Research Paper: Assessment of performance of 4th year dental students in detection of residual roots on panoramic radiographs of edentulous patients

Roghieh Bardal[1]* iD , **Shahrzad Mohammadi[2]** iD

[1] Assistant Professor, Department of Oral and Maxillofacial Radiology, Dental Caries Prevention Research Center, Qazvin University of Medical Sciences, Qazvin, Iran
[2] General Dentist, Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran

ABSTRACT

Introduction: This study sought to assess the performance of 4th year dental students in detection of residual roots on panoramic radiographs of edentulous patients.

Materials and Methods: This cross-sectional study evaluated 37 fourth-year dental students of School of Dentistry, Qazvin University of Medical Sciences. Ten panoramic radiographs of edentulous patients with residual roots in their alveolar ridge were retrieved from the archives of the Radiology Department and a private clinic. The residual roots were identified by two radiologists, and their diagnoses served as the gold standard. Dental students were then requested to detect and mark the residual roots on panoramic radiographs using Scanora software. The performance score of each student was calculated by the ratio of correct diagnoses to the total number of diagnoses. The mean performance score was analyzed based on gender and grade point average (GPA) of students. Data were analyzed using STATA version 14.0 at 0.05 level of significance.

Results: The mean performance score of students was found to be 62.9% (6.9). Male and female students had no significant difference in performance score (P>0.05). Educational status (GPA) and performance score were not correlated (P>0.05). Enostosis and sclerotic socket were the most common differential diagnoses mistaken for residual root by the students.

Conclusion: The performance score of 4th year dental students of Qazvin University in detection of residual roots on panoramic radiographs was moderate. The educational curricula should be revised, and further emphasis should be placed on this topic in practical courses.

* Corresponding Author:
Roghieh Bardal .
Address: Dental Caries Prevention Research Center, Qazvin University of Medical Sciences, Bahonar Blvd., Qazvin, Iran.
Tel: +98 -2833353064
E-mail: rbardal@qums.ac.ir

Introduction

Panoramic radiography is an extraoral imaging modality with a lower patient radiation dose than full-mouth periapical radiography, which provides an overall view of the maxillofacial structures.(1) This radiographic modality is specifically useful for visualization of pathologies and resorption of alveolar ridges as well as identification of anatomical landmarks.(2) Panoramic radiography has several applications for detection of caries, (3) residual roots and impacted teeth, and evaluation of submucosal status in edentulous patients with complete denture treatment plan.(1) Panoramic radiography is the efficient imaging modality for detection of residual roots. Some residual roots may undergo resorption or other changes that complicate their correct radiographic differential diagnosis from the adjacent bone and abnormalities.(2)

The anatomical form of root, root canal shadow, periodontal ligament, and lamina dura around the root may indicate the presence of a residual root.(2) It is important to differentiate a residual root from foreign bodies, impacted teeth,(2,4) healing or sclerotic extraction sockets,(5) anatomical landmarks, nasal septum, anterior nasal spine, hamular notch, coronoid process, genial tubercles, torus and exostosis, radiopaque lesions, enostosis, focal cemento-osseous dysplasia, and false periapical radiopacities such as sialoliths.(4)

Residual roots are often asymptomatic. (2) However, they may occasionally cause pain, infection, or oral cysts in some cases. (6) Moreover, they may cause some problems in orthodontic treatment, implant placement, and complete dentures. Therefore, they need to be detected and removed if necessary.(2)

Panoramic radiography may be requested for completely edentulous patients depending on their clinical signs and symptoms. Dental graduates should have adequate performance about the proper head position in radiography, identification of anatomical landmarks, errors of panoramic radiography, and correct interpretation of pathological lesions on panoramic radiographs upon passing the theoretical and practical courses on oral and maxillofacial radiology.(7, 8)

Search of the PubMed and Google Scholar databases by the authors yielded no study on performance level of students in detection of residual roots on panoramic radiographs. Residual roots have a typical radiographic manifestation. However, their diagnosis may become slightly complicated when only a small piece of root remains at the ridge crest, or roots have remained in the alveolar bone for quite a long time .(6) Correct diagnosis in such cases requires a comprehensive performance about the radiographic manifestations of residual roots and their differential diagnoses. Thus, this study sought to assess the performance level of dental students in detection of residual roots on panoramic radiographs of completely edentulous patients.

Materials and Methods

This study was approved by the ethics committee of Qazvin University of Medical Sciences (IR.QUMS.REC.1398.210). The participants were briefed about the study objectives and were ensured about the confidentiality of their information (such as their GPA and performance score).

