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## Rubber dam use during root canal treatment: findings from The Dental Practice-Based Research Network

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### Abstract

**Background**—The Dental Practice-Based Research Network (DPBRN) provides a venue to investigate whether certain procedures are performed routinely. Study objectives were to: (1) quantify rubber dam use during root canal treatment (RCT) among general dentists; (2) test the hypothesis that certain dentist or practice characteristics are associated with its use.

**Methods**—DPBRN practitioner-investigators participated in a questionnaire that included items about rubber dam use and other forms of isolation during root RCT. DPBRN Enrollment Questionnaire data provided certain practitioner and practice characteristics.

**Results**—A total of 729 practitioners responded (74%); 524 were general dentists and indicated they do RCT and the percentage of RCT in which they use a rubber dam. Of these 524, 44% use rubber dam for all RCTs; 24% use it for 51%–99% of RCTs; 17% use it for 1%–50%; 15% never use it during RCT. Usage varied significantly by geographic region and practice type. Cotton rolls and other forms of isolation were also reported.

**Conclusions**—Similar to other reports in the literature, not all DPBRN general dentists use a rubber dam during RCT.

**Clinical implications**—Because the current clinical standard of care is to use a rubber dam during RCT, increasing its use may be important.

## Keywords

Rubber dam; root canal treatment; practice-based research; dentistry

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## INTRODUCTION

The rubber dam has been used in dental care for decades and its use is well-described in many textbooks. It is considered the standard of care in root canal treatment (RCT) because of the advantages that it offers with regard to infection control, patient protection, and treatment efficacy.<sup>1-4</sup> Nonetheless, its use during RCT is hardly ubiquitous; indeed, studies have observed very wide ranges of use.<sup>5-20</sup> The small number of studies conducted with United States dentists have observed some low usage rates; the most-recent study (2007) found that 11% of general dentists never use a rubber dam during RCT and only 58% use one during every RCT.<sup>7</sup> One study in the United Kingdom reported on whether dentists use other isolation methods during RCT, and found that cotton rolls without rubber dam are also common.<sup>10</sup>

The Dental Practice-Based Research Network (DPBRN) is a consortium of dental practices with a broad representation of practice types, dentists, and treatment philosophies that conducts research with the ultimate goal of improving quality of care in dental practices.<sup>21-26</sup> It comprises practitioner-investigators and staff in outpatient dental practices mainly from five regions: AL/MS: Alabama/Mississippi, FL/GA: Florida/Georgia, MN: dentists employed by HealthPartners Dental Group (HPDG),<sup>27</sup> and private practitioners in Minnesota, PDA: Permanente Dental Associates,<sup>28</sup> in cooperation with Kaiser Permanente's Center for Health Research, and SK: the Scandinavian countries of Denmark, Norway, and Sweden. Additional practitioner-investigators have also been recruited in other U.S. states. The network provides a venue to investigate whether certain dental procedures are performed routinely in everyday clinical practice. DPBRN recently observed in one of its studies about restorative dentistry that 63% of practitioner-investigators did not use a rubber dam for any dental restorations in the study.<sup>29</sup> As part of an overall effort to quantify its infrastructure capabilities, DPBRN had an opportunity to include in a questionnaire items about use of a rubber dam during RCT.

The objectives for this report are to: (1) quantify -- among general dentists who report doing at least some RCT -- the percentage of DPBRN practitioner-investigators who indicate that they use a rubber dam during RCT; (2) quantify the percentage who report using some other form of isolation during RCT; and (3) test the hypothesis that certain dentist or practice characteristics are associated with use of a rubber dam during RCT.

## METHODS

### Network recruitment process

Practitioner-investigators were recruited into the network through continuing education courses and mass mailings to licensed dentists from the participating regions. The network has completed or launched a total of 22 studies, which include a broad range of study designs, topic areas, and enrollment sizes.<sup>23,30</sup> Although most DPBRN studies involve data collection from dental patients, some studies involve questionnaires only.

