Araştırma Makalesi/Research Article

Evaluation of Knowledge Levels of Undergraduate and Postgraduate Dentists Concerning Anatomical Landmarks on Panoramic Radiography

Lisans Diş Hekimliği Öğrencileri ve Diş Hekimlerinin Panoramik Radyografide Anatomik Landmarklara İlişkin Bilgi Düzeylerinin Değerlendirilmesi

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Abstract: Objective: This study aimed to evaluate the knowledge level of dental students and newly graduated dentists concerning anatomical landmarks identified on panoramic radiographs. Methods: This study was conducted as a web-based survey. Students continuing their education in the 4th and 5th grades of dentistry faculties and dentists who graduated within the last one year were included in our study. The answers given to the anatomical points on the panoramic radiograph were recorded as "true" and "false". SPSS was used to analyse the data. The data obtained were analysed by Kolmogorov-Smirnov test and Mann-Whitney U Test. $p<0.05$ was considered statistically significant. Results: 300 people participated of which 59.6% of the participants were female and 40.4% were male. The answers given to a total of 18 anatomical point questions did not show a significant difference according to gender (p=0.469). There was no question that all participants answered correctly. The highest correct answer rate was found for the anatomical point 'Mental foramen' with 289 (96.3%) participants. The lowest correct answer rate was found for the anatomical point 'Soft palate' with 48 (16%) participants. According to educational status, 5th grade students were the group with statistically significantly lower correct answers (p=0.017) Conclusions: These results indicate that training approaches should be developed for anatomical landmarks with lower correct response rates. Dentists working on a complicated structure should have a good command of this anatomy, and for this purpose, efforts should be made during the teaching program on anatomical structures that are difficult to identify and keep their knowledge up to date.

Keywords: Anatomical landmarks, Dental radiology education, Dentistry education, Diagnosis, Panoramic radiography.

Öz: Amaç: Bu çalışmanın amacı, diş hekimliği öğrencilerinin ve yeni mezun diş hekimlerinin panoramik radyografilerde tanımlanan anatomik işaretler hakkındaki bilgi düzeylerini değerlendirmektir. Gereç ve Yöntem: Bu çalışma internet-tabanlı bir anket çalışması olarak yürütüldü. Çalışmamıza diş hekimliği fakültelerinin 4. ve 5. sınıflarında eğitimlerine devam eden öğrenciler ve son 1 yıl içinde mezun olan diş hekimleri dahil edildi. Panoramik radyografideki anatomik nokta sorularına verilen cevaplar "doğru" ve "yanlış" olarak kaydedildi. Verilerin analizinde SPSS kullanıldı. Elde edilen veriler Kolmogorov-Smirnov testi ve Mann-Whitney U Testi ile analiz edildi. p<0,05 istatistiksel olarak anlamlı kabul edildi. Bulgular: 300 kişinin katıldığı ankete katılanların %59,6'sı kadın, %40,4'ü erkektir. Toplam 18 anatomik nokta sorusuna verilen cevaplar cinsiyete göre anlamlı bir farklılık göstermemiştir (p=0.469). Tüm katılımcıların doğru cevapladığı soru bulunmamaktadır. En yüksek doğru cevap oranı 289 (%96,3) katılımcı ile 'Mental foramen' anatomik noktası için bulunmuştur. En düşük doğru cevap oranı ise 48 (%16) katılımcı ile 'Yumuşak damak' anatomik noktası için bulunmuştur. Eğitim durumuna göre, 5. sınıf öğrencileri istatistiksel olarak anlamlı şekilde daha düşük doğru cevap veren grup olmuştur (p=0.017) Sonuçlar: Bu sonuçlar, doğru yanıt oranı daha düşük olan anatomik işaretler için eğitim yaklaşımları geliştirilmesi gerektiğini göstermektedir. Komplike bir yapı üzerinde çalışan diş hekimlerinin bu anatomiye hâkim olması gerekmektedir ve bu amaçla öğretim programı sırasında tanımlanması zor olan anatomik yapılar üzerinde çalışmalar yapılmalı ve bilgileri güncel tutulmalıdır.

Anahtar Kelimeler: Anatomik noktalar, Dental radyoloji eğitimi, Diş hekimliği eğitimi, Tanı, Panoramik radyografi.

