



## INVESTIGATION OF DENTAL AGE AND SKELETAL AGE IN OBESE AND NORMAL-WEIGHT CHILDREN: AN ARCHIVE STUDY

### OBEZ VE NORMAL KİLOLU ÇOCUKLARDA DIŞ YAŞI VE İSKELET YAŞININ ARAŞTIRILMASI: BİR ARŞIV ÇALIŞMASI

Dr. Öğr. Üyesi Münevver KILIÇ\*

Dr. Öğr. Üyesi Süleyman Kutalmış BÜYÜK\*\*\*

Dr. Öğr. Üyesi Hüseyin ŞİMŞEK\*\*

Arş. Gör. Dt. Murside Seda KÖSEOĞLU\*\*

Prof. Dr. Taşkın GÜRBÜZ\*\*\*\*

**Makale Kodu/Article code:** 4683

**Makale Gönderilme tarihi:** 17.11.2020

**Kabul Tarihi:** 12.03.2021

**DOI :** 10.17567/ataunidfd.895870

**Münevver Kılıç:** ORCID ID: 0000-0002-3470-0430

**HüseyinŞimşek:** ORCID ID: 0000-0002-9868-8266

**Süleyman Kutalmış Büyük:** ORCID ID: 0000-0002-7885-9582

**Murside Seda Köseoğlu:** ORCID ID: 0000-0002-4405-7127

**Taşkın Gürbüz:** ORCID ID: 0000-0002-8911-6530

#### ABSTRACT

**Aim:** The aim of this study was to assess dental and skeletal development in obese and normal-weight pediatric patients.

**Materials and Methods:** A sample of 65 patients (33 boys, 32 girls aged between 9 and 15) was selected. Dental panoramic radiographies were used for determining the dental age. Dental age was evaluated using the Demirjian Method scoring system. Skeletal age was measured by hand wrist radiographies using Greulich and Pyle method. The data were analyzed by Mann-Whitney U and Independent t-tests.

**Results:** There was no statistically significant difference between the obese and normal-weight groups in terms of dental age ( $P > 0.05$ ). Skeletal age was significantly increased in obese boys ( $P < 0.05$ ); however, there was no significant difference in girls ( $P > 0.05$ ).

**Conclusions:** Paediatric dentists should consider body mass index percentile when assessing growing children because it can affect dental and skeletal development.

**Keywords:** Dental Age, Skeletal Age, Obesity, Panoramic Radiography

#### ÖZ

**Amaç:** Bu çalışmanın amacı, obez ve normal kilolu çocuk hastalarda, diş ve iskelet gelişimini değerlendirmektir.

**Gereç ve Yöntem:** 65 hastadan (9 -15 yaşları arasında, 33 oğlan, 32 kız) oluşan bir örneklem seçildi. Diş yaşını belirlemek için panoramik radyografiler kullanıldı. Diş yaşı Demirjian yöntemi puanlama sistemi kullanılarak değerlendirildi. İskelet yaşı Greulich ve Pyle yöntemi kullanılarak el bileği radyografisi ile ölçüldü. Veriler Mann- Whitney U ve Independent t-testleri tarafından analiz edildi.

**Bulgular:** Diş yaşı açısından obez ve normal kilolu gruplar arasında istatistiksel olarak anlamlı farklılık yoktur. ( $p > 0.05$ )

**Sonuç:** Çocuk diş hekimleri, diş ve iskelet sisteminin gelişimi etkilenebileceğinden, çocukların büyümesini değerlendirirken vücut kitle indeksi yüzdeliğini göz önünde bulundurmalıdır.

**Anahtar Kelimeler:** Diş yaşı, iskelet yaşı, obezite, panoramik radyografi

\*Atatürk Üniversitesi Diş Hekimliği Fakültesi Pedodonti Anabilim Dalı, Erzurum.

\*\*Ordu Üni. Diş Hekimliği Fakültesi Pedodonti Anabilim Dalı, Ordu.

\*\*\*Ordu Üni. Diş Hekimliği Fakültesi Ortodonti Anabilim Dalı, Ordu.

\*\*\*\*Medipol Üniversitesi Diş Hekimliği Fakültesi, Pedodonti Anabilim Dalı, İstanbul.

**Kaynakça Bilgisi:** Kılıç M, Şimşek H, Büyük SK, Köseoğlu MS, Gürbüz T. Obez ve normal kilolu çocuklarda diş yaşı ve iskelet yaşının araştırılması: bir arşiv çalışması. Atatürk Üniv Diş Hek Fak Derg 2021; 31: 196-201.

