Influence of Coronal Restoration and Root Canal Filling Quality on Periapical Status: Clinical and Radiographic Evaluation

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Abstract

Introduction: The purpose of this study was to evaluate the relationship between periapical status and the quality of coronal restoration and of root canal filling, assessed both clinically and radiographically, in a cohort of Brazilian patients. **Methods:** A total of 523 teeth from 337 patients submitted to endodontic treatment were clinically and radiographically reexamined 2–10 years postoperatively. Restoration and root canal filling quality were classified according to modified criteria from Tronstad et al. Periapical status was evaluated according to periapical index scores. Mann-Whitney and Friedman tests were used to conduct the descriptive analysis. Correlations were analyzed by using simple and multivariate logistic regression analysis. **Results:** No significant difference was observed between the rates of apical periodontitis for adequate or inadequate coronal restorations assessed clinically (12.8% versus 19.4%), whereas these rates were significantly different when the restoration quality was assessed radiographically (11.6% versus 28.7%, $P < .001$). The rates of apical periodontitis in teeth with inadequate root canal filling, with or without adequate restoration, were significantly higher than in teeth with adequate canal filling, with or without adequate restoration (38.6% and 48.4% versus 6.5% and 14.6%, respectively; $P < .0001$). **Conclusions:** Using either a radiographic or clinical assessment alone was not a reliable method to ascertain whether restoration quality could be correlated with postoperative periapical status. Poor root canal filling quality was a prognostic determinant of endodontic treatment failure, whereas coronal restoration quality had a lesser impact on the outcome of the endodontic treatment. (*J Endod 2015;41:836–840*)

Key Words

Coronal restoration, endodontic treatment, periapical status, radiographic evaluation

B acterial infection/reinfection has been confirmed as the most important etiologic factor related to endodontic treatment failure. It is generally accepted that the prognosis of endodontic treatment can be positively correlated with the technical quality of the root filling [1]. However, *in vitro* studies [2–5] and a study by Ray and Trope [6] have found that the quality of the coronal restoration seems to have a greater impact on periapical status than the quality of the root filling.

Similar studies have confirmed the validity of these results by correlating the quality of both root canal filling and coronal restoration to the resolution of apical periodontitis in various populations and with different results [7–19].

The large majority of these studies used a cross-sectional design and relied on radiographic examination alone to assess the quality of the coronal restoration. Few studies [10, 11, 19] have evaluated coronal restorations both radiographically and clinically.

Thus, the purpose of this retrospective cohort study was to evaluate the relationship between periapical status and the quality of root canal filling and coronal restoration both clinically and radiographically.

Materials and Methods

Study Population

The sample for this retrospective cohort study consisted of 337 adult patients (122 men and 215 women) out of 1150 patients who received endodontic treatment administered by an endodontics specialist (M.A.C.) in a public dental service in Amparo, SP, Brazil, between the years of 2002 and 2012. The patients were recalled by letter or telephone. Those who responded and gave their written and informed consent were reexamined to determine treatment outcome between November 2011 and February 2014. Only teeth with a follow-up period of 2 years or more were included in this study. A total of 523 of the 2254 originally treated teeth were reexamined, representing a reply rate of 23.2%. This study was previously approved by the institutional review board, São Leopoldo Mandic Dental Research Center, Campinas, SP, Brazil (protocol no. 2012.0326).

Endodontic Treatment Protocol

All of the original endodontic treatment procedures were performed by a single endodontist (M.A.C.), who used an aseptic technique with rubber dam isolation. Preoperative pulpal and periradicular diagnoses were made during the first visit. All of the teeth were diagnosed as having a necrotic pulp and were treated following a standardized protocol.

Initially, the teeth were anesthetized, then the caries was removed, and the coronal structure was reconstructed, as required for proper isolation. After isolation, the teeth were surface-disinfected with 30% H_2O_2 and 5% iodine tincture. The root canals were accessed following conventional procedures.

Working length was established at the apical constriction with an electronic apex locator (Apex DSP; Septodont, Saint-Maur-des-Fossés, France) and confirmed with radiographs. Cleaning and shaping were performed by using either the crown-down or the modified step-back technique, with stainless steel and nickel-titanium hand files of different designs (Dentsply Maillefer, Ballaigues, Switzerland).

The canals were irrigated with 2.5% sodium hypochlorite, and the smear layer was removed with 17% EDTA (Biodinâmica, Ibiporã, PR, Brazil). Calcium hydroxide was used in all cases as an intracanal dressing between appointments (Callen PMCC; SS White Artigos Dentários, Rio de Janeiro, RJ, Brazil) and was applied with a lentulo spiral (Dentsply Maillefer).

Root fillings were performed with gutta-percha (Tanari Industrial, Manacapuru, AM, Brazil) and AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) by using the lateral compaction technique. Access cavities were temporized (Cimpat; Septodont) between sessions and after treatment completion. All of the treatments were completed in 2 visits.

