ORIGINAL RESEARCH ARTICLE

Jurnal Radiologi Dentomaksilofasial Indonesia August 2025, Vol. 9, No. 2: 76-81
P-ISSN.2685-0249 | E-ISSN.2686-1321

http://jurnal.pdgi.or.id/index.php/jrdi/index

The correlation between knowledge level of maxillary anatomical structures and panoramic radiograph interpretation among preclinical dentistry students at Mulawarman University

Salsabila Nazwa Balqis[1*], Sylvia Agustin[2], Musnar Munir[3], Saiful Rokhim[4], Danial[5]

ABSTRACT

Objectives: This study aimed to find out the correlation between the knowledge level of maxillary anatomical structures and the interpretation of panoramic radiographs among preclinical dentistry students at the University of Mulawarman.

Materials and Methods: This quantitative research utilized a cross-sectional design. The employed sample technique was non-probability total sampling, focusing on preclinical dentistry students from the 2021–2022 academic year who had finished courses in panoramic radiograph interpretation. The data collection included two validated questionnaires: one measuring knowledge of maxillary anatomical components and the other testing the ability to interpret panoramic radiographs. The Spearman correlation test was employed for data analysis.

Results: The findings revealed that 60.7% of students were classified as possessing a limited understanding of maxillary anatomical components, 73.8% had inadequate skills in reading panoramic radiographs, and 54.1% showed poor performance in both domains. The correlation test indicated a significant association between knowledge of maxillary anatomical structures and the interpretation of panoramic radiographs, with a Sig. (2-tailed) value of less than 0.001

Conclusion: A significant correlation exists between the knowledge level of maxillary anatomical structures and the interpretation of panoramic radiographs among preclinical dentistry students at Mulawarman University.

Keywords: *Knowledge level, maxillary anatomical structures, interpretation, panoramic radiography, preclinical students*

Cite this article: Balqis SN, Agustin S, Munir M, Rokhim S, Danial. *The correlation between knowledge level of maxillary anatomical structures and panoramic radiograph interpretation among preclinical dentistry students at Mulawarman University*. Jurnal Radiologi Dentomaksilofasial Indonesia 2025;9(2)76-81. https://doi.org/10.32793/jrdi.v9i2.1363

[1]Faculty of Dentistry, Universitas Mulawarman, Samarinda, Indonesia 75119

[2]Department of Dentomaxillofacial Radiology, Faculty of Dentistry, Universitas Mulawarman, Samarinda, Indonesia 75119

[3] Department of Pedodontics, Faculty of Dentistry, Universitas Mulawarman, Samarinda, Indonesia 75119

[4]Department Ortodontics, Faculty of Dentistry, Universitas Mulawarman, Samarinda, Indonesia 75119

[5]Department of Anatomy, Faculty of Medicine, Universitas Mulawarman, Samarinda, Indonesia 75119

[*]Correspondence to:
Salsabila Nazwa Balqis
nazwaa262@gmail.com

Received on: February 2025
Revised on: July 2025
Accepted on: August 2025

INTRODUCTION

Radiography is an important field in dentistry that plays a very important role in supporting the treatment process because it can help determine the diagnosis, make a treatment plan, and assess the results of the treatment that has been carried out.[1] Dental radiographs that are often used are panoramic in the form of extraoral radiographs that display the facial structure and oral cavity.[2] However, these radiographs have disadvantages such as distortion, magnification, and superimposition, which make understanding anatomical structures more difficult.[3,4]

Knowledge of the depiction of anatomical structures is fundamental in interpreting panoramic radiographs. However, recognizing anatomical structures on these radiographs is a challenge as the structures appear more complex, overlapping, and even some normal structures appear abnormal, such as in the maxilla. Therefore, it is more difficult to describe descriptively and may lead to discrepancies in interpretation.[5]

