Radiographic evaluation of root canal treatment technical quality in a Brazilian population

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ABSTRACT

This investigation aims to assess the prevalence of detectable apical periodontitis in periapical radiographs and the relationship between disease and quality of root fillings performed by undergraduate students. A random sample of 131 records of patients who had received root canal treatment (RCT) at the Araçatuba School of Dentistry – UNESP was investigated. Anamnesis, clinical examination to attempt to the pain symptom, presence and quality of the restoration, periodontal pocket, dental mobility and occlusal trauma radiographies were evaluated. The percentage of success obtained with the treatment performed by under graduate students was 87,7%. When the treatment was adequate (43 cases) the percentage of success was 90,69% (39 cases), while for the inadequate treatments (14 cases) the percentage of success was 78,57% with no statistically significant difference ($p>0.05$). It was not observed statistically significant difference in the success rate related to the gender ($p>0.05$). The pulp condition also did not interfered on the success rate ($p>0.05$). It was concluded that the endodontic treatment was satisfactory and achieved a suitable success rate around 90% of the cases.

Keywords: Follow up. Success rate. Obturation. Education.

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Introduction

Apical periodontitis is diagnosed by clinical and radiographic criteria. Clinical signs such as pain, swelling, tenderness and sinus tract formation occur to varying degrees and are only moderately specific.[1] Other markers such as saliva and blood samples are not diagnostically helpful. Radiographic interpretation is therefore the prime criterion for the diagnosis of apical periodontitis[2] and has been mostly used to achieve this evaluation.[3,4] Helminen et al[5] showed that success or prognosis of root canal treatment depended on the technical quality of the root filling.

Epidemiological surveys indicate technically satisfactory root fillings in 42–90% of cases.[3,6,7] Numerous studies have shown a high percentage of inadequately root filled teeth with concomitant apical periodontitis.[3,8]

Surveys of endodontic teaching suggest that the time devoted to the study of Endodontology in the UK is limited, particularly in respect of the time spent in preclinical laboratories and the development of practical skills.[9,10,11] In addition, the quality of the teaching by specialists can help the training excellence.[11]

In the Brazilian official Schools of Dentistry, such as Araçatuba School of Dentistry, the endodontic teaching is performed by PhD specialists, who are selected by an open competition. The students have to complete a practical course in Conservative Dentistry before progression to clinical practice. Preclinical teaching in Endodontology involves 16 h of lectures and 64 h of preclinical practical exercises during the first semester in the fourth year and the same time with clinical activities during the second semester of the same school year.

This investigation aims to assess the prevalence of detectable apical periodontitis as determined from periapical radiographs and the relationship between disease and quality of root fillings performed by undergraduate students.

Material and Methods

A random sample of 131 records of patients who had received dental treatment at the Araçatuba School of Dentistry – UNESP between the years 2000 and 2001 was investigated. Records of patients younger than 19 years of age were excluded. Records that did not include preoperative and postoperative periapical radiographs, those where the root canal treatment (RCT) was not completed or those whose the radiographic quality was poor were also excluded. The final sample consisted of 185 root filled teeth in 121 dental patients, considering that the same patient had more than one teeth treated and recorded in the same record paper. All RCTs were carried out by third year undergraduate students (two consecutive classes) using crown-down and step-back root canal preparation technique and a lateral compaction filling technique with gutta-percha and Sealapex sealer (Sybron Endo, Glendora, USA). The instrumentation technique consisted of an initial enlargement of the coronal third with manual amplifier (Dentsply Maillefer, USA), followed by Gates-Glidden in the 3, 2 and 1 sequence (Dentsply Maillefer, USA), root canal length determination, apical preparation with K files (Dentsply Maillefer, USA) and anatomic step back preparation with Hedström files (Dentsply Maillefer, USA). Calcium hydroxide dressing was used in all cases of pulp necrosis or in case of elapsed session time during the treatment of vital pulps. If complications such as lateral or furcal perforations, fractured instruments, etc. were determined, the root filling was considered inadequate.

All patients were called, but only 41 returned for control evaluation and a total of 57 teeth were evaluated in the year of 2009. At this time clinical and radiographic evaluations were performed. Clinically, anamnesis, clinical examination to attempt to the pain symptom, presence and quality of the restoration, periodontal pocket, dental mobility and occlusal trauma were performed. Periapical radiographs were also taken using Kodak Ektaspeed exposed for 0.5 seconds and X-ray equipment (Dabi-Atlante, Ribeirão Preto, Brazil) calibrated with 8 mA and 80 kV to observe the presence of apical periodontitis and their relationship with the quality of root fillings.

Two examiners interpreted the radiographs with an illuminated light source in a darkened room using magnification (2x). Apical periodontitis was recorded as present on the periapical radiographs if the Periapical Index[12] for the lesion exceeded 3 (score 1–5 for increasing size and severity) (Table 1). Calibration of the two examiners was carried out using 15 periapical radiographs, which were double-scored. Multi-rooted teeth were classified according to the root with the most severe score. Root fillings were either classified

as adequate or inadequate (Table 1). A well filled root canal, without visible voids contained within the tooth and ending no less than 2 mm from the radiographic apex. An inadequate root treatment was under filled, overfilled or poorly condensed. Statistical significance was assessed by the chi-square test; p-values less than 0.05 were considered statistically significant.

