

Radiographic evaluation of the quality of root canal treatment in a Bangladeshi population

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Abstract

Background and objective: Root canal treatment (RCT) has a high rate of success, when performed by properly trained dental surgeons. However, the failure rate is inappreciably high when the same procedure is done by less experienced dental graduates having no specialization on endodontics. This study was conducted to evaluate the technical quality of RCT performed by practicing dental graduates on Bangladeshi patient.

Methods: This cross-sectional study was conducted in the Department of Dentistry of BIRDEM General Hospital Dhaka over a period of 6 months from January to June 2019. Radiographs of patients who had undergone RCT in last 6 months were included in the study. Parameters used to evaluate the obturation of the root canal were presence of root-filled, posts and voids. The RCT was assessed for filling at the end of the root with radiographic apex, the density of the filling material and taper from the orifice to apex. The quality of RCT was evaluated as totally unacceptable (score: 0-2), poorly acceptable (score: 3-4), acceptable (score: 5) and perfect (score: 6) based on the treatment score. Post-treatment complications were determined by furcation and cavity wall perforation, transportation, root perforation, instrument breakage, ledge formation, voids and missed canal.

Result: A total of 180 postoperative readable radiographs with post root-canal treatment were evaluated. Evaluation of the technical quality of RCT revealed that 56% of the RCTs were of standard quality (41.7% were of perfect quality and 14.4% were of acceptable quality). The rest 23.3% were poorly acceptable and 20.6% were totally unacceptable. Majority (92.8%) of the obturation of the root canal revealed that roots were filled with sealing materials; however, 8.9% exhibited posts and 36.7% demonstrated voids. A sizable portion of the root canal obturation was unacceptable in terms of its length (12.2%), density (20%) and tapering (16.7%). Total 132 (73.3%) teeth developed at least one complication. Under filling and voids were predominant complications (42.8% and 41.1% respectively) followed by root perforation (12.2%), transportation (11.7%), ledge formation (5%), instrument breakage (2.8%) and missed canal (3.3%).

Conclusion: The study concluded that over forty percent of the RCTs performed by dental graduates having no specialization on endodontics are of substandard quality and hence not acceptable.

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Introduction

Retention of a high number of original teeth is becoming more popular in contemporary society [1].

Hence, endodontic therapy is becoming an increasingly routine part of general dental practice [2]. The primary goal of endodontic treatment is to

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eliminate or reduce the microbes from root canal space by chemo mechanical preparation in order to prevent re-infection and promote periapical healing by hermetically sealing the root canal space [3]. This treatment has a high rate of success (90 – 95%), when highest standards are followed during the procedure [4,5].

Root canal treatment involves the removal of the pulp (pulpectomy) and the preparation and obturation of the root canal system. Preparation of the canal involves the processes of cleaning and shaping; cleaning involves the removal of pulp tissue remnants and microorganisms, whilst shaping of the root canal involves its enlargement and the creation of a shape or form that will enhance irrigation and facilitate filling. According to European Association of Endodontists, a satisfactory root canal treatment shows a tapered canal from crown to apex and completely filled with sealing materials with no space between canal filling and canal wall. In addition, it should be 0–2 mm short of the radiographic apex to prevent post treatment failure [6]. However, there is substantial evidence that the technical quality of root canal treatment has a significant impact on the outcome of the procedure and the long-term retention of teeth. Chemo mechanical preparation and obturation confined to root canal space that is 0–2 mm from the radiographic apex is associated with less complication compared to obturation beyond the apex [7-11]. Also obturation is considered adequate when there are no voids within and between the root canal fillings and root canal walls. Post treatment disease is also caused by extrusion of necrotic debris into the periapex [12]. Research has confirmed that endodontic root canal fillings more than 2 mm from the radiographic apex, extruded beyond the apex and non-homogenous with voids between the fillings increase the risk of endodontic treatment failure [13]. Indeed, low quality root fillings assessed radiographically were found to be associated with post-treatment disease and reduced treatment outcomes [14,15].

Extensive investigations regarding the quality of root canal treatment performed by general dental practitioners in different populations demonstrated a high percentage of inadequate root canal treatment [16-18]. The reasons for this are complex

and may be related to the endodontic teaching that was undertaken at the dental schools [19], which in turn, may be due to limitation of time allocated to endodontics, poor staff to student ratio and reluctance of the teachers to teach their students [20]. Technical difficulties in preparing the canal, quality of the sealing materials and poor coronal restoration may also be responsible. Data pertaining to radiographic problems and failures in endodontically treated teeth as well as frequency of procedural errors in cases treated by general dental practitioners are scarce in Bangladesh. In view of the above, the present study was conducted to evaluate the technical quality of root-canal treatment performed by practicing dental graduates on Bangladeshi patients by examining the radiographs of treated teeth. .

