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Rubber Dam Use in Endodontic Versus Adhesive Restorative Procedures Among General Dental Practitioners: A Multiregional Cross-Sectional Survey

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Abstract

Introduction: Effective moisture control and prevention of microbial contamination are essential for predictable outcomes in endodontic and adhesive restorative dentistry. Rubber dam (RD) isolation is recommended for these procedures, but its use in general dental practice remains inconsistent. This study aimed to describe self-reported RD use during endodontic and adhesive restorative procedures among surveyed general dental practitioners in Europe, the Middle East, and Africa; compare routine use between regional groups; examine years of professional experience across endodontic RD-use categories; and characterize reported barriers to non-routine use.

Methods: A multicenter cross-sectional survey recruited a convenience sample of 548 general dental practitioners attending continuing professional development courses during 2017-2023; 539 were analyzed after exclusion of nine incomplete questionnaires. An anonymous, study-specific questionnaire, pilot-tested with 20 practitioners but not formally validated, recorded professional experience, self-reported RD use during endodontic and adhesive restorative procedures, and barriers to non-routine use. Responses were pooled across the recruitment period. Analyses used Pearson's chi-square tests and one-way analysis of variance (ANOVA) with Tukey post-hoc comparisons of professional experience across endodontic RD-use categories. No multivariable adjustment was performed.

Results: Reported routine RD use ("I use it") was 47.5% for endodontic procedures and 24.9% for adhesive restorative procedures. Routine RD use was less frequent in the Middle East/Africa than in Europe for both endodontic procedures (33.4% vs. 67.6%; χ^2_1=60.99; p<0.001) and adhesive restorative procedures (18.3% vs. 34.2%; χ^2_1=17.75; p<0.001). Years of professional experience differed across reported endodontic RD-use categories (one-way ANOVA; p<0.001). Among respondents included in the barrier analysis, patient-related barriers were reported more frequently in the Middle East/Africa than in Europe (21.6% vs. 5.7%; χ^2_1=15.00; p<0.001).

Conclusions: Self-reported routine RD use, defined as the "I use it" response category, was limited, particularly for adhesive restorative procedures, despite professional recommendations supporting RD isolation. Routine use was less frequent in the Middle East/Africa than in Europe, and routine endodontic users had fewer mean years of professional experience than non-users. These findings describe unadjusted associations in the surveyed sample during 2017-2023 and do not establish independent effects or current practice patterns. Targeted continuing education addressing technical skills and patient communication warrants formal evaluation as a potential strategy to improve routine RD use.

Categories: Epidemiology/Public Health, Dentistry
Keywords: clinical practice patterns, cross-sectional survey, dental isolation, endodontics, restorative dentistry, rubber dam

Introduction

Effective moisture control and prevention of microbial contamination are fundamental prerequisites for predictable outcomes in contemporary endodontic and adhesive restorative dentistry. Rubber dam (RD) isolation is recognized as the gold standard for achieving these objectives and is consistently recommended by major professional dental organizations worldwide, including the American Association of Endodontists, the European Society of Endodontology, and the American Dental Association [1-3]. The clinical benefits of RD isolation are well documented and multifaceted [1-5]. In endodontics, RD use prevents salivary contamination of the root canal system, reduces bacterial load, and improves disinfection efficacy, thereby enhancing treatment outcomes and reducing the risk of procedural complications [3,5]. In adhesive restorative dentistry, RD provides moisture control that supports bonding of resin-based materials to tooth structure [4,6-10]. Additional advantages include enhanced visibility and access and protection of the patient's airway from aspiration of instruments or irrigants [2]. RD isolation may also support infection-

control practices by limiting exposure to saliva and potentially reducing procedural aerosol contamination; these considerations received increased attention during the COVID-19 pandemic [11-15]. The clinical longevity of posterior resin-composite restorations has also been evaluated in a systematic review and meta-analysis [16].

Although RD isolation is taught during dental training, a survey of dental students found variation in its use and identified placement difficulty and time constraints as barriers [17]. Surveys involving dental practitioners likewise show that RD use is not consistent: a Saudi survey assessed attitudes and use across several practitioner groups, while a practice-based study found that fewer than half of general dentists reported always using RD during root canal treatment [18,19]. The European Society of Endodontology recommends dental dam isolation as part of a meticulous aseptic technique during the nonsurgical treatment of pulpal and apical disease [20]. Together, these findings highlight a gap between recommended isolation practices and their consistent use in clinical settings.

