THE EFFECTIVENESS OF A SELF-INSTRUCTIONAL RADIOGRAPHIC ANATOMY MODULE ON THE IMPROVEMENT OF TEST PERFORMANCE FOR DENTAL HYGIENE FACULTY

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A thesis submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in Dental Hygiene Education in the Department of Dental Ecology in the School of Dentistry.

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ABSTRACT

Demah Salem AlGheithy: The Effectiveness of a Self-Instructional Radiographic Anatomy Module on the Improvement of Test Performance for Dental Hygiene Faculty
(Under the direction of Jennifer Brame)

Objective: To evaluate the effectiveness of using a self-instructional-radiographic-anatomy (SIRA) module on Dental Hygiene (DH) faculty test performance when identifying normal radiographic anatomy. **Methods:** Pilot study with a repeated measures design. Exempt from Institutional-Review-Board review. DH clinical faculty (N=23) were invited to participate by completing an online: pre-test, SIRA module, immediate post-test, and a four-month follow-up post-test. Descriptive analyses, the Friedman's ANOVA, and the Exact-Wilcoxon-Signed-Rank test were used. **Results:** Pre-test response rate was 73.9% (N=17); 88.2% (N=15) completed both post-tests. Participants included: 5 full-time faculty, 5 part-time faculty, and 5 graduate teaching assistants. The Friedman's ANOVA indicated no significant difference in the percentage of correct responses between the tests. The Exact-Wilcoxon-Signed-Rank test indicated no statistical significance when comparing percent change between tests. **Conclusion:** The SIRA module did not significantly affect DH faculty test performance. Future research should include a larger sample size when evaluating the effectiveness of possible calibration methods.

To my loving mother, father, sisters, and little brother Numai: without you, I would not be where I am today. Thank you for your ongoing support from miles away.

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LIST OF ABBREVIATIONS

DH Dental Hygiene

GTA Graduate Teaching Assistant

IRB Institutional Review Board

SIRA Self Instructional Radiographic Anatomy

UNC University of North Carolina

U.S. United States

INTRODUCTION

Faculty calibration or training is a means of determining a standard that can be reproduced consistently. [1-3] Years of experience or educational background [4-6] may contribute to the lack of consistency among faculty, which can be frustrating for students, pose as a distraction to their learning, and affect their overall satisfaction with their education. [1,5,7,8] Calibration of faculty members is therefore a means to reduce inconsistency,[1- 2] especially when there is room for subjectivity.

Previous research has revealed low levels of agreement among dental educators with regards to clinical decisions or performance. [1,2,5,7-12] Calibration in the dental field mainly focuses on calibration of educators in the clinical setting. Calibration efforts have touched on topics such as: evaluating tooth preparations, [12,13] restorations [14] and dental sealants; [6] radiographic interpretation; [7] and treatment planning. [5] Various efforts to calibrate dental faculty in radiology have focused on areas of radiographic interpretation, periodontal diagnosis, quantifying bone loss, and detection of dental caries; [4,5,7,10,15,16] however, calibration in the use of radiographic terminology and identification of anatomical landmarks has not been assessed. Most of these studies include dentists, dental hygienists and graduate teaching assistants in calibration sessions as they all contribute to the teaching environment.

Calibration of dental hygiene faculty alone has been studied in areas of scaling error detection, writing clinical notes, and evaluation of calculus detection. [1,8,9] One of the responsibilities of the dental hygienist is preliminary interpretation of radiographs [17] as they are used in conjunction with the clinical exam during patient care. [18] Radiographs can provide significant findings related to the periodontal condition, prognosis, and long-term evaluation of treatment. [18] Moreover, dental radiology is an integral part of the dental

hygiene curriculum, and is largely incorporated on national/regional board examinations.[17,19] Hence, radiology is of great importance in dental hygiene, and to our knowledge there are no studies that attempt to calibrate dental hygiene faculty specifically in the area of radiology with respect to the identification of normal radiographic anatomy.

Many dental and dental hygiene programs are utilizing distance education sites to address access to care issues. With the addition of distance education and online teaching, educators must look at innovative and creative ways to calibrate faculty. Self-instructional modules have become popular in the dental education literature. [20] Many studies have evaluated the effects of self-instructional packages on student test performance, and found them to be no different or just as effective as other instructional formats. [21-26] Use of self-instructional packages in faculty groups has not been explored to the same extent. A shortage in dental hygiene educators has been documented. [27,28] In an attempt to overcome this faculty shortage, recruitment of part-time faculty has become a trend [28] with dental school part-time vacancies increasing by three percent. [29] Implementation of an online calibration due to the high number of adjunct or part-time faculty could prove to be useful.

With the aim of identifying a possible faculty calibration method, this study evaluated the effect of using a self-instructional radiographic anatomy module on the improvement of dental hygiene faculty test performance regarding the identification of normal intraoral and extraoral radiographic anatomy and whether the effect was sustained over four months. The study also aimed to assess if years of experience, preference of instructional method (face-to-face, and online), and faculty groupings (full-time, part-time, and graduate teaching assistants) affected test performance. It was hypothesized that use of a self-instructional radiographic anatomy module will improve dental hygiene faculty test performance and retention rates will decrease at four months, and that dental hygiene faculty with more years of teaching experience will perform better than those with less experience.

REVIEW OF THE LITERATURE

Low levels of agreement among dental educators with regards to clinical decisions or performance have been documented. [1,2,5,7-12] Attempts to reduce inconsistencies among educators through calibration or training have shown varied outcomes. Many studies that evaluate the effect of faculty calibration use face-to-face instruction, or interactive group sessions as the calibration intervention [1,7,8,12] Research that evaluates the use of self-instructional modules as a means to calibrate faculty seems to be scarce.

Studies have consistently showed the importance of faculty calibration in education.[2,3,30] Calibration efforts usually strive for standardization among faculty as instructor differences could result in inconsistencies when grading students. [9] Calibration studies related to dental education have included educators that participate in clinical teaching, including dentists, dental hygienists, or graduate teaching assistants. [1,7,8,12] Involvement of all instructors in calibration training is pivotal for identifying factors that could provide insight into the enhancement of faculty calibration. Accuracy and consistency of radiographic interpretation among clinical educators could be increased through training.[10] Lanning et al. aimed to calibrate faculty in radiographic interpretation through a three-part interactive training program that allowed faculty to rate bone loss from radiographs and discuss the responses with other faculty. [7] A pilot study that compared calculus detection skills of dental hygiene faculty that had undergone faculty training with those that had not, detected no difference between the faculty groups. [1] Recommendations for future research included use of a larger study sample, and evaluation of faculty calibration on student educational outcomes. Vehicles that assist educators in reaching a consensus in certain topic areas may enhance dental education. [5] Reinforcement of information that faculty are assumed to be proficient in could aid in reducing the variation

between instructors. Ongoing changes in education due to advancement of technology and its use may be useful when applied to faculty enhancement. Consideration of using an online self-instructional module as a possible calibration tool should therefore be explored.

Faculty calibration and retention rates

The literature on faculty calibration has not agreed upon consistent retention rates following calibration or training. Some studies have reported the effects of a calibration program to persist for some time. [7,8,12] One analysis that looked at short- and long-term effects of training on the capacity of dental hygiene faculty to write patient chart entries that adhered to an outlined format. [8] It was concluded that faculty could sustain the ability to write chart entries that followed the desired format for approximately one year. Haj-Ali and Feil found that with calibration training, inter-rater agreement improved and was sustained for ten-weeks among educators of an operative preclinical lab when evaluating Class II amalgam preparations. [12] Lanning et al. evaluated the accuracy and consistency of radiographic interpretation among a group of clinical instructors in conjunction with a three-part training program. Faculty in the study of Lanning et al. consecutively completed a pre-test, phase-I training, post-test 1, and phase-II training. Three months later, post-test 2 was administered and faculty attended phase-III training. The findings of Lanning et al. showed that faculty agreement with the correct choice improved over time, and it was concluded that lengthening a training program could result in further improvement. [7] Although the calibration literature reports a myriad of results related to the effects of calibration training, it remains essential to continually strive for standardization among educators. [2]

Hellén-Halme et al. evaluated whether educational level and dental practice affect the accuracy of diagnosing dental decay from radiographs in groups of dental, dental hygiene students and dentists with more than five years of clinical practice. It was reported that both practice and experience were important for diagnostic accuracy as experience accumulates during clinical practice. [4] Another study speculated that similarity in educational

background could have been the reason behind the consistent grading of graduate students compared to experienced faculty members. [2]

Use of instructional modules for continuing education

Literature that evaluates the use of self-instructional modules for faculty calibration or training seems to be rare. Jim et al. evaluated the use of a computer-assisted self-instructional module for continuing education of pharmacists. [22] This study reported significant improvement and retention of knowledge from pre-test to immediate post-test and two-week post-test. [22] Therefore, self-instructional modules could be considered as viable modes for faculty calibration, as well as adjuncts to other calibration methods. Enhancement of distance education through faculty development has yielded faculty and student satisfaction with online teaching and learning. [31] If self-instructional modules prove to be effective in training faculty at one institution, further research could explore the transferability of this effect to other educational settings.

Use of instructional modules in education of students

Different instructional methods in radiology, other than traditional lecture formats, have been assessed in student groups. [21,22,24-26,32] Studies that have evaluated the use of self-instructional modules in comparison to other instructional methods when educating students have reported no difference in test performance according to instructional format.[24-26] One study found the use of self-instructional modules to be the most effective when combined with a didactic format. [21] Shwkat et al. assessed the use of traditional lecture format, microfiche cards (4x6 inches of film that may contain a maximum of 45 images that can be enlarged), and a self-instructional module (combination of written text and microfiche images) for a radiographic interpretation course of second-year dental students. In this study, it was found that the most effective method of instruction was the one that combined a traditional lecture format with a self-instructional one.

