

Kertas Asli/Original Articles

Radiograph's Reject Rate Among Universiti Kebangsaan Malaysia Dental Undergraduates And Its Implications
Analisa Kadar Penolakan Imej Radiograf dan Implikasinya di Kalangan Pelajar Prasiswazah Universiti Kebangsaan Malaysia

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ABSTRACT

The aim of this study was to evaluate the reject rate of periapical and bitewing radiographs among dental undergraduate students of Universiti Kebangsaan Malaysia (UKM), identify the type of radiographic errors which are frequently encountered and compare reject rates between Year 3, Year 4 and Year 5 dental undergraduates. 118 rejected periapical radiographs and 27 rejected bitewing radiographs were collected from the UKM dental undergraduates' polyclinics for a duration of 10 months. These rejected radiographs were further evaluated to determine the type of radiographic error. A spiking increase in periapical radiographs reject rate from Year 3 (4%) to Year 4 (11%) was observed. This finding was consistent with the statistically significant difference in the periapical radiographs reject rates for Year 3 and Year 4 ($p = 0.0475$). In periapical radiographs, the most frequently committed radiographic error was apical cut, followed by high density film. Vice versa, high density film was accounted as the most common radiographic error in bitewing radiography. Analysis of periapical and bitewing radiographs' reject rates among UKM dental undergraduate entails the necessity to supervise undergraduate students regardless of the year of their undergraduate training in all aspects of the radiographic procedures which include positioning radiographic armamentarium, the setting of radiographic exposure time and the film processing procedure.

Keywords: Reject rate; dental undergraduates; bitewing; periapical

ABSTRAK

Kajian ini dijalankan adalah untuk menilai kadar penolakan radiograf periapikal dan radiograf bitewing di kalangan pelajar-pelajar prasiswazah pergigian di Universiti Kebangsaan Malaysia (UKM), mengenalpasti jenis-jenis kesalahan radiograf yang sering dijumpai dan membuat perbandingan kadar penolakan radiograf di antara prasiswazah Tahun 3, Tahun 4 dan Tahun 5. Sepanjang 10 bulan tempoh kajian, sebanyak 118 radiograf periapikal dan 27 radiograf bitewing yang ditolak diperolehi dari poliklinik prasiswazah pergigian UKM. Setiap radiograf yang ditolak ini seterusnya di nilai untuk menentukan jenis kesalahan radiograf. Kadar penolakan radiograf periapikal dari Tahun 3 (4%) ke Tahun 4 (11%) didapati meningkat dengan ketara. Penemuan ini adalah sejajar dengan perbezaan signifikan statistik pada kadar-kadar penolakan radiograf periapikal bagi Tahun 3 dan Tahun 4 ($p = 0.0475$). Bagi radiograf periapikal, kesalahan radiograf yang paling sering dilakukan adalah pemotongan apikal, diikuti dengan densiti filem yang tinggi. Sebaliknya, ketinggian densiti filem merupakan kesalahan yang paling kerap terjadi bagi pengambilan radiograf bitewing. Analisis kadar penolakan periapikal dan bitewing di kalangan prasiswazah pergigian UKM menunjukkan keperluan bagi penyeliaan pelajar prasiswazah tanpa mengira tahun pengajian dalam semua aspek prosedur pengambilan radiograf yang termasuk pemposisian peralatan radiografi, penentuan tempoh dedahan radiografi dan pemprosesan filem.

Kata kunci: kadar penolakan; prasiswazah pergigian; bitewing; periapikal

INTRODUCTION

A radiograph is rated as rejected when it shows radiographic error which detract the diagnostic utility of the radiograph (National Radiological Protection Board, 2001). In the event of rejected radiograph, a repeat radiation exposure is required to obtain a radiograph that is of at least diagnostically acceptable. Minimizing repeated radiation exposure is crucial even with conventional dental radiography. Although conventional dental radiography such as periapical and bitewing radiography associated with low radiation doses, however at high volumes and repeated exposures may pose as a potential hazard to patients (Malaysian Dental Council 2010).