Interpretation is a process of reading to find all the information in the radiograph. The requirements for interpretation are a thorough understanding of radiographic image types, characteristics, and knowing the difference between black, white, and grey.[6] This is important as a basis for understanding anatomical structures and how they are projected on radiographs.[7] If a dentist is unable to fulfil these requirements, there is a high likelihood of interpretation errors that can end the interpretation process prematurely and lead to missed diagnoses.[8]

Dentists can avoid interpretation errors by practicing these skills since pre-clinic. Preclinical students who have received dental radiology

courses are expected to be able to interpret panoramic radiographs in order to train their diagnostic skills and make treatment plans that will be applied when they become dentists.[4] However, based on the researcher's observations on the OSCE (Objective Structured Clinical Examination) results of 30 Dentistry students in the class of 2022 at Mulawarman University who took 3 regular OSCEs, there was only 1 student who passed the panoramic radiograph interpretation stage. This is one indication that there is still a lack of knowledge and ability of preclinical students in interpreting panoramic radiographs. Based on the background description, the researcher is interested in conducting research on the correlation between the knowledge level of maxillary anatomical structures and panoramic radiograph interpretation among preclinical dentistry students at Mulawarman University.

MATERIALS AND METHODS

The research conducted was a quantitative study with a cross-sectional design. This research was conducted at the Dentistry Study Program, Faculty of Dentistry, Mulawarman University in November 2024. The sampling technique used was a non-probability technique with a total sampling type by taking the entire population into the research sample. The sample included preclinical dentistry students from the Faculty of Medicine, Mulawarman University, class of 2021-2022, totaling 62 students. The inclusion criteria for this research sample are dentistry preclinic students who are still actively conducting lecture activities, have received lectures on panoramic radiograph interpretation, and are willing to become respondents by signing informed consent. The exclusion criteria in this study were students on academic leave and those who were not willing to become respondents.

Data collection used two questionnaires regarding the level of knowledge of the maxillary anatomical structure and the interpretation of panoramic radiographs, which were developed based on a comprehensive review of relevant literature and textbooks. The items were discussed and refined in consultation with expert lecturers in oral radiology to ensure content validity and clarity, and the questionnaires were further approved and validated through the expert judgment method. A pilot test was also conducted with a small group of students to confirm that the questions were understandable and appropriate before being finalized.

The questionnaire used in determining the level of knowledge of the maxillary anatomical structure will be presented in the form of an online questionnaire in the form of a Google Form containing fifteen multiple-choice questions. Questions and answer keys are sourced from textbooks. If the respondent's answer is correct, it will get 1 point, while if the answer is wrong, it will get a score of 0. In the results of filling out the questionnaire, the score will be taken from the answers that have been filled in and processed in the form of a percentage.

Similar to the questionnaire used in determining the level of knowledge of maxillary anatomical structures, the panoramic radiograph interpretation questionnaire is also presented in the form of an online questionnaire in the form of a Google Form, but contains ten questions with short entries. The results of filling out the questionnaire are good if the score is 80% - 100%, average if the score is 60% - 79%, and poor if the score is <60%. All data obtained were processed using Microsoft Excel and IBM SPSS Statistics version 29. The data obtained were analyzed with the Spearman correlation test to test the relationship between variables.

RESULTS

This study was conducted on all dentistry preclinical students in the classes of 2021 and 2022, with a total of 62 students. However, there was 1 student who fell into the exclusion criteria because he was taking academic leave, so the number of respondents was 61. In Table 1, the characteristics of respondents are based on gender, age, and academic level. It can be seen that most were female, with a total of 49 people (80.3%). Based on age, respondents aged 21 years had the highest number compared to other ages, namely 31 people (50.8%). When viewed from the academic year, the number of respondents between generations is not much different, namely, the class of 2021, as many as 32 people (52.5%), and the class of 2022, as many as 29 people (47.5%).

Table 1. Characteristics of students based on gender, age, and academic year.