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Introduction

The main aim of dental schools worldwide is to train dentists who can identify relevant information in patient presentation, make the right decisions by evaluating possible treatment methods thoughtfully and impartially, predict treatment outcomes, and improve themselves by evaluating their performance (Kalkwarf et al., 2005). A successful dental education system should provide students with biomedical, behavioral, and basic dentistry courses to enable them to transfer this theoretical knowledge to their practical training and to gain nonclinical, clinical, and personal capabilities and skills (Cowpe et al., 2010).

Radiographs are used in dentistry to diagnose and determine the treatment method. Among these radiographs, periapical and panoramic radiographs are frequently used (Alattar et al., 1980; Elsheikhi et al., 2021; Ertuğrul et al., 2023; Maeda et al., 2018; McNab et al., 2015; Serindere & Belgin, 2019). Panoramic radiographs (orthopantomograph-OPT) allow the visualization and interpretation of both jaws on a single film with a simplified extraoral procedure. Among the reasons for the preference of panoramic films are; The ease of application, relatively low radiation dose, use in patients with gag reflex, short procedure time, visualisation of the maxilla and mandible on a single film, evaluation of the eruption of deciduous and permanent teeth (Sanjay Mallya, 2018), evaluation of dentomaxillofacial trauma and developmental disorders of the maxillofacial structure, detection of impacted teeth, traumas and bone fractures, evaluation of the condition of teeth and supporting tissues (length and shape of the root, lamina dura, periodontal ligament, bone level, etc.) and evaluating whether there are any malformations in anatomical formations (Nileema et al., 2016; Sanjay Mallya, 2018). Another factor in the widespread use of panoramic films is that they are a "screening" method for the examination of unexpected pathological conditions (Rushton & Horner, 1996). Panoramic radiography is also essential in providing important technical, scientific, and legal data (Raitz et al., 2005).

In addition, often overlapping soft and hard tissues and airways may create confusing reflections and cause difficulties in radiograph interpretation. The evaluation of anatomical formations on radiographs is made difficult by superpositions and shadows resulting from the 2-dimensional visualization of the 3-dimensional structure (Perschbacher, 2012). Correct interpretation of panoramic radiography therefore requires a good-quality image, an understanding of the principles of panoramic imaging, and a high level of craniofacial anatomical knowledge. Learning the interpretation of normal anatomical structures and

pathological formations in panoramic radiography remains an integral part of dental education (Elsheikhi et al., 2021; Nileema et al., 2016).

Dental students in Turkey receive training about panoramic radiography and identifying and recognizing anatomical landmarks through intensive theoretical training from the 2nd to 5th year and through lectures and seminars in different dental specialties during clinical training in the 4th and 5th year. Throughout their educational process, students must distinguish anatomical structures as well as pathological findings. However, taking into account the fact that some anatomical structures are complex to identify or memorize, this study was conducted to evaluate the level of knowledge, awareness, and ability to identify or memorize anatomical landmarks taught on panoramic radiographs in new dentists who started their profession and 4th and 5th-year dentistry student. The information obtained from the questionnaire can be used to support changes that can be made to the current education of the theoretical and practical training on panoramic film given during the undergraduate period.

Methods

This study was conducted by including 4th and 5th-year undergraduate students studying at the faculties of dentistry of universities in different provinces of Turkey and dentists who graduated from these universities one year ago, after approval by the Human Research Ethics Committee of Karabük University (Decision No: 2023/1416). The questionnaire was developed using an online platform (Google Forms) and delivered to all participants online. Participation was voluntary and each participant gave consent before starting the survey. The questionnaire consisted of two parts. The first part included sociodemographic data, and the second part included the evaluation of 18 anatomical landmarks marked on a digital panoramic radiograph with high image quality. The first section also consists of the employment status of dentists who graduated in the last year and the average number of patients per day. The questions in the first part were prepared as a test, and the anatomical landmark evaluations in the second part were prepared as open-ended questions. A panoramic film in which the anatomical structures were as clear as possible was selected for the study and 18 different anatomical landmarks were indicated with arrows and numbers on the radiograph (Figure 1), and the participants were allowed to answer the questions in their own words. In the questionnaire form, it was compulsory to answer all questions to prevent data loss. Open-ended question answers were evaluated as true or false. The data obtained were then analyzed with the Kolmogorov-Smirnov

