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Survey on the modalities of rubber dam usage for root canal treatment



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المخلص

أهداف البحث: التعرف على أنماط استخدام السد المطاطي أثناء معالجة عصب القناة الجذرية للسن واستكشاف ما يفضله أطباء الأسنان في عزل الحالات الصعبة.

طرق البحث: تم الحصول على الموافقة الأخلاقية من لجنة أخلاقيات البحوث بكلية طب الأسنان بجامعة طيبة. بعد دراستين تجريبيتين، استُخدمت استبانة نهائية على الشبكة العنكبوتية تناولت الجوانب التالية: (أ) تصنيف المستطلعين، (ب) استخدام السد المطاطي، (ج) تعدد وطرائق استخدام السد المطاطي باعتبار موقع السن، (د) التعامل مع الحالات الصعبة. أرسلت الاستبانة إلى 375 طبيب أسنان عام و 53 من المتخصصين في علاج عصب القناة الجذرية للسن، وتم اختيارهم جميعاً بشكل منهجي ويعملون في المنطقة الغربية من المملكة العربية السعودية. وتم تحليل البيانات باستخدام مربع كاي واختبارات الترابط الخطية وتم تثبيت مستوى الدلالة عند 0.05.

النتائج: لم يستخدم السد المطاطي سوى 21% من أطباء الأسنان العامين بالمقارنة بـ 84.8% من المتخصصين في علاج عصب القناة الجذرية للسن. من الذين لم يوافقوا على استخدام السد المطاطي على الأسنان الأمامية، هناك نسبة 32% إضافية واطلبوا على استخدامها على الأسنان الخلفية. نسبة أولئك الذين استخدموا السد المطاطي في علاج الجذر الكامل ارتفع من 15.6% في الأسنان الأمامية إلى 27.3% في الأسنان الخلفية. تستخدم النسبة العظمى (40.3%) تقنية السد المنقسم في الأسنان المخروطية أو المعدة للتركيبات الثابتة. إضافة إلى ذلك فإن 63.3% يعيدون إصلاح الأسنان المتكسرة، في حين أن 52.9% من المتخصصين في علاج عصب القناة الجذرية للسن يستخدمون أوراسيل لختم السدود المطاطية المتسربة و 77.3% من أطباء الأسنان العامين يستخدمون كافيت.

الاستنتاجات: مستخدمو السد المطاطي، وبخاصة أطباء الأسنان العامين، مارسوا مزيداً من الاهتمام مع الأسنان الخلفية مقارنة بالأسنان الأمامية. فضل مستخدمو السد المطاطي علاج الحالات الصعبة بختم السدود المطاطية المتسربة واستخدام تقنية السد المنقسم.

الكلمات المفتاحية: علاج عصب القناة الجذرية للأسنان؛ العزل؛ التسرب؛ السد المطاطي؛ دراسة استقصائية

Abstract

Objectives: To identify the modalities for the use of rubber dam isolation during root canal treatments (RCTs) and to explore clinicians' preferences in isolating challenging cases.

Methods: Ethical approval was obtained from the College of Dentistry Research Ethics Committee, Taibah University. Following two pilot studies, a final web-based questionnaire addressed the following aspects: a) respondents classification, b) usage of rubber dam c) frequencies and modalities of rubber dam usage according to teeth location, and d) management of difficult cases. The questionnaire was sent to 375 systematically selected general dental practitioners (GDPs) and 53 endodontists in the Western province of KSA. Data were analysed using the Chi-square test at $p = 0.05$.

Results: Only 21% of GDPs used rubber dam compared to 84.8% of endodontists ($p < 0.001$). 32% of GDPs who did not always using a rubber dam on anterior teeth always used one on posterior teeth. The proportion of GDPs who used rubber dam during complete RCTs increased from 15.6% in anterior teeth to 27.3% in posterior teeth ($p = 0.006$). The highest proportion of GDPs (40.3%) used the split dam technique on conical or prepared teeth. In addition, 63.3% of GDPs rebuilt broken-down teeth. While 52.9% of endodontists used Oraseal to seal a leaking rubber dam, 77.3% of GDPs used Cavite.