A study comparing the use of bar-code book with computer-assisted instruction for advanced medical students found the two instructional methods to be educationally

equivalent; however use of the computer was preferred. [24] Both Ludlow et al. and Fleming et al evaluated the use of web-based instructional formats in comparison to slide/audiotape when teaching radiographic anatomy to dental or dental hygiene students. [25,26] Instructional formats did not affect test performance in these studies even though most students reported a preference for the web-based instructional format. [25,26]

Purpose

This study evaluated the effect of using a self-instructional radiographic anatomy module on the improvement of dental hygiene faculty test performance regarding the identification of normal anatomy in intraoral and extraoral radiographic images. Specific aims of this study determined if:

- There is no difference in DH faculty test performance at each test interval (pre-test, immediate-post and four-month follow-up post-tests).
- There is no difference in DH faculty test performance according to years of dental hygiene practice experience and clinical teaching experience.
- There is no difference in DH faculty test performance according to faculty groupings (full-time, part-time, and graduate teaching assistants).

INTRODUCTION AND REVIEW OF THE LITERATURE

Faculty calibration or training is a means of determining a standard that can be reproduced consistently. [1-3] Years of experience or educational background [4-6] may contribute to the lack of consistency among faculty, which can be frustrating for students, pose as a distraction to their learning, and affect their overall satisfaction with their education. [1,5,7,8] Calibration of faculty members is therefore a means to reduce inconsistency,[1- 2] especially when there is room for subjectivity.

Previous research has revealed low levels of agreement among dental educators with regards to clinical decisions or performance. [1,2,5,7-12] Calibration in the dental field mainly focuses on calibration of educators in the clinical setting. Calibration efforts have touched on topics such as: evaluating tooth preparations, [12,13] restorations [14] and dental sealants; [6] radiographic interpretation; [7] and treatment planning. [5] Various efforts to calibrate dental faculty in radiology have focused on areas of radiographic interpretation, periodontal diagnosis, quantifying bone loss, and detection of dental caries; [4,5,7,10,15,16] however, calibration in the use of radiographic terminology and identification of anatomical landmarks has not been assessed. Most of these studies include dentists, dental hygienists and graduate teaching assistants in calibration sessions as they all contribute to the teaching environment.

Calibration of dental hygiene faculty alone has been studied in areas of scaling error detection, writing clinical notes, and evaluation of calculus detection. [1,8,9] One of the responsibilities of the dental hygienist is preliminary interpretation of radiographs [17] as they are used in conjunction with the clinical exam during patient care. [18] Radiographs can provide significant findings related to the periodontal condition, prognosis, and long-term evaluation of treatment. [18] Moreover, dental radiology is an integral part of the dental

hygiene curriculum, and is largely incorporated on national/regional board examinations.[17,19] Hence, radiology is of great importance in dental hygiene, and to our knowledge there are no studies that attempt to calibrate dental hygiene faculty specifically in the area of radiology with respect to the identification of normal radiographic anatomy.

Many dental and dental hygiene programs are utilizing distance education sites to address access to care issues. With the addition of distance education and online teaching, educators must look at innovative and creative ways to calibrate faculty. Self-instructional modules have become popular in the dental education literature. [20] Many studies have evaluated the effects of self-instructional packages on student test performance, and found them to be no different or just as effective as other instructional formats. [21-26] Use of self-instructional packages in faculty groups has not been explored to the same extent. A shortage in dental hygiene educators has been documented. [27,28] In an attempt to overcome this faculty shortage, recruitment of part-time faculty has become a trend [28] with dental school part-time vacancies increasing by three percent. [29] Implementation of an online calibration due to the high number of adjunct or part-time faculty could prove to be useful.

With the aim of identifying a possible faculty calibration method, this study evaluated the effect of using a self-instructional radiographic anatomy module on the improvement of dental hygiene faculty test performance regarding the identification of normal anatomy in intraoral and extraoral radiographic images. In addition, it evaluated whether the effect was sustained over four months. The study also aimed to assess if years of experience, preference of instructional method (face-to-face, and online), and faculty groupings (full-time, part-time, and graduate teaching assistants) affected test performance. It was hypothesized that the use of a self-instructional radiographic anatomy module will improve dental hygiene faculty test performance and retention rates will decrease at four months, and that dental hygiene faculty with more years of teaching experience will perform better than those with less experience.

MATERIALS AND METHODS

This pilot study adopted a repeated measures design that was exempt from review by the Institutional Review Board (IRB) at the University of North Carolina (UNC). A sample of twenty-three clinical dental hygiene faculty members was identified through the UNC School of Dentistry online directory; faculty consisted of six full-time, eleven part-time, and six graduate teaching assistants (GTAs). Qualtrics, a web-based survey research software program (Copyright © 2015, Version 614720.331s of the Qualtrics Research Suite, Qualtrics, Provo, UT, USA) was used to generate all emails sent to possible study participants and to administer the tests for the study. The clinical dental hygiene (DH) faculty members that were identified, received a Qualtrics generated email that informed them of the study purpose and design, and invited them to participate in four parts of the study online: a pre-test, self-instructional radiographic anatomy (SIRA) module, immediate post-test, and a four-month follow-up post-test. Faculty implied consent to participate when they proceeded to use the link provided in the email prompting them to the Qualtrics pre-test instructions and questions. All pre and post-test questions were piloted prior to faculty testing by two UNC DH faculty members that do not participate in clinical teaching and therefore were not included in the study. Once a participant had completed and submitted the pre or post-test questions, the Qualtrics survey software did not allow resubmission and access to the test questions.

DH faculty members were given a one-week time frame to complete the online pre-test, which consisted of twenty-six items: six demographic questions, and twenty multiple-choice questions that asked faculty to correctly identify normal radiographic anatomy from multiple radiolgrahic images (intraoral periapical radiographs and extraoral panoramic radiographs as shown in Figure 1). Refer to appendix 1 to view the pre-test.

One week following the pre-test, a Qualtrics generated email was sent to the DH faculty members that had completed the pre-test. This email contained links to the online SIRA module, and the Qualtrics immediate post-test instructions and questions. Faculty was informed that they had two weeks to review the SIRA module once on their own time. The module was available online and could be accessed at any time during the two weeks. The online module consisted of text and visual aids that provide an introduction to the identification of normal radiographic anatomy on intraoral and extraoral radiographic images. The module is set-up in a way that allows users to read through explanations of the different anatomical landmarks, to view images, and to take a self-quiz that projects images with anatomic landmarks that need to be labeled. The length of time required for reviewing the module content depends on how familiar the reviewer is with the material. The self-instructional format allows reviewers of the module to scroll back and forth through the module text and view images as needed. Faculty members were instructed to complete the immediate post-test once they had finished reviewing the online SIRA module.

At the conclusion of the fall semester – four months following the initial viewing of the online SIRA module and completing the immediate post-test – a Qualtrics generated email was sent to the DH faculty members that had completed both the pre-test and immediate post-test. This email contained the link to the Qualtrics follow-up post-test instructions and questions. Faculty members were instructed to complete the follow-up post-test within a one-week time frame.

Questions on both post-tests (immediate post-test, and follow-up post-test) consisted of twenty-one items: one question regarding the preferred method of calibration, and the same twenty multiple-choice questions previously used on the pre-test; however, the questions were arranged in a different order. Refer to appendix 2 and 3 to view the immediate post and follow-up post-test questions.

Data Analysis

Data was downloaded from the Qualtrics server into an Excel spreadsheet and coded in numeric format. This data was then exported to a SAS program for statistical analysis (Version 9.3, SAS Institute, Cary, North Carolina, USA). Descriptive statistics of the group population were reported. The Friedman's ANOVA was used to determine whether there was a statistically significant difference in the percentage of correct responses between the three tests: pre-test, immediate post-test, and follow-up post-test. The exact form of the Wilcoxon-Signed-Rank test was used to determine whether there was a statistically significant difference in the percent change of correct responses from pre-test to immediate post-test, from immediate post-test to follow-up post-test, and from pre-test to follow-up post-test. Level of significance was set at 0.05. Participants who did not complete all parts of the study were omitted from data analysis that compared pre to post-test performance.

RESULTS

Out of the twenty-three (N=23) UNC clinical DH faculty members that were identified as possible study participants, seventeen (N=17) completed the online pre-test resulting in a 73.9% initial response rate. DH clinical faculty members that completed the online pre-test consisted of: five full-time faculty (29.4%), six part-time faculty (35.3%), and six GTAs (35.3%). Among these faculty members, years of practice as a dental hygienist of less than five years, five to fifteen years, and more than fifteen years was 29.4% (N=5), 41.2% (N=7), and 29.4% (N=5) respectively. Fifty-three percent (N=9) of these faculty members had less than five years of clinical teaching experience (refer to Table 1). Of the seventeen (N=17) participants that completed the online pre-test, fifteen (N=15) completed both the immediate and follow-up post-tests resulting in an 88.2% response rate. Faculty that completed all parts of the study consisted of: five full-time faculty (33.3%), five part-time faculty (33.3%), and five GTAs (33.3%). Years of practice as a dental hygienist was 33.3% across the less than five years, five to fifteen years, and more than fifteen years choices. The majority (53.3%) of these faculty members also had less than five years of clinical teaching experience (refer to Table 1).

When asked, most participating faculty (94.12%, N=16) expressed that calibration of DH faculty in radiology and normal radiographic anatomy was necessary. When asked to choose a preferred method of instruction for faculty calibration in radiology: face-to-face, online or none of the above, over half of the faculty (58.8% N=10, 60% N=9, and 60% N=9) indicated that face-to-face instruction was their preferred method.

