Rubber Dam Use during Post Placement Influences the Success of Root Canal–treated Teeth

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Abstract

Introduction: Salivary leakage after root canal therapy is of great concern and can lead to failure of the endodontic therapy. The aim of this study was to investigate whether the use of a rubber dam (RD) during post placement impacts the success of root canal–treated teeth. **Methods:** Retrospective chart reviews of 185 patients with an average recall of 2.7 years were assessed for the incidence of a new periapical lesion (periapical index score >2) after root canal therapy and post placement. The patients were divided into 2 groups based on the presence or absence of an RD clamp in the verification radiograph during post placement. **Results:** Twenty-six patients (30 teeth) had a post placed with the use of an RD, and 159 patients (174 teeth) had a post placed without an RD. In the non-RD group, 128 (73.6%) teeth were considered successful at follow-up. In the RD group, 28 (93.3%) teeth were considered successful at follow-up. Based on the bivariate GEE model, the difference in success between these 2 groups was statistically significant ($P = .035$). **Conclusions:** The use of an RD during prefabricated post placement provides a significantly higher success rate of root canal–treated teeth. Using an RD is already considered a standard of care for nonsurgical root canal therapy; in addition, using an RD during restorative procedures that involve open teeth should also become a standard of care. *(J Endod 2013;39:1481–1484)*

Key Words

Endodontic therapy, prefabricated post and core, root canal treatment, rubber dam

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It has been long established that oral bacteria are responsible for pulpal and periapical disease (1) and are the primary etiologic factors associated with root canal failure (2–4). Salivary bacteria gain access to the root canal system through coronal leakage both while the tooth is restored temporarily and permanently (3). Although it has been shown that a well-obturated root canal helps to delay the recontamination of the root canal system (5), it is only a temporary barrier, and nearly the entire length of the root canal can be recontaminated within as short as 72 hours in the presence of coronal leakage (6, 7). This is the shortest time period tested, and it may be possible that significant contamination could be caused by coronal salivary exposure occurring in an even shorter time period.

During the process of post placement without the use of rubber dam isolation by dental practitioners, root canal–treated teeth are potentially exposed to saliva and subsequent microbial contamination. The lack of tooth isolation and an extended procedural time period, including radiographs and post space preparation, allow the patients to open and close their mouths, bathing the pulp chamber and root canal in saliva.

The use of a rubber dam (RD) is the standard of care for root canal treatment. According to the American Association of Endodontists position statement, "Tooth isolation is the standard of care; it is integral and essential for any nonsurgical endodontic treatment…only the dental dam isolation minimizes the risk of contamination of the root canal system by indigenous oral bacteria" (8). According to Ingle et al (9) in the Washington Study, a significant cause of root canal failure is inadequate cleaning and obturation of the root canal system, which leaves behind bacteria. The protocol followed for root canal therapy with the use of the RD can be negated once the restorative dentist exposes a recently cleaned and obturated root canal to indigenous oral bacteria during post placement without an RD.

To the authors' knowledge, the impact of coronal leakage during post placement has never been investigated, and it has become common practice for dentists and dental students to place a restoration after root canal therapy, including a post, without the use of an RD. Following an aseptic technique used during root canal therapy, the practitioner often abandons the use of the RD in favor of convenience, thus allowing contamination of the obturated pulp chamber and coronal aspects of the obturated root canals. The purpose of this study was to investigate whether the use of an RD in the placement of a prefabricated post and core impacts the success of root canal–treated teeth.

Materials and Methods

Institutional review board approval was obtained from Tufts University, Boston, MA. All electronic data were kept on a password-protected computer and were only available to the study investigators. Each subject was assigned a unique numeric identifier, which allowed coding of data for analysis. Data were queried based on American Dental Association codes for root canal treatment and post placement by Tufts University Department of Information Technology. No specific patient identifiers were collected. All research was conducted at Tufts University School of Dental Medicine (TUSDM).

Eight hundred forty-six patients treated at TUSDM undergraduate and postgraduate endodontic clinics during the period of 2008–2011 comprised the study population. During this period, root canal therapy was completed, and, subsequently, a prefabricated post and core was used to restore the tooth by an undergraduate dental

student before crown placement. Because of the retrospective nature of this study, no attempts were made to standardize the techniques by which root canal therapy or obturation were completed. However, all treatment can be assumed to have been done with techniques being taught at the time, which included step-back hand instrumentation with lateral condensation for the patients treated before the fall of 2010 and rotary instrumentation with continuous wave vertical condensation after that time. All treatment, although it was performed by various providers, was supervised by experienced endodontic faculty and residents. Patient records from the Axium dental charting system (Exan Group, Coquitlam, British Columbia, Canada) were reviewed to assess the periapical status of the tooth at the time of post placement and again at a recall period of at least 6 months to 6 years.

Inclusion criteria included the following:

1. Records had to be available for patients who had root canal therapy completed by undergraduate and graduate students at TUSDM within the time period indicated.
2. The tooth did not have a periapical lesion or a widened periodontal ligament (PDL) greater than twice the width of an adjacent health PDL (periapical index [PAI] score 1 or 2 only) (10).
3. Only endodontic cases of good quality were selected for evaluation.