Preoperative and postoperative periapical radiographs (Kodak Ultraspeed film; Eastman Kodak Company, Rochester, NY) were taken by using the paralleling technique and were processed manually in a darkroom following the manufacturer's recommendations. All subjects were referred back to their referring clinician for definitive restoration.

Radiographic and Clinical Assessments

A single examiner (M.A.C.) performed the follow-up assessments. The teeth were grouped according to the quality of root filling and coronal restoration.

The quality of root canal filling was assessed both clinically and radiographically. All periapical radiographs were evaluated by using an x-ray viewer under ×3.5 magnification. The criteria used for radiographic evaluation were slightly modified from those described by Tronstad et al [7]. For the clinical evaluation, intraoral and extraoral examinations were performed to identify signs and symptoms related to root canal filling. The teeth were submitted to palpation and percussion. Thus, clinical and radiographic classification of root canal filling quality was made according to the criteria listed here:

1. *Adequate root canal filling:* All canals obturated, no voids present, root filling ends 0–2 mm short of the radiographic apex; no symptoms or clinical signs (elicited or spontaneous pain, fistula, edema, or exudation)
2. *Inadequate root canal filling:* Root filling ends more than 2 mm short of the radiographic apex or canal grossly overfilled or unfilled; root filling with voids or inadequate density; presence of symptoms or clinical signs

The quality of the coronal restoration was assessed both clinically and radiographically. All periapical radiographs were evaluated by using an x-ray viewer under ×3.5 magnification. The criteria used for radiographic evaluation were slightly modified from those described by Tronstad et al [7]. For the clinical evaluation, an intraoral examination was performed with the aid of #5 dental mirror and dental probe to identify the type and quality of coronal restoration. Thus, clinical and radiographic classification of coronal restoration quality was made according to the criteria listed here:

1. *Adequate coronal restoration:* A permanent, intact restoration, with good marginal fit, no fractures, cracks, or recurrent caries

2. *Inadequate coronal restoration:* Any permanent restoration showing detectable signs of overhangs, fractures, cracks, poor marginal fit, or recurrent caries, or else the presence of a temporary restoration (teeth with no coronal restoration were also included in this group)

Periapical Status Evaluation

Preoperative and postoperative periapical status was evaluated according to periapical index (PAI) scores [20].

The teeth were classified according to healthy/success (PAI 1 and PAI 2, no symptoms or clinical signs) or diseased/failure (PAI 3, 4, and 5, presence of symptoms and/or clinical signs). The unit of evaluation was the whole tooth; thus, multirooted teeth were assigned the highest score among all roots.

Statistical Analysis

SAS software (SAS 9.2; SAS Institute Inc, Cary, NC) was used for data processing and statistical analysis. The Cohen kappa was calculated to assess intraexaminer agreement (in 2 calibration sessions performed 1 month apart) for restoration quality, root canal filling, and periapical status as well as to assess interassessment (clinical and radiographic) agreement for restoration quality. The Mann-Whitney and Friedman tests were used as the univariate approach to detect statistically significant differences between categories. Logistic regression (multivariate approach) was further used to study the relationship between independent variables and periapical status. The level of significance adopted was 5%.

Results

The intraexaminer agreement values of 0.942, 0.844, and 0.971 were found for root canal filling quality, coronal restoration quality, and periapical status, respectively, thus indicating almost perfect intraobserver agreement. A kappa value of 0.5081 was found for the clinical and radiographic assessments of restoration quality, indicating moderate agreement between both assessments.

Of the 337 patients, 63.8% were female, and 47% were aged 30–50 years. The most frequent tooth group was that of molars, with 38.1%, and the most frequent restoration type was composite resin, with 63.3% of the cases. A descriptive analysis of the study sample is given in Table 1.

The overall success rate for the 523 teeth was significantly higher than that of failure ($P < .05$). Similarly, the rate of adequate root canal filling was significantly higher than that of inadequate root canal filling ($P < .0001$). No significant difference was observed between the rate of inadequate coronal restoration and that of adequate coronal restoration at the follow-up examination ($P = .1933$, Table 2).

TABLE 1. Descriptive Analysis of Study Sample (337 patients, 523 teeth) by Using Relative (%) and Absolute Frequencies (n)

Variable	Category	*N*	%
Gender	Male	122	36.2
	Female	215	63.8
Age (y)	18–30	83	24.5
	31–50	161	47.7
	Older than 50	93	27.6
Teeth group	Anterior	166	31.7
	Premolar	158	30.2
	Molar	199	38.1
Restoration type	Amalgam	83	15.9
	Composite	331	63.3
	Crown and post	53	9.74
	Temporary	24	3.9
	Absent	34	6.5