The results of the pre-test demonstrated that faculty did have knowledge of radiographic anatomy as the range of scores was 45-90% with a median score of 65%, refer to Table 2. The overall median test scores improved from pre-test (65%) to immediate

post-test (75%), and then decreased to 70% for the follow-up post-test. However, the Friedman's ANOVA indicated no statistically significant difference (P=0.179) in the percentage of correct responses between the three tests. An overall median percent change of 5% was noted from pre-test to immediate post-test, with a corresponding P-value of 0.054 as indicated by the exact form of the Wilcoxon-Signed-Rank test. No overall median percent change was noted from pre-test to follow-up post-test, and from immediate post-test to follow-up post-test. The exact form of the Wilcoxon-Signed-Rank test indicated no statistically significant difference when comparing percent of correct responses at pre-test and follow-up post-test (P=0.665), and when comparing percent of correct responses at immediate post-test and follow-up post-test (P=0.106).

Table 3 represents the percent change between the different tests according to faculty groupings: full-time, part-time, or GTA. Only the median percent change for the GTA group negatively decreased (-5%) from pre-test to immediate post-test, and from pre-test to follow-up post-test. Median percent change for full-time faculty was 5% for both the pre-test to immediate post-test, and pre-test to follow-up post-test intervals. Whereas median percent change for part-time faculty was 15% from pre-test to immediate post-test, and decreased to 10% from pre-test to follow-up post-test. Therefore, test performance of the GTA group decreased from pre to post tests, and improved for the full-time faculty group.

Faculty members with less than five years of practice as a dental hygienist had a median percent change of (-5%) from pre-test to both post-tests. This indicates that median percent change for this faculty group decreased both times. When comparing the median percent change for: pre to immediate post and pre to follow-up post-tests, faculty with over five years of practice as a dental hygienist had a positive median percent change at both intervals. Hence, median percent change for faculty with more than five years of DH practice improved by the same amount at both test intervals (refer to Figure 2). Median percent change according to years of clinical teaching experience among the study participants did not follow the same pattern however. As reflected in Figure 2, those with

more than fifteen years of teaching experience had the lowest (5%) median percent change from pre to immediate post-test, compared to the 7.5% and 15% change in the less than five years, and five to fifteen years of teaching experience groups. This tells us that all faculty had a positive median percent change from pre to immediate post-test regardless of the amount of teaching experience, but the degree of change was not the same for each teaching experience group. Median percent change from pre to follow-up post-test according to years of teaching experience was -2.5% for less than five years, 10% for five to fifteen years, and 0% for more than fifteen years. Therefore, median percent change from pre to follow-up post-test decreased in comparison to the median percent change from pre to immediate post-test, with the less than five years of teaching experience group being the only group that had a negative percent change.

Although 60% of the faculty chose face-to-face instruction as their preferred method of calibration, median percent change from pre to immediate post-test was equal for both instructional method choices (face-to-face or online). The median percent change from pre to follow-up post-test was -5% for the faculty members who chose online instruction as their preferred method of calibration (refer to Table 4). This tells us that preference for online instruction did not necessarily mean that faculty performed better given that they used an online module for this study.

DISCUSSION

Low levels of agreement among dental educators with regards to clinical decisions or performance have been documented. [1,2,5,7-12] Attempts to reduce inconsistencies among educators through calibration or training have shown varied outcomes. Many studies that evaluate the effect of faculty calibration use face-to-face instruction, or interactive group sessions as the calibration intervention. [1,7,8,12] Research that evaluates the use of self-instructional modules as a means to calibrate faculty seems to be scarce. This pilot study evaluated the effectiveness of a SIRA module on the improvement of test performance for DH faculty in the attempt to identify a possible calibration method. Participants in this pilot study included a sample of DH faculty that participate in clinical teaching (N=23) at the UNC School of Dentistry.

In the U.S. there are 332 entry-level DH programs [33,34] and the educational settings of these programs are: community colleges, technical colleges, schools of allied health, dental schools, and other types of settings. [34] Since the clinical DH faculty included in this study are part of a DH program that is housed within a dental school, perhaps the results may not be generalizable to faculty that teach in other educational settings. Other faculty calibration studies related to dental education have included faculty members that participate in clinical teaching whether they are dentists, dental hygienists, or GTAs. [1,7,8,12] In this study, faculty that completed all parts of the study consisted of: five full-time faculty (33.3%), five part-time faculty (33.3%), and five GTAs (33.3%).

Pre-test response rate was 73.9% (N=17) and 94.12% (N=16) of these participants expressed that calibration of DH faculty in radiology and normal radiographic anatomy was necessary; 88.2% (N=15) of the initial participants completed the immediate and follow-up post-tests. Given the small sample size, these response rates reflect the interest and

commitment of the faculty to self-enhancement. Since the majority of the faculty believed that calibration of DH faculty in radiographic anatomy was necessary, this could be an indicator for the need and acceptability of faculty calibration in the radiographic anatomy area.

Use of the online SIRA module as a calibration tool posed a few advantages: it was possible to include part-time faculty who are not bound to being at the university during all working hours of the week like full-time faculty are, information was available for review at any time and place, and it accommodated the preference for online instruction. Out of the twenty-three possible participants for this study, eleven (47.8%) were part-time faculty members; therefore, use of the online SIRA module enabled the inclusion of part-time faculty. Disadvantages of using the online SIRA module are: no way of knowing if all content was reviewed by the faculty, the need for internet and computer access to view the module, and not accommodating the preference for other instructional methods. The online SIRA module used for this study has been used for instruction of dental and DH students at the UNC in the past. Both Ludlow et al. and Fleming et al. used this web-based module and compared it to the use of slide/tape instruction of students. Both studies found that preference for web-based instruction did not necessarily mean that student test performance improved. [25,26] In agreement with these findings, this study found that even though over half of the DH faculty chose face-to-face instruction as their preferred method of instruction, the median percent change from pre-test to immediate post-test was equal for both instructional method choices (face-to-face or online). Therefore, preference for online instruction did not necessarily mean that faculty performed better than those that preferred face-to-face instruction. Age could have influenced the choice for an instructional method; however, this study did not inquire about the age of the participating faculty.

Studies that have evaluated the use of self-instructional modules in comparison to other instructional modalities when educating students have reported no difference in test performance according to instructional format, [24-26] whereas; some studies have found self-

instructional modules to be the most effective when combined with a didactic format. [21] Jim et al. evaluated the use of a computer-assisted self-instructional module for continuing education of pharmacists, and reported significant improvement and retention of knowledge from pre-test to immediate post-test and two-week post-test. Therefore, self-instructional modules could be viable modes for faculty calibration, as well as adjuncts to other calibration methods.

The Friedman's ANOVA indicated no significant difference in the percentage of correct responses between the three tests. Although the Exact-Wilcoxon-Signed-Rank test indicated no statistical significance when comparing the percent change between the tests, the P-value of 0.054 when comparing the percent change from pre to immediate post-test could be considered marginally significant. This could be a Type II error due to lack of statistical power because of the fairly small sample size.

Pre-test scores ranged between 45-90% with a median score of 65%, demonstrating that faculty did have knowledge of radiographic anatomy. Overall median test scores of the DH faculty improved by 10% from pre-test to immediate post-test, and then decreased by 5% upon four-month follow-up. This contrasts the findings of a few studies that reported the effects of a calibration program to persist after some time. [7,8,12] One of these studies looked at short- and long-term effects of training on the capacity of DH faculty to write patient chart entries according to a specific format. [8] While it was concluded that the ability of faculty to write chart entries that adhere to the desired format could be sustained for approximately one year, this task cannot be comparable to the task of correctly identifying radiological landmarks in the present study.

Haj-Ali and Feil found that with calibration training, inter-rater agreement improved and was sustained for ten-weeks among educators of an operative preclinical lab when evaluating Class II amalgam preparations. [12] In this study, the follow-up post-test was administered four months after faculty reviewed the online SIRA module. The retention of information may have decreased from immediate post-test to follow-up post-test due to the

extended lapse between viewing the material of the online module and taking the follow-up post-test. From this we can gather that a one-time intervention in the hopes of improving faculty test performance may not be enough, posing the question: how often should we train or calibrate faculty?

Lanning et al. evaluated the accuracy and consistency of radiographic interpretation among a group of clinical instructors in conjunction with a three-part training program. Faculty in the study of Lanning et al. consecutively completed a pre-test, phase-I training, post-test 1, and phase-II training. Three months later, post-test 2 was administered and faculty attended phase-III training. The findings of Lanning et al. showed that faculty agreement with the correct choice improved over time, and it was concluded that lengthening a training program could result in further improvement. [7] In this study, faculty were instructed to review the content of the online SIRA module once during a two-week period and the follow-up post-test was administered four months after, contrasting the three-part training program of Lanning et al. There was a decrease in DH faculty test performance from immediate post-test to follow-up post-test. If the study protocol had allowed DH faculty to review the SIRA module content several times, follow-up test performance may have improved.