Conclusions: Rubber dam users, especially GDPs, exercised more attention to posterior teeth compared to their anterior counterparts. Rubber dam users opted to manage difficult cases by sealing leaking rubber dam and to use the split dam technique.

Keywords: Endodontics; Isolation; Leaking; Rubber dam; Survey

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Introduction

Isolation of teeth undergoing root-canal treatments (RCTs) using a rubber dam (RD) was introduced by Sanford Barnum in 1864¹ and has been the most common isolation method. A RD provides a clean aseptic operating field, as it isolates the tooth from oral and salivary contamination.² Therefore, the outcome of RCTs performed under RD isolation is expected to be better. Goldffein et al found previous study³ concluded that using RD during prefabricated post placement provided a higher success rate for root canal treatment.³ They stressed that RD use should be a standard of care during restorative procedures. Nevertheless, the methodology of their study was questionable, as a radiograph showing a clamp in place was the confirmation of RD application. RD can be applied without the use of metallic clamps. A recent study reported a greater survival rate of teeth that received RCTs under RD isolation (90.3%) than the 88.8% survival observed among those treated without RD isolation.⁴ RD placement facilitates the use of intra-canal medicaments.^{2,5,6} Additionally, RD placement protects patients from the inhalation or ingestion of endodontic instruments and retracts soft tissues.⁷ These advantages are believed to contribute to a more efficient treatment.^{8,9} Therefore, RD isolation represents the indispensable gold standard of care in endodontic practice.^{8,10} This is especially important as the literature reports some cases of swallowing of endodontic files, which can be life-threatening.^{11,12}

Surveys are the only research tool that investigates aspects of RD use. Many studies were conducted in different countries and reported different usage frequencies^{6,13–22} demonstrating not only its popularity but also exploring factors influencing its usage among general dental practitioners (GDPs). Unfortunately, reports have shown poor RD usage among GDPs^{15–21} who claimed different reasons, including: placement difficulty, time-consumption, patients' rejection, lack of training, and high cost.^{17–19,22–24} However, other studies reported good RD use among GDPs in some countries.^{22,25,26} Moreover, some studies reported different preferences and usage modalities among users according to different clinical scenarios.^{6,24} Nevertheless, there is still need for more information on how RD users manage different challenging cases, including heavily broken teeth, teeth with conical or prepared crowns, and incomplete isolation.

This study is a second part of a survey study that was conducted in KSA and aimed at identifying preferred modalities of RD use during RCTs, according to teeth location and exploring clinician's preferences in isolating challenging cases and managing leaking RDs. Therefore, the null hypotheses of this study were:

- I. There would be no significant differences between GDPs and endodontists regarding RD use according to teeth location.
- II. There would be no significant differences between GDPs and endodontists with regards to the management of leaking RD.

Materials and Methods

This cross-sectional study was executed according to the latest World Medical Association's Declaration of Helsinki. The ethical approval was obtained from the Research Ethics Committee at the College of Dentistry, Taibah University, KSA. Because participants' identities and contact details were to remain anonymous, the ethical committee did not request participants' consent forms. Two pilot studies were conducted on staff members at Taibah University College of Dentistry and a group of dentists to ensure that relevant aspects were included and that questions were easily answered. The final web-based questionnaire related to this part was constructed addressing the following aspects: a) respondents classification, b) RD use, c) frequencies and modalities of RD use according to teeth location, and d) managing difficult cases and leaking RD. A sample size calculation was carried out considering a 40–60% expected response rate. Three-hundred-seventy-five GDPs were randomly and systematically selected from the dental register of the western province of KSA. The survey was emailed to the 375 GDPs and all of the endodontists working in the western province of KSA ($n = 53$). A reminder was sent after eight weeks. Data were collected and analysed using the Chi-square test at $p = 0.05$.

