Original Article

IMPACT OF TARGETED TRAINING ON INTRAORAL RADIOGRAPHIC QUALITY: A PROSPECTIVE COMPARATIVE STUDY OF DENTAL STUDENTS AND ASSISTANTS

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ABSTRACT

Objectives: *This study was conducted to evaluate the impact of training intervention on the intraoral radiographic quality acquired by dental students and qualified assistants.*

Materials and Methods: *This prospective, interventional study was carried out to evaluate the Impact of Targeted Training on Intraoral Radiographic Quality (Bitewing and Periapicals). A cohort of 25 dental students and 25 dental assistants was recruited. Each participant took 50 periapical (PA) and 50 bitewing (BW) radiographs during baseline session. All images were evaluated for diagnostic quality by two calibrated dentists using FGDP, UK guidelines. Following baseline assessment, a structured training and feedback session was provided to participants. One month post-training, a second session was conducted where participants took another set of 50 PA and 50 BW radiographs for evaluation. Data were analyzed using SPSS version 28.*

Results: *At baseline, the proportion of acceptable radiographs was low for both groups, with students demonstrating significantly lower PA acceptance rates than assistants (38% vs. 78%, p=0.001). Following training, students showed a significant improvement in PA radiographs (72% vs. 38%, p<0.001). Bitewing improvements for both groups and PA improvements for assistants were modest and not statistically significant.*

Conclusion: *Targeted training and feedback significantly improved the quality of periapical radiographs produced by dental students, closing the initial performance gap with experienced assistants. This study underscores the value of structured education in achieving quality radiographic results.*

Key words: *Bitewing, Clinical Competence, Dental Assistants, Dental Radiography, Periapical, Quality Improvement*

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INTRODUCTION

High-quality intraoral radiographs are a cornerstone of accurate dental diagnosis and treatment planning. To be diagnostically useful, images must meet defined technical standards, which directly impacts patient safety by minimizing the need for

repeat exposures and adhering to the As Low As Reasonably Practicable (ALARP) principle of radiation protection[1,2]. Quality assurance through clinical audit is therefore an essential, evidence-based practice for maintaining radiographic standards in dentistry[3,4].

Clinical environments often rely on a diverse team to acquire radiographs, including both dental students and qualified dental assistants. These groups possess varying levels of foundational training and practical experience. In busy clinical settings, particularly where direct supervision may be limited, this can increase the risk of technical errors that compromise image quality[5]. Audits in educational and clinical settings frequently report suboptimal radiographic quality, with acceptability rates falling well below established benchmarks[6,7,8].

As both students and assistants, regardless of different levels of education, training and experience play crucial role in dental practice, this prospective study aimed to evaluate and compare the clarity of intra-oral bitewing (BW) and Periapical (PA) images captured by them at baseline and after a structured feedback and training intervention, thus assessing the impact of the intervention on reducing technical errors, minimizing the repetition of radiographs, and ensuring least radiation exposure.

MATERIALS AND METHODS

This was a prospective, interventional study to evaluate the impact of targeted training on the quality of intra-oral radiographs. An Ethical approval from Institutional Review Board (IRB) of Frontier Medical & Dental College, Abbottabad was obtained vide Ref. No. 83-R.A.25 dated 15/02/25. The study was conducted from March to May 2025. A cohort of 25 dental students (clinical years 3-4) and 25 qualified dental assistants (with ≥6 months of experience) was recruited. All participants provided informed consent.

All participants took 50 bitewing (BW) and 50 periapical (PA) radiographs using a photostimulable phosphor (PSP) sensor and the paralleling technique. These radiographs were collected and evaluated to establish a baseline quality level.

Intervention (Training and Feedback, April 2025): Based on the baseline results, structured training sessions were organized for both groups. This included personalized feedback on their baseline performance, lectures on radiographic principles, and instructional videos demonstrating correct techniques as per FGDP, UK guidelines.

Follow-up Session (Post-Training, May 2025): One month after the intervention, the same participants took a second set of 50 BW and 50 PA radiographs under identical conditions. These images were collected for post-intervention evaluation.

All radiographs (from both sessions) were evaluated by two calibrated dentists (κ=0.82) who were blinded to the operator's identity and the session (baseline or follow-up). The evaluation was based on the FGDP, UK guidelines for digital imaging. Inter-rater reliability was re-checked midway through data collection.

Data were analyzed using IBM SPSS Statistics Version 28. Chi-square tests compared student-assistant performance within sessions, while McNemar's tests evaluated the effect of training within groups between the baseline and follow-up sessions, with α=0.05 defining significance.

