

# Retrospective Evaluation of Condyle and Ramus Asymmetry with Ortopantomography in Dentate and Total Edentulous Patients

Tam Dişli ve Total Dişsiz Hastalarda Kondil ve Ramus Asimetrisinin Ortopantomografi ile Retrospektif Olarak İncelenmesi

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## ABSTRACT

**Background:** It is aimed to compare the indexes of condylar and ramus asymmetry of dentate and edentulous patients in this study.

**Methods:** Panoramic radiographs of patients who applied to Fırat University Faculty of Dentistry for various dental complaints between February 2022-February 2023 were evaluated retrospectively. A total of 200 patients, 100 dentate and 100 edentulous, were included. Habets technique was used to identify condylar and ramus asymmetry in panoramic radiography. IBM SPSS Statistics 22 program was used for statistical analysis. In addition to descriptive statistical methods, mann-whitney u, chi-square test and t-test were used for comparison. Significance was evaluated at  $p<0.05$  level.

**Results:** The mean of the condylar asymmetry index was  $6.34 \% \pm 5.51$  in edentulous patients and  $6.30 \% \pm 5.81$  in dentate patients. The mean of the ramus asymmetry index was  $2.73 \% \pm 2.31$  in edentulous patients and  $2.81 \% \pm 2.31$  in dentate patients. Although the mean condyle and ramus asymmetry indexes were higher in dentate patients, this difference was not statistically significant. Also condylar asymmetry is more common than ramus asymmetry, no statistically significant difference was found in terms of condylar asymmetry and ramus asymmetry when edentulous and dentate patients were compared.

**Conclusion:** There is no statistically significant difference between dentate and edentulous patients in terms of condyle and ramus asymmetry index. Mandibular asymmetry caused by condylar and ramus asymmetries has a direct impact on facial appearance and can cause various functional and aesthetic problems clinically. Correct diagnosis of the causative factors in moderate and severe asymmetries is crucial for effective treatment planning.

**Keywords:** Condylar asymmetry; Habets technique; Ramus asymmetry

## ÖZ

**Amaç:** Bu çalışmada tam dişli ve tam dişsiz hastaların kondiler asimetri ve ramus asimetrisi indekslerinin karşılaştırılması amaçlanmıştır.

**Gereç ve Yöntemler:** Şubat 2022-Şubat 2023 tarihleri arası çeşitli dental sebeplerle Fırat Üniversitesi Diş Hekimliği Fakültesi'ne başvuran hastalara ait panoramik radyografiler retrospektif olarak değerlendirildi. 100 dişli ve 100 dişsiz olmak üzere toplam 200 hasta çalışmaya dâhil edildi. Panoramik radyografide kondiler asimetri ve ramus asimetrisi tespiti için Habets tekniği kullanıldı. Çalışmada elde edilen bulgular değerlendirilirken istatistiksel analizler için IBM SPSS Statistics 22 programı kullanıldı. Tanımlayıcı istatistiksel metotların yanı sıra verilerin karşılaştırılmasında mann-whitney u, ki-kare testi ve t-test kullanıldı. Anlamlılık  $p<0.05$  düzeyinde değerlendirildi.

**Bulgular:** Tam dişsiz hastalarda kondil ve ramus asimetri indeksi ortalaması sırasıyla  $6.34 \pm 5.51$  ve  $2.73 \pm 2.31$ , dişli hastalarda kondil ve ramus asimetri indeksi ortalaması sırasıyla  $6.30 \pm 5.81$  ve  $2.81 \pm 2.31$  bulundu. Dişsiz ve dişli hastalar karşılaştırıldığında kondiler asimetri ve ramus asimetrisi açısından istatistiksel olarak anlamlı bir fark bulunamadı.

**Sonuç:** Tam dişli ve tam dişsiz hastalar arasında kondil ve ramus asimetri indeksi açısından istatistiksel olarak anlamlı bir farklılık bulunmamaktadır. Kondiler asimetri ve ramus asimetrisinin neden olduğu mandibular asimetri, yüz görünümünü doğrudan etkilemekte ve klinik olarak çeşitli fonksiyonel ve estetik sorunlara neden olabilmektedir. Orta ve şiddetli asimetride etken faktörlerin doğru tanısı etkili tedavi planlaması için oldukça önemlidir.