Results

I. Response Rate Details

- The survey was emailed to 375 GDPs and 53 endodontists = 428.
- Overall response rate: $237/428 = 55.4\%$.
- GDPs and others' response rate: $203/375 = 54.1\%$.
- Endodontists' response rate: $34/53 = 64.2\%$.

II. Frequency of RD use

Only 37.3% of respondents used RDs, which was significantly lower than that of participants who did not use RDs (62.7%) [$p < 0.001$] [Table 1]. The proportion of GDPs who used RDs (21.6%) was significantly lower than that of endodontists (84.8%) [$p < 0.001$].

a) Anterior Teeth

Significantly, the highest proportion of RD users (63.6%) always used RDs in anterior teeth ($p < 0.001$) [Table 2], with significantly more endodontists (83%) using RDs compared to GDPs (50%) [$p = 0.003$].

b) Posterior Teeth

Significantly, the highest proportion of RD users (72.7%) always used RDs in posterior teeth ($p < 0.001$) [Table 3], with significantly more endodontists (91.9%) compared to GDPs (56.2%) [$p = 0.023$].

c) Differences according to location of the teeth

Participants reported significant differences in using RDs according to the location of the teeth (Table 4). The

Table 1: Rubber use among respondents (%).

Respondents	Yes	No	Total
Endodontists	28 (84.8)	5 (15.2)	33 (100)
Endodontics postgraduate students	9 (100)	(0) (0)	9 (100)
GDPs	33 (21.6)	120 (78.4)	153 (100)
Others	8 (57.1)	6 (42.9)	14 (100)
Total	78 (37.3)	131 (62.7)	209 (100)

proportion of participants who *always* used RDs in *posterior teeth* (72.7%) was significantly greater than participants who used RDS in *anterior teeth* (63.6%). Thirty-two per cent of participants who were *not always* using RDs in *anterior teeth* *always* used RDs on *posterior teeth* ($p < 0.001$) [Table 4].

III. Modalities of RD use

a) Anterior Teeth

Significantly, the highest proportion of participants who used RD in anterior teeth (61%) used it during *complete RCT* ($p < 0.001$) [Table 5], with significantly more endodontists (73%) than GDPs (46.9%) [$p = 0.029$].

b) Posterior Teeth

Significantly, the highest proportion of participants who used RD in *posterior teeth* (61%) used RDs during *complete RCT* ($p < 0.001$) [Table 6]; with a significantly more endodontists (73%) than GDPs (46.9%) [$p = 0.016$].

c) Differences according to the location of teeth

The proportion of endodontists using RDs during *complete RCT* in anterior and posterior teeth (73%) was greater than the proportion of GDPs (46.9 and 47%) [$p = 0.016$]. Approximately 53% of participants who used RDs during *cleaning and shaping only*, *root-canal filling* or *both phases* in *anterior teeth* shifted to using RDs during *complete RCT* (after accessing a cavity) in *posterior teeth*. This resulted in a significant increase in the proportion of the use of RDs during *complete RCT* (after accessing a cavity), from 15.6% in *anterior teeth* to 27.3% in *posterior teeth* ($p = 0.006$) [Table 7].

IV. RD Isolation of Difficult Cases

a) Conical or prepared teeth

For conical or prepared teeth, the highest proportion of participants (40.3%) used the *split dam* technique followed by participants *making composite-undercuts* (27.3%) [$p = 0.002$], with no significant difference between endodontists and GDPs ($p = 0.074$) [Table 8].

b) Broken-down teeth

The highest proportion of participants (63.3%) *rebuilt the tooth* followed by participants using the *split dam technique* (19.5%) [$p < 0.001$], with no significant difference between endodontists and GDPs ($p = 0.263$) [Table 8].

V. Management of Leaking RDs

Significantly, the majority of RD users (77.9%) *sealed the leaking RD* ($p < 0.001$), with significantly more endodontists (91.9%) than GDPs (68.8%) ($p = 0.020$) [Table 9]. While the highest proportion of endodontists (52.9%) used *Oraseal* to seal a leaking RD, the majority of GDPs (77.3%) used *Cavit* or other temporary fillings ($p < 0.001$).