Radiograph reject rate analysis is a part of the quality assurance programme in dental radiography which measures the percentage of rejected radiographs in a dental facility equipped with radiographic modality. It is a relatively inexpensive method of quality assurance which helps in reducing radiation dosage to patients and the cost of examinations by acting on effective solutions that target the causes of rejected radiographs (Acharya et al. 2015; Ofori et al. 2013).

According to the Malaysian Dental Council, 2010, corrective action should be taken if the radiograph's reject rate is more than 10%. Although the reject rate indicator for corrective action plan has been set at the national level, the parameters to be considered for the analysis of radiograph's reject rate are subjective to the dental facility. In a dental institution, these parameters may include the type of radiograph performed by dental undergraduates and the year of dental undergraduate's training. Several studies have described radiographic errors and reject rate among dental students (Nixon et al. 1995; Acharya et al. 2014; Elangovan et al. 2016). However, no data was found in published literature related to radiograph's reject rate among dental undergraduates in Malaysia and the trend in rejection rate from third to fifth year dental undergraduates. The objectives of this study was to evaluate the reject rate of periapical and bitewing radiographs among Universiti Kebangsaan Malaysia (UKM) dental undergraduates, identify the type of radiographic errors which are frequently encountered and compare the reject rates between Year 3, 4 and 5 dental undergraduates.

METHODOLOGY

In this cross-sectional study, 145 rejected radiographs were collected from undergraduates' polyclinics, Faculty of Dentistry, Universiti Kebangsaan Malaysia from March to December 2018. Data collection was initiated following

ethical approval from the Research Ethics Committee of the university. All rejected radiographs were labeled with a radiograph's tag consisting patient name, patient registration number, date, tooth to be imaged and type of projection (periapical or bitewing radiograph).

A pilot study was conducted for six weeks prior to data collection. During this period, all students within clinical phase of the Doctor of Dental Surgery programme (Year 3 to Year 5 dental undergraduates) were trained to follow the record keeping procedure for rejected radiographs at the undergraduates' polyclinics. Meanwhile, the dental assistants were trained to record each radiograph acquired by students. Figure 1 shows the procedure in recording the acquired and rejected radiograph at each of the undergraduates' polyclinics.

Rejected radiographs at each of the undergraduates' polyclinics were collected at the end of every week and viewed on a light box under room lighting. The collected radiographs were classified based on the type of radiographic projection (bitewing radiograph / periapical radiograph) and type of radiographic error such as black film, foreshortening, elongation, horizontal overlapping and cone-cutting.

Three Year 4 dental undergraduates who had undergone theoretical and practical training in the interpretation of intraoral radiograph's errors were recruited to evaluate the rejected radiographs along this study. Inter-examiners agreement in determining the type of radiographic error was evaluated with the Fleiss kappa test prior to commencement of the study by utilizing 20 rejected intraoral radiographs which were randomly selected.

In this study, the radiograph's reject rate among dental undergraduates was calculated using the standard formula as described by Teferi et al. 2012. Hence, with regards to the type of radiographic projection, periapical radiographs reject rate as well as bitewing radiographs reject rate among dental undergraduates were measured as follow:

$$\text{Periapical radiograph's reject rate (\%)} = \frac{\text{Number of rejected periapical radiographs} \times 100}{\text{Total number of periapical radiographs acquired}}$$

$$\text{Periapical radiograph's reject rate (\%)} = \frac{\text{Number of rejected bitewing radiographs} \times 100}{\text{Total number of bitewing radiographs acquired}}$$

In the final four months of the study duration, further analysis in the periapical radiograph's reject rate and bitewing radiograph's reject rate was carried out by considering the year of dental undergraduate study (Year 3, Year 4 and Year 5). At this stage, the rejected radiograph compartments and the form used by dental assistant to record the radiograph taken by students were categorized into three sections according to the year of undergraduate

study. The reject rates were classified and tabled according to the type of radiographic projection and the year of undergraduate study. An independent samples t-test, with a two-tailed distribution was used to compare the difference of reject rate between two different years of study. Result was considered statistically significant when p-value < 0.05.