Previous investigations of RD use have predominantly focused on single-country surveys or specific practitioner groups such as endodontists or pediatric dentists [17-19]. While these studies provide valuable insights into national practice patterns, comparative multinational data for general dental practitioners across diverse geographic and socioeconomic contexts remain limited. The influence of years of professional experience on RD adoption also appears to vary across regions, suggesting that cultural, educational, medico-legal, and healthcare system factors may differentially affect clinical practice patterns [17-19]. The primary objective of this multinational cross-sectional survey was to describe self-reported RD use during endodontic and adhesive restorative procedures among general dental practitioners attending continuing professional development courses in selected countries in Europe, the Middle East, and Africa. Secondary objectives were to compare reported routine use between Europe and the combined Middle East/Africa group, examine differences in years of professional experience across endodontic RD-use categories, and describe reported barriers to non-routine use and their regional differences. We hypothesized that reported routine RD use would be more frequent among practitioners in Europe than in the combined Middle East/Africa group and that practitioners reporting routine endodontic RD use would have fewer years of professional experience than non-users.

Materials And Methods

Study design and ethical considerations

This multicenter cross-sectional survey was conducted between 2017 and 2023 among general dental practitioners attending continuing professional development courses in restorative and endodontic dentistry across multiple countries. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies [21]. Participation was voluntary and anonymous, and verbal informed consent was obtained before questionnaire completion. Following review of the submitted study materials, the Scientific Committee of Dental College, Lebanon, determined that formal ethical approval was not required for the study as described and that the previously collected anonymous questionnaire data could be analyzed and reported for scientific purposes (decision reference: DC-2026-09; date: September 29, 2026). Questionnaires collected during the study period were pooled for the present analysis. The study was not designed to assess year-to-year trends in RD use or the effect of the COVID-19 pandemic.

Study population and sampling

A convenience sample of general dental practitioners was recruited from attendees of continuing education courses in restorative and endodontic dentistry conducted in Europe (France, Belgium, Switzerland, and the United Kingdom) and the Middle East and Africa (Lebanon, the United Arab Emirates, Saudi Arabia, Egypt, and Morocco).

Eligible participants were qualified general dental practitioners who were actively practicing, attended a designated course, and voluntarily consented to participate. Dental specialists (endodontists, prosthodontists, and pediatric dentists), dental students and interns, retired practitioners not in active clinical practice, and respondents with incomplete questionnaires were excluded.

No prospective sample-size calculation was performed; the sample size was determined by the number of eligible practitioners who participated during the recruitment period. Of 548 practitioners who participated, nine were excluded because of incomplete questionnaires, leaving 539 respondents for analysis: 222 from Europe and 317 from the Middle East and Africa.

Questionnaire design and data collection

The anonymous, structured Clinical European Dental Group for Evaluation (EDGE) questionnaire was developed by the principal investigator specifically for this study and was not reproduced or adapted from a previously published questionnaire. It was pilot-tested with 20 general dental practitioners who were excluded from the final sample, and minor wording changes were made to improve clarity and comprehensibility. This preliminary testing did not constitute formal validation, and no quantitative validity

or reliability measures were obtained. The questionnaire collected distinct descriptive information on professional background, RD use, and perceived barriers, rather than items intended to form a single composite scale; therefore, an overall Cronbach's alpha was not calculated. The questionnaire's measurement properties remain incompletely characterized.

The questionnaire items relevant to the present analysis covered three domains. The first domain is demographics and professional background which included year of graduation, country of current practice, and main practice setting (private, public, or academic). Years of professional experience were calculated from the graduation year, and countries of practice were grouped into geographic regions for analysis. The second domain is RD use patterns, where participants reported RD use during endodontic and adhesive restorative procedures using three response categories: "I use it", "I occasionally use it", and "I do not use it". Availability of RD materials in the practice setting was also recorded. For analysis, the "I use it" category was classified as reported routine RD use. The third and last domain is barriers to RD use, where participants who reported occasional use or non-use for either procedure were asked to select reasons for non-routine use from predefined categories: manipulation-related factors, patient-related factors, time/economic factors (availability, time, and cost), educational factors, and "other", with a free-text response option. Multiple responses were permitted. The questionnaire administered to participants is provided in the Appendices.