Characteristics		n	%
Gender	Male	12	19.7
	Female	49	80.3
Characteristics		**n**	**%**
Age (year)	19	5	8.2
	20	23	37.7
	21	31	50.8
	22	2	3.3

Characteristics		n	%
Academic Year	2021	32	52.5
	2022	29	47.5

In Table 2, it can be seen that the knowledge level of the maxillary anatomical structure of dental preclinical students did not fall into a good category, and the highest number was in the poor category, namely 60.7% of all students.

Table 2. Distribution of Students Based on Knowledge Level of Maxillary Anatomical Structures

Knowlegde Level of Maxillary Anatomical Structure	n	%
Good	0*	0
Average	24	39.3
Poor	37	60.7
Total	61	100.0

*No students achieved the 'Good' category, highlighting a significant performance gap

In Table 3, it can be seen that the results of the interpretation of panoramic radiographs of dentistry preclinical students. Similar to the knowledge level of the maxillary anatomical structure, the highest number was in the poor category, namely 73.8% of all students.

Table 3. Interpretation Scores of Panoramic Radiographs Among Preclinical Dental Students

Panoramic Radiograph Interpretation Results	n	%
Good	1*	1.6
Average	15	24.6
Poor	45	73.8
Total	61	100.0

*Only one student achieved the "Good" category, highlighting a significant performance gap.

Table 4 shows that, based on the results of the Spearman correlation test, the Sig (2-tailed) value is obtained at <0.001 and a correlation coefficient of 0.439. Thus, it can be concluded that the Sig. (2-tailed) which is less than 0.05, proves that there is a significant relationship between the level of knowledge of the maxillary anatomical structure and the interpretation of panoramic radiographs.

Table 4. Cross-Tabulation and Spearman Correlation Between Knowledge Level of Maxillary Anatomical Structures and Panoramic Radiograph Interpretation

	Panoramic Radiograph Interpretation			
Knowledge level of maxillary anatomical structure	**Good**	**Average**	**Poor**	**Total**
Good	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Average	1 (1.6%)	11 (18.0%)	12 (19.7%)	24 (39.3%)
Poor	0 (0.0%)	4 (6.6%)	33 (54.1%)	37 (60.7%)
Total	1 (1.6%)	15 (24.6%)	45 (73.8%)	61 (100%)

Note: Sig. (2-tailed) = <0.001, Pearson correlation coefficient = 0.439

DISCUSSION

Based on the results previously described, most students have poor knowledge and interpretation of results. This may be caused by several factors, which will be explained below.

Student Factors

One factor that influences student learning outcomes is interest. Interest can be defined as an individual's inclination and engagement toward a particular object or activity, arising voluntarily without external compulsion, as in the case of learning.[9] Learning interest has a significant influence on the achievement of learning outcomes, so students need to have the awareness to balance their interests and learning outcomes. The results of this study show that most students obtained low scores, reflecting low learning outcomes that may be influenced by learning interest. This is in line with research conducted by Lisiswanti et al., which found that high interest in learning can increase motivation and perseverance, enabling students to interact with learning materials more effectively. Conversely, low interest can reduce motivation and engagement, which can have a negative impact on learning outcomes. Therefore, fostering interest is very important for improving students' abilities, confidence, and satisfaction with their learning process.[10]

This low interest may lead to reluctance in reviewing anatomy material and engaging in

Jurnal Radiologi Dentomaksilofasial Indonesia 2025; 9 (2); 76-81 | DOI: 10.32793/jrdi.v9i2.1363

independent learning. In a study conducted by Asrul, it was mentioned that independent learning is a process that makes students fully responsible for planning, implementing, monitoring, and evaluating certain topics independently. This process can provide more benefits to students, namely that students will explore information based on their knowledge, interest, and motivations. This concept aims to enhance and deepen knowledge of the subject matter. The ability to learn independently also serves as a strong foundation for becoming a competent medical professional, particularly in interpreting radiographs as diagnostic tools.[11]