Methodology

This cross-sectional study was conducted in the Department of Dentistry of BIRDEM General Hospital, Dhaka over a period 6 months from January 2019 to June 2019. Patients reporting to the Endodontic department who had RCT in the last 6 months were selected for the study. For evaluation, radiographs showing pre-operative condition, records of working length/master cone, diagnostic length, try-in point of affected teeth were collected. Information regarding affected tooth (incisor/canine/ premolar/ molar), total number of canals in the affected tooth, total number of affected teeth, type of canals (straight or curved), degree of curvature that have endodontic treatment failures were recorded.

Two periapical radiographs were taken for each patient - one with straight angle and the other with mesial shift with long cone parallel technique. All the post root-canal treatment radiographs done in the last 6 months were provisionally included in the study. Radiographs in which root apex was not seen or too much elongated or shortened and of bad quality were excluded from the study. After screening, the eligible radiographs were kept for final analysis. The radiographs were independently evaluated by two endodontists. In case of disagreement a third, highly experienced endodontist was assigned to give final comment. All radiographs were viewed under even

illumination using a magnifier ($\times 2$) with all extraneous light excluded. Issues considered while examining the radiographs were number of visible roots and canals, degree of curvature of the canal(s) which was categorized as 0–10° curvature, 11° or over, or not assessable.

Parameters used to evaluate the obturation of the root canal were presence of root-filled, posts and voids. The RCT was assessed for filling up to the end of the root with radiographic apex, the density of the filling material, and taper from the orifice to apex. Detail of parameters used to evaluate the root canal obturation is shown in Table-1.

The quality of RCT was categorized as totally unacceptable (score: 0-2), poorly acceptable (score: 3-4), acceptable (score: 5) and perfect (score: 6) based on the treatment score. Post-treatment complications were determined by furcation and cavity wall perforation, transportation, root

perforation, instrument breakage, ledge formation, voids and missed canal.

Data were processed and analyzed using SPSS (Statistical Package for Social Sciences), version 17.0.

Result

A total of 180 postoperative readable radiographs with post RCT were evaluated. Distribution of the radiographic cases by tooth profile is shown in Table-2. Over half (52.2%) of the post root-canal treated radiographs were of male subjects and the rest (47.8%) were of female subjects. Nearly half (48.3%) of the radiographs showed maxillary tooth involvement and the rest half (51.7%) mandibular tooth involvement. Over two-thirds (68.9%) of the tooth were molar tooth, 17.8% were premolar and 13.9% were incisor. Approximately 44% of the canals were straight and 56.1% were curved. More

Table-1: Parameters used to evaluate the root canal obturation

| Parameter | Definition | Score |
|---|--|--|
| Length of root canal obturation | Root filling ending >2 mm short of the radiographic apex (under-filling) | 0 (unacceptable) |
| | Root filling limited to the pulp chamber | 0 (unacceptable) |
| | Root filling ending beyond the radiographic apex (over-filling) | 0 (unacceptable) |
| | Root filling ending at the radiographic apex (tip to tip) or 1-2 mm shorter than the radiographic apex | 1 (acceptable) |
| | Root filling ending 0.5-1 mm short of the radiographic apex (adequate) | 2 Perfect |
| | Density of root canal obturation | Inhomogeneous root canal obturation with several visible voids |
| Root canal obturation with only one visible void | | 1 (acceptable) |
| No void present in the root canal obturation (adequate) | | 2 Perfect |
| Taper of root canal obturation | Not consistently tapered from the apex to the coronal part (over- or under-shaped) | 0 (unacceptable) |
| | Not enough taper | 1 (acceptable) |
| | Consistently tapered from the apex to the coronal part (adequate) | 2 Perfect |

than half (53.3%) of the curved canals had degree of curvature between 0 - 10°, 33.9% had curvature of 11° or more and 12.8% of curved canals' curvature were not assessable. The average number of roots visible was 2 and the average number of canals visible was also 2. History of similar previous treatment was found only in 12.8% cases (Table-2). Evaluation of the obturation of the root canal revealed that 92.8% of the roots were filled with sealing materials, 8.9% exhibited posts and 36.7% demonstrated voids (Table-3).

Table-2: Distribution of the radiographic cases by tooth profile (n = 180)

| Tooth Profile | Frequency | Percentage |
|-----------------------------------|-----------|------------|
| Jaw involved | | |
| Maxillary | 87 | 48.3 |
| Mandibular | 93 | 51.7 |
| Incisor | 25 | 13.9 |
| Premolar | 32 | 17.8 |
| Molar | 124 | 68.9 |
| Type of canal | | |
| Straight | 79 | 43.9 |
| Curved | 101 | 56.1 |
| Degree of curvature | | |
| 0 - 10° | 96 | 53.3 |
| 11° or over | 61 | 33.9 |
| Not assessable | 23 | 12.8 |
| Similar previous treatment | | |
| Done | 23 | 12.8 |
| Not done | 157 | 87.2 |

Table-3: Evaluation of the obturation of the root canal (n=180)

| Obturation variables | Number* | Percentage |
|-------------------------|---------|------------|
| Presence of root-filled | 167 | 92.8 |
| Presence of posts | 16 | 8.9 |
| Presence of voids | 66 | 36.7 |

Note: * Multiple responses.