### Study design

The was a cross-sectional study, consisting of a single administration of a questionnaire entitled "Infrastructure Update Survey" (IUS) to all DPBRN practitioner-investigators who

had participated previously in one or more DPBRN studies of any type, and who were in current practice with an active practice address. Data were collected from December 2010 to May 2011. This project was approved by the human participants institutional review boards (IRBs) at the University of Alabama at Birmingham and all of DPBRN's regional IRBs. The informed consent of all human subjects who participated in this investigation was obtained after the nature of the procedures had been explained fully.

### Main Questionnaire Content

Questions about rubber dam use were included in a questionnaire designed to update information about certain infrastructure capabilities of DPBRN. The full questionnaire is publicly available at the DPBRN Supplement page.<sup>31</sup> The main questions of interest for this report were: (1) "Do you personally do any root canal procedures?"; (2) among those who responded affirmatively, "On what percent of these root canals do you estimate that you use a rubber dam?"; and (3) "Do you use any other type of isolation?" and if so, "please specify".

### DPBRN Enrollment Questionnaire

Since 2005, as part of enrollment in DPBRN practitioner-investigators complete a 101-item Enrollment Questionnaire about their practice characteristics and themselves. This questionnaire is publicly available<sup>32</sup> and the distribution of these characteristics for DPBRN dentists has been reported previously.<sup>24,25</sup> Among other items, this questionnaire includes practice location, type of practice (solo private practice, group private practice but not HPDG or PDA; HPDG or PDA; public health practice, community health center, or publicly-funded clinic; other type), whether the dentist is generalist or specialist, year of graduation from dental school, and the dentist's gender, race, and Hispanic/Latino ethnicity.

### Data collection process

Prior to full implementation of the survey, 34 practitioners and DPBRN staff pre-tested the questionnaire to assess the feasibility and comprehension of each questionnaire item and its online administration. Pre-printed invitation letters were sent by the network central office to eligible practitioners, inviting them to participate and to provide them with a unique identification number and log-in code to complete the online survey.

Practitioner-investigators were asked to complete the questionnaire within three weeks. A reminder letter was sent after the fourth week to those who had not completed the questionnaire. After an additional four weeks, a final reminder was sent, but this time a printed version of the questionnaire was also included and practitioners were offered the option of completing the online or paper version (ultimately, 87 practitioners (12% of all respondents) completed the paper version instead of the online version). Data collection was closed after a final three-week waiting period. Practitioners or their business entities were remunerated for completing the questionnaire if requested at the end of the survey.

### Statistical Methods

All analyses were done using SAS.<sup>32</sup> Statistical significance was assumed for  $p < 0.05$ . In addition to quantifying frequency distributions, bivariate cross-tabulations were done to examine associations between rubber dam use and certain dentist and practice characteristics, using  $\chi^2$  and Mantel-Haenszel  $\chi^2$  trend tests for statistical significance, or Fisher's exact test extension for RxC tables in case of small cell sizes. Multiple logistic regression was conducted to simultaneously examine the effect of explanatory variables (e.g., practice type, year of graduation) on the outcome (use of a rubber dam during RCT), after adjusting for the effect of other explanatory variables. Because use of rubber dam was

gathered on a four-point ordinal scale (none; 1%–50%; 51%–99%; 100%), a preliminary ordinal logistic regression was done using that scale. However, the proportional odds assumption required for ordinal logistic regression was violated, so the outcome was coded on a three-point scale (none; 1%–99%; 100%). With this three-point ordinal outcome, the proportional odds assumption was no longer violated. Because “type of practice” and “DPBRN region” are redundant for some regions, this precludes including both variables in a single regression due to multi-collinearity. “Type of practice” comprised five different types. In preliminary logistic regressions, it was clear that one practice type (HPDG or PDA) had a substantially different effect magnitude than the other practice types. Consequently, “type of practice” was thereafter coded dichotomously as “HPDG/PDA” or “not HPDG/PDA”. Preliminary regressions were adjusted for these variables: dentist’s year of graduation, gender, race, and ethnicity; none of these variables were statistically significant nor did they improve model fit, and were excluded from subsequent analyses. At that point, the multivariable regression became a regression with only one explanatory covariate (type of practice).