This descriptive, cross-sectional study evaluated the performance level of 4th year dental students of School of Dentistry, Qazvin University of Medical Sciences in detection of residual roots on panoramic radiographs of edentulous patients. The samples were selected using convenience sampling. A total of 38 dental students were enrolled; out of which, 37 remained in the study.

Data collection

Retrieving panoramic radiographs

Ten panoramic radiographs of edentulous patients with 11 residual roots were retrieved from the archives of the Radiology Department of School of Dentistry, Qazvin University of Medical Sciences and a private oral and maxillofacial radiology clinic.

Identification of residual roots by radiologists as the gold-standard

The images were uploaded into Scanora software and coded. The residual roots were detected on the panoramic radiographs by two oral and maxillofacial radiologists, coded with Latin alphabet and saved in a separate file. The selected residual roots did not have the typical root shape. Some lacked canal shadow and pulp chamber, some were embedded inside the bone and were seen as homogeneous radiopacities with un-even radiolucent rims which indicated an inflammatory lesion around them, and some were in the crest ridge level similar to healing sockets, so to diagnose of these cases it was necessary to differentiate from sclerotic sockets, healing sockets, alveolar tubercles, enostosis, focal cemento-osseous dysplasia, jaw radiopacities, etc. Most of the radiopacities mentioned above were also present in these panoramic images, and it was possible to misidentify them as the remaining roots.

Detection of residual roots by dental students

A checklist was then used to collect information regarding the grade point average (GPA) (obtained from the administrative office of the university) and gender of students. The panoramic radiographs were displayed on a Samsung monitor (LS22F355HN; DC14V, 1.79 A, 17 W, 19-inch; Sam Electronics, Iran) in a dimly-lit room. Dental students were allowed to observe the images on the monitor individually and adjust the density, contrast and magnification of images as desired. They identified the residual roots on each image using the software tools (Figure 1).
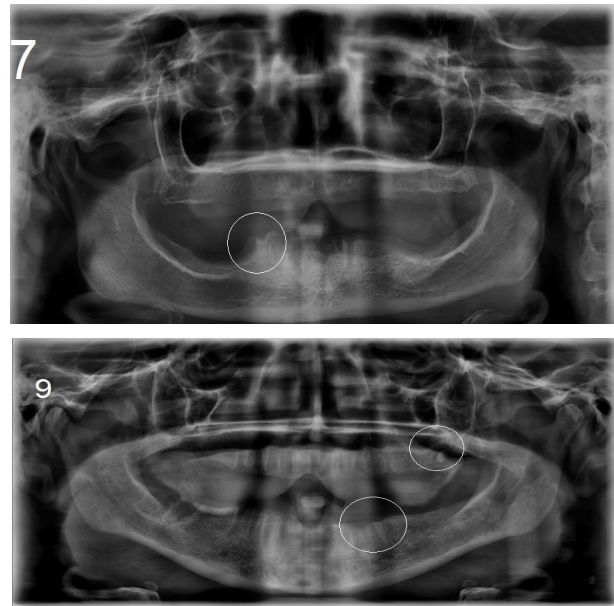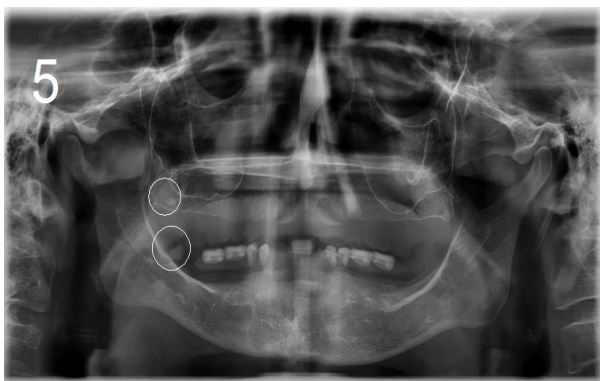

Figure 1. Areas outlined by a circle indicate the location of residual roots

Categorization of performance level

Finally, the diagnoses made by dental students were compared with the gold-standard, and the number of correct and incorrect answers was calculated. The performance level of each student was calculated by the ratio of correct answers to the total number of his/her answers. The performance level was categorized as follows based on the performance score:

Excellent: Mean performance score >75%

Moderate to good: Mean performance score between 40% to 74.99%

Poor: Mean performance score <39.99%. (8)

The number of incorrect answers was calculated for each student. Radiopacities that had been identified as residual roots were also noted and it was determined which radiopacity was misinterpreted as residual root.