**Anahtar Kelimeler:** Kondiler Asimetri; Habets tekniği; Ramus Asimetrisi

## INTRODUCTION

Although there is no perfect symmetry, a symmetrical facial appearance can play an important role in people's social relationships. One of the major factors that directly change the facial appearance is mandibular asymmetry.<sup>1</sup> Total edentulousness can be encountered with advancing age in clinically healthy individuals, which can cause size changes in the condyle and ramus region and cause asymmetry in the facial appearance.<sup>2</sup>

Condylar asymmetry (CA) is defined as the difference in vertical dimension between the right and left condyles.<sup>3</sup> During development, condylar growth is influenced by both genetic and functional factors. However, as the developmental process advances, the impact of external influences becomes more important, gradually reducing the influence of genetic control.<sup>4</sup> Various studies have shown that functional factors such as the transfer of chewing forces from the lower jaw to the skull base and the increase in joint load cause changes in condyle size. This overload may trigger hyperactivity in the masticatory muscles and the pathology may turn into osteoarthritis.<sup>5,6</sup> The gonial angle, one of the main landmarks of orthodontic analysis, is the angle between the ramus and corpus mandibula and it is highly effective on maximum chewing forces. In cases of ramus asymmetry (RA), changes in this angle

may cause a decrease in chewing forces.<sup>7,8</sup> Therefore, it is crucial to detect CA and RA.

Various techniques have been proposed to evaluate CA and RA in previous studies. In some of these techniques, panoramic radiographs have been used due to advantages such as the patient's exposure to a relatively lower radiation dose and ease of application.<sup>9</sup> The two most preferred techniques for CA and RA measurement in panoramic radiographs are Kjellberg and Habets techniques.<sup>9,10</sup> Kjellberg compared the condyle and ramus height ratios bilaterally to evaluate asymmetry and Habets used a linear calculation method.<sup>11</sup> It has been determined that the Habets technique gives the most accurate results in patients with conditions such as temporomandibular joint disorders.<sup>11</sup>

This study aims to compare the CA and RA indexes of dentate and edentulous patients using the Habets technique on panoramic radiography.

## MATERIAL AND METHODS

Panoramic radiographs of edentulous patients who applied to Fırat University Faculty of Dentistry for various dental complaints between February 2022-February 2023 were evaluated retrospectively. Signs of maxillofacial trauma and pathology, panoramic film errors due to

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patient position, presence of magnification, distortion and non-diagnostic panoramic radiographs with low resolution were not included in the study. The sample size was calculated as 55 patients for each group (110 patients in total) by power analysis. After applying the inclusion criteria, 100 edentulous patients were included in the study to prevent data loss. 100 dentate patients which randomly selected within the previously specified time period were determined as the control group. Additionally, patients with missing teeth (except the third molar teeth) were not included in the control group. Panoramic radiographs were obtained with the Planmeca Promax (Helsinki, Finland) panoramic device with 60-90 kVp, 3-16 mA, 14 sec exposure. The radiographs were evaluated together by an oral, dental and maxillofacial radiologist with 5 years of experience and a research assistant with 2 years of experience. Right and left condyle and ramus measurements were made using a lead pencil and tracing paper under the reflector light according to the Habets technique.

### Habets Technique

In order to determine the reference points in the Habets technique, firstly the A line was drawn tangent to the most lateral points of the condyle ( $O_1$ ) and ramus ( $O_2$ ), and then the B tangent was drawn from the top of the condyle to cross the line A perpendicularly. The point where line A cross tangent B is called X. Then, the length from the  $O_1$  point to the X point was recorded as the condyle height (CH), and the length from the  $O_1$  point to the  $O_2$  point as the ramus height (RH) (Figure 1). CA and RA calculations were made using the following formula with the obtained data.<sup>12</sup> While it was stated that a value up to 3% in the Habets index could be caused by X-ray magnification, above 6% were accepted as asymmetry.<sup>9</sup>

Asymmetry Index (AI) =  $(CH_{right} - CH_{left} / CH_{right} + CH_{left}) \times 100$

Asymmetry Index (AI) =  $(RH_{right} - RH_{left} / RH_{right} + RH_{left}) \times 100$

IBM SPSS Statistics 22 program was used for statistical analysis. In addition to descriptive statistical methods, mann-whitney u, chi-square test and t-test were used for comparison and  $p < 0.05$  were considered significant. The difference between right and left condyle and ramus heights was calculated using the paired t-test.

