Müracaat Tarihi / Application Date: 24.11.2017
Kabul Tarihi / Acceptance Date: 06.12.2017

ÖZGÜN ARAŞTIRMA/ORIGINAL RESEARCH

Three Dimensional Evaluation of Relationship Between Cranial Base Angulations and Different Malocclusions

Farklı Maloklüzyonlar ile Kafa Tabanı Açılanmaları Arasındaki İlişkinin Üç Boyutlu Değerlendirilmesi

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Öz

Amaç: Bu çalışmanın amacı; farklı maloklüzyonu olan hastalarda kafa tabanı açılanmalarının konik ışınlı bilgisayarlı tomografi (KIBT) ile değerlendirilmesidir.

Gereç-Yöntem: Anteroposterior maloklüzyonlara göre, hastalardan elde edilen KIBT görüntüleri (135 kadın, 98 erkek, ortalama yaş: 13,05 ± 1,79) Sınıf I, Sınıf II ve Sınıf III olarak üç gruba ayrıldı. KIBT'dan sefalometrik görüntüler elde edildi ve hastalar ANB açısına göre sınıflandırıldı. Üç boyutlu KIBT görüntülerinde sagital, aksiyel ve koronal kafa tabanı açılanmaları ölçüldü. Farklı anteroposterior maloklüzyonlarla kafa tabanı açılanmaları Kruskal-Wallis istatistiksel testi ile analiz edildi.

Bulgular: Sagital kafa kaidesi ölçümleri Sınıf I, II ve III grupları arasında anlamlı bir fark göstermedi ($p > 0.05$). Koronal ve aksiyel kraniyal açı değişkenlerine göre anteroposterior maloklüzyon grupları arasında da anlamlı farklılık yoktu ($p > 0.05$).

Sonuç: Elde edilen sonuçlara göre, kafa tabanı açılanmalarının üç düzlemde de (sagital, koronal ve aksiyal) farklı anteroposterior iskelet malokluzyonları üzerine herhangi bir etkisi bulunmamaktadır. KIBT, anterior ve posterior kafa tabanındaki morfolojik farklılıkların tespiti ve teşhisi için yararlı olabilir.

Anahtar Kelimeler : Kafa Tabanı Açılanmaları, KIBT, Maloklüzyon

Abstract:

Aim: This study aimed to evaluate the cranial base angulations in patients with different malocclusions by using cone-beam computed tomography (CBCT).

Material-Methods: According to anteroposterior malocclusions, CBCT images of subjects (135 female, 98 male, average age: 13,05±1,79) were divided into three groups; Class I, Class II and Class III. Cephalometric images were obtained from CBCT and

patients were classified according to ANB angle. Sagittal, axial and coronal cranial base angulations were measured in three dimensional CBCT images. Cranial base angulation with different anteroposterior malocclusions were analyzed with the Kruskal-Wallis statistical test.
Results: Sagittal cranial base measurements showed no significant differences between Class I, II and III groups ($p>0.05$). Also there were no significant differences between anteroposterior malocclusion groups according to coronal and axial cranial angle variables ($p>0.05$).
Conclusion: According to the results, there were no effect of cranial base angulations in three planes (sagittal, coronal and axial) on different anteroposterior skeletal malocclusions. CBCT may be helpful for detecting and diagnosing morphological differences in anterior and posterior cranial base.

Keywords: Cranial Base Angulations, CBCT, Malocclusion

Introduction

Cranial base measurements and associations between maxilla and facial structures has been the study subject for orthodontists for a hundred years (1, 2). In orthodontic field cranio -facial growth and development knowledge is very important for diagnosis and treatment planning. Maxillar complex is located under the anterior cranial base and mandible is associated with middle cranial fossa via temporomandibular joint (3).
Cranial base morphology may be have an interaction between sagittal malocclusions and facial aesthetic since it is in close proximity with maxilla and mandibula. Therefore, several two dimensional cephalometric radiography studies has been done in this research area(4). Andria et al. studied the correlation of the cranial base angle and skeletal/dental variables using by cephalometric records of patients(5). In addition to this Gong et al. performed another meta-analysis study with consisting two dimensional radiographs about relationship between cranial base between anteroposterior malocclusions(6). Cephalometric two-dimensional (2D) conventional images show distortion and errors in diagnosis of morphologic structures in maxillofacial region and cause unexpected situations in orthodontic treatment planning. Hayashi et al. studied the morphological relationship between the cranial base and dentofacial complex with CT images (7). In addition to this, CBCT enables 3D skeletal and dental maxillofacial and cranial base evaluation. Afrand et al. published an article about growth changes in the anterior and middle carnial bases assesment with CBCT(8). In our study, cranial base angles and anteroposterior skeletal malocclusions were evaluated with CBCT.
The purpose of this study was to evaluate the sagittal, axial and coronal cranial base angulations in patients with skeletal Class I, II and III malocclusions by using cone-beam computed tomography (CBCT).

Materials and Method

The sample compromised 233 patients (98 male, 135 female, mean age 13,05+/-1,79 years) CBCT images were obtained from Eskişehir Osmangazi University Dentistry Faculty Orthodontic Department archives and ALARA principle (as low as reasonably achievable) was applied on the taking of all CBCTs on patients. All tomographic images were obtained in standing position by using CBCT machine (Planmeca Promax 3D mid, Helsinki, Finland). Exposure parameters were 94 kVp, 14 mA, 27 second. The exclusion criterias were include; craniofacial syndrome, presence of cleft lip or palate, osseous diseases of cranio-facial region, orthognathic surgery. Total samples were divided into three groups according to according to sagittal malocclusion type; ANB angle from 0° to 4° were classified

as the Class I group , >4° were classified as skeletal Class II and <0° were classified as Class III (4). Descriptive characteristics of the study are showed in Table I. Cephalometric landmarks and angular variables (SNA, SNB and ANB) were traced with Dolphin tracing software program (v11.9, Dolphin Imaging and Management Solutions, Chatsworth, CA, USA). Simplant O&O (Materialise, Leuven, Belgium) dental software was used to evaluate the sagittal, axial and coronal cranial base angulations in three dimensional images (9). The CBCT images were evaluated in all three planes (i.e., sagittal, axial, and coronal) by a single orthodontist (İ.M.D.) who had three dimensional tracing experience.