RESULT

Periapical radiograph was the most common intraoral radiograph performed by dental undergraduates (Table 1). Throughout the study, 2315 periapical radiographs were acquired from March to December 2018 with 118 of the

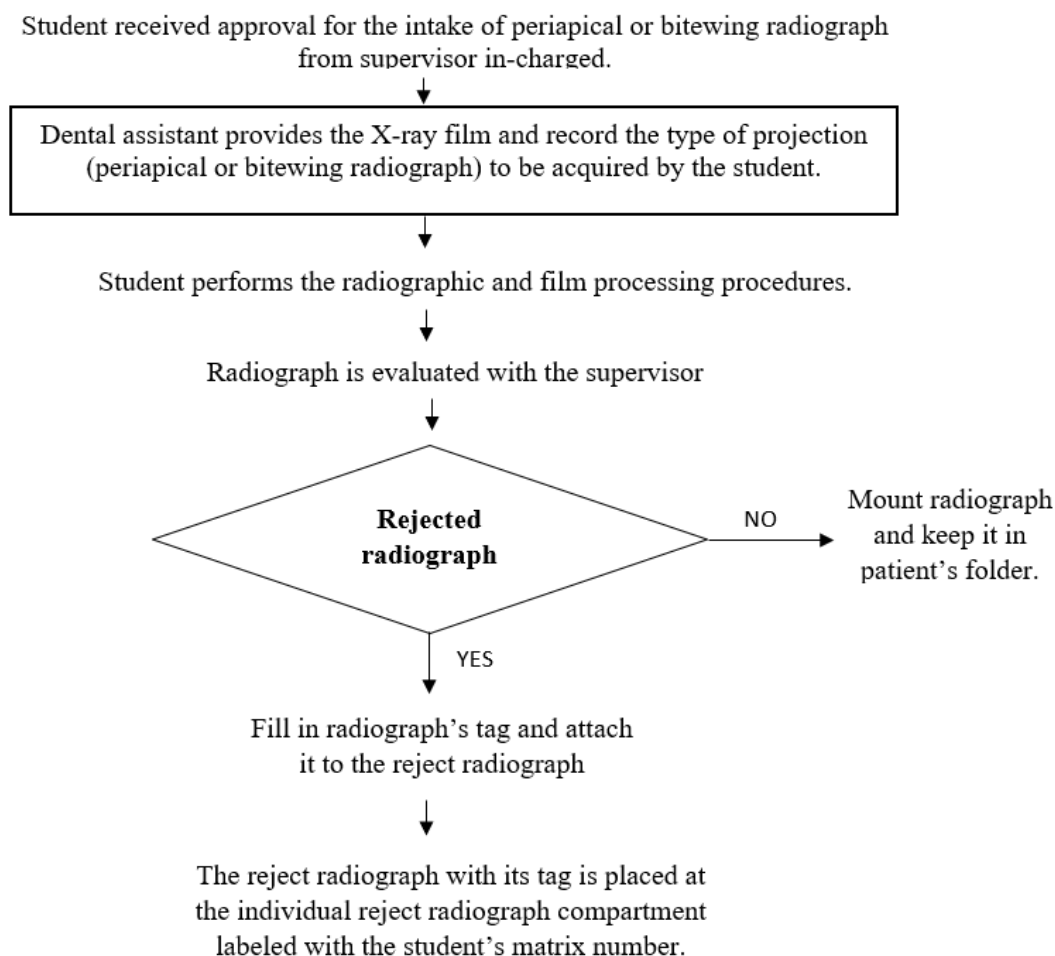


FIGURE 1. Procedure in recording the acquired and rejected radiograph at each of the undergraduates' polyclinics

radiographs rendered as rejected. Meanwhile, 27 radiographs were rejected out of 275 bitewing radiographs acquired. On that account, the reject rate for periapical and bitewing radiographs were 5.1% and 9.8% respectively. Overall, the number of intraoral radiographs (periapical and bitewing radiographs) acquired by third to fifth year dental undergraduates was 2590 radiographs with 145 of the intraoral radiographs rendered as rejected. As a result, the intraoral radiograph's reject rate among these dental undergraduates was 5.6% within 10 months duration of study.

