EVALUATION OF THE RADIOGRAPHIC QUALITY OF ROOT FILLINGS PERFORMED BY UNDERGRADUATES IN THE FACULTY OF DENTAL SCIENCES, UNIVERSITY OF PERADENIYA, SRI LANKA.

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ABSTRACT

This study was carried out to assess the radiographic quality of endodontic treatment performed by undergraduates at the Faculty of Dental Sciences (FDS), University of Peradeniya, Sri Lanka. Post-operative radiographs of endodontic treatment performed by final-year dental undergraduates were assessed for length of obturation, voids, homogeneity of obturation and taper of preparation. Radiographs were viewed under x2.5 magnification using an illuminated viewing box with extraneous light blocked. Assessment was done by two experienced examiners with ethical clearance from the Research Committee of the FDS. Of the 2426 radiographs 81.1% were obturated within 2mm of the radiographic apex, 72.8% had no voids, 78.5% were homogenously obturated and 82.1% were adequately tapered. 46.5% of radiographs satisfied all criteria (Excellent), 27.8% satisfied 3 criteria (Good) whereas an insignificant 1.2% satisfied none of the criteria (Poor). Root canal treatment undertaken by FDS students, are of acceptable radiographic quality.

KEYWORDS

Endodontics, Radiographic quality, Undergraduates
INTRODUCTION

Dental radiography since been introduced by Dr. Otto Walkoff has revolutionised investigative dentistry to such an extent that it is a mandatory for screening and diagnostic purposes. Many developments have come to light over the past few decades which have improved the quality diagnostic value and reproducibility, minimised the hazards of radiation, made the exposure and processing techniques very user friendly and most importantly enhanced storage and retrievability by means of digital visiography. The availability and usage is widespread and almost all dental curricula around the world devote time in training undergraduates, auxiliaries and other stakeholders in radiographic techniques.

Endodontics is a speciality in dentistry where routine use of multiple periapical radiographs is advocated. It is an essential investigation prior to, during and after completion of endodontic treatment. A periapical radiograph is assessed to determine many factors related to the tooth to be endodontically treated such as the length, patency and curvature of the canal which may determine the difficulty of treatment and its ultimate prognosis. Additionally an intra-operative view is obtained to determine the accuracy of the working length, while a post-endodontic radiograph is mandatory to assess the treatment outcome and asses the length, condensation and homogenicity of the obturation. In order to deem the treatment successful the tooth concerned should be symptom and sign free, functional and show an acceptable level of obturation on a radiograph. Thus one of the key determinants of success of endodontic treatment is the radiographic quality of the root canal treatment.

For standardization, better dimensional accuracy a paralleling technique is advocated for assessment of post endodontic radiographs. In addition digital radiography has simplified the storage and comparison of radiographs during periodic reviews.

There are a number of criteria to be assessed in determining the radiographic acceptability of post endodontic radiographs. Of these, the criteria used by Saunders is the most widely used. According to these criteria the length of obturation as seen on the radiograph together with the homogenicity of the obturation material is assessed.

Many studies have assessed the radiographic quality of root fillings performed by undergraduate students using such criteria of assessment. A study done in Ireland has determined that 70% of the teeth showed an acceptable quality whereas another study in Turkey has shown a higher level of acceptability of 79%. In the Asian region the level of acceptability has been slightly lower than the European studies, where a study in Taiwan has shown a 62% acceptable level and a 61% acceptable level in Jordan.

In this context endodontic treatment is deemed acceptable if the obturation is within 2mm of the radiographic apex with a homogenously obturated canal which is well condensed, lacks any voids and is well tapered.

On average a dental undergraduate would perform endodontic treatment on 8-10 patients within their appointments.

Thus this study is to be carried out to determine the radiographic quality of root canal treatment performed by dental undergraduates covering six (6) final year groups of students.

MATERIALS AND METHOD

Periapical radiographs obtained by dental undergraduates over a six year period were used for the study. Written consent was obtained for endodontic treatment which included obtaining radiographs for working length assessment and post operative assessment. All radiographs were obtained using one periapical x-ray machine installed at the department of Restorative Dentistry. A standard periapical film was used for these radiographs and taken using a long cone paralleling technique. The films were developed in a standard automated developer.