test and Mann-Whitney-U Test to compare the knowledge levels of dental students and dentists on panoramic radiography according to their clinical experience.
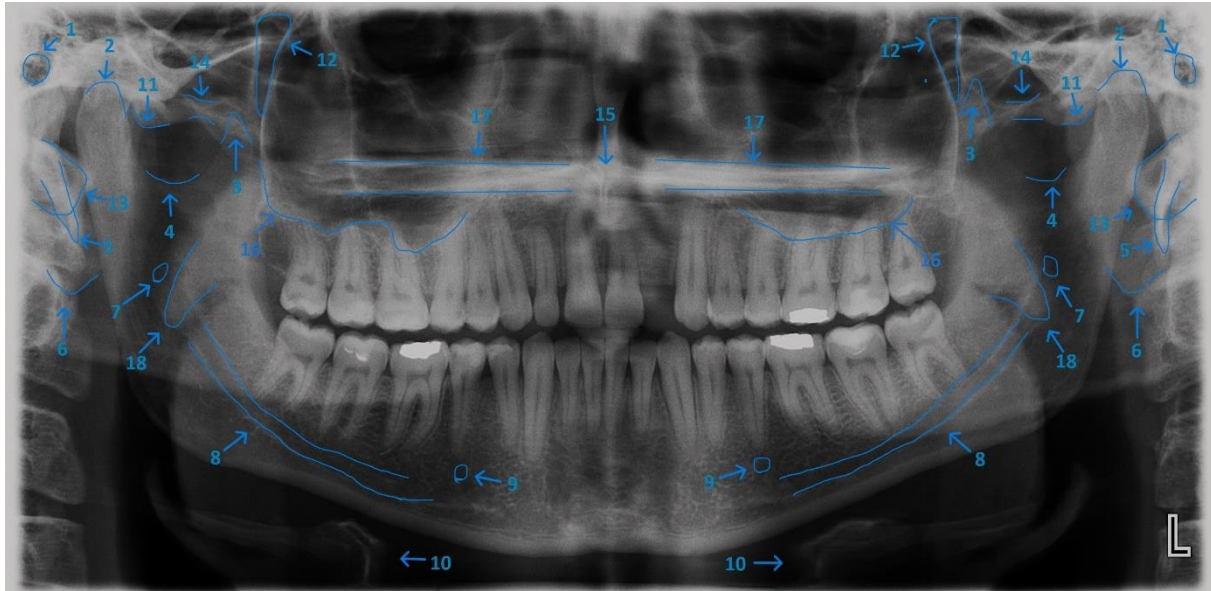

Figure 1. 1. External Acoustic Foramen 2. Condyle 3. Coronoid Process 4. Sigmoid Notch 5. Styloid Process 6. Ear Lobe 7. Mandibular Foramen 8. Mandibular Canal 9. Mental Foramen 10. Hyoid Bone 11. Articular Eminence 12. Pterygopalatine Fossa 13. Cervikal Vertebrae 14. Zygomatic Ark 15. Anterior Nasal Spine 16. Maxillary Sinus 17. Hard Palate 18. Soft Palate.

Results

179 (59.6%) women and 121 (40.4%) men participated in our study. The answers to 18 anatomical landmark questions did not show a significant difference according to gender (p=0.469) (Figure 2). There was no question that all participants answered correctly. The highest rate of correct answers was found for the anatomical point *'mental foramen'* with 289 (96.3%) participants. The lowest rate of correct answers was found for the anatomical point *'soft palate'* with 48 (16%) participants.