The GTA group test scores decreased from pre-test to immediate post-test and from pre-test to follow-up post-test with a median percent change of -5%. Full-time faculty test performance however, indicated improvement at both intervals: pre-test to immediate post-test, and pre-test to follow-up post-test. Median percent change for part-time faculty showed a 15% improvement from pre-test to immediate post-test, and slightly less improvement of 10% from pre-test to follow-up post-test. GTAs are considered students as well as faculty so they are in the process of learning while carrying a student workload in addition to their teaching responsibilities. This could have affected their test performance negatively, especially if they did not have sufficient time to thoroughly review the SIRA module material. In contrast with the results of our investigation, Firestone et al. reported

that the diagnostic accuracy of dental students diagnosing dental caries from radiographs was similar to that of experienced clinicians. [35]

This study compared test scores according to years of DH practice and clinical teaching experience. Participant DH practice experience ranged from less than five years (N=5; 33.3%), five to fifteen years (N=5; 33.3%), and more than fifteen years (N=5; 33.3%). Results indicated that those with more than five years of DH practice performed better than those with less than five years of DH practice when comparing pre to post-test performance. Those with more years of practice as a dental hygienist may have performed better on the tests as they have been exposed to a wider variety of clinical situations that include the examination of radiographs in comparison with those with less experience. Hinkelman et al. researched methods of decreasing subjective evaluation in a preclinical environment and reported that reliability of examiners was not significantly affected by years of clinical experience. In the case of this study, faculty evaluation practices were not assessed in comparison to their test performance. Hellén-Halme et al. evaluated whether educational level and dental practice effect the accuracy of diagnosing dental decay from radiographs in groups of dental and DH students, and dentists with more than five years of clinical practice. It was reported that both practice and experience were important for diagnostic accuracy as experience accumulates during clinical practice. [4]

When comparing years of clinical teaching experience, all participants scored better on the immediate post-test, regardless of the amount of teaching experience. Those with five to fifteen years of teaching experience (N=3) had the most improvement. Only those with less than five years of teaching experience (N=8) had a negative percent change when comparing the pre-test to the four-month follow-up post-test scores. Experience with teaching dental radiology or clinical courses that touch on radiology could possibly explain why those with more teaching experience did not have a negative percent change when comparing pre to four-month post-test scores.

Faculty were instructed to review the content of the SIRA module once on their own time over the period of two weeks prior to taking the immediate post-test. This could pose a limitation as we cannot be sure of how many times faculty reviewed the module, and if all of the module material was indeed reviewed or not. Faculty were instructed to refrain from using a smartphone to view the module as images may be distorted. In our present time, smartphones with internet access are often at hand and people often use them to quickly access information even when clarity is compromised. It can only be assumed that faculty members did not use a smartphone to view the module, and that test performance was not affected by distortion of images due to use of a smartphone.

CONCLUSION

This study aimed to evaluate the effectiveness of using a SIRA module as a possible method of calibrating DH faculty in radiographic anatomy. Use of a SIRA module did not significantly affect dental hygiene faculty test performance. Lack of statistical significance may be attributed to the small number of participants. Test performance at four-months was lower in comparison to immediate post-test results, indicating a possible need for frequent calibration interventions. Full-time, part-time, and GTA clinical DH faculty seemed to be receptive of using a SIRA module for knowledge enhancement; however, the preference for face-to-face instruction needs to be considered. Research evaluating the effectiveness of instructional methods aimed at calibrating DH faculty in intraoral and extraoral radiographic anatomy is scarce. Future research should therefore consider a larger sample size when evaluating the effectiveness of possible calibration methods.

TABLES

Table 1: Descriptive statistics of clinical dental hygiene faculty

	Pre-test		**Immediate post-test**		**Follow-up post-test**	
	N	%	N	%	N	%
Faculty group						
Full-time faculty	5	29.4	5	33.3	5	33.3
Part-time faculty	6	35.3	5	33.3	5	33.3
Graduate Teaching Assistant	6	35.3	5	33.3	5	33.3
Total	17	100.0	15	100.0	15	100.0
Dental hygiene practice						
<5 years	5	29.4	5	33.3	5	33.3
5 – 15 years	7	41.2	5	33.3	5	33.3
>15 years	5	29.4	5	33.3	5	33.3
Total	17	100.0	15	100.0	15	100.0
Clinical teaching experience						
<5 years	9	52.9	8	53.3	5	53.3
5 – 15 years	4	23.5	3	20.0	5	20.0
>15 years	4	23.5	4	26.7	5	26.7
Total	17	100.0	15	100.0	15	100.0

Table 2: Dental hygiene faculty test performance for all pre and post-tests

	P25	Median	P75	P-value
Percentage of correct responses:				0.179*
Pre	60.0	65.0	70.0	
Immediate post	65.0	75.0	80.0	
Follow-up post	60.0	70.0	75.0	
Percent change between tests:				
Pre to immediate post	-5.0	5.0	15.0	
Pre to follow-up post	-10.0	0.0	10.0	
Immediate post to follow-up post	-15.0	0.0	0.0	

*P-value for the Friedman's ANOVA

Table 3: Percent change between the different tests according to faculty groupings

	N	Q1	Median	Q3
Percent change from pre-test to immediate post-test				
Full-time faculty	5	5.0	5.0	10.0
Part-time faculty	5	10.0	15.0	20.0
Graduate teaching assistant	5	-10.0	-5.0	5.0
Percent change from pre-test to follow-up post-test				
Full-time faculty	5	-10.0	5.0	10.0
Part-time faculty	5	-5.0	10.0	10.0
Graduate teaching assistant	5	-5.0	-5.0	0.0
Percent change from immediate post-test to follow-up post-test				
Full-time faculty	5	-15.0	0.0	0.0
Part-time faculty	5	-10.0	-5.0	0.0
Graduate teaching assistant	5	-10.0	0.0	5.0

Table 4: Percent change between the different tests according to preference of instructional method

	N	Q1	Median	Q3
Percent change from pre-test to immediate post-test				
Face-to-face instruction	9	-5.0	5.0	10.0
Online instruction	5	5.0	5.0	15.0
Other	1	20.0	20.0	20.0
Percent change from pre-test to follow-up post-test				
Face-to-face instruction	9	-5.0	0.0	5.0
Online instruction	5	-10.0	-5.0	10.0
Other	1	20.0	20.0	20.0
Percent change from immediate post-test to follow-up post-test				
Face-to-face instruction	9	-10.0	0.0	0.0
Online instruction	5	-15.0	-10.0	-5.0
Other	1	0.0	0.0	0.0

FIGURES

(a)
Q7) The radiopaque feature at the tips of the arrows is:

O Nasal border
O Nasal fossa
O Anterior nasal spine
O Posterior nasal spine

(b)
Q22) The anatomic feature delineated by the arrows is:

O Glenoid fossa
O Maxillary tuberosity
O Maxillary sinus
O Infraorbital canal

Figure 1: Examples of the Qualtrics multiple choice test questions
Questions asked participants to correctly identify normal radiographic anatomy from **(a)** intraoral periapical radiographs or **(b)** extraoral panoramic radiographs.
The images used were obtained from an online SIRA module that has been used for education of dental and DH students at the UNC School of Dentistry (copyrighted in 1999 by Dr. Ludlow, UNC Department of Diagnostic Sciences, Professor of Oral and Maxillofacial Radiology). Images included in the module originally came from film that was removed from patient charts during chart archiving and recycling at the UNC School of Dentistry.

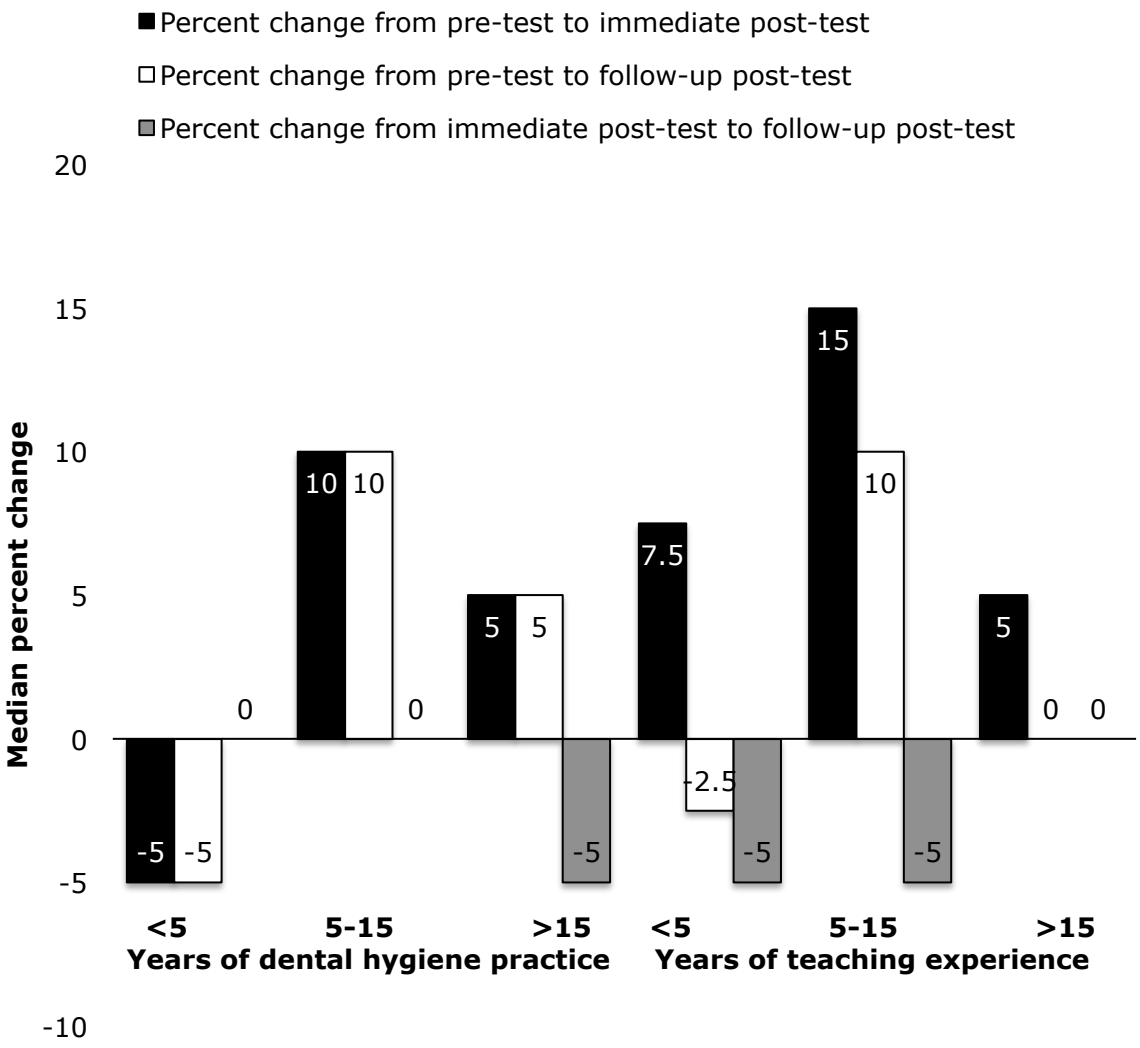


Figure 2: Median percent change for different test intervals according to years of dental hygiene practice and years of teaching experience

APPENDIX 1: PRE-TEST

Thank you for choosing to participate in our study. Your kind participation will help contribute to the advancement of knowledge in the area of faculty calibration.