The inter-examiners agreement in determination the type of radiographic error was substantial (k -value: 0.79). In periapical radiographs, the most frequently committed

radiographic error was apical cut, followed by high density film and black film (Figure 2). Vice versa, high density film was accounted as the most common radiographic error in bitewing radiography (Figure 3). This was followed by patient's not biting on bite block and low density film.

Following categorization of periapical radiograph into year of training (Year 3, Year 4 and Year 5) over the final four months of the study duration, the acquisition of periapical radiographs was found highest among Year 5 dental undergraduates (Table 2). This was followed by Year 4 dental undergraduates with total number of periapical radiographs of 346 which almost double the total periapical radiographs acquired by Year 3 students. Although Year 5 outperformed periapical radiographs acquisition, the peak

TABLE 1. Number of periapical and bitewing radiographs acquired, rejected and radiographs reject rate at dental undergraduates' polyclinics for 10 months duration.

Months	Periapical (Pa) radiographs		Bitewing (BW) radiographs		Overall (Pa & BW) radiographs	
	Acquired	Rejected	Acquired	Rejected	Acquired	Rejected
March	106	5	3	2	109	7
April	334	19	36	3	370	22
May	216	8	15	0	231	8
June	291	9	20	4	311	13
July	53	0	5	0	58	0
Aug	0	0	0	0	0	0
Sept	179	13	68	1	247	14
Oct	468	18	78	14	546	32
Nov	297	14	15	0	312	14
Dec	371	32	35	3	406	35
March-Dec	2315	118	275	27	2590	145
Reject rate	5.1%		9.8%		5.6%	

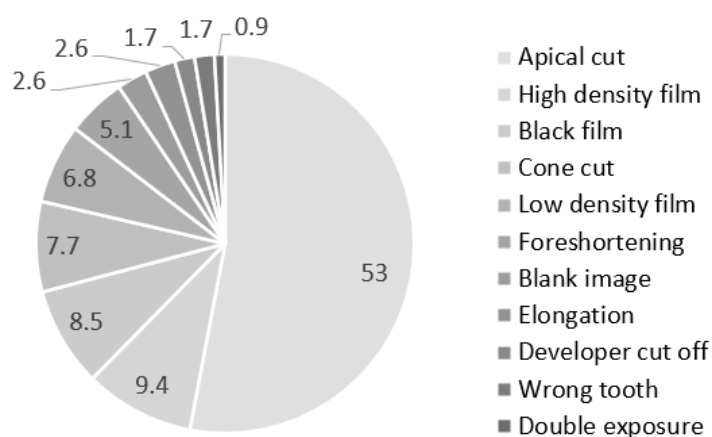


FIGURE 2. Frequency in the type of periapical radiograph error

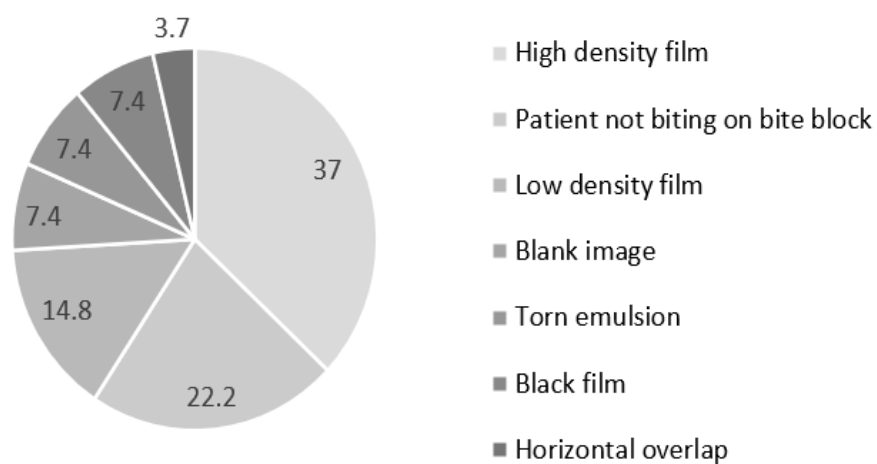


FIGURE 3. Frequency in the type of bitewing radiograph error

TABLE 2. Number of radiographs acquired and rejected as well as reject rate in 3 different clinical years over a period of four months (September –December)