Statistical analysis

Data were entered into Microsoft Excel (Microsoft Corporation, Redmond, Washington, United States) and analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, New York, United States). Categorical variables are presented as frequencies and percentages and years of professional experience as means and standard deviations. Analyses were restricted to respondents with data available for the variables being examined; denominators are specified where they differ from the final sample of 539 respondents. Accordingly, analyses involving years of professional experience included 532 respondents with available experience data. Associations between categorical variables, including reported RD use, reasons for non-use, and geographic region, were assessed using Pearson's chi-squared test. Differences in years of professional experience across the three endodontic RD-use categories ("I use it", "I occasionally use it", and "I do not use it") were assessed using one-way analysis of variance (ANOVA), followed by Tukey post-hoc comparisons when the overall test was statistically significant. Chi-squared results are reported as the Pearson χ^2 statistic, degrees of freedom, and two-sided p-value. The overall ANOVA result is reported with a two-sided p-value.

Regional differences in reported routine RD use were expressed as absolute prevalence differences, prevalence ratios (PRs), and crude odds ratios (ORs), each with 95% confidence intervals (CIs), using Europe as the reference group. No multivariable adjustment was performed; therefore, all effect estimates represent unadjusted associations and should not be interpreted as independent effects of geographic region. Statistical significance was set at $p<0.05$.

Results

Demographics and professional characteristics

The final study sample comprised 539 general dental practitioners, with 222 (41.2%) from Europe and 317 (58.8%) from the Middle East and Africa. The overall mean professional experience was 12.76 years (SD: 10.43). The distribution of professional experience was as follows: <5 years, 28.4%; 5-10 years, 31.2%; 11-20 years, 24.7%; and >20 years, 15.7%. Most respondents practiced in private settings (72.3%), followed by public clinics (18.6%) and academic institutions (9.1%).

Overall RD use patterns

The proportion of respondents who reported routine RD use ("I use it") was 47.5% (n=256) for endodontic procedures and 24.9% (n=134) for adhesive restorative procedures. The distribution of RD-use categories for endodontic procedures and routine versus non-routine use for adhesive restorative procedures is illustrated in Figure *1*. RD materials were available in 68.3% of practice settings and were significantly more frequently available in Europe (81.5%) than in the Middle East and Africa (59.3%) (Pearson's chi-squared test: $\chi^2_1=29.87$; $p<0.001$).

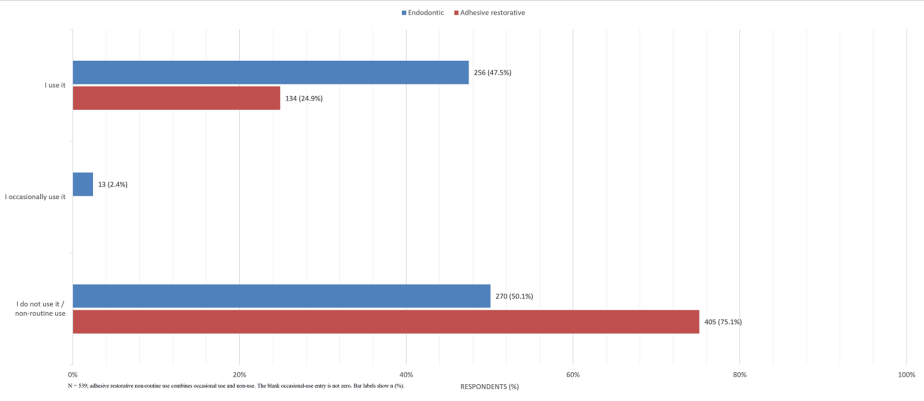


FIGURE 1: Self-reported rubber dam use during endodontic and adhesive restorative procedures

Bars show the percentages of respondents reporting rubber dam use during endodontic and adhesive restorative procedures (N=539). Endodontic use is presented as "I use it", "I occasionally use it", and "I do not use it". For both procedure types, "I use it" was classified as reported routine use. Adhesive restorative non-routine use combines "I occasionally use it" and "I do not use it"; these categories are not displayed separately. The shared label "I do not use it/non-routine use" represents endodontic non-use and adhesive restorative non-routine use, respectively. The blank adhesive restorative entry under "I occasionally use it" does not indicate zero respondents. Bar labels show the number and percentage of respondents, n (%).