**Citation Information:** Kılıç M, Şimşek H, Büyük SK, Köseoğlu MS, Gürbüz T. Investigation of dental age and skeletal age in obese and normal-weight children: an archive study. J Dent Fac Atatürk Uni 2021; 31: 196-201.

#### INTRODUCTION

Skeletal and dental age in pediatric patients is used with chronological age in the evaluation of growth and development <sup>1</sup>. In the field of pediatric dentistry and orthodontics, estimation of dental age is

important to make correct diagnosis and treatment planning. Dental development is a useful indicator due to its high reliability, low coefficient of variation and resistance to environmental effects <sup>2</sup>.

Different methods have been used to predict dental age from past to present. Many methods have



been described to estimate the dental age according to the calcification degree of the tooth with radiographies<sup>3</sup>. These methods make scoring according to the degree of mineralization of the teeth observed<sup>4</sup>. Demirjian et al. is the most commonly used method. Together with crown and root calcification, it presents root tip closure with eight stages (A-H)<sup>5</sup>.

Some skeletal developmental stages of the hand and wrist are closely related to pubertal growth<sup>6</sup>. Skeletal age and skeletal maturity stages are grouped by atlases using wrist radiographs. The Greulich and Pyle atlas formed a skeletal age database by comparing wrist radiography with standard plaques<sup>7</sup>.

Obesity rates have recently increased in the world<sup>8</sup>. Lifestyles that cause children to move less and the low level of school activities increased this rate<sup>9, 10</sup>. There are some points to consider when planning treatment in orthodontics and pedodontics in obese patients<sup>11</sup>.

The aim of this study is to investigate whether there is a significant relationship between the teeth development and the skeletal development of the children in the group of normal weight and obese patients.

## **MATERIALS AND METHODS**

### **Subjects**

The Atatürk University Faculty approved this retrospective archive scan study of the Medicine Ethics Committee. Children who previously applied to the endocrinology clinic and whose birth dates, height, and weights were recorded were included in the study. Obese children who a hand wrist X-ray is taken for fractures, growth, etc., were included in the study. Then it was checked whether the orthopantomographies of these children were recorded in the telemedicine system. Orthopantomographies were taken beforehand due to caries, pain, or control. We were able to reach 30 obese patients who hand wrist radiography and OPT. Dates of birth and x-ray dates were available in the telemedicine system. For the control group, patients who applied to the dentistry faculty and had dates of birth, height, and weight were selected. An attempt was made to reach children who had an OPT record and hand wrist radiography in telemedicine. We arrived at 35 children with normal weight. X-rays (hand wrist and OPT) were selected from those previously recorded in telemedicine.

This study was carried out on 30 (15 girls-15 boys) obese patients, 35 (17 girls-18 boys) normal-

weight patients aged between 8-15 who applied to Atatürk University Faculty of Dentistry. The weight, height, date of birth, race, and gender of each patient were obtained from the patient's records. All orthopantomograms and hand-wrist radiographs were categorized by gender and chronological age.

### *Inclusion criteria*

- All patients were of Turkish origin.
- There was no serious systemic diseases in the patients.
- Patients did not receive any orthodontic treatment.
- There was no trauma history in the face and jaw area of the patients

### *Exclusion criteria*

- Patients with image defects in their radiographs were excluded from the group.
- Patients with growth and developmental disorders were excluded.
  - Patients with any congenital anomaly in hand and wrist were separated.
  - Patients with any permanent tooth extraction were excluded.

Body mass indexes were performed based on the weight and height of the patients. In the study, two groups were divided into normal healthy individuals and obese individuals. The obesity of the patients was determined according to the BMI percentile criteria. According to this;

- 0-5 percentile underweight,
- Between 5-85 percentile normal weight,
- Between 85-95 percentile over-weight,
- Above 95 percentile obese group<sup>12</sup>

### **Evaluation of dental calcification stage**

Dental calcification was evaluated in conformity with the method described by Demirjian et al. and 8-stage calcification was given, to A, H for each tooth. Dental age was determined according to the Demirjian's gender differentiate tables. The scores taken from the tables were calculated separately for boys and girls 100 points for girls correspond to a 16 years old dental age and in boys, 98.4 points correspond to 16 years of age<sup>5</sup>

### **Evaluation of skeletal maturity stage**

Skeletal age was attempted to be estimated using the ossification stages in the Atlas of Hand and Wrist Skeletal Development Radiography (Greulich and Pyle).<sup>7</sup>

Skeletal stages of ossification in wrist radiographs were determined by using the Fishman method<sup>13</sup>:



1.MP3: In the middle phalanx of the third finger, the epiphysis is equal to the diaphysis.