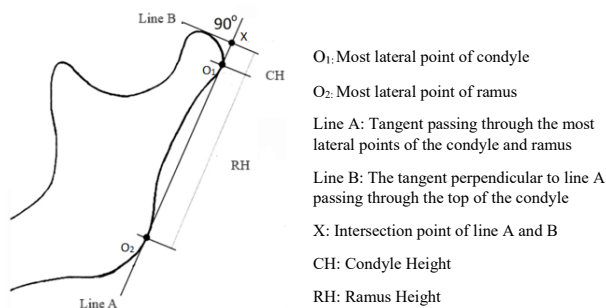


Figure 1. Habets technique

### RESULTS

In our study, the mean of the CA index was  $6.34 \% \pm 5.51$  in edentulous patients and  $6.30 \% \pm 5.81$  in dentate patients. According to these values,  $p$  was calculated 0.804 for the CA. The mean RA index was found to be  $2.73 \% \pm 2.31$  in total edentulous patients and  $2.81 \% \pm 2.31$  in dentate patients. According to these values,  $p$  was calculated 0.786 for the RA. According to the t-test, the mean of the CA and RA index was found to be higher in dentate patients, but this difference was not statistically significant ( $p > 0.05$ ) (Table 1).

Table 1. Mean values and standard deviations of CA and RA of patients in the study and control groups

Parameters	Dentate		Total Edentulous		P
	Mean	SD	Mean	SD	
Condylar Asymmetry Index	6.30	5.81	6.34	5.51	0.804
Ramus Asymmetry Index	2.81	2.31	2.73	2.31	0.786

SD: Standard deviation

### DISCUSSION

Complete edentulism is a weakening and irreversible condition that can affect facial appearance and cause a variety of clinical problems. Moderate and severe asymmetries occurring in the ramus and condyle can also cause various functional and aesthetic problems in edentulous patients. Early detection of factors that may cause asymmetry is one of the important variables affecting diagnosis and treatment planning.

Chou et al.<sup>13</sup> evaluated the relationship between CA and gender; they found that CA did not change depending on gender. Based on this result, gender was not taken into account in studies conducted on CA in recent years. Therefore, differences between genders were not evaluated in our study.

According to a recent study of Kambylafkas et al.,<sup>14</sup> panoramic radiographs can be used to examine mandibular vertical asymmetry and a lot of researchers suggested that the repeatability of angular and vertical measurements is high if the patient position is correct. In our study, radiographs with positioning errors were not included. Kambylafkas et al.<sup>14</sup> also stated that condyle height measurement on panoramic radiographs is not a reliable method for evaluating mandibular asymmetries; total ramus height could be used to determine asymmetry but mostly it would be misdiagnosed. Therefore, patients with a difference of less than 6% between the left and right sides may not be diagnosed on panoramic radiography.<sup>14</sup> While it was stated that a value up to 3% in the Habets index could be caused by X-ray magnification, above 6% were accepted as asymmetry.<sup>9</sup> In our study, the presence of asymmetry was accepted in patients with values above 6%.

Tooth loss occurs due to mechanical or pathological reasons. Although spontaneous tooth loss is seen due to progressive periodontal disease and trauma, the loss of all teeth usually occurs as a result of a relatively long term process.<sup>15</sup> In this process that progresses towards complete edentulism, the time of tooth loss and positions of missing teeth may vary and this may lead to occlusal irregularities, malocclusions and asymmetries. In our research, we aimed to compare CA and RA indexes of edentulous and dentate patients. It is very challenging to say if the CA originates from the right or left condyle in asymptomatic cases. Researchers did not find a statistically significant difference between the asymmetries originating from the right or left sides of the mandible and the condyle heads.<sup>16</sup>

In a study by Halicioğlu et al.<sup>17</sup> which investigated the causes of asymmetry, it was evaluated whether tooth loss could be the cause of asymmetry. Researchers compared 51 patients with unilateral mandibular molar tooth loss before the age of 12 with 51 patients with normal occlusion and no tooth loss and reported that there was no difference in mandibular asymmetry on either groups. In our study, bilateral edentulous and dentate patients were compared and similar results were obtained.

Cardinal et al.<sup>18</sup> conducted a study on 39 patients to evaluate CA and they divided the patients into two groups as: patients with unilateral crossbite (G1) and patients without crossbite (G2). In this study, where there was no difference between the groups in terms of gender and age, no statistically significant difference was found in condylar asymmetry in the G1 and G2 groups compared to the contralateral side. Likewise, when G1 and G2 groups are compared with each other, there is no statistically significant difference in terms of condylar asymmetry. Additionally, the relationship between age and asymmetry was evaluated and it was concluded that mandibular asymmetry does not have any correlation with age.

