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Knowledge and Practice of Endocrown Application Among Dentists in Saudi Arabia

ABSTRACT

Background: Among the different restorative options, the endocrown has emerged as an adhesive and minimally invasive alternative for restoring endodontically treated posterior teeth. However, how well these principles were understood and translated into routine practice among dentists in the Kingdom of Saudi Arabia had not been consistently quantified.

Methods: In this study, a crosssectional, online questionnaire survey was carried out among licensed dentists practicing in Saudi Arabia. Data collection pertained to sociodemographics, knowledge related to endocrowns, and selfreported practice patterns.

Results: A total of 400 dentists participated. At least one endocrown cemented, representing endocrown adoption, equated to 94.5% (378/400). Adoption significantly varied with clinical experience, including 88.9% (144/162) among dentists with ≤5 years, 98.2% (223/227) among those with 6–10 years, and 100.0% (11/11) among those with >10 years (χ^2=16.56, df=2, p<0.001). By experience, the intensity of endocrown use also varied (χ^2=51.86, df=6, p<0.001), with 61.5% (240/390) reporting 6–10 endocrowns cemented in the past year, followed by <5 (30.0%, 117/390), >10 (3.1%, 12/390), and none (5.4%, 21/390).

Conclusion: The adoption rate of the endocrown among the surveyed dentists in Saudi Arabia was high; however, its adoption and annual use intensity varied with clinical experience and knowledge, the latter remaining an independent predictor after adjustment.

INTRODUCTION

Restoration of endodontically treated posterior teeth remains a central challenge in contemporary restorative dentistry due to frequent extensive loss of coronal tissue from caries, previous restorations, access cavity preparation, and endodontic procedures. This tissue depletion results in reductions in stiffness and altered stress distribution under occlusal loading [1]. In this context, endocrowns have gained popularity as a conservative, adhesive alternative to conventional post–core–crown workflows for severely compromised molars and premolars, especially when radicular preparation is undesirable or unnecessary and when modern adhesive protocols and CAD/CAM fabrication are available. Recent questionnairebased studies conducted in the Saudi Arabia context have reported variable levels of awareness, conceptual understanding, and perceived indications for endocrowns among dentists and trainees, reflecting ongoing diffusion of the technique with heterogeneity across practitioner groups and settings [2–4]. Conceptually, the endocrown is envisaged as a monolithic indirect restoration that derives retention and resistance through a combination of intracoronal extension within the pulp chamber and adhesive bonding to enamel and dentin, by this means minimizing or avoiding post space preparation and conserving radicular dentin [5]. The related biomechanical concept considers a "monoblocklike" restoration–tooth complex in which functional loads are dissipated through a broad cervical buttjoint margin and internal walls, potentially simplifying the procedure without compromising regarding the iatrogenic risks of post placement [67].

However, the clinical outcome of an endocrown relies on several interconnected variables, such as the amount and quality of the remaining tooth structure, the geometry and depth of the pulp chamber, cervical margin design, occlusal concept, and the chosen restorative material and bonding approach [8].

Observational studies conducted in the Saudi environment emphasized that awareness of these determinants and confidence in adhesive procedures are not uniform and might therefore lead some clinicians to underindicate endocrowns where they would be the material of choice or to apply them in incomplete accordance with established principles of preparation and cementation [1, 9].

From a healthsystems perspective, practitioner knowledge and the adoption of techniques go beyond theoretical considerations to shape the predictability, costeffectiveness, and complication profiles of postendodontic restorations delivered at scale [10]. The placement of an endocrown requires knowledge of case selection criteria, including but not limited to remaining walls assessment and ferrule feasibility; preparation parameters, such as margin design and internal divergence; and bonding steps, including substrate management and cement selection, each susceptible to practice variability [11]. As such, to what extent dentists possess accurate knowledge and translate it into consistent clinical practice, presents a critical determinant of treatment standardization and patient outcomes in particular, in settings where digital dentistry and indirect adhesive restorations are increasingly accessible.

In view of these considerations, it is relevant to establish an evidenceinformed baseline of how Saudi Arabian dentists understand and apply endocrown concepts. An evidenceinformed baseline supports the identification of educational needs, targeting continuing professional development, and aligning curricular emphasis and clinical guidance within restorative and prosthodontic training pathways. This questionnaire survey was therefore conducted to characterize the knowledge and selfreported clinical practice patterns of dentists related to endocrown application in the Kingdom of Saudi Arabia, with the purpose of delineating areas of concordance with contemporary concepts and identifying domains where focused training or guideline reinforcement may be warranted.

MATERIALS AND METHODS

Study design and setting

The design of the present study was crosssectional, and it used an online questionnaire survey among registered dentists practicing in different regions of the Kingdom of Saudi Arabia. Data were collected through a structured self-administered instrument that represented socio-demographic variables along with knowledge and practice concerning endocrownrelated variables. The current survey was executed after receiving ethics clearance within the study period of 2025.