Regional differences in RD use

The detailed distribution of RD use categories by region for endodontic and adhesive restorative procedures is presented in Table *1* and illustrated in Figures *2*-*3*. Routine RD use was significantly less frequent in the Middle East/Africa than in Europe for endodontic procedures (33.4% vs. 67.6%) and adhesive restorative procedures (18.3% vs. 34.2%; both p<0.001).

Procedure	Rubber dam-use category	Middle East/Africa, n (%)	Europe, n (%)	Total, n (%)
Endodontic procedures	I use it (routine)	106 (33.4)	150 (67.6)	256 (47.5)
	I occasionally use it	0 (0)	13 (5.9)	13 (2.4)
	I do not use it	211 (66.6)	59 (26.6)	270 (50.1)
Adhesive restorative procedures	I use it (routine)	58 (18.3)	76 (34.2)	134 (24.9)
	Non-routine (occasionally use or do not use)	259 (81.7)	146 (65.8)	405 (75.1)

TABLE 1: Self-reported rubber dam use during endodontic and adhesive restorative procedures by region of practice

Percentages were calculated within region for the Middle East/Africa (N=317) and Europe (N=222) and across the final analytical sample for the total column (N=539). For adhesive restorative procedures, "non-routine" combines "I occasionally use it" and "I do not use it"; these categories are not reported separately.

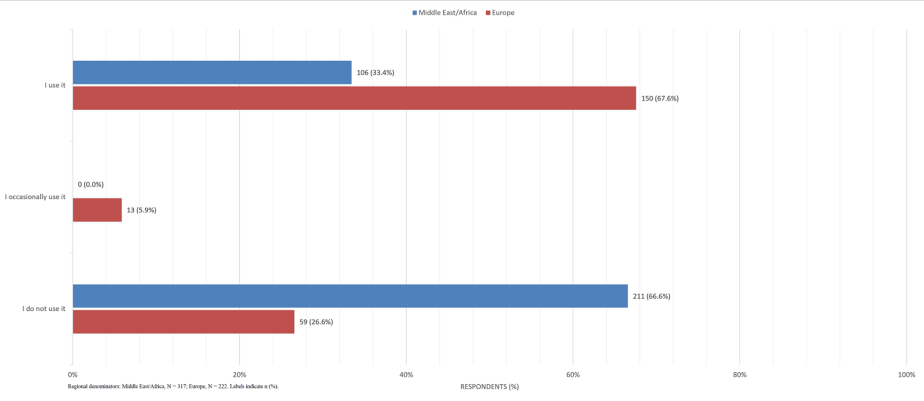


FIGURE 2: Self-reported rubber dam use during endodontic procedures by region of practice

Bars show the percentages of respondents reporting "I use it", "I occasionally use it", or "I do not use it" during endodontic procedures in the Middle East/Africa (N=317) and Europe (N=222). "I use it" was classified as reported routine use. Percentages were calculated using the respective regional denominators. Bar labels show the number and percentage of respondents, n (%).

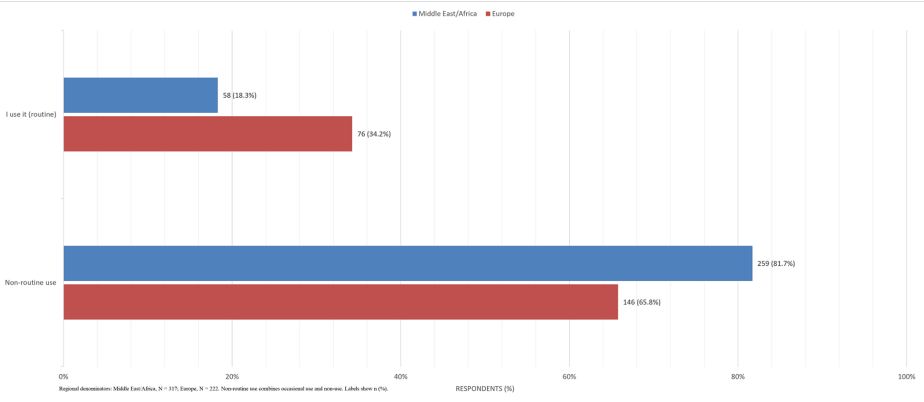


FIGURE 3: Self-reported rubber dam use during adhesive restorative procedures by region of practice