Anatomy is also taught in the early years of medical education during the transition from high school to college. This requires a more complex approach, extensive memorization, and a deeper understanding. These challenges, coupled with low interest in learning, can limit students' ability to master anatomical knowledge, which is fundamental to interpreting radiographs, especially panoramic ones.[12]

The low level of anatomical knowledge among students can lead to perceptual errors when interpreting radiographs. Perceptual errors are basically failures that occur in identifying at the initial detection phase, so that when they see a certain image, students immediately determine the structure without reconsidering the details of the structure seen. This leads to overlooking other relevant structural findings and early termination of interpretation.[13]

The interpretation process that uses open-ended questions also allows students to provide more varied answers and is not limited by predetermined choices. This causes students who make misperceptions to be free to determine answers and end up inaccurate because they answer incompletely or randomly. This kind of answer leads to errors in determining the structure, and the score obtained is lower than it should be, even though the student actually knows the structure in question.

Curricular and Facility Limitations

The limitations of preclinical students' abilities in this study may also be due to limitations in the curriculum, such as the limited number of lectures on panoramic radiography interpretation, which is only conducted once during the preclinical level. The limited implementation of this lecture time can certainly reduce students' understanding and skills in the field of dental radiology, such as when interpreting radiographs. In addition, the number of lecturers in the field of radiology dentistry is only 1 person. The minimal number of lecturers is certainly very influential because lecturers play a very important role in every lecture activity and help solve problems related to learning.[9,14]

The limited dental radiology equipment also shows that the facilities to support learning are less than optimal. In previous studies, it was stated that learning facilities, such as educational facilities, simultaneously affect learning outcomes. Educational facilities such as learning tools, teaching aids, and learning media can facilitate the learning process, as well as increase student intelligence, which in turn will affect their success rate in learning.[15]

In another study conducted by Sangi et al., it was also stated that the average knowledge score regarding normal anatomical structures on panoramic radiographs among preclinical students was lower compared to clinical students. The study explains that factors that may influence knowledge of anatomical structures are caused by a lack of attention among preclinical students in understanding normal anatomy, and the duration of dental radiology learning for preclinical students is more limited compared to clinical students. Clinical students who have engaged in or are currently undergoing radiology discussions generally possess greater knowledge, particularly in the interpretation of radiographs.[4]

Technical Constraints

Technical limitations may be caused by the complexity of maxillary anatomical structures and superimposition in radiographs, which makes it difficult to accurately identify specific structures. It cannot be denied that radiographs are two-dimensional images; it must be realized that radiographs do not depict depth, so that anatomical structures such as the maxilla will appear to overlap with surrounding structures even though in reality they are in front of or behind them.[16]

Wide and broad panoramic radiographs can also affect the interpretation results of preclinical students. In a previous study, it was mentioned that wide and broad panoramic radiographs would be more difficult to interpret because they display several diverse anatomical structures in addition to the teeth and jaws, so that some images appear distorted and superimposed when observed. This can also be further exacerbated by technical errors in film processing, which complicates the interpretation process and increases the risk of interpretation errors.[7]

Completing the questionnaire in the afternoon after a long day of classes can also lead to fatigue that interferes with interpretation performance. This aligns with research conducted by Herwita et al., who reported that the low percentage of correct answers among students regarding questions related to dental radiology interpretation competence was due to data collection being conducted in the afternoon after an exam. The time of data collection may have affected the respondents' concentration when answering, as fatigue can reduce students' responsiveness. Fatigued respondents may have provided answers without careful consideration.[17] Another study also mentioned that increased fatigue can reduce accuracy in interpretation in both conventional radiography and CT. In another study, it was also mentioned that towards the end of the day, after a long day of activities, observers may experience decreased ability to concentrate, increased symptoms of fatigue, and decreased ability to

interpret, as accuracy becomes significantly lower.[8,13]