The following "**pre-test**" you will be completing will constitute the **first** of four parts of this study.

Please read the following instructions carefully before taking the pre-test:

- Please **do not review any material prior** to taking the pre-test.
- Please **do not** use a smart phone to take the pre-test because images you will be viewing may not be reflected with a high resolution.
- There are **26 multiple choice questions** on the pre-test, please answer each question.
- You may need **at least 30 minutes** to complete the pre-test.
- You can only take this test **once**, but you can edit your responses before submitting your answers.
- By hitting the "**Next**" or "**Back**" buttons you will be able to navigate back and forth between each page of questions.
- You have a **one-week** time frame in which you can complete this pre-test.
- The **last day for submission** of your responses will be ***add date: MM/DD/YYYY at time***

To continue to the questions please hit the "Next" button.

1) Identify yourself as one of the following:
   a) Full-time faculty
   b) Part-time (adjunct) faculty
   c) Graduate teaching assistant

2) How many years of dental hygiene practice do you have?
   a) <5 years
   b) 5-15 years
   c) >15 years

3) How many years of dental hygiene clinical teaching experience do you have?
   a) <5 years
   b) 5-15 years
   c) >15 years

4) Do you think that calibration of dental hygiene faculty in radiology is necessary?
   a) Yes
   b) No

5) Do you think that calibration of dental hygiene faculty in normal radiographic anatomy is necessary?
   a) Yes
   b) No

6) Which method of instruction would you prefer for calibration of faculty in radiology?
   a) Face-face instruction
   b) Online instruction

c) None of the above

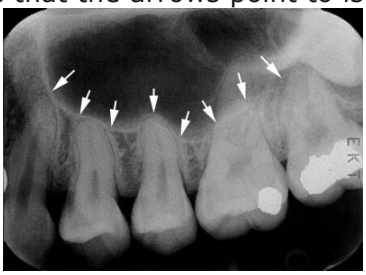
7) The radiopaque feature at the tips of the arrows is:

a) Nasal border
b) Nasal fossa
c) Anterior nasal spine
d) Posterior nasal spine

8) The linear radiopaque feature is:

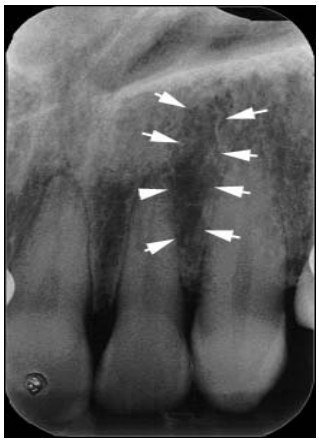
a) Sinus pneumatization
b) Sinus
c) Hard palate
d) Floor of the maxillary sinus

9) The linear radiopaque feature that the arrows point to is:



a) Maxillary sinus
b) Floor of the maxillary sinus
c) Sinus pneumatization
d) Sinus septation

10) The radiolucent anatomy delineated by the arrows is:



a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

11) The radiolucent anatomic feature delineated by the arrows is:

a) Incisive suture
b) Incisive canal
c) Incisive fossa
d) Incisive foramen

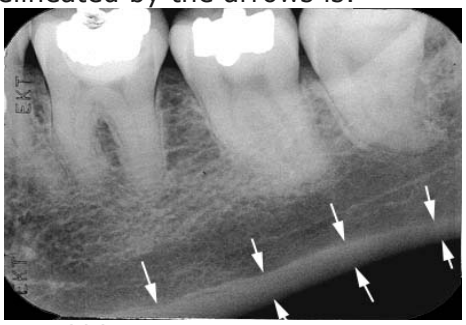
12) The radiopaque feature surrounded by the arrows is:

a) Sinus pneumatization
b) Border of the sinus
c) Hard palate
d) Torus palatinus

13) The radiolucent feature delineated by the arrows is:

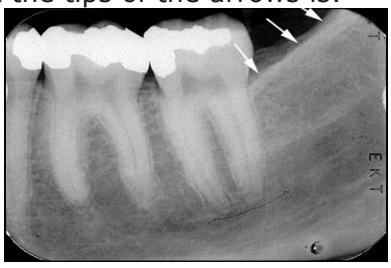
a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

14) The radiopaque feature delineated by the arrows is:



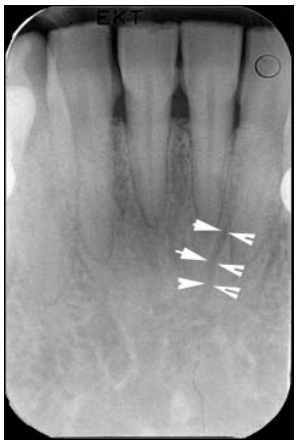
a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

15) The linear opaque feature at the tips of the arrows is:



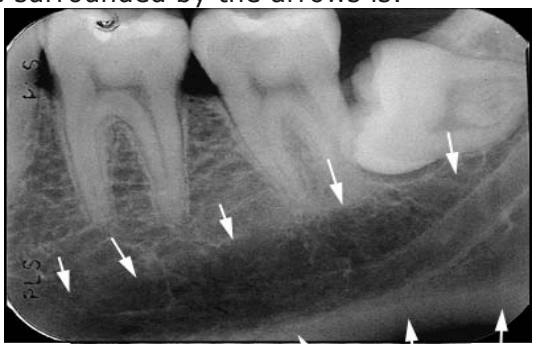
a) Internal oblique ridge
b) External oblique ridge
c) Inferior border of the mandible
d) Superior border of the mandible

16) The radiolucent feature delineated by the arrows is:



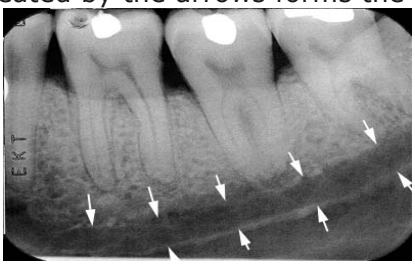
a) Nutrient canals
b) Accessory canals
c) Submandibular canal
d) Mandibular canal

17) The radiolucent feature surrounded by the arrows is:



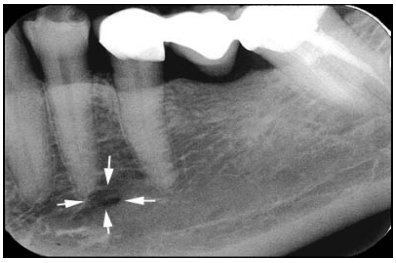
a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

18) The linear radiopacity delineated by the arrows forms the following feature:



a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

19) The radiolucent feature outlined by the arrows is:

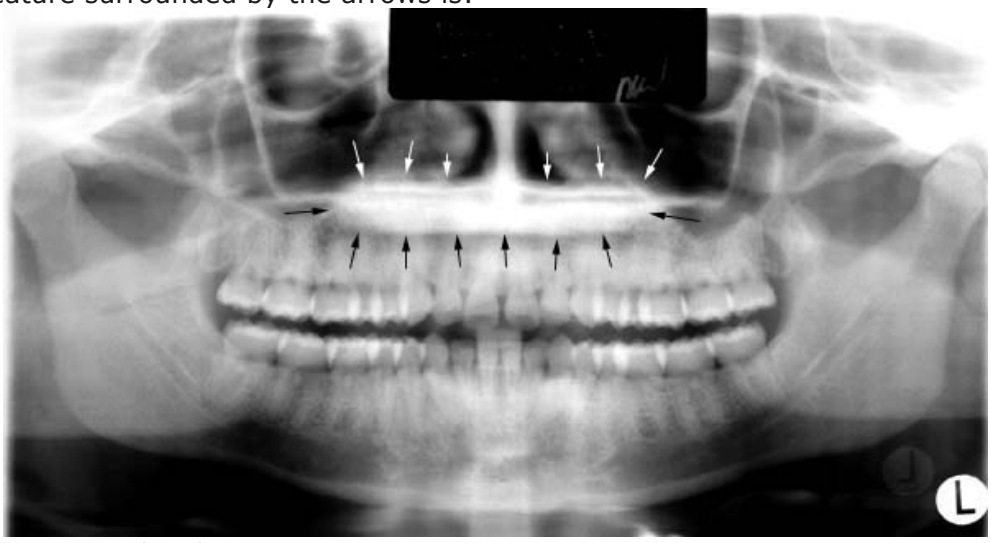


a) Genial tubercles
b) Lingual foramen
c) Mental foramen
d) Incisive foramen

20) The arrows delineate the following radiopaque features:

a) Nutrient canals
b) Accessory canals
c) Submandibular canal
d) Mandibular canal

21) The feature surrounded by the arrows is:



a) Inferior nasal turbinate
b) Floor of nasal fossa
c) Hard palate
d) Torus palatinus