## RESULTS

### Characteristics of dentists who reported doing RCTs

Of 1,007 practitioner-investigators invited to participate, 16 were ultimately determined to be ineligible (13 retired or sold their practice, 2 no longer had an active practice address, and 1 was deceased), leaving 991 practitioners. Of these 991, 74% (n=729) completed the questionnaire or almost all of it. Differences in characteristics between responders (n=729) and non-responders (n=262) were not statistically significant with regard to the dentist’s gender of dentist or year of graduation from dental school. Practitioner-investigators in the AL/MS region had a significantly lower response rate (67%;  $p < 0.01$ ;  $\chi^2$  test) than those in the other regions combined (79%).

Of the 729 who completed the questionnaire, 76% (n=554) responded “Yes” to the question about whether they personally do any RCTs, and 553 of these also reported the percentage of RCT procedures in which they use a rubber dam. Of these 553 dentists, 14 were endodontists and 15 reported some other non-generalist category. All of the endodontists (n=14) reported that they use a rubber dam for 100% of the root canal procedures that they do. For the 15 others who were not general dentists, 7% (n=1) said “none” of the time was a rubber dam used; 20% (n=3) said 1%–50% of the time; 27% (n=4) said 51%–99%; 47% (n=7) said 100% of the time. The remaining 524 dentists, all of whom are general dentists, are the focus of the remainder of this report and their characteristics are shown in Table 1.

### Use of rubber dam and dentist/practice characteristics

A total of 44% (n=229) reported that they use a rubber dam for all RCTs (Table 2), and 15% (n=80) reported that they do not use a rubber dam for any of the RCTs that they do.

Table 2 also relates rubber dam use to certain dentist and practice characteristics. There was a statistically significant association between the DPBRN region and rubber dam use, with the highest use occurring in the PDA or other West region, and the lowest in the AL/MS region. Significant associations were also observed between rubber dam use and practice type, and year of graduation from dental school.

The ordinal logistic regression using the three-point outcome scale (none; 1%–99%; 100%) exhibited a modest model fit ( $c = 0.59$ ; likelihood ratio  $\chi^2 = 67.4$ ; 1 df;  $p < 0.0001$ ). The “type of practice” variable (“HPDG/PDA” or “not HPDG/PDA”) was statistically significant, with a large effect magnitude (odds ratio of 10.1; 95% confidence interval of 5.1

– 19.8). No other variables were included because they were not statistically significant and did not improve model fit.

### **Other types of isolation used during RCTs**

In addition to using a rubber dam, other forms of isolation were also reported. Of the 524 general dentists who performed RCT and reported the percentage of time in which they use a rubber dam, 204(39%) reported at least one other type of isolation in addition to reporting about whether or not they use a rubber dam. These open-ended responses were re-coded into three categories: (1) cotton rolls or gauze; (2) Isolite™<sup>33</sup>; and (3) all others. Responses from the 204 who reported at least one other type of isolation were evaluated by dis-aggregating into three groups of respondents: (1) practitioners who reported never using a rubber dam (n=53); (2) practitioners who reported using a rubber dam but in less than 100% of RCT (n=126); and (3) practitioners who reported using a rubber dam on all RCTs (n=25).

Among the 53 practitioners who reported never using a rubber dam, 44 reported using cotton rolls or gauze, 8 reported using Isolite™, and 1 reported another type of isolation. Among the 126 practitioners who reported using a rubber dam but in less than 100% of RCT, 95 reported using cotton rolls or gauze, 13 reported using Isolite™, and 18 reported using some other method of isolation. Among the 25 practitioners who reported using a rubber dam on all RCTs, 7 reported also using cotton rolls or gauze, 4 reported also using Isolite™, and 14 reported using some other isolation method in addition to a rubber dam.