Discussion

Survey studies should be well planned and carefully performed so the results are representative.^{27,28} This study had a few inescapable limitations. It approached only GDPs and endodontists of the western province of KSA. Our unpublished data showed no significant differences in RCT practice between the clinicians of the western province of KSA and those of other areas of KSA. Using web-based questionnaires rather than a postal self-administrative questionnaires may be another limitation. However, the results are invalid only if the non-respondents differ from the respondents.²⁹ If the non-response is not attributed to the study design, the non-respondents can be neglected and the respondents are a representative sample of the population.²⁹ One reported approach to inspect non-response bias is to identify the late-response bias by comparing the early response with the late response.³⁰ Our results showed no significant differences between the proportion of *early respondents* who sealed the leaking RD (78.7%) and that of *late respondents* who sealed the leaking RD (76.7%). Two pilot studies were conducted to ensure that the questions could be easily answered to avoid interpretation-related bias.³¹ However, good sampling is a key factor that validates survey results.³¹ The GDPs in the current study were randomly and systematically selected from the dental register. Although a 70–80% response rate minimizes the risk of bias,^{28,32} a response rate as low as 43% was considered to have a minimum non-response bias.³¹ Therefore, the 55% response rate reported in the current study is acceptable, considering that web-based questionnaires usually have a poor response rate compared to those sent by post.³³

RD isolation of teeth receiving RCTs has been a standard of care.⁸ However, our results showed that only 21.6% of GDPs used RD isolation. Tooth location has been suggested to be an influencing factor.^{6,10,24} Mala *et al*²⁴ reported no significant difference in the use of RDs between anterior, premolars, or molar teeth (98% for each of the three groups). However, respondents were final year students and the use of RDs was mandatory. Shashirekha *et al*¹⁰ also reported similar results. By contrast, Lynch and McConnell reported different rates of RD use per tooth type.⁶ RD was ‘never’ used by 39, 32 and 26% of respondents when performing RCTs in anterior, premolar and molar teeth, respectively.⁶ Lynch and McConnell reported that the proportion who ‘always’ used RDs when performing RCTs increased from 27% for anterior teeth to 32% for premolars and 40% for molars. However, the proportions were calculated from all respondents. In our study, the proportions were calculated within the RD users group. Our results showed a similar trend, which may

Table 2: RD frequency of use in anterior teeth.

Respondents	Always (100%)	Generally (90–99%)	Frequently (50–89%)	Sometimes (10–49%)	Rarely (1–9%)	Total
Endodontists	83.8	10.8	0	2.7	2.7	100
GDPs	50	12.5	2.5	6.2	18.8	100
Others	25	25	0	12.5	37.5	100
Total	63.6	13	5.2	5.2	13	100

Table 3: RD frequency of use in posterior teeth.

Respondents	Always (100%)	Generally (90–99%)	Frequently (50–89%)	Sometimes (10–49%)	Total
Endodontists	91.9	8.1	0	0	100
GDPs	56.2	21.9	9.4	12.5	100
Others	50	12.5	25	12.5	100
Total	72.7	14.3	6.5	6.5	100

Table 4: Differences in the RD frequencies of usage between anterior and posterior teeth.

		Frequency of usage in posterior teeth		Total
		Always	Other frequencies	
Frequency of usage in anterior teeth	Always	95.9 (83.9)	4.1 (9.5)	100 (63.6)
	Other frequencies	32 (16.1)	67.9 (90.5)	100 (36.4)
Total		72.7 (100)	27.3 (100)	100

The numbers in parentheses are frequencies for columns.