A total of 3128 radiographs were selected for the study. Of these all single rooted teeth were included for evaluation. Multi-rooted teeth and radiographs which were faded, elongated, shortened together with radiographs not showing the entire tooth concerned were excluded from the sample. A total of 2426 post endodontic radiograph was assessed to determine the radiographic quality of endodontic treatment. The radiographs were viewed on a illuminated viewing box with all extraneous light blocked. A
x2.5 magnification was used to assess the radiographs. Assessment was carried out by 3 independent examiners who were calibrated prior to the study by assessing 10 radiographs not taken for the study.

All endodontic treatment was carried out using standard ISO tapered K-files using the step back technique as described by Mullany. Canals were obturated with standard ISO master points and Accessory points using a cold lateral condensation technique with a resin based root canal sealant.

Three determinants were assessed and the radiographic quality was deemed acceptable or not acceptable based on the following criteria.

1) Length
Acceptable – Obturation within 2mm of the radiographic apex
Not Acceptable - Obturation short by more than 2mm of radiographic apex or Obturation beyond the apex

2) Homogenosity
Acceptable - Radiopacity of the obturation material uniform, well condensed and no voids
Not Acceptable - Non uniform radio-opacity poorly condensed and presence of voids

3) Taper
Acceptable - Well tapered preparation and obturation
Non Acceptable - Poorly tapered preparation and obturation

Any acceptable assessment was given a score of one (1) and any unacceptable assessment carried a score of zero (0). The results were tabulated and analysed using SPSS version 16.

RESULTS

Of the 2426 radiographs 52% were of female patients whereas 48% were of males. A higher number of radiographs were obtained on patients in the 31-40 age group (682) and 21-30 age group (574).

As only patients of 16 years and above are treated in the department of restorative dentistry there were a very few patients in the 11-20 age group (104). (Table 1)

When the length of obturation was assessed 81.1% (1969) were obturated within 2mm of the radiographic apex. Eleven percent (11%) of radiographs showed the length of obturation was shorter than 2mm of the radiographic apex whereas 7.9% were obturated beyond the radiographic apex (Table 2).

Table 2: Length of Obturation

<table>
<thead>
<tr>
<th>Length</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>1969</td>
</tr>
<tr>
<td>Under-filled</td>
<td>11%</td>
</tr>
<tr>
<td>Over-filled</td>
<td>8%</td>
</tr>
</tbody>
</table>

Where the homogenicity was concerned 72.8% of the post operative radiographs were homogenously obturated whereas 27.2% were scored as unacceptable. These contained voids or irregularities of the obturation material (Table 3).

Table 3: Homogeneity of Obturation

<table>
<thead>
<tr>
<th>Homogeneity</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>72.8%</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>27.2%</td>
</tr>
</tbody>
</table>
Analysis of the level of taper as seen on the radiographs revealed that 82.1% were adequately tapered as opposed to 27.8% being poorly tapered.

When the assessment criteria was combined 46.5% of radiographs were deemed satisfactory with respect to length of obturation, homogeneity, and taper and were classified as excellent. A further 27.8% were satisfactory in respect of length of obturation and homogeneity (Table 4). These radiographs were classified as acceptable. Radiographs that were acceptable only on one criteria of assessment were considered inadequate and 25% of radiographs were of such quality. An insignificant 1.2% satisfied none of the criteria and were deemed poor (Chi sq 25.95).

### Table 4: Level of acceptability of radiographs by combining the assessment criteria

<table>
<thead>
<tr>
<th>Level</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>46%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>28%</td>
</tr>
<tr>
<td>Inadequate</td>
<td>25%</td>
</tr>
<tr>
<td>Poor</td>
<td>1%</td>
</tr>
</tbody>
</table>

A chi square goodness of fit test revealed a value of 1.053 (p<0.001) for excellent radiographic quality of endodontic treatment which was significantly low. When the excellent and acceptable levels were assessed 74% of the radiographs were of radiographically satisfactory root canal fillings ($\chi^2$ Goodness of fit 162.88 p<0.001). This was based on an expected radiographic success rate of 80%.