Lemes et al.<sup>19</sup> conducted studies on CA and RA on computed tomography by comparing patients with different facial growth patterns. According to their results, the ramus height of the hyperdivergent group were found to be remarkably shorter than the hypodivergent and normodivergent skeletal models ( $p<0.05$ ). However, there is no significant difference between linear measurements of the ramus height of normodivergent and hypodivergent patterns ( $p>0.05$ ). The effect of facial growth pattern on RA index was not statistically significant ( $p=0.0822$ ). Finally, CA did not differ significantly between the groups. In a study conducted in 2016, the radiation doses of conventional radiographs and advanced imaging techniques were compared; 5 millisieverts (mSv) for lateral cephalometric radiography, 9 mSv for posteroanterior cephalometric radiography and 22 mSv for panoramic radiography were reported. While in CBCT, the exposed radiation dose was 131 to 429 mSv.<sup>20</sup> We evaluated CA on panoramic radiographs due to ease of application and lower dose radiation and we did not find a significant difference between the groups in terms of CA and RA in parallel with the results of Lemes et al.<sup>19</sup>

In a study by Uysal et al.,<sup>21</sup> the CA and RA of patients with unilateral and bilateral crossbites and patients with normal occlusion were examined. There was no statistically significant difference in CA and RA indexes between right and left sides in patients with posterior bilateral crossbite and patients with normal occlusion. In unilateral posterior crossbite patients, the same measurements in cross-bite and normal side were not statistically different. ANOVA results, CA index, RA index and CA+RA index measurements were not statistically different between normal occlusion and cross-bite groups (19). Kiki et al.<sup>22</sup> found a higher rate of CA in patients with crossbite compared to patients with normal occlusion in their study. Condylar, ramus and condylar+ramus heights were not significant between the right and left sides. In our study, we compared dentate and total edentulous patients in terms of CA and RA, but we could not make crossbite evaluation since our study was retrospective. Despite this, the results of our study showed similar findings with the studies of Uysal and Kiki.<sup>21,22</sup>

#### Limitations

Since our study is retrospective, there are limitations such as the systemic conditions of the patients, presence of TMJ disorders, skeletal growth patterns and malocclusions are not known. Also here are some concerns about the reliability of panoramic radiographs for evaluating mandibular asymmetries due to disadvantages of two dimensional imaging such as magnification or distortion.

#### CONCLUSION

There is no statistically significant difference between dentate and edentulous patients in terms of condyle and ramus asymmetry index. Mandibular asymmetry caused by condylar and ramus asymmetries has a direct impact on facial appearance and can cause various functional and aesthetic problems clinically. Correct diagnosis of the causative factors in moderate and severe asymmetries is crucial for effective treatment planning. There may be many factors that cause asymmetry in processes that can generally result in total edentulism in elders. In cases of total edentulism, it should be investigated whether the existing moderate and severe asymmetry conditions continue and necessary precautions should be taken.

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Bu çalışma, yüksek lisans ya da doktora tezi esas alınarak hazırlanmamıştır.

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It is declared that during the preparation process of this study, scientific and ethical principles were followed and all the studies benefited are stated in the bibliography.