Type of radiographic projection	Year 3		Year 4		Year 5	
	Acquired	Rejected	Acquired	Rejected	Acquired	Rejected
Periapical radiographs (Pa)	175	7	346	38	794	32
Bitewing radiographs (BW)	113	11	33	2	50	5
Pa Reject rate	4.0%		11.0%		4.0%	
BW Reject rate	9.7%		6.1%		10.0%	

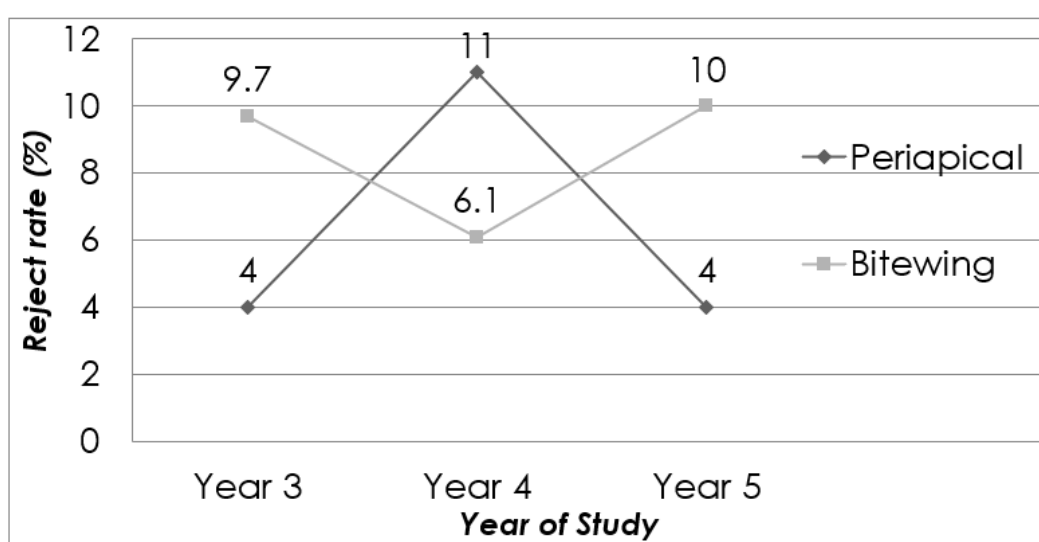


FIGURE 4. Line graph demonstrating periapical and bitewing radiographs reject rate in 3 different clinical years

incidence of rejected periapical radiographs was among Year 4 dental undergraduates. Year 4 students demonstrated 38 rejected periapical radiographs which was 5 times greater than the rejected radiographs by Year 3 students. A spiking increase in periapical radiographs reject rate from Year 3 (4%) to Year 4 (11%) was observed, as demonstrated in the line graph (Figure 4). This finding was consistent with the statistically significant difference in the periapical radiographs reject rates for Year 3 (mean 3.4%, SD 3.286) and Year 4 (mean 10.4%, SD 5.68); $p = 0.0475$. Both Year 3 and Year 5 demonstrated similar finding in the periapical radiographs reject rate which was 4%. In contrast to periapical radiographs reject rate, bitewing radiographs reject rate plummeted from Year 3 (9.7%) to Year 4 (6.1%). Meanwhile, bitewing radiographs reject rate among Year 5 students (10%) was comparable with year 3 students (9.7%). Bitewing radiography was mainly performed by Year 3 students and the least common intraoral radiographic projection performed by Year 4 students (Table 2).

DISCUSSION

Previous findings from studies performed in training institutes showed a wide range of radiographs' reject rates from 3.06% (Nixon et al. 1995), 7.1% (Acharya et al. 2014) to 27% (Elangovan et al. 2016). In this study, the overall radiographs' reject rate among Year 3 to Year 5 dental undergraduates was 5.6% within 10 months duration. In spite of the lower overall reject rate recorded in this study in comparison to the previous studies (Acharya et al. 2014; Elangovan et al. 2016), the reject rate of periapical radiographs among Year 4 students reached the value that require corrective action plan as advocated in the national guideline (Malaysian Dental Council 2010).