The relationship between the level of knowledge of maxillary anatomical structures and the interpretation of panoramic radiographs produced by this study proves that knowledge of anatomical structural images is the basis for interpretation. Interpretation, which is considered the process of deciphering all the information contained in the radiograph, requires a good visual mastery. This will be helpful in identifying anatomical structures that will appear more complex and superimposed, as in the maxillary structure.[5,18]

In this study, according to Spearman's interpretation, a correlation coefficient of 0.439 represents a moderate positive correlation. This finding suggests that the relationship between knowledge of maxillary anatomical structures and the interpretation of panoramic radiographs is moderately strong and unidirectional. In other words, an increase in knowledge of maxillary anatomical structures tends to improve the accuracy of panoramic radiograph interpretation, and conversely, limited knowledge may result in lower interpretation performance.

The resulting coefficient value proves that students with a poor level of structural knowledge will affect their interpretation results. This can also be seen from the tabulation results in Table 4, that as many as 54.1% of students with a poor level of knowledge of maxillary anatomical structures also produced poor interpretations. As explained earlier, knowledge of the anatomical structure description is the basis for interpretation.

This study has limitations in the form of filling out questionnaires that cannot be done in the morning, so it is done in the afternoon, after students have attended lectures all day, which is suspected to cause fatigue and have an impact on the results of filling out questionnaires that are less than optimal. In addition, the devices used to interpret the panoramic radiographs were different because they used the respondents' own devices. This may have caused differences in the interpretation results made by each respondent. Therefore, for future research, filling out the questionnaire can be done at certain times when students are still fresh, so that they can answer optimally, and the interpretation can use the same type of device for all respondents to avoid differences in interpretation results.

CONCLUSION

Based on the results and discussion, it can be concluded that the knowledge of maxillary anatomical structures and panoramic radiograph interpretation among preclinical dentistry students at Mulawarman University falls into the poor category. Furthermore, a significant relationship was found between the level of anatomical knowledge and the ability to interpret panoramic radiographs. These findings highlight the need for curriculum enhancement and additional training to improve students' understanding and diagnostic skills.

ACKNOWLEDGMENTS

-

FOOTNOTES

All authors have no potential conflict of interest to declare for this article. This study has received ethical feasibility approval from the Health Research Ethics Commission of the Faculty of Medicine, Mulawarman University (287/KEPK-FK/XI/2024) on November 11, 2024. All procedures conducted were in accordance with the ethical standards.