Good quality was defined as "all canals were obturated, no voids were present, and fill of the main gutta-percha point was within 0.0–2.0 mm from the radiographic apex" (11). Exclusion criteria were as follows:

1. Teeth with a periapical lesion as determined by the presence of periapical radiolucency beyond that of a widened PDL (>2× PDL width) at the time of root canal treatment and post placement (PAI 3–5)
2. Patients without a follow-up radiograph of at least 6 months
3. Teeth extracted within the first 6 months after root canal therapy
4. Cases in which procedural errors (perforation, separated file, and transportation) occurred during post placement that resulted in extraction or decreased prognosis
5. Teeth with development anomalies, immature roots, and crown or root fracture

The charts and radiographs of patients were reviewed to determine eligibility. For charts meeting the inclusion criteria, the following data were recorded:

1. The presence of an RD clamp in the post placement verification radiograph, thus indicating the use of an RD during post placement (Fig. 1)
2. The presence or absence of periapical radiolucency upon the most recent recall examination not to be less than 6 months after post placement

The presence of periapical radiolucency, a PDL space wider than 2 times its normal width, or evidence of extraction at the time of recall, was determined as treatment failure.

Data collection was completed by 2 of the authors. The determination of a pre- and postoperative lesion was determined at the time of data collection and also by a third observer. The third observer was blinded to whether or not an RD was used by blocking out the coronal portion of the radiograph at the time of evaluation. All radiographs were projected to approximately 2 × 1.5 ft on a 9-foot screen and viewed under darkened lighting conditions. All disagreements were resolved by discussion among the 3 clinician investigators; if no consensus was reached, the tooth was excluded from analysis.

The follow-up radiographs were collected at the time of data collection and later evaluated for the presence of a postoperative lesion. At the time of the evaluation, none of the observers were aware of the RD isolation status of the follow-up radiograph being evaluated.

Statistical Analysis

A power calculation was conducted using nQuery Advisor (Version 7.0; Statistical Solutions, Saugus, MA). Assuming a 91% survival rate in the RD group and a 44% survival rate in the non-RD group (11), a sample size of at least 20 patients with an RD post placement and at least 100 patients with a non-RD post placement was determined to be adequate to obtain a type I error rate of 5% and a power greater than 90%.

Descriptive statistics (counts and percentages for categoric variables and means and standard deviation [SD] for continuous variables) were calculated. To account for the existence of multiple treatments on the same patient, statistical significance was assessed via generalized estimating equations (GEEs). A bivariate GEE model was used to test the association between the type of placement (RD or no RD) and success. A multivariate GEE model was also run to adjust for the number of years to follow-up. P values <.05 were considered statistically

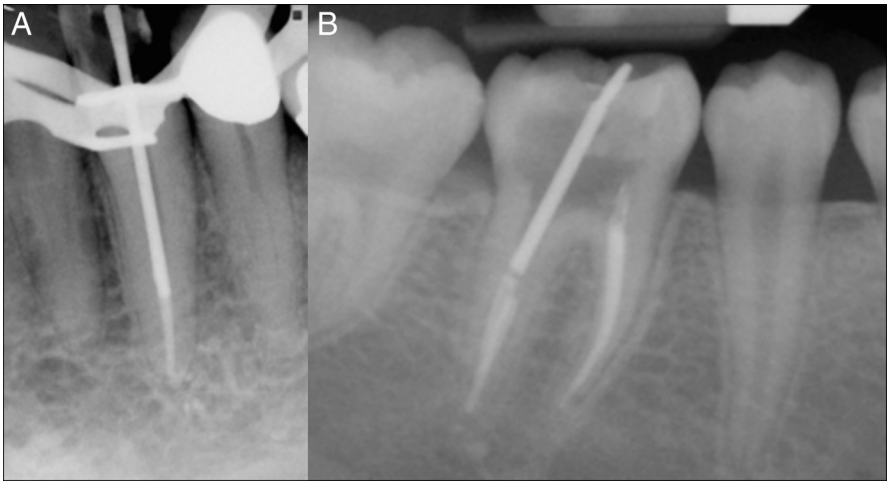

Figure 1. A typical post verification radiograph showing the (*A*) presence and (*B*) absence of an RD clamp. This is an example of a case that was included in the RD group.

significant. SAS Version 9.2 (SAS Institute, Cary, NC) was used to analyze the data.

Results

Charts were reviewed until a sufficient number of patients were obtained to satisfy the power analysis. One hundred eighty-five patients (204 teeth) met the inclusion criteria for the study. Recall ranged from 6 months–5.75 years (average = 2.7 years, SD = 1.5). Twenty-six patients (30 teeth) received at least 1 post placed with the use of an RD, and 159 patients (174 teeth) received at least 1 post placed without RD isolation (Table 1). Only 1 patient fell into both groups. The average age of the study population was 58.5 years (SD = 15.6 years). The average age of the RD group was 53 years (SD = 17.9); the average age of the non-RD group was 59.4 years (SD = 15.1). There was no statistically significant difference in age between the 2 groups.