Bars show the percentages of respondents reporting routine or non-routine rubber dam use during adhesive restorative procedures in the Middle East/Africa (N=317) and Europe (N=222). Routine use represents "I use it", whereas non-routine use combines "I occasionally use it" and "I do not use it"; occasional use and non-use are not displayed separately. Percentages were calculated using the respective regional denominators. Bar labels show the number and percentage of respondents, n (%).

The corresponding crude prevalence differences, PRs, and ORs are presented in Table *2*.

Outcome	Europe, n/N (%)	Middle East/Africa, n/N (%)	Absolute prevalence difference, percentage points (95% CI)	Prevalence ratio (95% CI)	Crude odds ratio (95% CI)	Pearson's χ^2_1	P-value
Reported routine RD use ("I use it") for endodontic procedures	150/222 (67.6)	106/317 (33.4)	−34.1 (−42.2 to −26.1)	0.49 (0.41 to 0.59)	0.24 (0.17 to 0.35)	60.99	<0.001
Reported routine RD use ("I use it") for adhesive restorative procedures	76/222 (34.2)	58/317 (18.3)	−15.9 (−23.5 to −8.4)	0.53 (0.40 to 0.72)	0.43 (0.29 to 0.64)	17.75	<0.001

TABLE 2: Crude regional associations with reported routine rubber dam use among general dental practitioners

Regional differences in reported routine RD use ("I use it") were assessed using Pearson's chi-squared test (χ^2; 1 degree of freedom). Effect estimates compare practitioners in the Middle East/Africa with those in Europe, the reference group. Negative absolute prevalence differences and ratios below 1 indicate lower reported routine RD use in the Middle East/Africa. Estimates are crude and unadjusted.

RD: rubber dam; CI: confidence interval; n: number of respondents reporting routine use; N: total number of respondents in the region

Association between professional experience and RD use

Among the 532 respondents with available data on years of professional experience, mean experience differed across the three reported endodontic RD-use categories (one-way ANOVA; p<0.001). Respondents reporting routine use had fewer mean years of experience than non-users, whereas occasional users had the highest mean experience. Group sizes, means, standard deviations, and the post-hoc groupings reported in the original statistical analysis are presented in Table *3*.

Endodontic rubber dam-use category	n	Mean (SD), years	Overall test
I use it	253	10.79[a] (10.22)	
I occasionally use it	13	21.92[c] (9.35)	One-way ANOVA; p<0.001
I do not use it	266	13.84[b] (10.18)	

TABLE 3: Years of professional experience according to reported rubber dam use during endodontic procedures

Years of professional experience were unavailable for seven of the 539 respondents; therefore, this analysis included 532 respondents. Differences across endodontic rubber dam-use categories were assessed using one-way ANOVA, followed by Tukey post-hoc tests. Different superscript letters (a, b, and c) indicate groups reported as significantly different in the original Tukey post-hoc analysis; exact adjusted pairwise p-values were not available. Diagnostic results for normality and homogeneity of variances were unavailable; comparisons involving the occasional-use group (n=13) should be interpreted cautiously.

ANOVA: analysis of variance; SD: standard deviation; n: number of respondents in each category

Barriers to RD use

Among the 350 respondents included in the barrier analysis (227 from the Middle East/Africa and 123 from Europe), availability-, time-, and cost-related factors and manipulation-related difficulties were the most frequently reported reasons for not using RD. Patient-related factors were reported more frequently in the Middle East/Africa than in Europe (21.6% vs. 5.7%; Pearson's χ^2_1=15.00; p<0.001), as were other factors (χ^2_1=10.03; p=0.002). Manipulation-, availability-, time-, and cost-related and educational factors did not differ significantly between regions. Percentages, test statistics, and p-values for each barrier category are presented in Table *4*.