The intraoral radiographs acquired in this study were mainly periapical radiographs since this radiographic projection had wider utilization in dentistry in comparison to bitewing radiograph which was used specifically for interproximal caries detection at the crowns of teeth (Wenzel A. 2004). Even though the acquisition of bitewing radiograph was pronouncedly lesser than periapical radiographs, the bitewing radiographs' reject rate in this

study demonstrated its close proximity to the level that require corrective action plan. Thus, looking at both periapical and bitewing radiographs' reject rates warrants for further understanding on the common contributing factors associated with rejected radiographs in these two radiographic projections.

In periapical radiography, apical cut was observed as the most frequently committed radiographic error. This type of error can be associated with either film misplacement or cone misplacement during acquisition of periapical radiograph. In patient with anatomical limitation such as shallow hard palate, film positioning utilizing paralleling technique also potentially lead to apical cut due to insufficient depth of the palatal arch to accommodate the height of the film. In general, in this study the major contributing factor to the periapical radiograph's reject rate was related to the faulty in the positioning of radiographic armamentarium. The finding matches previous literature (Haghnegahdar et al. 2013; Nixon et al. 1995) which reported positioning faults as the most frequent reason for radiographic errors in periapical radiography.

The most common error associated with bitewing projection was high density film which was the second most common error in periapical radiographs. More than half of the reject bitewing radiographs was due to error in film density, with 37% of the radiographs demonstrated high density and 14.8% presented with low density. High density film indicates the possibility of excessive exposure time set at the control panel prior to image acquisition or prolong immersement of film in the developer during film processing. On the other hand, insufficient exposure time, inadequate developing time or exhausted developer may contribute to low density film. Thus, in contrast to periapical radiography, faulty in film exposure and processing is the main reason for reject bitewing radiographs among undergraduates.

Many studies (Acharya et al. 2014; Elangovan et al. 2016) found that increase in clinical training decreases the reject rate of radiographs. In this study, although the reject rate of periapical radiographs encountered from Year 4 to Year 5 students follow similar trend like the previous study (Elangovan et al. 2016), the periapical radiograph's reject rate from year 3 (4%) to year 4 (11%) was surprisingly spiking. Meanwhile in bitewing radiography, the reject rate observed among Year 5 students (10%) was comparable with bitewing radiographs' reject rate among Year 3 students (9.7%). This finding also deviated from the typical trend of radiographs' reject rate described in the earlier studies (Acharya et al. 2014; Elangovan et al. 2016).

During the period of this study, supervision in periapical and bitewing radiography was emphasized among Year 3 students particularly in the first month upon commencement of their clinical sessions. Meanwhile, Year

4 and Year 5 students performed the periapical and bitewing radiographs independently, throughout the respective year of the clinical training. Increased in the incidence of radiographs' reject rate among Year 4 and Year 5 students which exceeds the reject rate of Year 3 students suggesting that close monitoring of reject radiographs among undergraduates should be performed continuously and radiographic supervision may need to be considered regardless of the number of year in the undergraduates' clinical training.

CONCLUSION

The reject rate of the overall radiographs consisting of periapical and bitewing radiographs among UKM dental undergraduates was low. Nevertheless, with bitewing radiographs reject rate which almost reached the value that requires corrective action and the significant increase of periapical radiographs reject rate among Year 4 students, analysis of the type of radiographic error further entailed the necessity to supervise not only in terms of positioning radiographic armamentarium, but also, the setting of radiographic exposure time and the film processing procedures regardless of the year of the undergraduate training. Thus, evaluation of radiographic reject rate among dental undergraduates require detail analysis in several aspects including the type of radiographic projection, type of radiographic error as well as their year of training. In this way, the actual scenario pertinent to radiographic reject rates among dental undergraduates can be identified and a detail corrective action can be planned.

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