## **DISCUSSION**

### **Use of rubber dam overall**

Rubber dam isolation is considered the standard of care for RCT by the American Association of Endodontists. However, only 44% of general dentists in the current study reported that they always use a rubber dam during RCT, with another 24% indicating that they used it more than half of the time. Previous studies have reported a broad range of rates of rubber dam usage,<sup>5–20</sup> and the finding in this study of DPBRN practitioner-investigators is within this range. For example, a study of RCT among practitioners in the United Kingdom observed that less than 19% of practitioners ever use a rubber dam during RCT; 45% reported that they never use a rubber dam.<sup>9</sup> Another British study found that 63% of respondents never use a rubber dam during RCT,<sup>10</sup> and 65% reported never or seldom use a rubber dam in a study of Belgian dentists.<sup>11</sup> In the Belgian study, only 7% of practitioners used a rubber dam in all RCT cases.<sup>11</sup> In a national survey of general dentists in New Zealand, a rubber dam was used routinely during RCT by 57% of practitioners.<sup>15</sup>

### **Association between rubber dam use and certain dentist/practice characteristics**

We observed significant variation in rubber dam use across our DPBRN regions, although region is confounded with practice type because in two DPBRN regions (Minnesota and the PDA region), most or all of the practitioner-investigators are in a large group practice model (more than 3 dentists in a practice). We observed substantially higher rubber dam use among HPDG and PDA (as shown in Table 2 and in the logistic regression results), even though practitioners in other group practices in DPBRN reported rubber dam use at rates similar to those in solo private practice or public health clinics. One reason for higher use among HPDG and PDA may be that these groups have a high level of peer review that occurs within the dentist's own practice organization, which reinforces the standard of care. Additionally, because training and emphasis may be different between the U.S. and Scandinavian dentists in DPBRN, we considered limiting this report to U.S. dentists only. However, the results with or without the Scandinavian dentists were substantively the same, leading to the same conclusions from the results. For example, with the Scandinavians

excluded, 15% (n=70) reported never using a rubber dam, 16% (n=77) use it from 1%–50%, 24% (n=110) from 51%–99%, and 45% (n=211) use it all the time. This compares to a very similar overall percentage distribution shown at the top of Table 2.

The literature provides little guidance about the possible role of practice type on rubber dam use. A National Health Insurance System study in Taiwan indicated that rubber dam usage was significantly higher in hospital settings compared to private dental clinics.<sup>17</sup> Practitioners in group practices used rubber dam more than those in solo practices.<sup>15,34</sup> However, higher use of rubber dam in private practices was reported when compared to mixed practices (mix of private and public patients) and National Health Services practices (68%, 55%, 45%) respectively.<sup>5</sup>

We observed that rubber dam use was universal among DPBRN endodontists (n = 14) - much higher than that for general dentists and other non-endodontists. Although few studies have investigated this topic, a U.S. national study done in 1994 observed that 92% of endodontists always used a rubber dam, compared to 59% of general dentists.<sup>13</sup> We did not have information from our respondents regarding whether they had other advanced training, such as that from a general practice residency or advanced education in general dentistry program, and therefore we could not determine if advanced training among the general dentists was associated with higher rubber dam use. Attendance at continuing education courses about this topic also could influence rubber dam use, but this was not measured in this study. It also is possible that rubber dam use is higher among general dentists who have their dental assistants place the rubber dam for RCT and other procedures.