Study population and the eligibility criteria

The target population consisted of licensed dental practitioners who were registered to practice in Saudi Arabia, including general dentists and specialists. Dentists were excluded if they were retired, not currently practicing clinically, or not otherwise engaged in clinical dentistry. Convenience sampling was used; eligible participants were invited to respond by electronic distribution of the questionnaire link through commonly used professional communication channels. Responses were returned through an online survey platform in selfadministered format.

Sample size estimation

The sample size was estimated for an analytical cross-sectional design using a chisquare framework (Cohen's w) with α = 0.05 and power (1−β) = 0.80, targeting at least a moderate association (w = 0.30). The base requirement from this approach was then conservatively inflated to account for nonresponse and incomplete submissions, and the final target sample size was set at 400 completed responses. For transparency, the chisquare effectsize definition and sample size relationship were expressed as:

$$w = \sqrt{\sum \frac{(p_i - p_{0i})^2}{p_{0i}}} \text{ and } N = \frac{\chi_{1-\alpha, df}^2 + \chi_{1-\beta, df}^2}{w^2}, \text{ where } w \text{ denotes}$$

Cohen's effect size, p_i and p_{0i} represent category proportions under the alternative and null hypotheses, respectively, and df denotes degrees of freedom.

Questionnaire Development and Structure

This instrument was developed based on pertinent literature and expert input, organized into three domains: 1) socio-demographic information; 2) knowledge concerning endocrowns; and 3) practicerelated items in regard to the application of endocrowns. The sociodemographic domain captured information on gender, highest qualification, type of workplace, and years of clinical experience. The knowledge domain assessed selfperceived knowledge as well as other important conceptual/technical aspects, such as indications, elements of preparation design, restorative material selection, and cementation considerations. The practice domain elicited information on endocrown utilization, for example estimated annual frequency, perceived failure patterns, and perceived technique sensitivity in comparison with conventional postcorecrown approaches.

Statistical Analysis

Survey responses were exported for statistical analysis. Descriptive statistics were employed to summarize respondent characteristics and itemlevel responses. Bivariate associations between dentist characteristicsfor example, experience strata, qualification, and practice settingand endocrown adoptionrelated outcomes were tested by using Pearson's chisquare test. Multivariable logistic regression analysis was conducted to determine independent predictors of endocrown adoption, where statistical significance was set at p < 0.05. Analyses were performed using SPSS (IBM Corp.), version 29.0.2.0.

Ethical Approval and Informed Consent

The study protocol was titled "Knowledge and Practice of Endo Crown Application in Dentistry among Dentists of the Kingdom of Saudi Arabia: A Questionnaire Survey" and was reviewed and approved by the Institutional Review Board at Riyadh Elm University, approval number FUGRP/2025/458/1360/1240. Participation in the survey was strictly on a voluntary basis. Electronic informed consent was obtained at the start of the questionnaire, with responses anonymous to maintain confidentiality.

RESULTS

Figure 1 reveals that gender distribution was exactly even, with 200 females and 200 males represented (50% each). The educational status was almost equal, consisting of 206 undergraduates and 194 postgraduates (51.5% and 48.5%, respectively). The highest number of respondents had employment in private practice (234/397; 58.9%), followed by government employment at 154/397 (38.8%), while a small cohort was unemployed (9/397; 2.3%). Clinical experience was concentrated in the 6–10year category, at 216/380 or 56.8%, whereas 154, or 40.5%, had ≤5 years of experience and 10, or 2.6%, had >10 years.
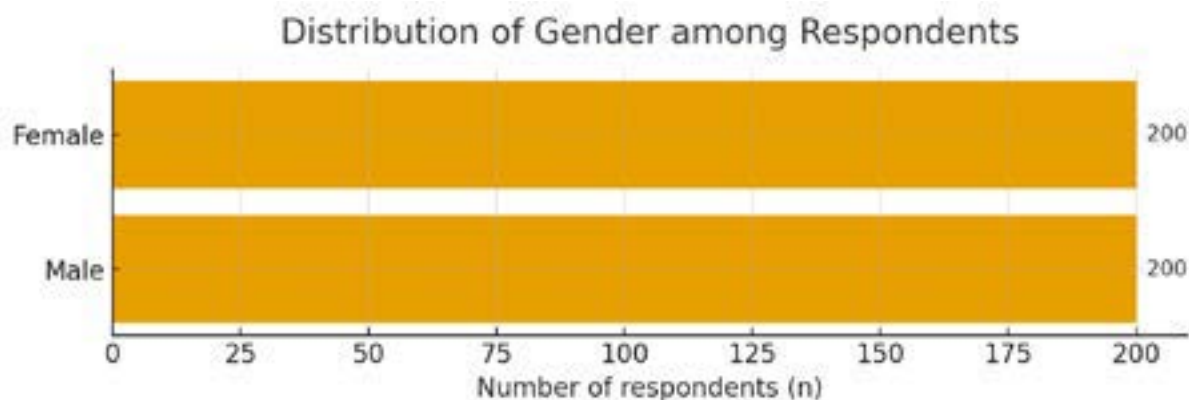
Figure 1. Sociodemographic characteristics