According to the educational status, the lowest number of participants was "graduate" (number=86, 28.6%), and the highest number of participants was "5th-grade student" (number=113, 37.6%). The other 101 participants (33.6%) were in the "4th grade student" group. According to the results of the paired Mann-Whitney U Test according to educational status, 5th-grade students were found to be the group with statistically significantly lower

correct answers among all groups (p=0.017) (Figure 3). The question *'mental foramen'* was the question with the highest rate (96.4%) of correct answers among 5th-year dentistry students.
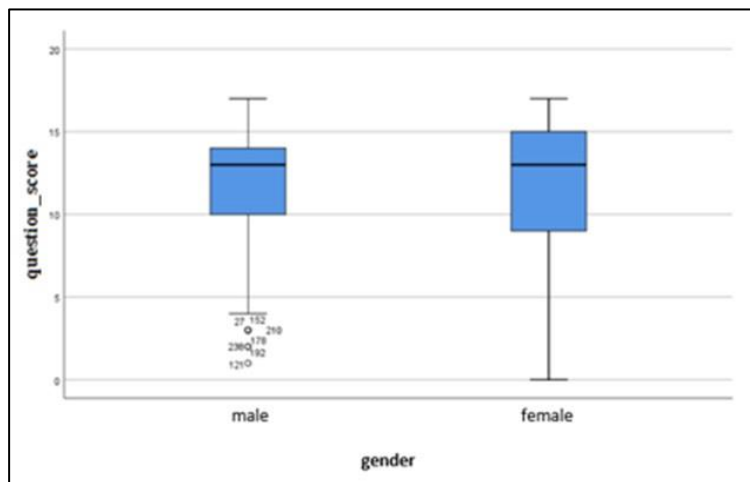

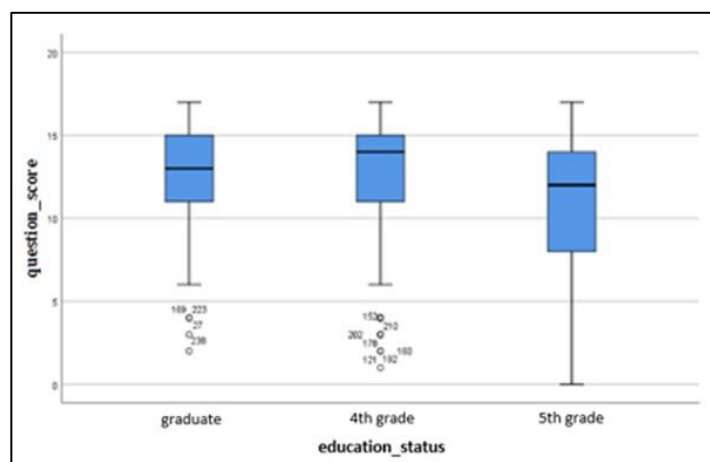**Figure 2.** Distribution of The Answers Given By The Participants According to Gender

Figure 3. Distribution of The Answers Given By The Participants According to Their Education Level

When newly graduated dentists were compared, no statistically significant difference was found between them according to their working status (p=0.656) (Figure 4). When the graduated dentists were evaluated according to their working status, 18% (16 people) were working in public hospitals, 67% (57 people) were studying for the Dental Speciality Examination (DUS), 10% (8 people) were working in private clinics, and 5% (5 people) were doing specialty/doctorate. The anatomical point *'condyle'* was the most frequently answered question correctly by the graduated dentists (number=86, 93.02%).
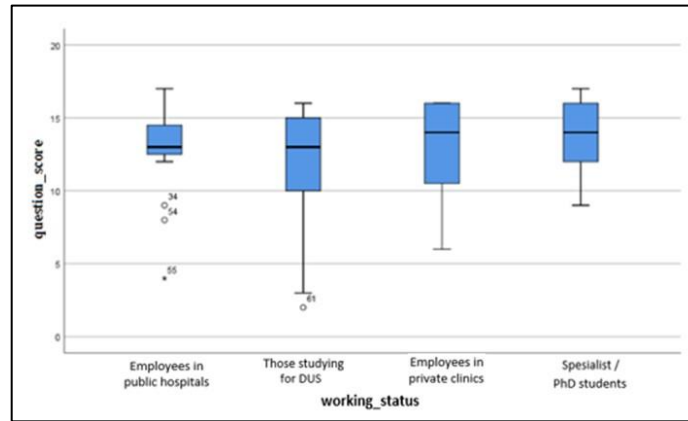
Figure 4. Distribution of The Answers Given By Graduated Dentists According to Their Employment Status

Discussion

Conventional radiographic methods are frequently used due to their advantages, such as being simple and easy to apply and standardization (Bayrakdar & Görkem, 2020; Shintaku et al., 2013). Especially panoramic radiography is widely used as an imaging method in dental practice due to its general and effective visualization of stomatognathic structures, and many anatomical points can be evaluated at the same time with a single radiograph (Shintaku et al., 2013). The level of anatomical knowledge has become very important to make accurate evaluations and thus make the correct diagnosis. In other words, a good knowledge of the anatomical formations in panoramic films, which dentists routinely use in clinical practice since their student years, correct interpretation and differentiation of pathological formations will reduce misdiagnosis and thus incorrect treatments (Hellén-Halme et al., 2007; Perschbacher, 2012).