The length, density and taper of root canal obturation were found perfect in 59.4%, 58.9% and 57.8% of radiographs respectively (Table-4). After summing up the root canal quality score, 41.7% was of perfect quality and 14.4% was of acceptable quality. The rest 23.3% was poorly acceptable and

20.6% totally unacceptable. Detail periapical status based on length, density and taper of the root canal obturation is given in Table-4.

Table-4: Periapical status based on length, density and taper of the root canal obturation (n=180)

| Periapical status | Number | Percentage |
|--|--------|------------|
| Length of root canal obturation (0- 2) | | |
| 0 (unacceptable) | 22 | 12.2 |
| 1 (acceptable) | 51 | 28.3 |
| 2 (perfect) | 107 | 59.4 |
| Density of root canal obturation (0- 2) | | |
| 0 (unacceptable) | 36 | 20.0 |
| 1 (acceptable) | 38 | 21.1 |
| 2 (perfect) | 106 | 58.9 |
| Taper of root canal obturation (0 - 2) | | |
| 0 (unacceptable) | 30 | 16.7 |
| 1 (acceptable) | 46 | 25.6 |
| 2 (perfect) | 104 | 57.8 |
| Root canal quality (score 0-6) | | |
| Totally unacceptable (0-2) | 37 | 20.6 |
| Poorly acceptable (3-4) | 42 | 23.3 |
| Acceptable (5) | 26 | 14.4 |
| Perfect (6) | 75 | 41.7 |

Table-5: Complications seen radiographically during or after RCT

| Complications | Number | Percentage |
|-------------------------|--------|------------|
| Furcal perforation | 3 | 1.7 |
| Cavity wall perforation | 3 | 1.7 |
| Transportation | 21 | 11.7 |
| Root perforation | 22 | 12.2 |
| Instrument breakage | 5 | 2.8 |
| Ledge formation | 9 | 5.0 |
| Under filling | 77 | 42.8 |
| Voids | 74 | 41.1 |
| Missed canal | 6 | 3.3 |

Analysis of complications resulting from root-canal treatment showed that a total of 132 (73.3%) teeth developed at least one complication (32.8% one complication, 32.2% two complications and 8.3%

three complications). Under filling and voids were predominant complications (42.8% and 41.1% respectively). The less common complications were root perforation (12.2%) and transportation (11.7%). Ledge formation (5%), instrument breakage (2.8%), missed canal (3.3%), furcal perforation and cavity wall perforation seldom occurred (Table-5).

Discussion

Evaluation of the success or failure of endodontic therapy is still problematic for the endodontists. Although root canal treatment is technically demanding, there is evidence that a substantial proportion of the root canal treatment performed by general dental practitioners all over the world including Bangladesh is of substandard quality which has a significant impact on the outcome and the long-term retention of teeth. The present study revealed that about 55% of RCT performed by the dental graduates was of either perfect or of acceptable quality. Consistent with the findings of this study, Chowdhury *et al* [21] in a recent evaluation of the quality of root canal treatment by undergraduates of Bangladesh Dental College found 55% to be of acceptable quality. However, their perfect quality was very low (4%). Thus, the finding of the present study and that of Chowdhury *et al* suggest that Bangladeshi dental graduates are not skilled in performing RCT of teeth. Similar findings are reported from all over the world. Only 13% of root fillings were categorized as satisfactory in terms of both radiographic quality of obturation and distance of the root filling from the radiographic apex [22]. Saunders *et al*. [10] found that 39% of root fillings were greater than 2 mm from the radiographic apex and Dummer [23] found that only 10% of root fillings placed by general dentists under the terms of the UK National Health Service fulfilled criteria for standards of care as defined by the European Society of Endodontology [24]. A study from Switzerland noted that 64% of root fillings were unsatisfactory because they contained voids or were greater than 2 mm from the apex [25]. About 43% of Norwegian root fillings ended more than 2 mm from the apex [8]. A study from Sweden reported that only 38% of teeth were obturated completely and another study in USA found that only 42% of root fillings

were technically satisfactory [7,26]. Similarly, a study on French population also reported poor technical quality of RCT treatment [27]. Also, in our study we found that about 73% teeth developed at least one complication following RCT. The findings of the present study suggest that specific training during the undergraduate endodontic course might be useful to improve the skills of dental graduates and therefore, shall provide quality root canal treatment.

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