Reason category	Middle East/Africa, n (%)	Europe, n (%)	Total, n (%)	Pearson's χ^2_1	P-value
Manipulation-related factors	101 (44.5)	59 (48)	160 (45.7)	0.39	0.533
Patient-related factors	49 (21.6)	7 (5.7)	56 (16)	15.00	<0.001
Time/economic factors (availability, time, and cost)	104 (45.8)	57 (46.3)	161 (46)	0.01	0.925
Educational factors	17 (7.5)	15 (12.2)	32 (9.1)	2.13	0.145
Other factors	4 (1.8)	11 (8.9)	15 (4.3)	10.03	0.002

TABLE 4: Reasons for non-routine rubber dam use according to region of practice: Middle East/Africa versus Europe

Reasons for non-routine rubber dam use among respondents included in the barrier analysis, by region of practice (Middle East/Africa, N=227; Europe, N=123; total, N=350). Non-routine use comprises occasional use or non-use of rubber dam. Respondents could select more than one reason; therefore, percentages may sum to more than 100%. Percentages were calculated using the respective regional denominators and, for the Total column, the total barrier-analysis sample. Regional differences were assessed using Pearson's chi-squared test (χ^2; 1 degree of freedom).

n: number of respondents reporting each reason; N: number of respondents included in the barrier analysis; χ^2: chi-squared statistic

Discussion

Overall RD adoption rates

This multinational cross-sectional survey found that routine self-reported RD use among general dental practitioners was limited, particularly for adhesive restorative procedures, despite professional recommendations supporting RD isolation [1-3,20]. Routine RD use was reported by 47.5% of respondents for endodontic procedures and by 24.9% for adhesive restorative procedures; these frequencies are consistent with those reported in previous national surveys [17-19]. The extended recruitment interval should be considered when interpreting these pooled prevalence estimates.

The substantially lower utilization of RD in adhesive restorative procedures is noteworthy because effective moisture control is important for predictable bonding [4,6-10]. The observed difference between endodontic and restorative use may reflect the stronger emphasis placed on isolation during endodontic treatment, as well as clinicians' perceptions of procedural risk, treatment duration, and the time required for RD placement. However, these explanations were not directly evaluated in the present study and should therefore be interpreted cautiously.

Regional differences and experience-related patterns

A notable finding was that years of professional experience differed according to reported endodontic RD-use category. Respondents reporting routine endodontic RD use had fewer mean years of experience than non-users, whereas occasional users had the highest mean experience. Because the analysis was cross-sectional and did not assess undergraduate training, regulatory requirements, medico-legal considerations, infection-control attitudes, or other determinants of clinical practice, the mechanisms underlying this association cannot be determined.

Material availability, costs, workflow constraints, continuing professional development, and the transition from training to independent practice may be relevant to RD use [18,19,22-29]. Material availability was recorded, but it was not incorporated into a multivariable analysis; the other potential determinants were not assessed comprehensively and should be examined in future research. The broad regional categories should be interpreted as regional patterns rather than country-specific practice profiles.

Patient-related barriers were reported more frequently among non-routine RD users in the Middle East and Africa than among those in Europe (21.6% vs. 5.7%; p<0.001). This difference identifies a reported barrier that may merit further investigation. Prior research suggests that patient concerns about RD use may be influenced by practitioner communication, confidence, and procedural experience; however, these mechanisms were not evaluated in the present survey [18,22,30]. Qualitative studies could explore how practitioners and patients perceive RD use and how these perceptions vary across practice settings.

The reported barrier categories may be examined in future research using behavioral frameworks such as the COM-B (Capability, Opportunity, Motivation-Behavior) model. For example, manipulation-related difficulties could be explored as capability-related factors, while material availability and time constraints could be explored as opportunity-related factors. Perceived patient resistance may involve social opportunity, practitioner motivation, or both; these possibilities require further investigation. Such

frameworks may guide the design and evaluation of future interventions but were not used to explain the associations observed in the present study.

These regional and experience-related findings represent crude cross-sectional associations and should not be interpreted as independent effects or causal relationships. Multivariable, country-specific studies using contemporaneous data are needed to clarify the magnitude, independence, and potential determinants of these associations.