REFERENCES

1. Raidha F, Epsilawati L, Wardani R. Pengetahuan radiografi di bidang Kedokteran Gigi pada siswa Sekolah Menengah Atas. Padjadjaran J Dent Res Students [Internet]. 2018 30;2(2):150-4. Available from: https://doi.org/10.24198/pjdrs.v3i1.21449
2. Arifin NF, Jaya T. Hubungan tingkat pengetahuan teori dan kemampuan interpretasi gambar radiografi panoramik Kedokteran Gigi pada mahasiswa kepaniteraan klinik. DENThalib Journal [Internet]. 2023;1(2):28–32. Available from: https://journal.fkg.umi.ac.id/index.php/denthalib/article/view/29
3. Peker ÖH, Avsever İH, Şenel B, Özgedik HS, Kurt MH. A retrospective evaluation of condylar morphology using panoramic radiography in a sample of Turkish population. Folia Morphol (Warsz) [Internet]. 2023;83(1):192–9. Available from: https://doi.org/10.5603/fm.a2023.0045
4. Sangi SH, Prativi SA, Putri S. Perbedaan pengetahuan struktur anatomi normal radiograf panoramik antara mahasiswa preklinik dan klinik. B-Dent J Kedokt Gigi Univ Baiturrahmah [Internet]. 2021;7(1):73–80. Available from: https://doi.org/10.33854/jbd.v1i1.492
5. Whaites E, Drage N. Essentials of Dental Radiography and Radiology. 6th ed. Elsevier; 2021. p. 569-570
6. Fatimatuzzahro N, Supriyadi S, Vanadia A. Tingkat kesesuaian pembacaan struktur normal maksila pada radiografi panoramik: Studi Observasional. J Kedokt Gigi Univ Padjadjaran [Internet]. 2023;35(2):152-8. Available from: https://doi.org/10.24198/jkg.v35i2.47848
7. İlgüy D, İlgüy M, Dölekoğlu ZS, Ersan N, Fişekçioğlu E. Evaluation of radiological anatomy knowledge among dental students. Yeditepe Dent J [Internet]. 2017;13(3):31–6. Available from: https://doi.org/10.5505/yeditepe.2017.49140
8. Waite S, Scott J, Gale B, Fuchs T, Kolla S, Reede D. Interpretive error in radiology. Am J Roentgenol [Internet]. 2017;208(4):739–49. Available from: https://doi.org/10.2214/AJR.16.16963
9. Julianti UF. Prestasi belajar mahasiswa kaitannya dengan kualitas pengajaran dosen. Singkawang: PT. Nasya Expanding Management; 2022. p. 21,29
10. Lisiswanti R, Merry IS, Swastyardi D. Factors affecting low academic achievement of undergraduate medical students: student experience. J Pendidik Kedokt Indones [Internet]. 2022;11(1):108–18. Available from: https://doi.org/10.22146/jpki.65566
11. Asrul NAM. Gambaran tingkat pengetahuan anatomi dan fisiologi pada mahasiswa program studi pendidikan profesi ners angkatan XVI UIN Alauddin Makassar. J Kesehat Pertiwi [Internet]. 2021;3(1):179–84. Available from: https://www.journals.poltekesbph.ac.id/index.php/pertiwi/article/view/48
12. Fairus FN, Titaley CR, Manuputty AG, Malakauseya MLV, Taihuttu YMJ, Bension JB. Academic and adaptation difficulties of medical students with low academic achievement in the first two years. J Pendidik Kedokt Indones Indones J Med Educ [Internet]. 2023;12(2):175–85.

Available from: https://doi.org/10.22146/jpki.80162
13. Degnan AJ, Ghobadi EH, Hardy P, Krupinski E, Scali EP, Stratchko L, et al. Perceptual and interpretive error in diagnostic radiology—causes and potential solutions. Acad Radiol [Internet]. 2019;26(6):833–45. Available from: https://doi.org/10.1016/j.acra.2018.11.006
14. Widiansyah A. Peranan sumber daya pendidikan sebagai faktor penentu dalam manajemen sistem pendidikan. Manaj Sist Pendidikan Cakrawala [Internet]. 2018;18(2):229–34. Available from: https://doi.org/10.31294/jc.v18i2.4347
15. Marhamah S, Yolanda A, Sari RA, Nurismilida N. Pengaruh fasilitas belajar terhadap prestasi belajar mahasiswa pada perguruan tinggi. Edu Cendikia J Ilm Kependidikan [Internet]. 2021;1(2):40–5. Available from: https://doi.org/10.47709/educendikia.v1i2.1023
16. Stabulas-Savage JJ. Frommer's Radiology for the Dental Professional. 10th ed. St. Louis Missouri: Elsevier; 2019. p. 217
17. Herwita ANN, Yanuaryska RD, Naritasari F. Evaluasi tingkat pengetahuan Mahasiswa Fakultas Kedokteran Gigi Universitas Gadjah Mada pada Ilmu Penyakit Mulut dan Radiologi Kedokteran Gigi. MKGK (Majalah Kedokt Gigi Klin (Clinical Dent Journal) UGM [Internet]. 2024;10(3):75–81. Available from: https://doi.org/10.22146/mkgk.100571
18. Mallya SM, Lam EWN. White and Pharoah's Oral Radiology Principle and Interpretation. 8th ed. St. Louis, Missouri: Elsevier Health Sciences; 2018. p. 688