#### Benzerlik Taraması / Similarity scan

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## REFERENCES

1. Silvestrini-Biavati F, Ugolini A, Laffi N, Canevello C, Silvestrini-Biavati A. Early diagnostic evaluation of mandibular symmetry using orthopantomogram. *Indian J Dent Res* 2014;25:154-9.
2. Akın M, İleri Z, Polat Ö, Başçiftçi FA. Evaluation of mandibular asymmetry in class II subdivision malocclusion. *Selcuk Dental Journal* 2015;2:43-50.
3. Catić A, Celebić A, Valentić-Peruzović M, Catović A, Jerolimov V, Muretić I. Evaluation of the precision of dimensional measurements of the mandible on panoramic radiographs. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics* 1998;86(2):242-8.
4. Siegel MI, Doyle WJ. Stress and fluctuating limb asymmetry in various species of rodents. *Growth* 1975;39:363-9.
5. Hohl TH, Tucek WH. Measurement of condylar loading forces by instrumented prosthesis in the baboon. *J Maxillofac Surg* 1982;10:1-7.
6. Hylander WL, Bays R. An in vivo strain gauge analysis of the squamosal-dentary joint reaction force during mastication and incisal biting in *Macaca mulatta* and *Macaca fascicularis*. *Arch Oral Biol* 1979;24:689-97.
7. Panneerselvam E, Prasad PJ, Balasubramaniam S, Somasundaram S, Raja KV, Srinivasan D. The influence of the mandibular gonial angle on the incidence of mandibular angle fracture A radiomorphometric study. *J Oral Maxillofac Surg*. 2017;75:153-9.
8. Lima FJC, Oliveira Neto OB, Barbosa FT, Sousa-Rodrigues CF. Location, shape and anatomic relations of the mandibular foramen and the mandibular lingula: A contribution to surgical procedures in the ramus of the mandible. *Oral Maxillofac Surg* 2016;20:177-82.
9. Habets LL, Bezuur JN, van Ooij CP, Hansson TL. The orthopantomogram, an aid in diagnosis of temporomandibular joint problems. The factor of vertical magnification. *J Oral Rehabil* 1987;14:475-80.
10. Kjellberg H, Ekestubbe A, Kiliaridis S, Thilander B. Condylar height on panoramic radiographs. A methodologic study with a clinical application. *Acta Odontol Scand* 1994;52:43-50.
11. Iturriaga V, Navarro P, Cantin M, Fuentes R. Prevalence of vertical condilar asymmetry of the temporomandibular joint in patients with signs and symptoms of temporomandibular disorder. *Int J Morphol* 2012;30:315-21.
12. Çelikoğlu M, Büyük SK, Şekerci A. Unilateral Mandibular İkinci Premolar Eksikliği Olan Hastalarda Kondiler Asimetri. *Türk Ortodonti Dergisi* 2012;25(2):122-33.
13. Chou ST, Tsai PL, Chen SC, Lin SH, Chen CM, Tseng YC. Condylar and ramus volume in asymmetric and symmetric skeletal class III malocclusion: A cone-beam computed tomography study. *Journal of Dental Sciences* 2023;18(1):175-183.
14. Kambylafkas P, Murdock E, Gilda E, Tallents RH, Kyrkanides S. Validity of panoramic radiographs for measuring mandibular asymmetry. *The Angle Orthodontist* 2006;76(3), 388-393.
15. Akın C, Mutlu ŞN, Güntekin N. Yetişkin Hastalarda Artan Yaş ile Diş Kaybı Şiddetinin İlişkisi. *Necmettin Erbakan Üniversitesi Diş Hekimliği Dergisi* 2020;2(2):64-8.
16. Altuğ B, Özdiler O, Özdiler E. Mandibular Asimetri Dağılımının Değerlendirilmesi. *Ankara Üniversitesi Diş Hekimliği Fakültesi Dergisi* 2019;46(1):17-24
17. Halıcıoğlu K, Çelikoğlu M, Büyük SK, Şekerci AE, Çandırılı C. Effects of early unilateral mandibular first molar extraction on condylar and ramal vertical asymmetry. *Eur J Dent*. 2014;8(2):178-83.
18. Cardinal L, Martins I, Gribel BF, Dominguez GC. Is there an asymmetry of the condylar and coronoid processes of the mandible in individuals with unilateral crossbite? *The Angle Orthodontist* 2019;89(3):464-9.
19. Lemes CR, Tozzi CF, Gribel S, Gribel BF, Venezian GC, do Carmo Menezes C, et al. Mandibular ramus height and condyle distance asymmetries in individuals with different facial growth patterns: A cone-beam computed tomography study. *Surgical and Radiologic Anatomy* 2021;43(2):267-74.
20. Signorelli L, Patcas R, Peltomäki T, Schätzle M. Radiation dose of cone-beam computed tomography compared to conventional radiographs in orthodontics. *J Orofac Orthop* 2016;77:9-15.
21. Uysal T, Şişman Y, Kurt G, Ramoğlu Sİ. Condylar and ramal vertical asymmetry in unilateral and bilateral posterior crossbite patients and a normal occlusion sample. *American journal of orthodontics and dentofacial orthopedics* 2009;136(1):37-43.
22. Kiki A, Kılıç N, Oktay H. Condylar asymmetry in bilateral posterior crossbite patients. *The Angle orthodontist* 2007;77(1):77-81.