Clinical and educational implications

The findings suggest a gap between reported RD use among surveyed practitioners and professional recommendations supporting RD isolation, particularly for adhesive restorative procedures [3,20]. However, this cross-sectional survey did not evaluate the effectiveness of educational interventions, communication training, reimbursement policies, guideline-implementation strategies, or regulatory approaches [22-28].

Future initiatives could be designed and formally evaluated to address the barriers reported by participants. Potential approaches include practical training in efficient RD placement, strategies for discussing RD isolation with patients, and practice-level measures to improve access to RD materials [22,23,29]. Comparative implementation studies are needed to determine which approaches are effective in increasing routine RD use across different settings and regions.

Study limitations

This study has several important limitations. First, the use of convenience sampling among continuing education course attendees may have introduced selection bias, as these practitioners may be more motivated, guideline-aware, and more likely to use RD than the broader population of general dental practitioners. Accordingly, the observed prevalence may exceed that in the wider population of general dental practitioners and should not be considered population-representative.

Second, all data were self-reported and were not verified through clinical observation or record review. This may have introduced recall and social desirability biases, potentially leading to over-reporting of guideline-concordant behaviors such as RD use, as reported in previous questionnaire-based studies on RD attitudes and use [18,26,28]. In addition, although the study-specific questionnaire was pilot-tested for clarity and comprehensibility, it was not formally validated, and its measurement properties remain incompletely characterized.

Third, data were collected over an extended period, from 2017 to 2023. During this interval, professional awareness of the importance of RD isolation, clinical guidance, access to materials, training, and infection-control practices may have changed, including during the COVID-19 pandemic [11-15,20]. Changes in professional awareness were not measured, and calendar-year trends and pandemic-related changes were not assessed. Consequently, the pooled analysis could not determine whether changes in awareness or practice over time contributed to the overall frequencies or regional differences in reported RD use. The findings should therefore be interpreted as aggregated observations for the surveyed sample over the recruitment period, rather than estimates of current practice or evidence of changes attributable to increased awareness or the pandemic.

Fourth, the broad regional category "Middle East and Africa" includes countries with substantial differences in healthcare systems, education, regulation, and economic conditions. Accordingly, the findings should be interpreted as regional patterns within the surveyed sample and should not be generalized to individual countries.

Finally, regional comparisons were unadjusted, so potential confounding by professional experience, practice setting, material availability, or other factors cannot be excluded, and the cross-sectional design precludes causal interpretation. Unavailable normality and variance-homogeneity diagnostics warrant caution when interpreting the ANOVA and Tukey findings, particularly for the small endodontic occasional-use group (n=13). Selection of the 350 respondents included in the barrier analysis was not documented; the barrier findings should therefore not be assumed to represent all non-routine RD users.

Future research directions

Future investigations should include longitudinal cohort studies of recent graduates to determine whether initial RD use habits are maintained or decline and to identify factors influencing practice evolution. Qualitative research exploring practitioner attitudes, decision-making processes, and perceived barriers in greater depth would provide important insights for designing educational interventions [18,22,24-28].

Studies evaluating the effectiveness of different educational approaches, such as hands-on workshops, peer mentoring, patient communication training, and incentive structures, would help identify efficient strategies for improving RD adoption [22-25,28,30]. Direct observational studies in diverse practice settings would provide more accurate utilization data than self-reported surveys [18,26,28]. Finally, research examining the

relationship between RD use and clinical outcomes, such as endodontic success rates, restoration longevity, and complication rates, in general practice would strengthen the evidence base and support educational and policy initiatives promoting RD use [4-7,9,16,20].

Conclusions

Among surveyed general dental practitioners, routine self-reported RD use was more common for endodontic than for adhesive restorative procedures. Routine use for both procedure types was reported more frequently in Europe than in the Middle East/Africa. Respondents reporting routine endodontic RD use had fewer mean years of professional experience than non-users. Within the barrier-analysis subset, patient-related barriers were reported more frequently in the Middle East/Africa than in Europe.