Dental students enrolled in clinical years (years 3–4) at the institute and Qualified dental assistants with ≥6 months of experience in intraoral radiography.

Digital intraoral radiographs (bitewing/periapical) captured using PSP sensors and paralleling technique. Full patient demographic/anatomic coverage (e.g., no cropped roots).

Adults (≥18 years) requiring routine diagnostic radiographs for standard diagnostic purposes (caries, periodontal assessment).

Students/assistants with <10 radiographs per session. Operators who did not participate in both sessions.

Images with technical errors unrelated to technique (e.g., sensor artifacts, software glitches). Non-diagnostic images due to patient factors (e.g., gag reflex, movement). Radiographs taken outside the defined study periods (e.g., April 2025 training month). Duplicate/repeated exposures for the same tooth.

Pediatric patients (<18 years). Cases with anatomical abnormalities (e.g., severe tori, limited mouth opening).

RESULT

Intra-oral radiographic evaluations comprising of 50 BW and 50 PA images per phase (baseline and follow-up) by students and dental assistants (25 each) were done. The results are shown in Table 1.

Session 1 (Baseline): Dental assistants signifi-

cantly outperformed students in PA radiographs (78% vs. 38%, p=0.001). No significant difference was found in BW radiographs at baseline.

Session 2 (Follow-up): Students' PA quality improved significantly from 38% to 72% (p<0.001), eliminating the significant difference that existed between the groups at baseline. No other significant improvements were observed post-training.

A prior approved from the Ethics Committee of Frontier Medical and Dental College was obtained (EC # FMDC-83-R.A-25).
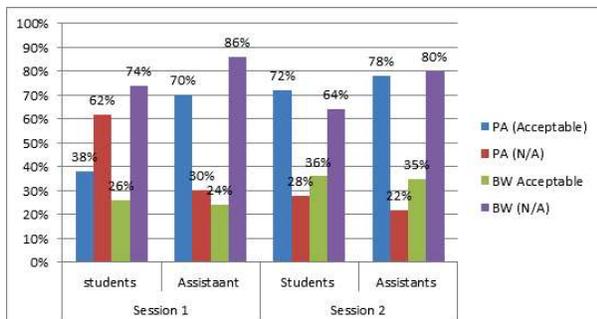

Fig 1: Stacked bar charts illustrated the proportion of acceptable to non-acceptable images for each group (students/assistants), facilitating direct comparison of radiographic quality outcomes.
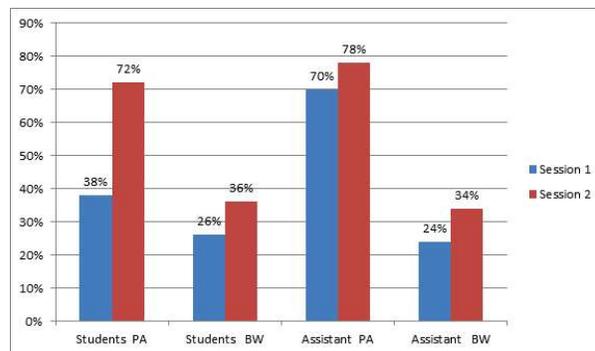
DISCUSSION

Fig 2: Percentage comparisons of acceptable radiographs (BW = bitewing; PA = periapical) between student and assistant cohorts across two assessment sessions.

Table 1: Distribution of acceptable radiographs at baseline and follow-up.

Session	Participants	Radiographs			
		Peri-apical (PA) (50 for each group)		Bite wings (BW) (50 for each group)	
		Acceptable	Not Acceptable	Acceptable	Not Acceptable
1	Students	19 (38%)	31 (62%)	13 (26%)	37 (74%)
	Assistants	35 (78%)	15 (22%)	12 (24%)	38 (76%)
2	Students	36 (72%)	14 (28%)	18 (36%)	32 (64%)
	Assistants	39 (78%)	11 (22%)	17 (34%)	33 (66%)

Table 2: Statistical Comparison of Pre-Post Training Changes (McNemar's Test)

Group	Radiograph	p-value	% increase	Effect Size (OR [95% CI])
Students	PA	<0.001*	+ 34	4.24 (1.92-9.36)
Students	BW	0.227	+ 10	1.50 (0.61-3.36)
Assistant	PA	0.267	+ 8	1.73(0.73-4.10)
Assistants	BW	0.180	+ 11	1.71 (0.74-3.94)

McNemar's tests revealed significant improvement in periapical radiographs among students after training (p<0.001), with acceptance rates increasing from 38% to 72% (Δ=34%, OR=4.24, 95% CI[1.92-9.36]). No significant improvements were observed for bitewings in either group or periapicals among assistants.