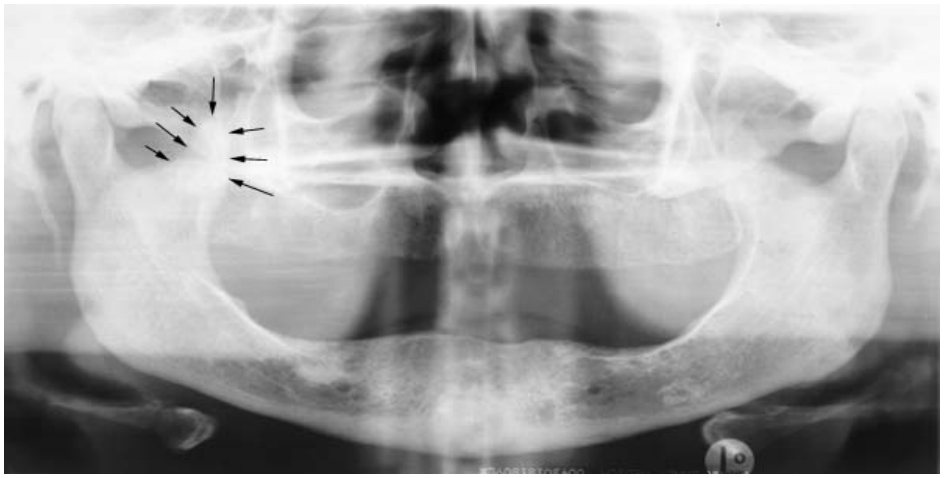
22) The anatomic feature delineated by the arrows is:

a) Glenoid fossa
b) Maxillary tuberosity
c) Maxillary sinus
d) Infraorbital canal

23) The radiolucent feature surrounded by the arrows is:

a) Infraorbital foramen
b) Glenoid fossa
c) Nasal fossa
d) Infraorbital canal

24) The radiopaque anatomy surrounded by the arrows is:

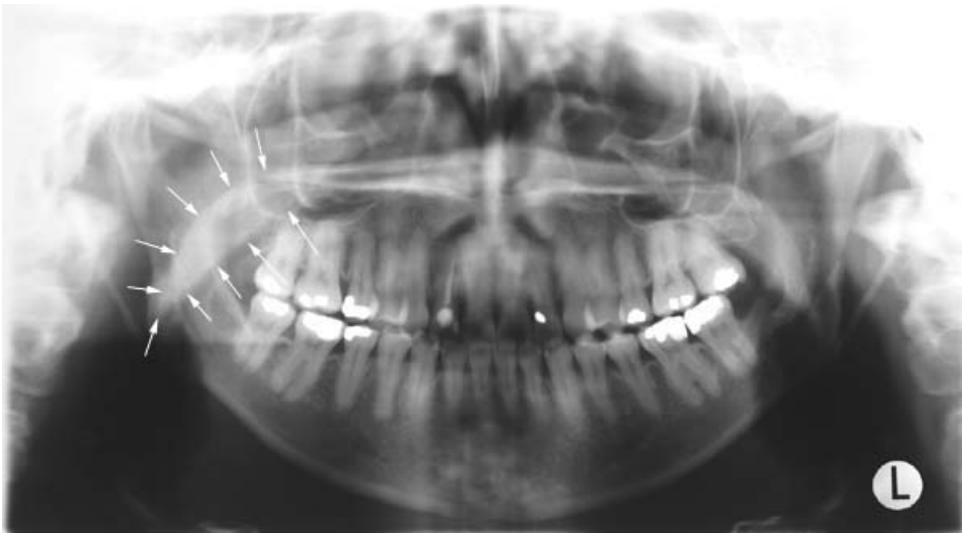


a) Condyle
b) Coronoid process
c) Styloid process
d) Sigmoid notch

25) The radiolucent area delineated by the arrows is:

a) Mental foramen
b) Lingual foramen
c) Genial tubercles
d) Submandibular fossa

26) The radiopaque feature delineated by the arrows is:



a) Posterior pharyngeal wall
b) Glossopharyngeal air space
c) Tongue
d) Soft palate

APPENDIX 2: IMMEDIATE POST-TEST

Thank you for choosing to participate in our study. Your kind participation will help contribute to the advancement of knowledge in the area of faculty calibration.

The following "**immediate post-test**" you will be completing will constitute the **third** of four parts of this study.

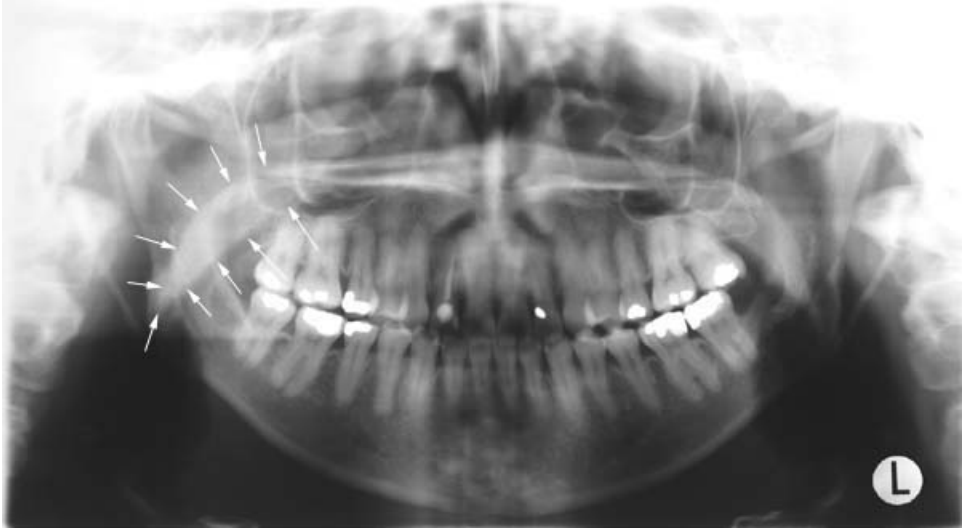
Please read the following instructions carefully before taking the immediate post-test:

- **Prior to taking the immediate post-test**, you must have **reviewed the material** contained in the online self-instructional module one time only.
- Please **do not** use a smart phone to take the immediate post-test because images you will be viewing may not be reflected with a high resolution.
- There are **21 multiple choice questions** on the immediate post-test, please answer each question.
- You may need **at least 30 minutes** to complete the immediate post-test.
- You can only take this test **once**, but you can edit your responses before submitting your answers.
- By hitting the "**Next**" or "**Back**" buttons you will be able to navigate back and forth between each page of questions.
- You have a **two-week** time frame in which you can review the self-instructional module content **and** complete this immediate post-test.
- The **last day for submission** of your responses will be: **Monday, September 15 at 11:59PM**

To continue to the questions please hit the "Next" button.

1) Which method of instruction would you prefer for calibration of faculty in radiology?
   a) Face-face instruction
   b) Online instruction
   c) None of the above

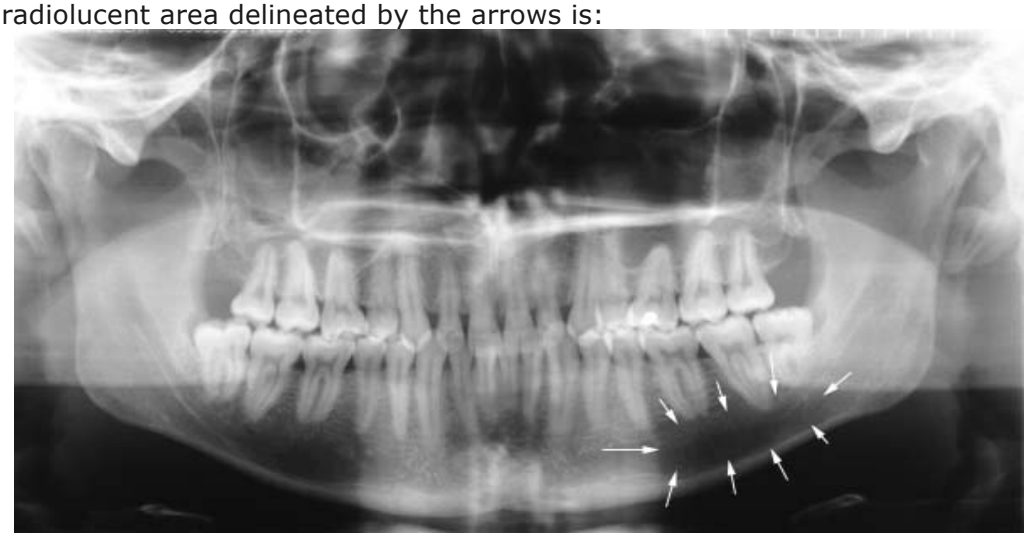
2) The radiopaque feature delineated by the arrows is:



   a) Posterior pharyngeal wall
   b) Glossopharyngeal air space

c) Tongue
d) Soft palate

3) The radiolucent area delineated by the arrows is:



a) Mental foramen
b) Lingual foramen
c) Genial tubercles
d) Submandibular fossa

4) The radiopaque anatomy surrounded by the arrows is:

a) Condyle
b) Coronoid process
c) Styloid process
d) Sigmoid notch

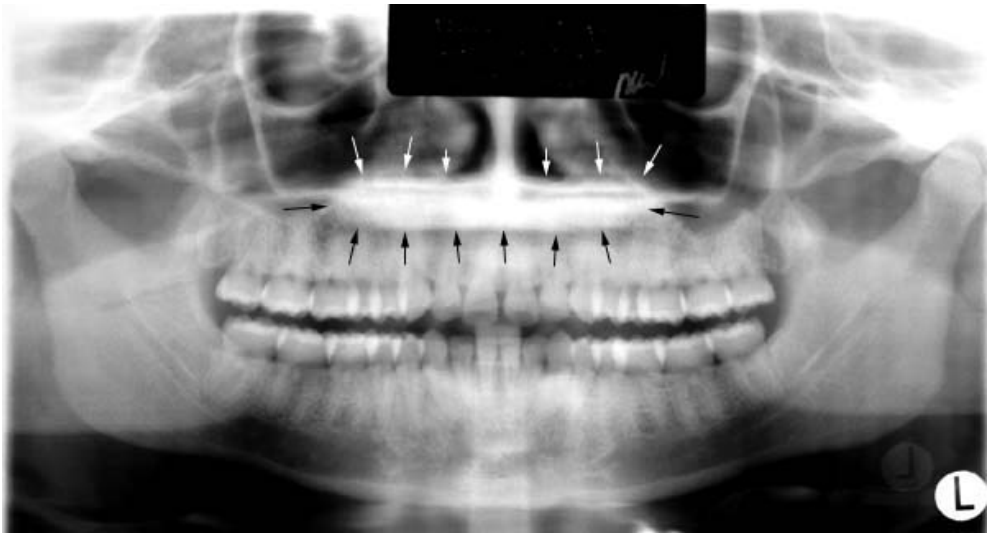
5) The radiolucent feature surrounded by the arrows is:

a) Infraorbital foramen
b) Glenoid fossa
c) Nasal fossa
d) Infraorbital canal

6) The anatomic feature delineated by the arrows is:

a) Glenoid fossa
b) Maxillary tuberosity
c) Maxillary sinus
d) Infraorbital canal