2.S phase: Ulnar sesamoid bone mineralization has started.

3.MP3cap: The epiphysis in the middle phalanx of the third finger involves diaphysis.

4.DP3u: Full epiphysis fusion is seen in the distal phalanx of the third finger.

5.MP3u: The middle phalanx of the third finger fuses full epiphysis.

All assessments were performed in a viewing box illuminated in a dark room and by the same observer. Interpretations of both panoramic radiographs and hand-wrist were discussed until agreement was reached. In order to clarify the accuracy of each method, the difference between chronological age and dental age was calculated. The chronological ages of the patient were confirmed according to the date of birth of the patient.

#### Statistical analysis

Data analysis was conducted in IBM SPSS V20.0 (SPSS Inc., Chicago, IL, USA) software package program on the computer. Normal distribution (Shapiro-Wilks) test was applied to the data before performing statistical tests. While independent t test is applied to the parameters that are normally distributed; Mann-Whitney U test was used for parameters that did not show normal distribution. The statistical significance of the difference was accepted as  $p < 0.05$ .

Twenty cases were randomly selected after 2 weeks, and panoramic films and wrist radiographs were re-evaluated. A weighted kappa score was used to measure control reliability. The weighted kappa values varied from 0.66 (for the first molar) to 0.94 (for the second premolar).

#### RESULTS

Our study was performed on a total of 65 individuals, 30 obese (15 girls, 15 boys), 35 normal weight individuals (18 boys, 17 girls).

The mean age was  $12.73 \pm 1.76$  years (girls  $12.66 \pm 1.93$ , boys  $12.74 \pm 1.32$ ), the mean dental maturation was  $13.65 \pm 1.98$  years (girls  $13.51 \pm 2.09$ , boys  $13.92 \pm 1.73$ ), the mean skeletal age was  $13.23 \pm 1.62$  years (girls  $13.19 \pm 1.80$  boys  $13.32 \pm 1.56$ ) and the mean BMI percentile was  $71.6 \pm 50.2$ . (girls  $68.2 \pm 48.4$ , boys  $73.4 \pm 51.2$ ). The sample distribution included 53.9% (n = 35) normal weight

and 46.1% (n = 30) obese subjects.

There were no statistically significant differences between obese and normal-weight groups in terms of dental age ( $P > 0.05$ ), skeletal age increased significantly in obese individuals in boys ( $P < 0.05$ ) (Table 1).

There were no statistically significant differences between obese and normal-weight groups in terms of dental age and skeletal age in girls ( $P > 0.05$ ) (Table 2).

Table 1. Evaluation of dental age and skeletal age in normal weight and obese boys.

	N	Chronologic al age	Dental age	Skeletal age
		Mean±SD	Mean±SD	Mean±SD
<b>Normal weight</b>	18	12.81 ± 1.41	13.83 ± 1.95	12.63 ± 1.77
<b>Obese</b>	15	12.63 ± 1.20	14.02 ± 1.54	13.95 ± 1.32
<b>P value</b>		0.710	0.890	0.041

Table 2. Evaluation of dental age and skeletal age in normal weight and obese girls.

	N	Chronological age	Dental age	Skeletal age
		Mean±SD	Mean±SD	Mean±SD
<b>Normal weight</b>	17	12.75 ± 1.86	13.37 ± 2.16	12.85 ± 1.78
<b>Obese</b>	15	12.58 ± 2.05	13.64 ± 2.01	13.63 ± 1.83
<b>P value</b>		0.801	0.716	0.222

#### DISCUSSION

Obesity prevalence is rapidly increasing and is one of the common metabolic diseases in developed countries. The obesity is defined as the accumulation of abnormal or excess fat in the adiposis tissue to a level which can harm health. Excessive food consumption, poor nutrition and insufficient physical activity are some of the reasons for this. According to the World Health Organization (WHO), childhood obesity is one of the most important health problems due to its rapid increase rate. Childhood obesity development is closely related to obesity in adulthood <sup>14</sup>.