Dental students were categorized into the following categories regarding their educational status based on their GPA:

Poor: GPA<14.99

Moderate: GPA between 15-15.99

Good: GPA between 16-16.99

Excellent: GPA>17.

Statistical analysis

The frequency ratio and 95% confidence intervals were reported for qualitative variables, and the mean and standard deviation values were reported for quantitative variables. The normal distribution of data was evaluated using the Shapiro-Wilk test. The chi-square test, t-test and one-way

ANOVA were applied to compare the groups. All statistical analyses were carried out using SPSS version 19 at 0.05 level of significance.

Results

This study was carried out on 37 dental students of Qazvin University including 18 (48.6%) females and 19 (51.3%) males.

Table 1 showed the educational status of male and female students based on their GPA. As shown, the educational level (GPA) of most students (40.5%) was moderate.

Table 1. Educational status of male and female students based on their GPA

Educational status	Female students Number (percent)	Male students Number (percent)	Total Number (percent)
Poor (<15)	1 (5.7%)	5 (26.3%)	6 (16.3%)
Moderate (15-16)	6 (33.3%)	9 (47.3%)	15 (40.5%)
Good (16-17)	8 (44.4%)	4 (21.0%)	12 (32.4%)
Excellent (>17)	3 (16.6%)	1 (5.4%)	4 (10.8%)
total	18 (100%)	19 (100%)	37 (100%)

Table 2 shows the mean number of correct, incorrect answers and performance scores based on gender and educational status of students in comparison with the gold-standard (which was 11 residual roots). As shown, the mean number of correct answers in male and female dental students with different GPA values was over 9. Accordingly, the mean total score of incorrect answers was 5-6. The maximum wrong answers were noted in the group of students with excellent educational status while the minimum wrong answers were noted in the group of students with poor educational status.

Table 2. The mean number of correct, incorrect answers and performance scores based on gender and educational status

Sex	Mean correct answers (SD)	Mean incorrect answers (SD)	perfomance score (SD)	P-value
Female students	9.6 (0.6)	5.8 (1.6)	62.6 (6.4)	0.809
Male students	9.2 (0.7)	5.5 (1.7)	63.2 (7.5)	
Educational status				
Poor (<15)	9.5 (0.8)	5.0 (1.8)	66.6 (8.5)	
Moderate (15-16)	9.0 (0.7)	5.8 (1.5)	61.2 (6.0)	0.464
Good (16-17)	9.9 (0.2)	5.8 (1.6)	63.5 (6.6)	
Excellent (>17)	9.5 (0.5)	6.0 (2.3)	62.2 (9.3)	
Total	9.4 (0.7)	5.7 (1.6)	62.9 (6.9)	

The mean performance score of students was 62.2% to 66.6%. The results of t-test revealed no significant difference in the performance score of males and females (P=0.89). The performance score was not significantly different in students with different ranges of GPA (P=0.464).

Figure 2 shows the frequency of wrong diagnosis by students. Enostosis (52.3%) was the most common entity mistaken for a residual root. Sclerotic socket (17.9%), healing socket (8.9%) and alveolar tubercles (8.9%) were other entities commonly mistaken for residual roots.
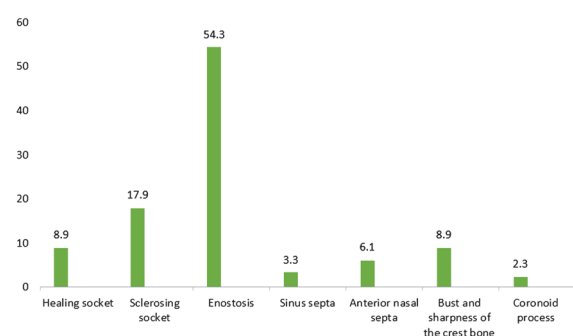

Figure 2. Frequency of wrong diagnosis by students

Discussion

This study evaluated the performance level of 4th year dental students in detection of residual roots on panoramic radiographs of

edentulous patients. Selection of 4th year dental students for this study was because they had recently passed the theoretical and practical oral and maxillofacial radiology courses. Due to the lack of a similar study, the results of studies that evaluated students' performance in interpreting or diagnosing of other cases on radiographic images were compared with the present study.

The performance level of students was found to be moderate (62.9%).