Because the survey used convenience sampling, self-reported data, broad regional groupings, and crude bivariate analyses, these findings should be interpreted as descriptive associations. Future studies should use contemporaneous, country-specific sampling and multivariable analyses to identify modifiable determinants of RD adoption.

Appendices

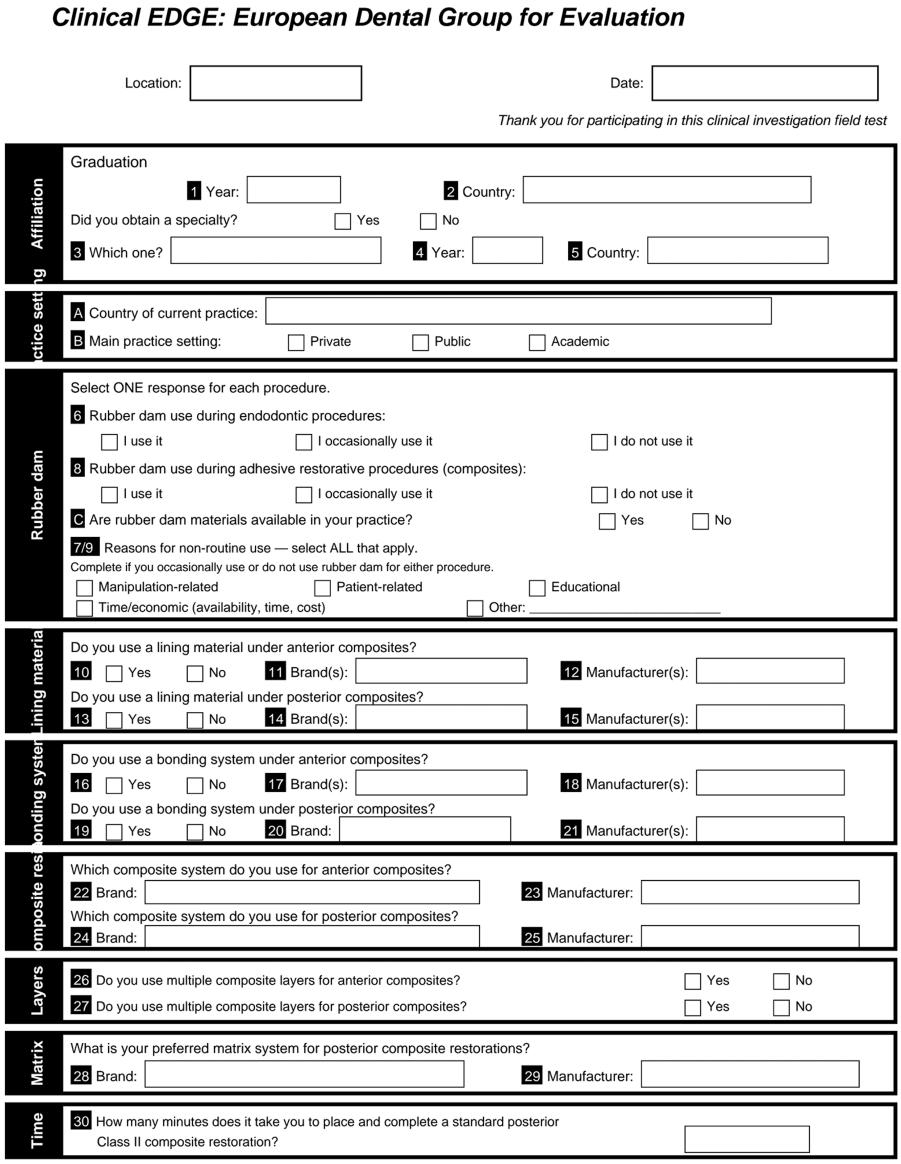


FIGURE 4: Study questionnaire

Questionnaire administered to participating dental practitioners. The present manuscript reports the rubber dam-related findings.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Fidele Nabbout, Joseph Sabbagh

Acquisition, analysis, or interpretation of data: Fidele Nabbout, Joseph Sabbagh

Drafting of the manuscript: Fidele Nabbout, Joseph Sabbagh

Critical review of the manuscript for important intellectual content: Fidele Nabbout, Joseph Sabbagh

Supervision: Fidele Nabbout, Joseph Sabbagh

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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