reflect a similar perception by respondents towards the use of RDs despite the different practice environment. Respondents who *always* used RDs in *posterior* teeth (72.7%) were greater in proportion than the respondents who *always* used RDs in *anterior* teeth (63.6%). In addition, 32% of respondents who did *not always* use RDs on *anterior* teeth, *always* used RDs on *posterior* teeth. Practitioners may give more attention to posterior teeth because performing a RCT may have a

greater risk of ingestion or inhalation of endodontic instruments. In addition, the need for soft tissue retraction is emphasised. Moreover, accumulation of saliva and fluids around posterior teeth can be greater than for anterior teeth, which stresses the need for isolation that may not be achieved sufficiently by cotton rolls and/or saliva ejectors. Conversely, dentists believe that isolation of anterior teeth may be obtained by these alternatives. Nevertheless,

Table 5: Modalities for RD use in anterior teeth.

Respondents	Complete RCT during	During complete RCT but after accessing cavity	During obturation	During C&S and obturation	Total
Endodontists	73	13.5	2.7	10.8	100
GDPs	46.9	15.6	0	37.5	100
Others	62.5	25	12.5	0	100
Total	61	15.6	2.6	20.8	100

Table 6: Modalities for RD use in posterior teeth.

Respondents	Complete RCT during	During complete RCT but after accessing cavity	During C&S	During obturation	During C&S and obturation	Total
Endodontists	73	18.9	0	0	8.1	100
GDPs	46.9	37.5	6.2	3.1	6.2	100
Others	75	25	0	0	0	100
Total	61	27.3	2.6	1.3	6.5	100

Table 7: Difference in the modalities of RD usage between anterior and posterior teeth.

		Modalities of RD usage in posterior teeth		Total
		During complete RCT but after accessing cavity	Other modalities	
Modalities of RD usage in anterior teeth	During complete RCT (but after accessing cavity)	100	0	100
	Other modalities	53.3	46.7	100

Table 8: Methods of RD placement for conical, prepared and broken-down teeth.

Type of teeth	Rebuild the tooth	Make opposite undercut	Split dam technique	Clamp the gingiva	Refer to specialist	Total
Conical or prepared for prosthetics		27.3	40.3	23.4	9.1	100
Broken down	63.6		19.5	14.3	2.6	100

practitioners need to realize that RDs should always be placed in all cases regardless of teeth location. Additionally, RDs should be placed during all RCT procedures, with few exceptions. To our knowledge, there has been no study on dentists' preference in this regard. Almost 61% of users, in our study, used RDs *during complete RCT* on both *anterior* and *posterior* teeth. Approximately 53% of those who used RDs during *cleaning and shaping only*, *root-canal filling* or *both phases* in *anterior* teeth shifted to the use of RDs during *complete RCT (after accessing the cavity)* in *posterior* teeth. This again may reflect practitioners' greater attention towards posterior teeth. Preparation of access cavity without RDs predisposes inhalation or ingestion of tooth fragments, restorative materials or drilling burs that may secondarily fracture during the procedure.^{34–37} Nevertheless, this policy can be acceptable in specific cases, such as crowned teeth or abutments for fixed bridges, as dentists may misdirect the bur during access.³⁸

Conical shaped teeth, teeth prepared for crowns or bridges or severely broken-down teeth are difficult to retain

RDs clamps in a stable manner. In the current study, RD users reported different approaches according to each case. The highest proportion of them (40.3%) used a *split dam technique* for *conical* or prepared teeth. Anchoring the dam to the adjacent teeth is an acceptable approach. However, complete isolation cannot be achieved, which can result either in contamination with oral fluids or escape of the irritating irrigants. This necessitates sealing the leaking RD. The second highest proportion of RD users (27.3%) would *make composite-undercuts* to place RDs on conical or prepared teeth. An acid etched composite or self-curing resin beads can remain attached to the tooth between appointments, facilitating RD placement at each visit.^{39,40} The highest proportion of RD users (63.6%) opted to *rebuild the broken-down tooth* to enable RD placement before commencing RCTs. Although this technique requires special bands and extra time, which means extra cost, it possesses many advantages, including easier clamp placement and better isolation and vision. In addition, there will be a lower risk of inter-appointment coronal leakage because the coronal restoration will be better

Table 9: Leaking RD management.