Of the 174 teeth treated without the use of an RD, 128 (73.6%) were considered a success at the time of their final radiographic follow-up. Of the 30 teeth treated with the use of an RD, 28 (93.3%) were considered a success at the time of their final radiographic follow-up. Based on the bivariate GEE model, there was a statistically significant difference between the success rate when an RD was used during post placement ($P = .035$). When the model was adjusted for the number of years to follow-up, there was still a statistically significant difference in success rate based on the use of an RD ($P = .035$); however, there was no statistically significant association between follow-up time and success ($P = .652$).

Discussion

A minimum recall time of 6 months was chosen to permit sufficient time for radiographic and clinical signs and symptoms of failure to become apparent (12, 13). Animal models in monkeys have shown that periapical breakdown will become visible by 6 months in infected root canals (14). A maximal recall of 6 years was chosen because digital radiographs were implemented in 2007 and the authors were not able to access paper charts before this time.

The results of this study emphasize the importance of a quality aseptic technique in restoring root canal–treated teeth to preserve an uncontaminated environment within the root canal system. Salivary contamination results in oral pathogens being sealed within the pulp chamber. These bacteria then feed on the breakdown products of the bonded restorative materials, leading to coronal leakage and sustained bacterial contamination (15, 16). Coronal leakage and salivary contamination within the root canal system contribute to failure more often than an inferior technical quality root canal procedure (11). Specifically, a well-obturated tooth with a poor and presumably leaking coronal restoration has a survival rate of 44%, whereas a radiographically well-sealed restoration regardless of the quality of the root canal therapy provided an 80% survival rate. If we only consider good quality root canal therapy, the survival becomes over 91% (11). In addition, *in vivo* and *in vitro* leakage studies (6, 7) have shown that coronal leakage of saliva significantly contaminates nearly the entire length of the root canal system in as little as 72 hours.

It is common practice to leave at least 5–7 mm of gutta-percha apically during post space preparation to preserve an adequate apical seal. Removal of gutta-percha beyond this level has been shown to significantly increase the susceptibility to leakage (17). Furthermore, removal of gutta-percha to a level of 6 mm has been shown to lead to an unpredictable and significantly inferior seal compared with an intact root canal filling (18). The uncertain quality of the compromised apical seal as a result of gutta-percha removal during post space preparation leads to an even greater concern for the occurrence of salivary contamination. For this reason, during post space preparation and post placement, an RD should be used.

Both step-back hand instrumentation with lateral condensation and rotary instrumentation with continuous wave vertical condensation were used to treat patients in this study; however, no attempt was made to differentiate between which technique was used for each patient. Some studies suggest the type of instrumentation or obturation has no significant impact on the outcome of root canal treatment (19, 20), whereas other studies show that the type of instrumentation and obturation significantly impacts the outcome (21). Despite this observation, no differentiation was made between data samples taken in this study. This may be assumed to be a shortcoming of this study.

Given the limited availability of data for teeth treated with the use of an RD, this bias could not be avoided while obtaining a large enough data sample. This provides an opportunity for future research; however, a prospective study with a larger sample size and more controls of both bias and additional variable is warranted. The authors warn against drawing too many unwarranted conclusions from this article and recommend that it be used as the basis for future research on this topic.

To establish success in root canal–treated teeth, radiographic assessment and interpretation may be graded using a PAI score (22). A modified PAI score can be used when the tooth in question is free of a periapical lesion at the time of obturation. Therefore, a tooth that begins the observation period with a normal or widened PDL can only be ruled an absolute failure based on the development of a new frank periapical lesion (PAI > 2) (22). In the presence of an intact lamina dura and PDL space less than 2 times the width of adjacent healthy PDL space, the root canal therapy can be declared a success at the end of the observation period. Additionally, to remove confounding factors of inter- and intraobserver agreement as to the healing extent of an existing lesion, only teeth free of an existing preoperative lesion should be included. It has been well established that the interpretation of radiographs can be inconsistent (23).

The results of this study support previous findings that coronal contamination of the pulp chamber with salivary fluids in root canal–treated teeth decreases the long-term prognosis. The results further emphasize the importance of RD isolation and aseptic techniques in the restoration of these teeth. It was also observed that only 26 of 185 patients (14%) had an RD used during post placement. Given that dental school faculty do not emphasize its use, it is unlikely that upon graduation dental students will incorporate this technique into their dental practice. It is imperative that the importance of RD use is emphasized as a critical component of dental education.

TABLE 1. Outcomes for Post Placement with and without the Use of an RD

	Total (*n*)	Lesion on follow-up	Success (PAI ≤2)	Success (%)
No rubber dam	174	46	128	73.6
RD	30	2	28	93.3

PAI, periapical index; RD, rubber dam.

Conclusion

During prefabricated post placement, it was found that the success rate of the underlying endodontic treatment was significantly enhanced when an RD was used. Further studies need to be done to advance the knowledge about this important finding.

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The authors deny any conflicts of interest related to this study.

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