7) The feature surrounded by the arrows is:

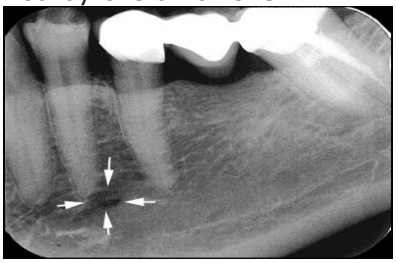


a) Inferior nasal turbinate
b) Floor of nasal fossa
c) Hard palate
d) Torus palatinus

8) The arrows delineate the following radiopaque features:

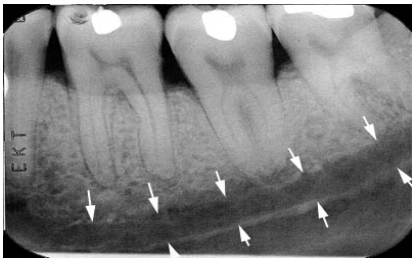
a) Nutrient canals
b) Accessory canals
c) Submandibular canal
d) Mandibular canal

9) The radiolucent feature outlined by the arrows is:



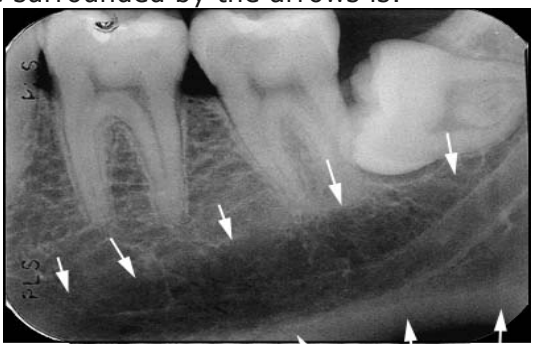
a) Genial tubercles
b) Lingual foramen
c) Mental foramen
d) Incisive foramen

10) The linear radiopacity delineated by the arrows forms the following feature:



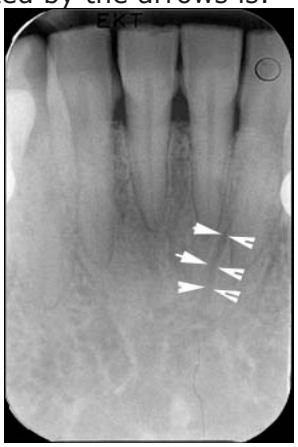
a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

11) The radiolucent feature surrounded by the arrows is:



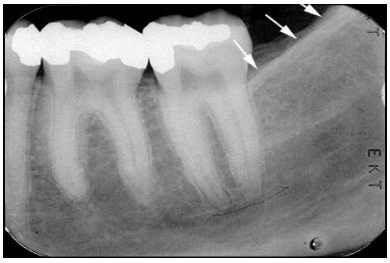
a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

12) The radiolucent feature delineated by the arrows is:



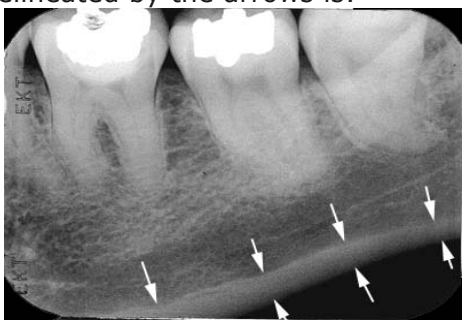
a) Nutrient canals
b) Accessory canals
c) Submandibular canal
d) Mandibular canal

13) The linear opaque feature at the tips of the arrows is:



a) Internal oblique ridge
b) External oblique ridge
c) Inferior border of the mandible
d) Superior border of the mandible

14) The radiopaque feature delineated by the arrows is:

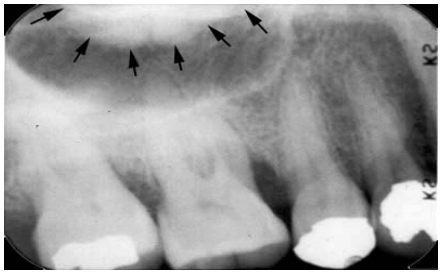


a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

15) The radiolucent feature delineated by the arrows is:

a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

16) The radiopaque feature surrounded by the arrows is:

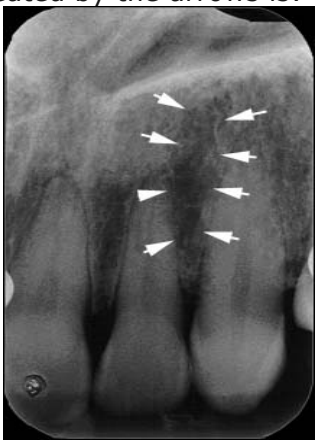


a) Sinus pneumatization
b) Border of the sinus
c) Hard palate
d) Torus palatinus

17) The radiolucent anatomic feature delineated by the arrows is:

a) Incisive suture
b) Incisive canal
c) Incisive fossa
d) Incisive foramen

18) The radiolucent anatomy delineated by the arrows is:



a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

19) The linear radiopaque feature that the arrows point to is:

a) Maxillary sinus
b) Floor of the maxillary sinus
c) Sinus pneumatization
d) Sinus septation

20) The linear radiopaque feature is:

a) Sinus pneumatization
b) Sinus
c) Hard palate
d) Floor of the maxillary sinus

21) The radiopaque feature at the tips of the arrows is:

a) Nasal border
b) Nasal fossa
c) Anterior nasal spine
d) Posterior nasal spine

APPENDIX 3: FOLLOW-UP POST-TEST

Thank you for choosing to participate in our study. Your kind participation will help contribute to the advancement of knowledge in the area of faculty calibration.

The following "**follow-up post-test**" you will be completing will constitute the **last** of four parts of this study.

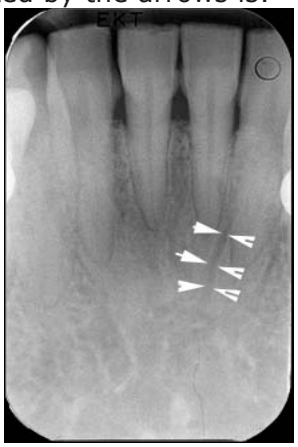
Please read the following instructions carefully before taking the follow-up post-test:

- Please **do not review any material prior** to taking the follow-up post-test.
- Please **do not** use a smart phone to take the follow-up post-test because images you will be viewing may not reflected with a high resolution.
- There are **21 multiple choice questions** on the follow-up post-test, please answer each question.
- You may need **at least 30 minutes** to complete the follow-up post-test.
- You can only take this test **once**, but you can edit your responses before submitting your answers.
- By hitting the "**Next**" or "**Back**" buttons you will be able to navigate back and forth between each page of questions.
- You have a **one-week** time frame in which you can complete this follow-up post-test.
- The **last day for submission** of your responses will be: **Tuesday, January 13 at 11:59PM**

To continue to the questions please hit the "Next" button.

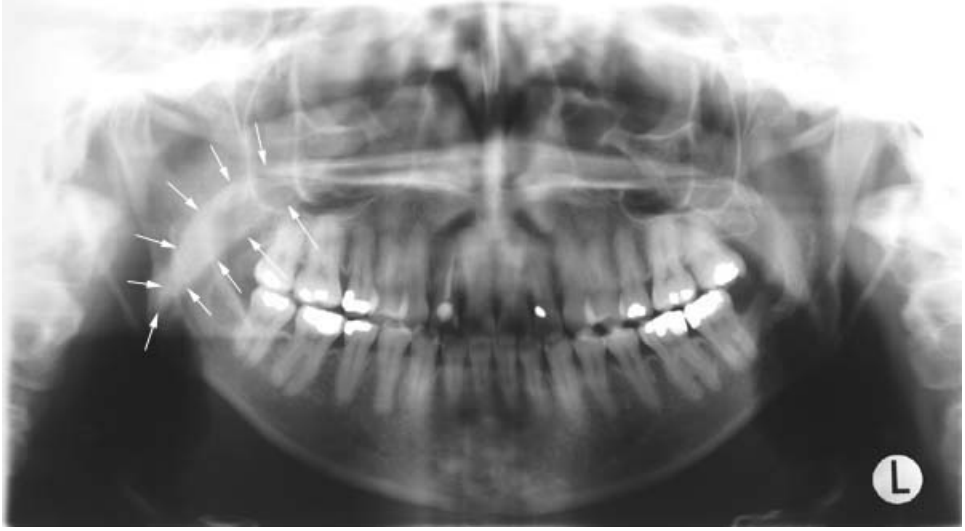
1) Which method of instruction would you prefer for calibration of faculty in radiology?
   a) Face-face instruction
   b) Online instruction
   c) None of the above

2) The radiolucent feature delineated by the arrows is:



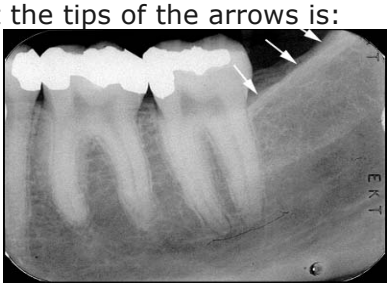
   a) Nutrient canals
   b) Accessory canals
   c) Submandibular canal
   d) Mandibular canal

3) The radiopaque feature delineated by the arrows is:



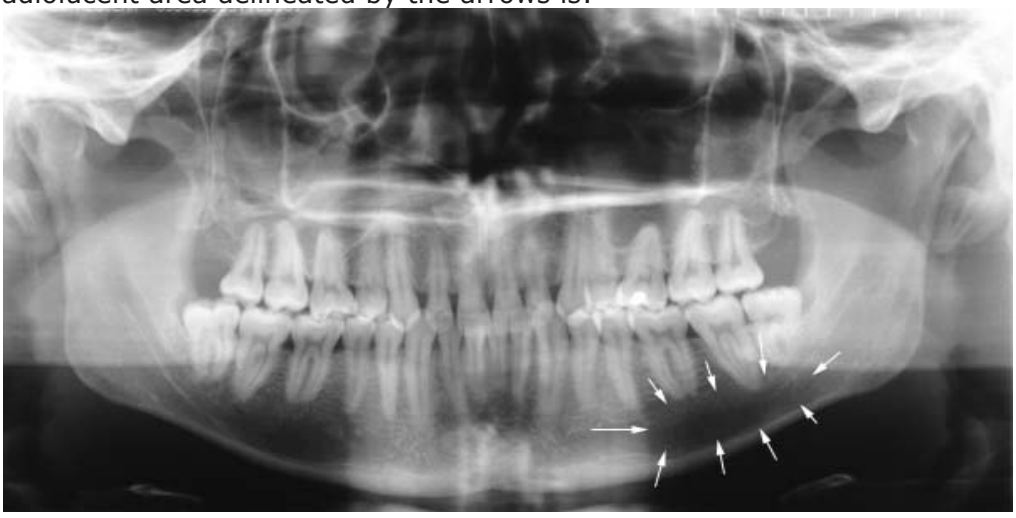
a) Posterior pharyngeal wall
b) Glossopharyngeal air space
c) Tongue
d) Soft palate

4) The linear opaque feature at the tips of the arrows is:



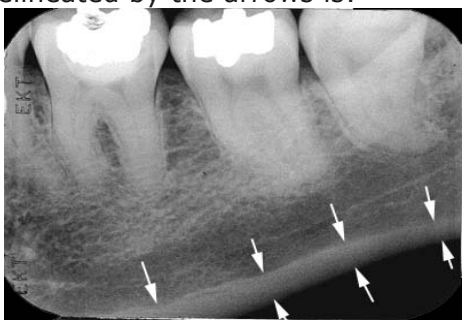
a) Internal oblique ridge
b) External oblique ridge
c) Inferior border of the mandible
d) Superior border of the mandible

5) The radiolucent area delineated by the arrows is:



a) Mental foramen
b) Lingual foramen
c) Genial tubercles
d) Submandibular fossa

6) The radiopaque feature delineated by the arrows is:



a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

7) The radiopaque anatomy surrounded by the arrows is:

a) Condyle
b) Coronoid process
c) Styloid process
d) Sigmoid notch

8) The radiolucent feature delineated by the arrows is:

a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

9) The radiolucent feature surrounded by the arrows is:

a) Infraorbital foramen
b) Glenoid fossa
c) Nasal fossa
d) Infraorbital canal

10) The radiopaque feature surrounded by the arrows is:

a) Sinus pneumatization
b) Border of the sinus
c) Hard palate

d) Torus palatinus

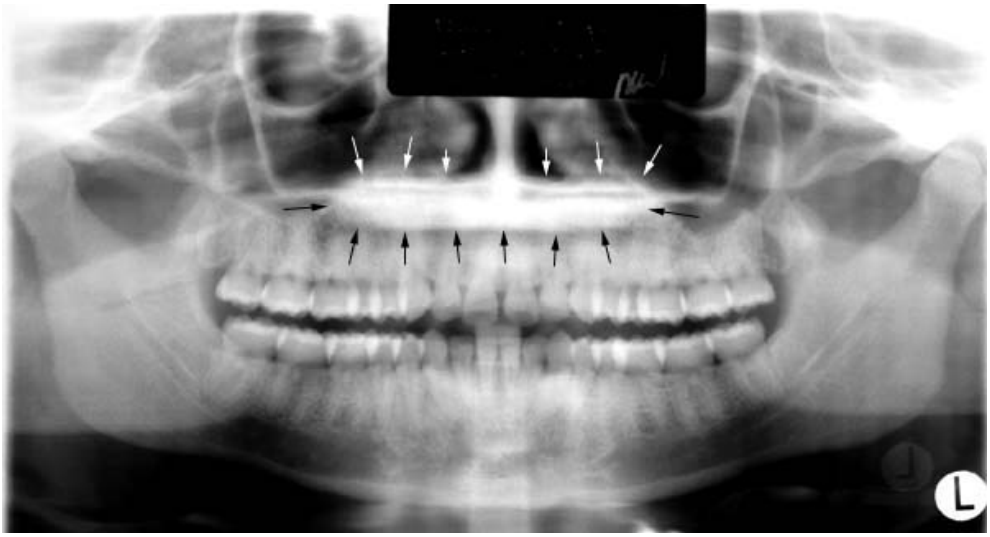
11) The anatomic feature delineated by the arrows is:

a) Glenoid fossa
b) Maxillary tuberosity
c) Maxillary sinus
d) Infraorbital canal

12) The radiolucent anatomic feature delineated by the arrows is:

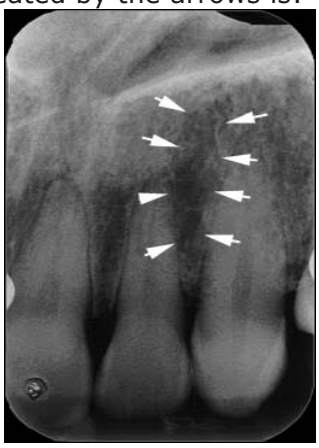
a) Incisive suture
b) Incisive canal
c) Incisive fossa
d) Incisive foramen

13) The feature surrounded by the arrows is:



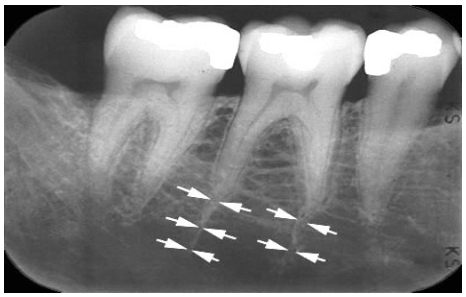
a) Inferior nasal turbinate
b) Floor of nasal fossa
c) Hard palate
d) Torus palatinus

14) The radiolucent anatomy delineated by the arrows is:



a) Incisive fossa
b) Canine fossa
c) Incisive canal
d) Incisive foramen

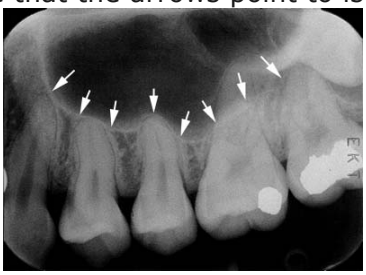
15) The arrows delineate the following radiopaque features:



a) Nutrient canals

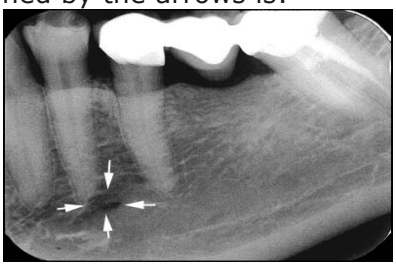
b) Accessory canals
c) Submandibular canal
d) Mandibular canal

16) The linear radiopaque feature that the arrows point to is:



a) Maxillary sinus
b) Floor of the maxillary sinus
c) Sinus pneumatization
d) Sinus septation

17) The radiolucent feature outlined by the arrows is:

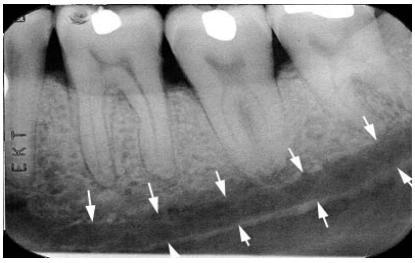


a) Genial tubercles
b) Lingual foramen
c) Mental foramen
d) Incisive foramen

18) The linear radiopaque feature is:

a) Sinus pneumatization
b) Sinus
c) Hard palate
d) Floor of the maxillary sinus

19) The linear radiopacity delineated by the arrows forms the following feature:

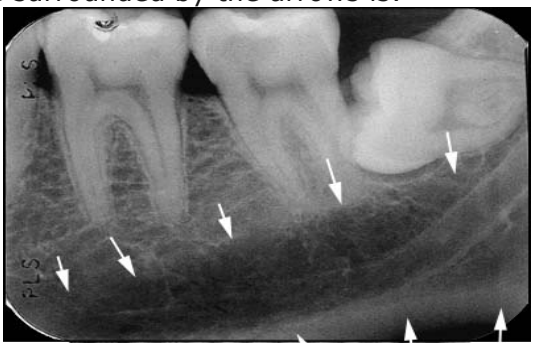


a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

20) The radiopaque feature at the tips of the arrows is:

a) Nasal border
b) Nasal fossa
c) Anterior nasal spine
d) Posterior nasal spine

21) The radiolucent feature surrounded by the arrows is:



a) Inferior border of the mandible
b) Mental ridge
c) Submandibular fossa
d) Mandibular canal

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