between anterior and posterior hard tissue expansion values was not statistically significant (p=0.173).

In a previous study evaluating hard tissue enlargement after SARME, the difference between right and left sides of the subjects was clinically significant if the difference between the right and left expansion amounts was more than 3 mm (30).

In the present study, soft tissue expansions in left and right sides of the subjects was evaluated and was found to be different. Expansion difference both in peri-alar and malar regions in the right and left sides of the subjects was found to be statistically important however it was not thought to be important clinically. This disparity between the right and left sides may be related to the surgery.

The small sample size and narrow age interval could be evaluated as the weaknesses of our study.

CBCT can not be used in all cases for ethical reasons. In our study, patients with second CBCT due to other dental reasons were selected retrospectively from the data pool. That is the reason of small sample size of this study. Further investigations with larger sample sizes and larger age intervals are needed to determine absolute soft tissue effects of SARME.

Conclusion

There was no correlation between soft tissue projection and hard tissue expansion amounts after SARME thus the null hypothesis was accepted. In addition, the difference between the anterior and posterior hard tissue expansion amounts was not statistically significant.

Ethics

Ethics Committee Approval: Ethical approval of the study was given by Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee (decision no: 10840098-604.01.01-E.28865, date: 23.08.2017).

Informed Consent: Written informed consents were taken from all of the patients.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: D.D.K., E.D., Design: D.D.K., E.D., Data Collection or Processing: D.D.K., E.D., Analysis or Interpretation: D.D.K., E.D., Literature Search: D.D.K., E.D., Writing: D.D.K., E.D.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Brunetto M, Andriani Jda S, Ribeiro GL, Locks A, Correa M, Correa LR. Three-dimensional assessment of buccal alveolar bone after rapid and slow maxillary expansion: a clinical trial study. Am J Orthod Dentofacial Orthop 2013; 143: 633-44.
2. Lagravere MO, Major PW, Flores-Mir C. Long-term skeletal changes with rapid maxillary expansion: a systematic review. Angle Orthod 2005; 75: 1046-52.
3. Koudstaal MJ, Poort LJ, van der Wal KG, Wolvius EB, Prahl-Andersen B, Schulten AJ. Surgically assisted rapid maxillary expansion (SARME): a review of the literature. Int J Oral Maxillofac Surg 2005; 34: 709-14.
4. Suri L, Taneja P. Surgically assisted rapid palatal expansion: a literature review. Am J Orthod Dentofacial Orthop 2008; 133: 290-302.
5. Nervina JM, Kapila S, Flores-Mir C. Assessment of maxillary transverse deficiency and treatment outcomes by cone beam computed tomography. In: Kapila DS, editor. Wiley-Blackwell; 2014: 383-409.
6. El H, Palomo JM. Three-dimensional evaluation of upper airway following rapid maxillary expansion: a CBCT study. Angle Orthod 2014; 84: 265-73.
7. Joss CU, Joss-Vassalli IM, Kiliaridis S, Kuijpers-Jagtman AM. Soft tissue profile changes after bilateral sagittal split osteotomy for mandibular advancement: a systematic review. J Oral Maxillofac Surg 2010; 68: 1260-9.
8. Berger JL, Pangrazio-Kulbersh V, Thomas BW, Kaczynski R. Photographic analysis of facial changes associated with maxillary expansion. Am J Orthod Dentofacial Orthop 1999; 116: 563-71.
9. Karaman AI, Basciftci FA, Gelgör IE, Demir A. Examination of softtissue changes after rapid maxillary expansion. World J Orthod 2002; 3: 217-22.
10. Kim KB, Adams D, Araújo EA, Behrents RG. Evaluation of immediate soft tissue changes after rapid maxillary expansion. Dental Press J Orthod 2012; 17: 157-64.
11. Basciftci FA, Karaman AI. Effects of a modified acrylic bonded rapid maxillary expansion appliance and vertical chin cap on dentofacial structures. Angle Orthod 2002; 72: 61-71.