DPBRN dentists who graduated more recently were significantly more likely to have reported rubber dam use, although its use among dentists who graduated in the year 2000 or later was still only 53%. We remind the reader that graduation year was not statistically significant in multivariable regressions that included the “type of practice” variable. Higher use among recent graduates was also observed in studies reported in 2000 and 2002.<sup>8,15</sup> Similar findings were also found within the age group of practitioners who were less than 40 years old in two British and Irish studies.<sup>5,19</sup> This is in contrast with another study that showed a trend for older practitioners to use rubber dam more than their younger counter parts.<sup>9</sup>

It is possible that many of the general dentists in this study only perform RCT on anterior teeth and refer to endodontists all RCT in posterior teeth; perhaps these general dentists would use rubber dams on posterior teeth if they did this type of treatment. Another possible explanation for low rubber dam use is that the general dentists in this sample use rotary endodontics when doing RCT. With rotary instrumentation, files are attached to a handpiece itself. Although this circumstance would decrease the likelihood of a patient aspirating or ingesting a file, the other reasons for using a rubber dam are not obviated (namely, infection control and treatment effectiveness). Additionally, rotary instrumentation is supplemented with hand files.

### Other forms of isolation

In the current study, other than the rubber dam, the most common method used for isolation was cotton rolls or gauze squares. This is consistent with a study conducted in 2009 that indicated that 37% of respondents used rubber dam to isolate some cases, 29% used cotton rolls alone or with some other form, and 3% replied that they did not use any form of isolation.<sup>10</sup>

A total of 25 general dentist practitioners reported using Isolite™, a device that simultaneously provides light, suction, retraction, and aspiration prevention.<sup>33</sup> We are not



aware of any studies that have compared the safety, comfort, and effectiveness of this device to the rubber dam, although there has been one opinion piece.<sup>35</sup>

This study does have certain limitations, and conclusions made from it should take this into account. The main limitation is that it relies on questionnaire information rather than information based on direct observation of procedures. Additionally, although the response rate was very good, it is possible that non-respondents would have reported different behavior. Furthermore, although DPBRN practitioner-investigators have much in common with dentists at large<sup>24,25</sup>, it is possible that their RCT procedures are not representative of dentists at large. Although rubber dam use was queried using the four-point ordinal scale, the multivariable regression analyses had to be done with a three-point scale (0%; 1%–99%; 100%), and this could have affected these results.

Rubber dam use reduces the potential for swallowing or inhaling materials or objects used during RCT, as well as pieces of tooth structure, restorative material, or necrotic tissue dislodged during access preparation.<sup>36–40</sup> In addition to patient safety and occupational safety benefits, benefits due to better infection control and treatment effectiveness have been reported.<sup>1–3</sup> For these reasons, use of a rubber dam during RCT is considered the standard of care.

## Conclusion

Although they have much in common with dentists at large,<sup>24</sup> DPBRN practitioner-investigators may be more attuned to the role of evidence in everyday clinical practice and be more open to incorporating it.<sup>21,23,41,42</sup> However, even among these practitioners, the use of rubber dam during RCT is not ubiquitous. Finding high use among certain sub-groups is encouraging. Previous research from DPBRN suggests that dentists who are currently doing procedures consistent with the latest scientific evidence can act as change agents to encourage adoption by their colleagues<sup>42</sup>; this circumstance may provide guidance as to how to improve rubber dam usage among the group at large.

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**Table 1**

Characteristics of general dentist practitioner-investigators included in analysis of rubber dam use (n=524)

<b>Characteristic (n)</b>	<b>Percentage</b>
<i>DPBRN region</i>	
Alabama/Mississippi (196)	37%
Florida/Georgia (117)	22%
Other Southeast (39)	7%
Midwest or Northeast (69)	13%
PDA or other West (47)	9%
Scandinavia (56)	11%
Missing (0)	
<i>Type of Practice</i>	
Solo private practice (263)	50%
Group private practice, but not HPDG or PDA (156)	30%
HPDG or PDA (72)	14%
Public health practice, community health center, or publicly-funded clinic (26)	5%
Other type (7)	1%
Missing (0)	
<i>Year of graduation from dental school</i>	
Before 1970 (14)	3%
1970–1979 (132)	25%
1980–1989 (176)	34%
1990–1999 (111)	21%
2000 or later (91)	17%
Missing (0)	
<i>Gender of dentist</i>	
Male (408)	78%
Female (116)	22%
Missing (0)	
<i>Race of dentist</i>	
White/Caucasian (435)	89%
Non-white (54)	11%
Missing (35)	
<i>Hispanic/Latino ethnicity of dentist</i>	
Non-Hispanic (413)	97%
Hispanic (15)	3%
Missing (96)	

Not all columns add to 100% due to rounding.