In our study, the basic anatomical points that every dentist should have knowledge of in routine clinical work were marked on panoramic radiographs and the radiographic anatomical knowledge levels of 4th and 5th year dental students and dentists who graduated one year ago were evaluated. In the literature, there are various studies evaluating the radiographic anatomy knowledge of dentists (Çiftçi et al., 2016; Ertuğrul et al., 2023; Hellén-Halme et al., 2007); however, studies measuring the radiographic anatomy knowledge level of dental students are rare. Razmus et al. (Razmus et al., 1993) evaluated the overall knowledge of graduating and beginning American dental students about anatomical landmarks on panoramic radiographs. Still, they did not focus on the level of recognition of individual anatomical structures. Maeda et al. (2018) conducted a similar study on Japanese dental students in two different academic years and aimed to identify the easy or difficult-to-recognize anatomical landmarks among 28 anatomical landmarks marked on panoramic radiographs (Maeda et al., 2018).

A study similar to the present study was conducted by İlgüy et al. (2018) on 3rd, 4th, and 5th-year dental students and postgraduate students of dental radiology on both periapical and panoramic radiography and patient positions. However, the number of participants in each group in this study varied between 23 and 46, which is among the limitations of the study (İlgüy et al., 2018). There is no comprehensive study in the literature in which the level of radiographic anatomy knowledge of dental students and newly graduated dentists is measured. It is thought that this study, which was conducted to measure the effect of education level and treatment practice on the level of knowledge about panoramic anatomical points, will contribute to the literature.

To provide each participant with an optimal environment for observation, the anatomical points to be answered were presented as fine-line tracings on the panoramic radiograph, taking into account the complex overlapping of hard and soft tissues. In addition, tracings with lines show the regions more clearly compared to radiographic images. By using this method, the anatomical point knowledge of the participants can be evaluated rather than their radiograph interpretation skills. On the other hand, since the tracings are drawn on the original radiograph, they will be able to find anatomical points by interpreting the radiograph by considering the differences in density between bone, soft tissue, and air layers. The 18 panoramic radiographic landmarks in the present study were chosen because they are likely to be more significantly affected by oral and maxillofacial diseases. In addition to hard tissue, soft tissue, air layer, and ghost images created by panoramic radiography were also included, recognizing the possibility that these may lead to misdiagnosis of the image. The number of anatomical landmarks was limited to 18, and the duration of the questionnaire was approximately 20 minutes to ensure that the participants focused on all questions and to prevent them from leaving the survey unfinished.

In the present study, the rates of correct answers to anatomical points did not show a significant difference between male and female participants. There was no question that all participants answered correctly. The highest correct answer rate was found in the *'mental foramen'* question with 289 (96.3%) participants, and the lowest correct answer rate was found in the *'soft palate'* question with 48 (16%) participants. Çiftci et al. (2016) used some of the anatomical points mentioned above and similar to the present study, they found no significant difference between the answers given and the genders (p=0.214). Their study grouped the participants according to age groups, specialty areas, and years of professional experience (Çiftçi et al., 2016). In the present study, no such grouping was made, and the participants'

gender, educational status, and working status of the graduated dentists were considered. In the study conducted by Ertuğrul et al. (2023) to measure the level of panoramic anatomical knowledge of dentists, the number of women who answered correctly to the anatomical landmarks "*sigmoid notch*" and "*zygomaticotemporal suture*" was significantly higher than men (p=0.042; p=0.026); however, no significant difference was found in other questions (Ertuğrul et al., 2023). Our study found no significant difference in the "*sigmoid notch*" question according to gender.