Body mass index (BMI) is a convenient and easy way to classify obesity. It is formulated as divide the length (meter) into unit of weight (kilograms) <sup>15</sup>. However, BMI percentiles in children do not give safe results in childhood as they also increase the fat-free



tissues. For now, age and gender-specific BMI percentile is used to provide an accurate classification in childhood and is called BMI-age<sup>16</sup>. In this cross-sectional, epidemiological study, body mass was compared with various variables. Classifications according to the weight of the patients in this study was performed according to BMI percentile score.

Growth charts used in Disease Control Centers are based on 5 cross-sectional studies made from 1963 to 1994 [14]. In order to establish standards, more than 15% of children should be obese in a sample group consistent with the data. In our study, the observed prevalence of obesity (46%) indicates that the BMI percentile in the population is consistent with other publications<sup>17</sup>. In statistical modelling, we use the continuous measure of percentage of BMI rather than categorical classifications. Because there are more BMI percentage patients in the "normal weight" category. Recently, it has been reported that the prevalence of high BMI percentiles is slightly higher in boys than in girls<sup>17</sup>. However, if more work will be done on more samples, we can get better results. In our study, BMI percentile showed poor correlation with dental and skeletal development. There are other studies that support this<sup>6, 18</sup>. Groups from different geographical regions of the world as well as malnourished populations, would be more useful in assessing the accuracy of the findings. Individual ethnic variations related to body mass and development can enrich the database. Socioeconomic status information will also be useful in a future study.

The effect of obesity on skeletal system has been the subject of literature. Mechanical loading due to increased body weight in overweight and obese people provides a beneficial effect on bone formation. This situation acts as a natural preservative that prevents the formation of osteoporosis<sup>19</sup>. Obesity is reported to increase bone mass and reduce fracture risk<sup>20</sup>. Many studies have shown that bone mineral density (BMD) and bone mineral content (BMC) are higher in overweight and obese children<sup>21, 22</sup>. In contrast, cases of increased risk of fracture in overweight patients have also been shown<sup>22</sup>. Unlike studies that define a positive relationship between obesity and bone mass, there are several studies in the literature that show a negative relationship between these two<sup>22, 23</sup>. Obesity influences bone metabolism with various mechanisms. These mechanisms include increased proinflammatory cytokines, changes in bone turnover, hormones and

mechanical stress on the bone<sup>24</sup>. Studies have shown that obesity affects cortical bone rather than trabecular bone<sup>23</sup>. Leonardo et al.<sup>25</sup> reported that body bone sizes and mass increase were associated with obesity during childhood and adolescence. In our study, skeletal age was more prominent especially in obese men. Although the numerical values of skeletal age were predominant in obese girls patient group, no statistically significant difference was found. When we look at the dental age in the obese girl and boy group, there was no statistically significant difference when compared with the normal patient group, although the values of the table were high. We thought that the reason for this situation may be that the girls' pubertal development attacks differ from men.

Demirjian et al.<sup>5</sup> made scoring according to the gender and the maturation stage of teeth and this has been beneficial to determine dental age more accurately. Although this method of detection is often used in predicting chronological age, several authors have shown that this method differs from ethnicity and needs to be adapted to populations<sup>5, 26</sup>. It has been previously reported that there are ethnic variations in the relationships between the calcification stages of teeth and skeletal development<sup>26</sup>. Therefore, this study was conducted to investigate the stages of calcification of various teeth and skeletal maturity among Turkish individuals.

The timing of dental eruption which is considered as the most obvious and easily detected indicator of dental maturation, was claimed to be much more variable than skeletal maturation<sup>27</sup>. Also, according to Nolla, dental eruption is more variable than the dental calcification<sup>4</sup>. Dental eruption is a temporary phenomenon which is under environmental factors<sup>5</sup>. In this study, the calcification stages of the teeth were preferred instead of the eruption time of the teeth<sup>4</sup>. Therefore, Demirjian et al., dental maturity evaluation stages were used<sup>27</sup>. The criterion of this method is to consider the degree of crown and root development rather than the length of crown and root<sup>27</sup>. Despite some criticisms about the accuracy of Demirjian et al.<sup>5</sup> method in the determination of dental age, there is no other widely accepted systematic method that is valid in different ethnic and geographical groups<sup>28</sup>.