HPDG: HealthPartners Dental Group

PDA: Permanente Dental Associates

**Table 2**

Number (percentage) of RCT in which a rubber dam is used, by characteristic (n=524)

Characteristic (n)	Percentage of RCT in which a rubber dam is used			
	None	1–50%	51–99%	100%
<b>Overall</b>	80 (15%)	90 (17%)	125 (24%)	229 (44%)
<b>DPBRN Region *</b>				
Alabama/Mississippi (196)	50 (26%)	48 (25%)	52 (27%)	46 (23%)
Florida/Georgia (117)	13 (11%)	18 (15%)	29 (25%)	57 (49%)
Midwest or Northeast (69)	4 (6%)	6 (9%)	18 (26%)	41 (59%)
Other Southeast (39)	3 (8%)	5 (13%)	9 (23%)	22 (56%)
PDA or other West (47)	0 (0%)	0 (0%)	2 (4%)	45 (96%)
Scandinavia (56)	10 (18%)	13 (23%)	15 (27%)	18 (32%)
<b>Type of Practice *</b>				
Solo private practice (263)	42 (16%)	58 (22%)	69 (26%)	94 (36%)
Group private practice, but not HPDG or PDA (156)	34 (22%)	25 (16%)	37 (24%)	60 (38%)
HPDG or PDA (72)	0 (0%)	1 (1%)	10 (14%)	61 (85%)
Public health practice, community health center, or publicly-funded clinic (26)	2 (8%)	5 (19%)	8 (31%)	11 (42%)
Other type (7)	2 (29%)	1 (14%)	1 (14%)	3 (43%)
<b>Year of dental school graduation *</b>				
Before 1970 (14)	7 (50%)	4 (29%)	0 (0%)	3 (21%)
1970–1979 (132)	22 (17%)	19 (14%)	35 (27%)	56 (42%)
1980–1989 (176)	25 (14%)	34 (19%)	44 (25%)	73 (41%)
1990–1999 (111)	15 (14%)	24 (22%)	24 (22%)	48 (43%)
2000 or later (91)	11 (12%)	9 (10%)	22 (24%)	49 (54%)
<b>Gender of dentist <sup>ns</sup></b>				
Male (408)	63 (15%)	72 (18%)	97 (24%)	176 (43%)
Female (116)	17 (15%)	18 (16%)	28 (24%)	53 (46%)
<b>Race of dentist <sup>ns</sup></b>				
Non-white (54)	7 (13%)	6 (11%)	14 (26%)	27 (50%)
White/Caucasian (435)	70 (16%)	77 (18%)	107 (25%)	181 (42%)
Missing (35)	3 (9%)	7 (20%)	4 (11%)	21 (60%)
<b>Hispanic/Latino ethnicity of dentist <sup>ns</sup></b>				
Hispanic (15)	1 (7%)	2 (13%)	6 (40%)	6 (40%)
White/Caucasian (413)	63 (15%)	73 (18%)	98 (24%)	179 (43%)
Missing (96)	16 (17%)	(16%) 15	21 (22%)	44 (46%)

\*  $p < 0.05$ , the association between the characteristic and percentage of root canal treatments in which the dentist uses a rubber dam is statistically significant. Missing data were excluded before the statistical test was done. These variables had no missing data: DPBRN region, type of practice, type of dentist, year of dental school graduation, gender of dentist. This table is limited to the 524 general dentists who reported doing at least some root canal treatment and who reported the percentage of root canal treatments in which they use a rubber dam.

*ns* not statistically significant

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