Results

No patient presented pain, as well as color, volume or texture alteration of the soft tissues. The percentage of success obtained with the treatment performed by under graduate students was 87,7%. Table 2 shows distribution of the patients by age range. The most prevalent rage age was between 51 and 60 years (13 cases) old. Table 3 shows the prevalence of tooth type and position (FDI Classification) for treatment and the most prevalent teeth was the 21 (6 cases) and 22 (6 cases). Table 4 shows the percentage of success related to the quality of the endodontic treatment. When the treatment was adequate (43 cases) the percentage of success was 90,69% (39 cases), while for the inadequate treatments (14 cases) the percentage of success was 78,57% with no difference statistically significant ($p>0.05$). It was not observed difference statistically significant in the success rate related to the gender ($p>0.05$) (Table 5). The pulp condition also did not interfered on the success rate of the endodontic treatment performed by under graduate students ($p>0.05$) (Table 6).

Discussion

The data used in this study consisted of a sample of periapical radiographs of patients who received root canal treatment at the Araçatuba School of Dentistry, São Paulo State University, in Araçatuba, São Paulo, Brazil. All periapical radiographs used in this study were taken during routine root canal treatment

Table 1. PAI (Periapical Index).[12]

Items	Criterion	Grouped criterion
Periapical condition	1 - normal apical periodontium 2 - bone structural changes indicating not pathognomonic apical periodontitis 3 - bone structural changes with some mineral loss characteristic of apical periodontitis 4 - well-defined radiolucency 5 - radiolucency with radiating expansions of bone structural changes	1 and 2 – normal periapical status 3, 4 and 5 – apical periodontitis.
Sealing quality	1 - adequate seal (no visible lateral or apical voids) 2 - inadequate seal (visible lateral or apical voids or canal lumen in the apical third of the root canal)	
Distance from the filling to the apex	1 - root filling ending ≤2 mm from radiographic apex 2 - root filling ending >2 mm from radiographic apex 3 - over-filling; root filling material visible in the periapical area.	

Table 2. Age range of patients of the sample.

Age (years)	21-30	31-40	41-50	51-60	61-70	71-80
n	4	10	10	13	3	1
%	9.75	24.39	24.39	31.70	7.31	2.43

Table 3. Prevalence of tooth type and position (FDI Classification) for treatment.

Maxilla	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**Total**
n	0	1	3	3	2	4	4	6	6	3	3	2	2	0	39
%	0	1.75	5.26	5.26	3.50	7.01	7.01	10.52	10.52	5.26	5.26	3.50	3.50	0	68.42
Mandible	**47**	**46**	**45**	**44**	**43**	**42**	**41**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**Total**
n	2	2	4	3	1	0	0	0	0	0	1	2	1	2	18
%	3.50	3.50	7.01	5.26	1.75	0	0	0	0	0	1.75	3.50	1.75	3.50	31.58

Table 4. Prevalence of success related to the quality of the endodontic treatment.

Quality of the Endodontic treatment	Total	Success (n)	% of success
Adequate	43	39	90.69
Inadequate	14	11	78.57
Total	57	50	87.71

*Statistically significant.

Table 5. Prevalence of success related to the gender.

Gender	Total	Success (n)	Success (%)
Female	38	34	89.47
Male	19	16	84.21

*Statistically significant.

Table 6. Prevalence of success related to the pulp condition.

Pulp condition	Total	Success (n)	Success (%)
Vital	19	17	89.47
Non vital	38	33	86.84
Total	57	50	87.71

*Statistically significant.

procedures within a dental student practice but the proservation periapical radiographs was taken especially for this study. As panoramic radiographs do not reveal details and inter-observer variability is greater with panoramic radiographs,[13] periapical radiographs were used instead of panoramic radiographs.

The radiographic criteria used to asses root canal treatment quality were the same as those used previously.[12] This index accept the a double thickness of apical periodontal ligament space related to the lateral periodontal ligament space and was used in several other reports.[14,15,16]

An obturation with ideal characteristics related to the apical limit, taper and filling are desired to achieve the success.[17-20] The percentage of adequate root canal treatment was 75,4% in the present study. Although it is difficult to compare these results with other studies, the percentage of root fillings that had adequate length were superior when compared with those reported by previous studies that showed 31.2%,[20] 48.9%,[15] 34.8%[21] and 47.4%.[17] These differences may be the result of the fact that dental students take several radiographs during root canal treatment in order to obtain correct working lengths, as well as a constant supervision oriented the students to concluded the treatment only when a periapical radiograph showed an acceptable quality. Moreover, the standardization of the operatory technique may have diminished the inter-professor variability related to the working philosophy, materials and medicaments. Kerekes and Tronstad[22] reported reduction of overfillings from 24% to 3% after the standardization of the operatory technique and the frequency of adequate filling raised from 78% to 97% and the success rate from 82% to 91%, which corroborates the success rate observed in the present study around 87%.

Another point to be mentioned is the time spending in the preclinical and clinical formation. In the Cork University (Ireland), the preclinical course occurs in the third year and has 2 lectures of one hour each, 48 hours with preclinical and literature revision. In England, the students have 8 lectures and 24 hours of practical classes.[9] The quantity of preclinical activities in the Oriental Europe (16 h), England (24 h), North America (41 h), Turkey (56 h) and Scandinavia (66 h).[23] At the Araçatuba School of Dentistry,

the students spend 80 hours of preclinical activities and more 80 hours of clinical activities with PhD professors. The level of the professors around the world is not the same. The Endodontic curriculums of the England Universities show a lack of at least specialist professors in clinical activities.[9,10,23]

The instrumentation technique used by the students may have also contributed to the results. The technique used can easily instrument straight as well as curve root canals after the correct training. However some improvements could be done to achieve higher success rate such as to reduce the student/professor relation from 10 in practical classes and 80 in lectures, as well as the real competency of the general dentist could be established to focus on the more important and fundamental concepts and training, investing in didactic software and hardware, modernization of the preclinical laboratories and learning evaluation systems.

It was concluded that the treatment performed by the undergraduate students from Araçatuba School of Dentistry was satisfactory and achieved a suitable success rate.

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