The kappa value for the consensus agreement was 0.924. The mean intra-examiner agreement for examiner 1 was 0.892, 0.882 for examiner 2 and 0.895 for examiner 3.

**DISCUSSION**

A post endodontic radiograph is one of the key elements assessed in determining the success of endodontic therapy. Such radiographs are routinely taken as a means of assessing the quality of obturation which has a direct bearing on the long term viability of an endodontically treated tooth. In this context determining the adequacy of obturation requires careful assessment focussing on the length of obturation and the homogeneity of the obturation material.

Adequate length of obturation would ensure that the entire canal has been instrumented upto the apex of the tooth and could be presumed that an apical seal has been achieved. This would prevent subsequent ingress of microbes and infective material into the canal. Many endodontists are of the opinion that obturation within 2mm of the radiographic apex is considered acceptable as the apical constriction on average lies within 1-2 mm of the radiographic apex.

This study revealed that a high percentage of root canal treated teeth had a adequate length of obturation (81%) This percentage was slightly lower in comparison to a European study which revealed an adequacy of length in 84% of radiographs assessed. However the sample size of the present study is large in comparison to this study. In comparison to most studies done in the asian region the students in this study had a higher level of success with respect to length of obturation which was around 60% in studies done in Taiwan and Jordan.

Obturating the canal homogenously ensures that the canal has been adequately debrided and most of the open dentinal tubules being sealed. It also ensures proper vertical and lateral condensation leading to improved sealing ability of the obturation material. This study revealed that 72.8% of the radiographs had a homogenous obturation which was lower that comparative studies done in Europe. The Sri Lankan students scored better in comparison to most asian studies.

An adequate taper would ensure proper shaping of the root canal which is a fundamental step in endodontic treatment. This would facilitate penetration of adequate amounts of irrigants to chemomechanically disinfect the canal. The study revealed a 82.1% acceptability when taper was considered.

A homogenous obturation to an acceptable length is considered a good quality endodontic work (GQEW). The study revealed that 74% of radiographs assessed carried GQEW which is close to the European levels but much lower than the Sri Lankan students.
higher than comparative studies in Asia such as in Jordan, Saudi Arabia and Taiwan\textsuperscript{7,8}. However only single rooted teeth were selected for this study. For accurate comparison the acceptability of endodontically treated multi-rooted teeth has to be assessed which was not carried out in this particular study.

It was expected that the radiographic acceptability of endodontically treated teeth was about 80%. Whereas the results revealed an acceptability level of 74%. A chi square goodness of fit test revealed a significant difference between the expected values and the actual results and thus further improvement in the canal preparation and obturation is necessary to achieve better standards. However all radiographs assessed were endodontics performed by undergraduates and thus the results show a high acceptability compared with other asian studies and quite comparable with European studies\textsuperscript{4,8}.

Although the post-operative radiographic appearance would give an idea about the success rate, long term evaluation is necessary to deem clinical success\textsuperscript{12}. Also the technique used for preparation and obturation may play a role in determining the success. In the current study only a step back technique was utilized and thus comparison of the techniques is not possible.

In addition the success rates of single visit and multi visit endodontics is variable especially in teeth having apical periodontitis. In such teeth multi visit endodontics shows a better success rate with concurrent inter visit calcium hydroxide dressings\textsuperscript{13}. However this aspect was not compared in the current study where there was no separation of the single visit treatment from the multi-visit cases.

Healing of periapical lesions take time and may not be apparent in the immediate post-operative radiographs and thus long term follow-up is needed to assess the success of such cases\textsuperscript{14}. Healing could take to between 3 and 24 months post operatively and success can only be determined after such periods\textsuperscript{15}. Thus in the current study the follow-up of patients is being carried out to determine the long term success.

CONCLUSION

The radiographic quality of endodontics performed by undergraduates dental students at the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka is of an acceptable quality. Further refining of techniques is required to improve the quality to European standards.

References

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