Azimi et al.(9) evaluated the performance of dental students about interpretation of radiographic features of oral lesions. The mean performance score of students was found to be over 70%, which was higher than the mean performance score in our study. In their study, dental students first interpreted different features of the lesions and then reported a possible diagnosis, and a separate score was allocated to each step, which resulted in an overall higher performance score compared with our study. Taheri et al. (10) assessed the performance, attitude and performance of senior dental students of Shahid Beheshti University in radiographic diagnosis and differentiation of malignant lesions. The mean performance score was found to be <50%. Their study was a preliminary study on performance, attitude and performance of students regarding radiographic diagnosis. Incorrect diagnoses were allocated a negative score in their study. In the present study, the performance level was calculated by dividing the number of correct responses by the total number of per student responses; thus, the wrong answers of each person were included in the evaluation of the level of performance, which seems to be a better method than assigning a negative score. In addition, the number of incorrect answers in the present study was calculated separately; and the cases that were interpreted from the student's point of view as remaining roots were also investigated.

Lanning et al. (11) evaluated the accuracy and performance of periodontists and general dentists in radiographic interpretation after participation in an educational course. Their mean performance score was 70.2%, which was higher than the value in our study. The accuracy and performance of participants in detection of bone loss were evaluated in 25 teeth in four groups of radiographic images. Participation in an educational course increased the performance score of participants to 85%.(11) Meada et al. evaluated the performance level of students in diagnosis and interpretation of anatomical landmarks on panoramic radiographs.(12)

The mean performance score was 53%, which was lower than the score in our study.

Difference in the performance level of students attending different universities worldwide, use of different tools for assessment of performance and performance of students in interpretation and diagnosis based on panoramic radiographs, and different factors studied are responsible for the variability in the reported results. Moreover, method of assessment, and the scoring system of performance and attitude also affect the results. For instance, Azimi et al. allocated 9 out of 10 total scores to interpretation and only 1 score to diagnosis. By doing so, the mean total score decreased in their study.(9) However, Taheri et al. allocated separate scores to each of the performance, attitude and performance domains.(13) In our study, only the performance of students (final diagnosis) was scored and Knowledge and attitude were not evaluated.

This study assessed the performance level of male and female dental students and found no significant difference between them. Normal distribution of students regarding gender can explain lack of a significant correlation between gender and performance level. Similarly, Taheri et al. found no significant difference in performance score of male and female students regarding interpretation of panoramic radiographs.(13)Yellowitz et al, in the United States reported that performance level of dental clinicians was not affected by their gender, and performance level of male and female dentists was the same. (14) The results of some other studies were in agreement with our findings as well.(10,15)

No significant correlation was noted between the educational status of students (GPA) and their performance. Non-homogenous distribution of students in the GPA groups

(such that the majority of students had average GPA scores) may be responsible for the moderate performance score found in our study.

Our results and those of previous studies indicate that education enhances the performance level of students; however, favorable performance with regard to correct diagnosis and differentiation of lesion requires experience and repeated observation of lesions with different radiographic manifestations.(11,13) This statement is confirmed by absence of a significant correlation between educational status (GPA) and performance of students in our study. The low variance of GPA score of students in our study can be another reason for absence of a significant correlation between educational status and performance of students. Tafakhori et al, mentioned the low quality of education, the high number of students in the department and the inappropriate ratio of students to professors, intensive and periodic training and low experience of students as reasons for the decline in performance.(16)

Dental students with excellent GPA score had higher frequency of wrong answers in our study probably due to their higher level of stress in detection of residual roots. On the contrary, students with low GPA score were less sensitive to the existing radiopacities due to their lower performance level and consequently, had lower frequency of wrong answers.

Enostosis (52.3%) and sclerotic socket (17.9%) were the most common differential diagnoses mistaken for residual root by dental students. Location, radiographic appearance mimicking that of residual root, well-defined borders, and radiopacity similar to that of residual root are the main reasons for mistaking enostosis and sclerotic sockets for residual roots.

Conclusion

The performance level of 4th year dental students of Qazvin University in detection of residual roots on panoramic radiographs of edentulous patients was found to be moderate in 2019. Enostosis was the most common dif-ferential diagnosis mistaken for a residual root.

Limitations

Limited number of students and panoramic radiographs and low variance of GPA scores of students were the main limitations of this study, which could have affected the results. Also, most previous studies have assessed the performance of students regarding description and interpretation of landmarks or pathological lesions on panoramic radiographs or detection of imaging errors, and no similar study was found to compare our results with. This affects the comparison and subsequent generalizability of the results.

Suggestions

Similar studies with larger sample size on dental students at different academic levels and dental graduates are recommended. Multi-center studies on several national universities are required to evaluate and compare the performance level of students and assess the efficacy of different dental educational curricula. Interventional studies are recommended to assess the efficacy of an educational course for enhancement of performance and practice of dental students regarding detection of residual roots on panoramic radiographs. In this study, dental students evaluated the panoramic radiographs under standard conditions in terms of density, contrast and magnification of images. However, standard conditions may not be available in the clinical setting. Performance of students in substandard conditions should also be investigated. In this study, only panoramic radiographs of patients with residual roots were evaluated. Future studies should include a mixed set of panoramic radiographs with and without residual roots.