Some studies was reported that the clinician could more easily define the relationship between the dental calcification degrees and the stages of skeletal maturity by using panoramic films<sup>27, 29, 30</sup>. If there is a strong connection between the skeletal maturity and



dental calcification stages, the calcification stages of the tooth can also be used as a first status diagnostic tool to determine the timing of the pubertal growth increase.<sup>31</sup> Different imaging methods such as MRI can also be successful in determining the tooth age. Vertebrae can also be used for tooth age determination.<sup>32, 33</sup>

Skeletal maturation is an important factor in the planning of orthodontic treatment or Pediatric dental treatment<sup>34</sup>. Orthodontists relate to skeletal age rather than chronological age as an indication of when to start treatment<sup>29</sup>. Different methods have been defined to evaluate skeletal age. Hand-wrist radiographs are most commonly used by dentists in determining skeletal maturation<sup>34</sup>. With this method, we determined that skeletal development of obese boys is more predominant than normal children. When planning treatment as a dentist, the development of dental age or skeletal development in children should be considered. There are various methods to evaluate the dental and skeletal development. Good and reliable results can be obtained using the appropriate ones. In addition, pedodontists should consider the health problems associated with overweight and obesity and should direct the patients to the relevant health units.

This study has some limitations. The sample size is low because it is difficult to find children with wrist radiography and OPT. it is not classified according to the age groups of children. There is a need to support the results with alternative imaging methods for dental and skeletal maturity.

## CONCLUSIONS

The increase in BMI percentile appears to be related to the increase in skeletal development in boys. Although there was a numerical increase in girls, no statistically significant difference was viewed. In the development of this condition, it is seen that ethnic origin is effective and it should be studied in larger patient groups. As health professionals, pedodontists may be helpful in collecting weight information for treatment planning purposes and health counselling.

*Bu çalışma, çalışmayı yürüten tüm yazarlar tarafından okunmuş ve onaylanmış orijinal bir çalışmadır. Herhangi bir yazar, kurum ya da kuruluş ile çıkar çatışması olmadığını belirtmek isteriz.*

## REFERENCES

1. Eid RM, Simi R, Friggi MN, and Fisberg M. Assessment of dental maturity of Brazilian children aged 6 to 14 years using Demirjian's method. Int J Paediatr Dent 2020; 12:423-8.
2. Lee SS, Kim D, Lee S, Lee UY, Seo JS, Ahn YW, and Han SH. Validity of Demirjian's and modified Demirjian's methods in age estimation for Korean juveniles and adolescents. Forensic Sci Int 2011; 211: 41-6.
3. Liversidge H. Interpreting group differences using Demirjian's dental maturity method. Forensic Sci Int 2010; 201: 95-101.
4. Nolla CM. The development of permanent teeth. University of Michigan; 1952.
5. Demirjian A, Goldstein H, and Tanner J. A new system of dental age assessment, Human Biol 1972: 211-27.
6. Fanning, EA. Effect of extraction of deciduous molars on the formation and eruption of their successors. Angle Orthod 1962; 32: 44-53.
7. Greulich WW, Pyle SI, and Todd TW. Radiographic atlas of skeletal development of the hand and wrist. Stanford Univ Press Stanford 1952; Vol. 2.
8. Flegal KM. Epidemiologic aspects of overweight and obesity in the United States. Physiology & behavior 2005;86; 599-602.
9. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman, RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, and Pivarnik, JM. Evidence based physical activity for school-age youth. J Pediatr 2005; 146; 732-7.
10. Kiliç MÇ, Gürbüz T, Çayır A. Çocuk diş hekimliğinde obezite. Atatürk Üniv Diş Hek Fak Derg 2015; 26:109-14.
11. Öhrm K, Al-Kahlili B, Huggare J, Forsberg CM, Marcus C, Dahllöf G. Craniofacial morphology in obese adolescents, Acta Odontol Scand 2002: 60; 193-7.
12. Kuczmarski, RJ. 2000 CDC growth charts for the United States; methods and development 2002.
13. Fishman LS. Radiographic evaluation of skeletal maturation: a clinically oriented method based on hand-wrist films. The Angle Orthodontist 1982; 52:88-112.
14. Guo S, Huang C, Maynard L, Demerath E, Towne B, Chumlea WC, and Siervogel R. Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: the Fels Longitudinal Study. Int J