Anatomical Landmarks;

SAC point: Sella at mid-point of the anterior clinoid processes, Sella (S) : the center of the hypophyseal fossa, A point: Located in deepest point between the supradentale and the spina nasalis anterior, B Point: Deepest point between pogonion and infradentale, Nasion (N):Located in the most anterior region of frontonasal suture in the midsagittal plane, Basion (Ba): The most posteroinferior point of the anterior margin of the foramen magnum, Right Pterygoidal Notch: Most superior furcation point of right medial and right lateral sphenoid plate, Left Pterygoidal Notch: Most superior furcation point of medial and left lateral sphenoid plate (Figure 1).

Analysis of variables;

Sagittal Cranial Angle: Angle from point Nasion via point SAC to point Basion

Axial Cranial Angle: Angle from point Right Spheno-Orbital via point SAC to point Left Spheno-Orbital

Coronal Cranial Angle: Angle from point Right Sphenoidal Base via point SAC to point Left Sphenoidal Base (Figure 1).

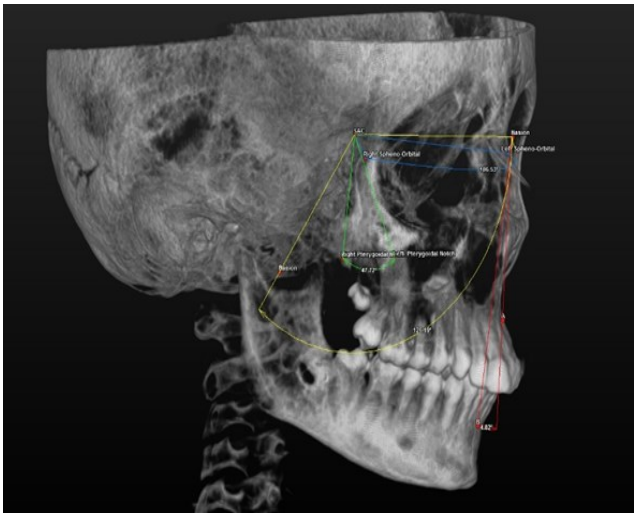

Figure 1: Definitions and measurements of CBCT landmarks and variables in three dimensional image.

Statistical analyses were performed with MedCalc Software for Windows (v17.5) (Broekstraat, Mariakerke, Belgium). To define the normality, the Kolmogorov-Smirnov statistical test was used. Cranial base angulation with different anteroposterior malocclusions were analyzed with the Kruskal-Wallis test. 0.05 significance level was used for all statistical analyses.

Results

Non-parametric statistical test was performed. Means and standart deviations of the ages in the Skeletal Class I, II and III subjects were 13.15±1.88, 13,06±1,67 and 12,34±1,80 respectively (Table 1). Sagittal cranial base measurements showed no significant differences between Class I, II and III groups ($p>0.05$). Also there were no significant differences between anteroposterior malocclusion groups according to coronal cranial angle parameter ($p>0.05$). The Class III group had larger axial cranial angle than Class I and II groups, but there were no significant differences between Skeletal Class I, II and III groups ($p>0.05$) (Table 2).

Groups	Mean age ±Standart deviation	Male (n)	Female (n)	Total
Class I	13,15±1,88	49	63	112
Class II	13,06±1,67	41	59	100
Class III	12,34±1,80	8	13	21
Total	13,05±1,79	98	135	233

Table 1: Descriptive statistics of study groups.

Variables	Class I	Class II	Class III	P value
Sagital Cranial Angle	128,88±5,78	129,26±6,28	127,95±5,96	0,629
Coronal Cranial Angle	56,71±6,68	56,47±6,18	56,83±5,05	0,879
Axial Cranial Angle	108,51±5,06	108,90±5,38	109,18±4,07	0,642

Table 2: Three dimensional cranial base angular measurements of skeletal Class I, II and III malocclusions.

Discussion

In this study, CBCT images of 233 subjects were divided into three groups via to the ANB angle values. And sagittal, axial and coronal cranial angles were measured in three dimensional CBCT images.

Maxillofacial anatomical and morphological features are complicated, therefore relationship between the cranial base and different skeletal sagittal malocclusions has not been fully explained so far. In addition to this, there were many investigations about evaluation of cranial base angulation in skeletal anteroposterior malocclusions, most of them consisted two dimensional radiographic studies (2, 10). Since the studies were performed in two dimensional radiographs, only sagittal cranial base measurements were measured. Different from other studies in the literature, we performed three dimensional angular measurements in cranial base and also we used SAC point as an alternative to sella point (pituitary cavity) which is a point in the gap that is not exactly certain.

Facial vertical height may also affect the skeletal malocclusions because of this, further CBCT studies are needed to evaluate the relationship between vertical facial features and cranial base angulation with larger study samples.

Within the limitation of this study, the following conclusions were drawn:

-Sagittal, axial and coronal cranial base angle measurements did not show statistically differences between skeletal class I, II and III malocclusions.

- The use of three dimensional CBCT images and measurements might play an important role in detection of cranial base morphology and angulations.

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