Respondents	Do not Seal	Seal the Leaking RD using:				Total
		Cavit or other temporaries	Oraseal	Liquid RD	Others	
GDPs	31.2	77.3	4.5	9.1	9.1	100
Endodontists	8.1	35.3	52.9	11.8	0	100
Others	50	50	0	0	50	100
Total	22.1	51.7	31.7	10	6.7	100
		77.9				

retained. Amalgam, composite and glass ionomer cement have been used for rebuilding broken-down teeth before RD placement.^{38,41–43} In such situations, copper or orthodontic bands are of great value to accommodate the restorative material.⁴⁴ The third most common technique for placing RDs on conical, broken-down or prepared teeth (23.4%) was *clamping the gingiva*. This is an easy, but not frequently recommended, procedure because clamping the gingiva is traumatic to soft tissues and results in bleeding that may jeopardizes adequate isolation.⁴² Therefore, modified clamps, such as *tiger clamps* (clamps with serrated jaws), can be used. Crown lengthening, tooth orthodontic extrusion, using molar clamps to isolate two adjacent single-rooted teeth, using clamps with apically inclined prongs, using a S-G clamp or placing a temporary crown are other effective alternatives that enable RD placement.^{39,41,45,46} Another method of isolation is using interproximal wedges, either pieces of RD or a commercial product, such as Wedgets. This is usually a convenient method to isolate several anterior teeth, providing a clear operating field.⁵ In this method, the adjacent teeth are used to hold the dam in place to enable the isolation of a single tooth in case a clamp cannot be retained. Another method to isolate severely broken teeth or roots is by cutting a slot in the dam to enable the tooth or the root to be isolated.⁵ However, it is essential that a caulking material is applied to provide adequate isolation.

Nevertheless, when a dentist cannot place the RD, referring the patient to a specialist should be the last resort. Nine percent of RD users, in the current study, would do so in cases of *conical* or *prepared* teeth, which may reflect clinicians' awareness of their limitations and their willingness to provide a high quality of treatment.

There may be clinical situations (especially in broken-down, prepared or tilted teeth) in which placing a RD does not offer complete isolation. Hence, intra-oral liquids may contaminate the root-canal system² and irrigation solutions may escape, damaging surrounding soft tissues, which necessitates sealing the leaking RD. The majority of RD users in the current study (77.9%) sealed the leaking RD. This reflects their understanding of the importance of isolating teeth, and sealing the leaking RD. It also shows their intention to provide RCTs at high standards. The proportion of endodontists who would *seal the leaking RD* (91.9%) was significantly greater than the proportion of GDPs who would do so (68.8%). Many materials have been used to seal the leak, including Cavit (3M ESPE, St. Paul, MN, USA), Orabas, periodontal dressing, rubber base adhesive, or Oraseal.^{2,47,48} Whilst the majority of GDPs (77%) preferred *Cavit* or other *types of temporary fillings*, 53% of endodontists used the *OraSeal* material. This might be explained in light of the properties of both materials. Unlike the *Cavit* filling, OraSeal (Ultradent Products, Inc. South Jordan, UT, USA), as the manufacturer claims, can effectively adhere to wet surfaces, such as RDs, gingival and mucosal tissues, teeth and metals.⁴⁹

Conclusions

Within the limitations of this study, it can be concluded that RD users, especially GDPs, exercised more attention to

isolate posterior teeth compared to anterior teeth. RD users opted to manage difficult cases by sealing leaking RDs and using the split dam technique.

Authors' contributions

AAM was the project founder and leader. He designed and prepared the questionnaire, applied for ethical approval, conducted the online questionnaire, performed statistics, wrote the methods and results, prepared tables, revised the final manuscript and acted as corresponding author. HABY designed the questionnaire, converted EXCEL document to SPSS document, and wrote the first draft of introduction and discussion. Both authors read and approved the final manuscript.

Conflict of interest

The authors have no conflict of interest to declare.

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