- Obesity 2000; 24:1628.
15. Kopelman PG. Obesity as a medical problem. *Nature* 2000; 404: 635.
  16. Akridge M, Hilgers KK, Silveira AM, Scarfe W, Scheetz JP, and Kinane DF. Childhood obesity and skeletal maturation assessed with Fishman's hand-wrist analysis. *Am J Orthod Dentofac Orthop* 2007; 132: 185-90.
  17. Ogden CL, Carroll MD, Curtin LR, Lamb MM, and Flegal KM. Prevalence of high body mass index in US children and adolescents 2007-2008. *JAMA* 2010;303: 242-9.
  18. Gaur R, Boparai G, and Saini K. Effect of under-nutrition on permanent tooth emergence among Rajputs of Himachal Pradesh, India. *Ann Human Biol* 2011; 38: 84-92.
  19. Villareal DT, Apovian CM, Kushner RF, and Klein S. Obesity in older adults: technical review and position statement of the American Society for Nutrition and NAASO, The Obesity Society. *Obesity Res* 2005; 13: 1849-63.
  20. De Laet C, Kanis J, Odén A, Johanson H, Johnell O, Delmas P, Eisman J, Kroger H, Fujiwara S, and Garnero P. Body mass index as a predictor of fracture risk: a meta-analysis. *Osteoporosis Int* 2005;16: 1330-8.
  21. Kemp JP, Sayers A, Smith GD, Tobias JH, and Evans DM. Using Mendelian randomization to investigate a possible causal relationship between adiposity and increased bone mineral density at different skeletal sites in children. *Int J Epidemiol* 2016; 45, 1560-72.
  22. Nava-González EJ, Cerda-Flores RM, García-Hernández PA, Jasso-de la Peña GA, Bastarrachea RA, and Gallegos-Cabiales EC. Densidad mineral ósea y su asociación con la composición corporal y biomarcadores metabólicos del eje insulino-glucosa, hueso y tejido adiposo en mujeres, *Gaceta Médica de México* 2015; 151, 731-40.
  23. Longhi S, Pasquino B, Calcagno A, Bertelli E, Olivieri I, Di Iorgi N, and Radetti G. Small metacarpal bones of low quality in obese children. *Clin Endocrinol* 2013; 78: 79-85.
  24. Shapses SA, and Sukumar D. Bone metabolism in obesity and weight loss. *Ann Rev Nutr* 2012; 32: 287-309.
  25. Leonard MB, Shults J, Wilson BA, Terhakovec AM, and Zemel BS. Obesity during childhood and adolescence augments bone mass and bone dimensions. *Am J Clin Nutrition* 2004; 80:514-23.
  26. Tomás LF, Mónico LS, Tomás I, Varela-Patiño P, and Martin-Biedma B. The accuracy of estimating chronological age from Demirjian and Nolla methods in a Portuguese and Spanish sample. *BMC Oral Health* 2014;14: 160.
  27. Krailassiri S, Anuwongnukroh N, and Dechkunakorn S. Relationships between dental calcification stages and skeletal maturity indicators in Thai individuals. *Angle Orthod* 2002: 72; 155-66.
  28. Nik-Hussein NN, Kee KM, and Gan P. Validity of Demirjian and Willems methods for dental age estimation for Malaysian children aged 5–15 years old. *Forens Sci Int* 2011; 204: 208. e201-8.
  29. Uysal T, Sari Z, Ramoglu SI, and Basciftci FA. Relationships between dental and skeletal maturity in Turkish subjects, *Angle Orthod* 2004;74:657-64.
  30. Antunovic, M., Galic, I., Zelic, K., Nedeljkovic, N., Lazic, E., Djuric, M., and Cameriere, R. The third molars for indicating legal adult age in Montenegro. *Legal Med* 2018;33; 55-61.
  31. Cericato GO, Bittencourt M, and Paranhos L. Validity of the assessment method of skeletal maturation by cervical vertebrae: a systematic review and meta-analysis. *Dentomaxillofac Radiol* 2015;44; 20140270.
  32. Predko-Engel A, Kaminek M, Langova K, Kowalski P, and Fudalej P. Reliability of the cervical vertebrae maturation (CVM) method. *Bratislavské lekárske listy* 2015: 116; 222-6.
  33. Gulsahi A, Çehreli SB, Galić I, Ferrante L, and Cameriere R. Age estimation in Turkish children and young adolescents using fourth cervical vertebra. *Int J Legal Med* 2020: 1-7.
  34. Flores-Mir C, Nebbe B, and Major PW. Use of skeletal maturation based on hand-wrist radiographic analysis as a predictor of facial growth: a systematic review. *Angle Orthod* 2004;74; 118-24.

#### **Sorumlu Yazarın Yazışma Adresi**

Dr. Öğr. Üyesi Münevver KILIÇ  
Atatürk Üniversitesi  
Diş Hekimliği Fakültesi  
Pedodonti Anabilim Dalı, Erzurum.  
E-mail: mnvvr\_25@hotmail.com