References

1.   Kose TE, Demirtas N, Karabas HC, Ozcan I. Evaluation of dental panoramic radiographic findings in edentulous jaws: A retrospective study of 743 patients "Radiographic features in edentulous jaws. J Adv

Prosthodont. 2015;7(5):380-5.https://doi.org/10.4047/jap.2015.7.5.380

2. Zarb G, Hobkirk J, Eckert S, Jacob R. Prosthodontic Treatment for Edentulous Patients: Complete Dentures and Implant-Supported Prostheses. 13th ed. St. Louis, Mo: Elsevier Mosby; 2012, p.464.

3. Matsumoto K, Vongsa S, Nakajima I, et al. Assessment of quality and interpretation of panoramic radiographs obtained in the Lao People's Democratic Republic as part of a teleradiology collaboration with Japan. J Oral Sci. 2015;57(3):235-9.https://doi.org/10.2334/josnusd.57.235

4. Norman K WN, Paul W, Goaz P. Differential diagnosis of Oral lesions and Maxillofacial lesions. 5th ed. London: A Times Mirror Company; 1997. 479-83 p.

5. White S, Pharoah M. Oral Radiology: Principles and Interpretation. 7th ed. St. Louis, Mo: Elsevier Mosby; 1997, p.696.

6. Hupp J, Tucker M, Ellis E. Contemporary Oral and Maxillofacial Surgery. 6th ed. St. Louis, Mo: Elsevier Mosby; 2014, p.718.

7. Kratz RJ, Nguyen CT, Walton JN, MacDonald D. Dental Students' Interpretations of Digital Panoramic Radiographs on Completely Edentate Patients. J Dent Educ.2018;82(3):313-321.https://doi.org/10.21815/JDE.018.033

8. Reddington AR, Egli AJ, Schmuck HM. Interprofessional Education Perceptions of Dental Assisting and Radiologic Technology Students Following a Live Patient Experience. J Dent Educ. 2018;82(5):462-8.https://doi.org/10.21815/JDE.018.051

9. Azimi S, Tofangchiha M, Shapoori M, Rafieian N. Iranian Dental Students' Level of Knowledge Regarding the Interpretation of Radiographic Images of Oral Lesions: Is the Standard Training Sufficient? Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2020;5(2):1-5.https://doi.org/10.18869/acadpub.3dj.5.2.1

10. Alonge OK, Narendran S. Opinions about oral cancer prevention and early detection among dentists practising along the Texas-Mexico border. Oral Dis.2003;9(1):41-5.https://doi.org/10.1034/j.1601-0825.2003.01831.x

11. Lanning SK, Best AM, Temple HJ, Richards PS, Carey A, McCauley LK. Accuracy and consistency of radiographic interpretation among clinical instructors using two viewing systems. J Dent Educ. 2006;70(2):149-59. https://doi.org/10.1002/j.0022-0337.2006.70.2.tb04071.x

12. Maeda N, Hosoki H, Yoshida M, Suito H, Honda E. Dental students' levels of understanding normal panoramic anatomy. J Dent Sci. 2018;13(4):374-7.https://doi.org/10.1016/j.jds.2018.08.002

13. Taheri JB, Moshfeghi M, Anbari F, et al. Knowledge, Opinions and Practice of Last Year Dentistry Students of Shahid Beheshti University Regarding Diagnosis

and Differentiation of Malignant Lesions. Research Journal of Medical Sciences. 2010;4(3):238-42.https://doi.org/10.3923/rjmsci.2010.238.242

14. Yellowitz J, Horowitz AM, Goodman HS, Canto MT, Farooq NS. Knowledge, opinions and practices of general dentists regarding oral cancer: a pilot survey. J Am Dent Assoc. 1998;129(5):579-83.https://doi.org/10.14219/jada.archive.1998.0275

15. Canto MT, Horowitz AM, Drury TF, Goodman HS. Maryland family physicians' knowledge, opinions and practices about oral cancer. Oral Oncol. 2002;38(5):416-24.https://doi.org/10.1016/S1368-8375(01)00080-X

16. Tafakhori, Z. and E. Shahrokhi, An Evaluation of the Ability of the Senior Dental Students of Rafsanjan University of Medical Sciences in Detecting Proximal Caries in Digital Bitewing Radiography in the Academic Year of 2019-2020. 2021.