Table 3: Chi-square Test Results Comparing Students and Assistants

Session	Radiograph	χ^2	Df	p-value	OR (95% CI)	Interpretation
1	PA	10.306	1	0.001	5.72(2.29-14.28)	Significant difference
	BW	0.053	1	0.817	0.92(0.39-2.16)	No significant difference
2	PA	0.480	1	0.488	1.38(0.58-3.29)	No significant difference
		0.044	1	0.834	1.09(0.48-2.49)	No significant difference

OR: Odds Ratio; CI: Confidence Interval. OR > 1 favors Assistants. Chi-square tests comparing students and assistants revealed: - Significant performance difference in Session 1 PA radiographs (p=0.001) - No significant differences in Session 1 BW or any Session 2 comparisons.

Intra oral radiographs are important tool of dental practice. For making appropriate diagnosis, quality of radiographs is very important. Dental students and assistant frequently take radiographs but their training for quality imaging is very important and does affect the results. Our prospective study was designed to evaluate the image quality and compare them between dental students and assistants before and after a targeted training intervention[5].

The results of our baseline evaluation suggest that acquired radiographic characteristics from both groups did not meet the required standards of FGDP (UK) Guidelines of digital imaging (at least 95% acceptable and not more than 5% unacceptable)[7] just like other researches[9-12]. (Table-1). The images in our study were not of the desired quality due to positioning errors, which affected their quality and diagnostic use.

Dental assistants showed higher percentage of 'not acceptable' bitewing and more 'acceptable' PA images in baseline session But after the planned training intervention, they showed modest BW improvement (24% to 34%) which was not statistically significant (p=0.180) seen in our study. During student's evaluation, Students demonstrated significant gains in periapical radiographs (38% to 72%, p<0.001), while their bitewing improvement remained non-significant (26% to 36%, p=0.227) (table 1,3, Fig. 1,2). The high number of unacceptable radiographs at baseline might be due to certain errors or knowledge deficiency and ignoring ideal quality criteria and Improvement of quality seems to be due to raised awareness, highlighting errors, useful feedback about quality, calibrating and training them through audio-visual aids regarding correct technique and guidelines. This extensive approach helped dental assistants to enhance their skills[5,9,12]. Despite improvements, neither group met FGDP's 95% acceptability benchmark for digital radiographs. This aligns with Javed et al[6] who reported only 45.7% acceptable radiographs in undergraduate clinics, and underscores persistent positioning challenges-particularly with bitewings where posterior sensor placement complicates technique mastery[13].

In our prospective study, overall poor quality images might be related to digital exposure. The discrepancy in bitewing performance may reflect greater technical complexity of posterior sensor placement compared to periapical techniques (con-

ing off, vertical angulation) as key barriers[6,14]. In contrast to some studies, exposure results of digital imaging are better than the conventional images[15]. Comparative studies between assistants and students are lacking; however, several studies of dental students have reported similar results of image quality like our study[10-12]. Whereas, one study among UK dental graduates, also indicated improved results after feedback similar to our study[16,17].

Our prospective design showed the importance of upgrading dental curriculum and learning experience of fields requiring attention. As it was done at a dental institute, where dental students and dental assistants are always monitored by seniors but at other clinical workplaces, similar help might not be available. Therefore, a regular self learning, evaluation and positive feedback along with learning aids provision can help maintain and improve radiographic techniques and quality of images of dental professionals[5].

LIMITATIONS

Based on our findings, this study suggests that enhancing dental education programs, modernizing imaging technology, enriching hands-on training, and utilizing radiographic positioning aids can significantly improve image quality. Additionally, ongoing professional development and skill reinforcement are crucial to ensure proper and error-minimized use of radiographic equipment. Although it was done at a particular place, the procedures followed can be implemented to other clinical settings for betterment as well.

CONCLUSION

This prospective study demonstrates that a structured training and feedback intervention significantly improved the quality of periapical radiographs produced by dental students, effectively closing their initial performance gap with experienced dental assistants. The findings confirm that targeted educational programs can markedly enhance radiographic technique among trainees.

Although improvements in bitewing radiographs and among assistants were less pronounced, the results underscore the practical value of regular, structured training and audit in clinical environments where radiographic quality is variable. Integrating such training into dental curricula and continuing

professional development is recommended to ensure consistently high diagnostic standards and adherence to radiation safety principles.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	AM, MR, MR, MA, UDB, FS
Acquisition, Analysis or Interpretation of Data:	AM, MR, MR, MA, UDB, FS
Manuscript Writing & Approval:	AM, MR, MR, MA, UDB, FS

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.