In the present study, when the groups were evaluated according to educational status, the correct answer rate of 5th-grade dentistry students was found to be statistically significantly lower than that of 4th-grade students and newly graduated dentists (p=0.017). It is an expected result that 4th-grade dentistry students gave a higher rate of correct answers in the field of anatomy than 5th-grade students because the subjects of radiograph interpretation and learning anatomical points have been taught and analyzed more recently in the courses. In addition, as the 5th grade is the last year of dentistry education, theoretical education's intensity decreases and the excitement of starting the profession occurs soon. In our study, the lower correct answer rate of the 5th-grade students may be attributed to these situations. The question with the highest rate (96.4%) of correct answers in the 5th-year dentistry students was "*mental foramen*" question. All 4th year dentistry students (100%) answered this question correctly. The mental foramen is a point that can be easily distinguished because there is no other anatomical point in its immediate neighborhood that can be confused. However, in the study conducted by İlgüy et al. (2018) 76% of 46 students in the 4th grade and 91% of 45 students in the 5th grade answered the "*mental foramen*" question correctly, and a lower correct answer rate was reported compared to our study (İlgüy et al., 2018). When newly graduated dentists were compared, no statistically significant difference was found between them according to their employment status (p=0.656). In our study, dentists newly graduated dentists answered the "*condyle*" question correctly at the highest rate (93%). High tissue density and distinct configuration of the condyle usually facilitates its recognition. In the present study, 89.3% of all participants answered this question correctly, compared to 75.6% in the study by Elsheikhi et al. (2021) 97% in the study by Japanese students who successfully recognized the condyle; and 100% in the study by Ertugrul et al. (2023) who compared dentists based on their clinical experience. On the other hand, the results showed that our students and newly graduated dentists (84.3%) were more familiar with the mandibular canal than Japanese students (17%). In our study, the questions with the highest number of correct answers were "*mental foramen, hyoid bone,*

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maxillary sinus", except for the condyle question.

In our study, the question with the least number of correct answers (16%) was 'soft palate'. 72.3% of the participants answered the question 'hard palate' correctly. Therefore, it would be wrong to interpret that the anatomy of the region is not known. The soft palate image does not appear clear because hard tissues appear more radiopaque, and soft tissues create vague radiopaque images overlapping bone and tooth structures due to air gaps. Therefore, participants may not have been able to interpret this anatomical landmark. In addition, this result may indicate that less attention was paid to this point for diagnostic purposes during the learning process or that there was little and limited exposure to this structure. On the other hand, in a study comparing the level of knowledge of anatomical and pathological formations on panoramic radiographs of final-year dental students; final year Oral Health students; graduated dentists, and graduated Oral Health Therapists, the rate of correct answers to the question 'soft palate' was reported as 50.2% (McNab et al., 2015).

Rushton and Horner (1996) concluded that, in general, abnormalities are often not detected by general practitioners and that more emphasis should be placed on radiological diagnosis in pre-graduate dental education and for qualified dentists. In addition, the professional experience of the dentists, the number of patients they treat per day, and the frequency with which they diagnose on radiographs may also make a difference in the answers given (Rushton & Horner, 1996).

In the present study, it was hoped that the anonymized administration of the questionnaire would eliminate concerns about low scores among the participants. On the other hand, although the time limit of 20 minutes was imposed on the questionnaire, there is a possibility that the respondents may have consulted textbooks or online information since it could not be supervised. This is seen as a potential limitation of the study. Another limitation of the study was that the participants were confused about the post-graduation options in the sociodemographic questions and gave incompatible answers about their working status. Finally, another limitation is the possibility of being affected by the results of the study by attracting only participants who trust their knowledge of the subject due to voluntary participation. However, it is thought that the selection of basic anatomical points that every dentist should have knowledge of in routine clinical life reduces the effect of this situation.

Conclusion

Knowledge of radiographic anatomy is very important for accurate diagnosis and treatment planning. This study showed that both 4th-year dental students and newly graduated

dentists had a similar level of knowledge in identifying most of the anatomical structures shown on panoramic radiographs, but 5th-year dental students had a lower level of knowledge. Dentists working on a complicated structure should have a good command of this anatomy, and for this purpose, efforts should be made during the teaching program on anatomical structures that are difficult to identify and keep their knowledge up to date.

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