12. Chung CH, Font B. Skeletal and dental changes in the sagittal, vertical, and transverse dimensions after rapid palatal expansion. Am J Orthod Dentofacial Orthop. 2004; 126: 569-75.
13. Cross DL, McDonald JP. Effect of rapid maxillary expansion on skeletal, dental, and nasal structures: a postero-anterior cephalometric study. Eur J Orthod 2000; 22: 519-28.
14. Nada RM, van Loon B, Maal TJ, Bergé SJ, Mostafa YA, Kuijpers-Jagtman AM, et al. Three-dimensional evaluation of soft tissue changes in the orofacial region after tooth-borne and bone-borne surgically assisted rapid maxillary expansion. Clin Oral Investig 2013; 17: 2017-24.
15. Ryckman MS, Harrison S, Oliver D, Sander C, Boryor AA, Hohmann AA, et al. Soft-tissue changes after maxillomandibular advancement surgery assessed with cone-beam computed tomography. Am J Orthod Dentofacial Orthop 2010; 137(Suppl 4): 86-93.
16. Badreddine FR, Fujita RR, Alves FEMM, Cappellette M Jr. Rapid maxillary expansion in mouth breathers: a short-term skeletal and soft-tissue effect on the nose. Braz J Otorhinolaryngol 2018; 84: 196-205.
17. Baratieri C, Nojima LI, Alves Jr M, Souza MMGD, Nojima MG. Transverse effects of rapid maxillary expansion in Class II malocclusion patients: a cone-beam computed tomography study. Dental Press J Orthod 2010; 15: 89-97.
18. Altorkat Y, Khambay BS, McDonald JP, Cross DL, Brocklebank LM, Ju X. Immediate effects of rapid maxillary expansion on the naso-maxillary facial soft tissue using 3D stereophotogrammetry. Surgeon 2016; 14: 63-8.
19. Ballanti F, Lione R, Baccetti T, Franchi L, Cozza P. Treatment and posttreatment skeletal effects of rapid maxillary expansion investigated with low-dose computed tomography in growing subjects. Am J Orthod Dentofacial Orthop 2010; 138: 311-7.
20. Bazargani F, Feldmann I, Bondemark L. Three-dimensional analysis of effects of rapid maxillary expansion on facial sutures and bones. Angle Orthod 2013; 83: 1074-82.
21. Christie KF, Boucher N, Chung CH. Effects of bonded rapid palatal expansion on the transverse dimensions of the maxilla: a cone-beam computed tomography study. Am J Orthod Dentofacial Orthop 2010; 137(Suppl 4): 79-85.
22. Garrett BJ, Caruso JM, Rungcharassaeng K, Farrage JR, Kim JS, Taylor GD. Skeletal effects to the maxilla after rapid maxillary expansion assessed with cone-beam computed tomography. Am J Orthod Dentofacial Orthop 2008; 134: 8-9.
23. Torun GS. Soft tissue changes in the orofacial region after rapid maxillary expansion : A cone beam computed tomography study. J Orofac Orthop 2017; 78: 193-200.
24. Dolce C, Hatch JP, Van Sickels JE, Rugh JD. Five-year outcome and predictability of soft tissue profiles when wire or rigid fixation is used in mandibular advancement surgery. Am J Orthod Dentofacial Orthop 2003; 124: 249-56.
25. Melugin MB, Hanson PR, Bergstrom CA, Schuckit WI, Gerard Bradley T. Soft tissue to hard tissue advancement ratios for mandibular elongation using distraction osteogenesis in children. Angle Orthod 2006; 76: 72-6.

26. Moura PM, Giraldi G, Lira PH, Leite DA, Rodrigues PS, Faria M, et al. Image assessment of MSCT and CBCT scans for rapid maxillary expansion: a pilot study. Comput Methods Biomech Biomed Engin 2011; 14: 1089-95.
27. Berger JL, Pangrazio-Kulbersh V, Borgula T, Kaczynski R. Stability of orthopedic and surgically assisted rapid palatal expansion over time. Am J Orthod Dentofacial Orthop 1998; 114: 638-45.
28. Pangrazio-Kulbersh V, Wine P, Haughey M, Pajtas B, Kaczynski R. Cone beam computed tomography evaluation of changes in the naso-maxillary complex associated with two types of maxillary expanders. Angle Orthod 2012; 82: 448-57.
29. Ramieri GA, Nasi A, Dell'acqua A, Verzé L. Facial soft tissue changes after transverse palatal distraction in adult patients. Int J Oral Maxillofac Surg 2008; 37: 810-8.
30. Huizinga MP, Meulstee JW, Dijkstra PU, Schepers RH, Jansma J. Bone-borne surgically assisted rapid maxillary expansion: A retrospective three-dimensional evaluation of the asymmetry in expansion. J Craniomaxillofac Surg 2018; 46: 1329-35.