Figure 2 shows that selfrated knowledge tended to fall between the middle to high scores, with the most common ratings being 8 (117/400; 29.2%), 5 (103/400; 25.8%), and 6 (77/400; 19.3%). Only 15 respondents (3.8%) had very low scores of from 0 to 2. The most common source of information reported was college education, cited by 348 of 400 dentists (87.0%), while workshops/conferences (27/400; 6.8%), textbooks (13/400; 3.3%), and online media (12/400; 3.0%) made up a much smaller percentage.
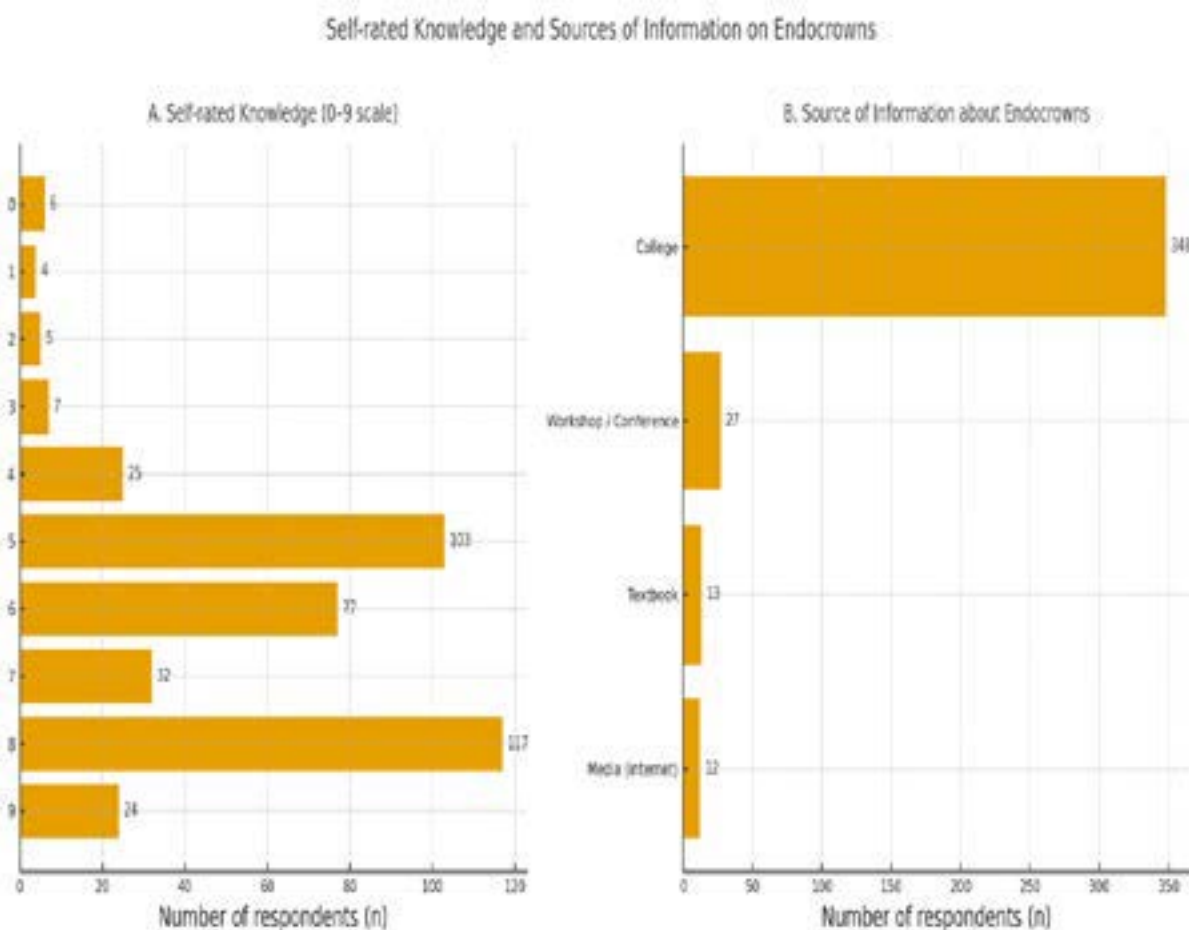

Figure 2. Knowledge level and sources of information

Figure 3 indicates that premolar teeth were most frequently selected as the indication for endocrowns, 254/400; 63.5%, followed by molars, 91/400; 22.8%, with anterior teeth, 38/400; 9.5%, and "I don't know", 17/400; 4.3% being smaller proportions. Remaining tooth structure: moderate loss, 232 of 400 respondents, 58.0%; extensive loss, 98, 24.5%; minimal loss, 59, 14.8%, with 11, 2.8%, reporting uncertainty. Adequate interarch space was considered favorable by 212 respondents, 53.0%, and limited by 172, 43.0%. A 3 mm pulp chamber extension was favored by the majority of the participants, 227/400; 56.8%, followed by 4 mm, 140/400; 35.0%, with 2 mm, 20/400; 5.0%, and "I don't know", 13/400; 3.2% less often.

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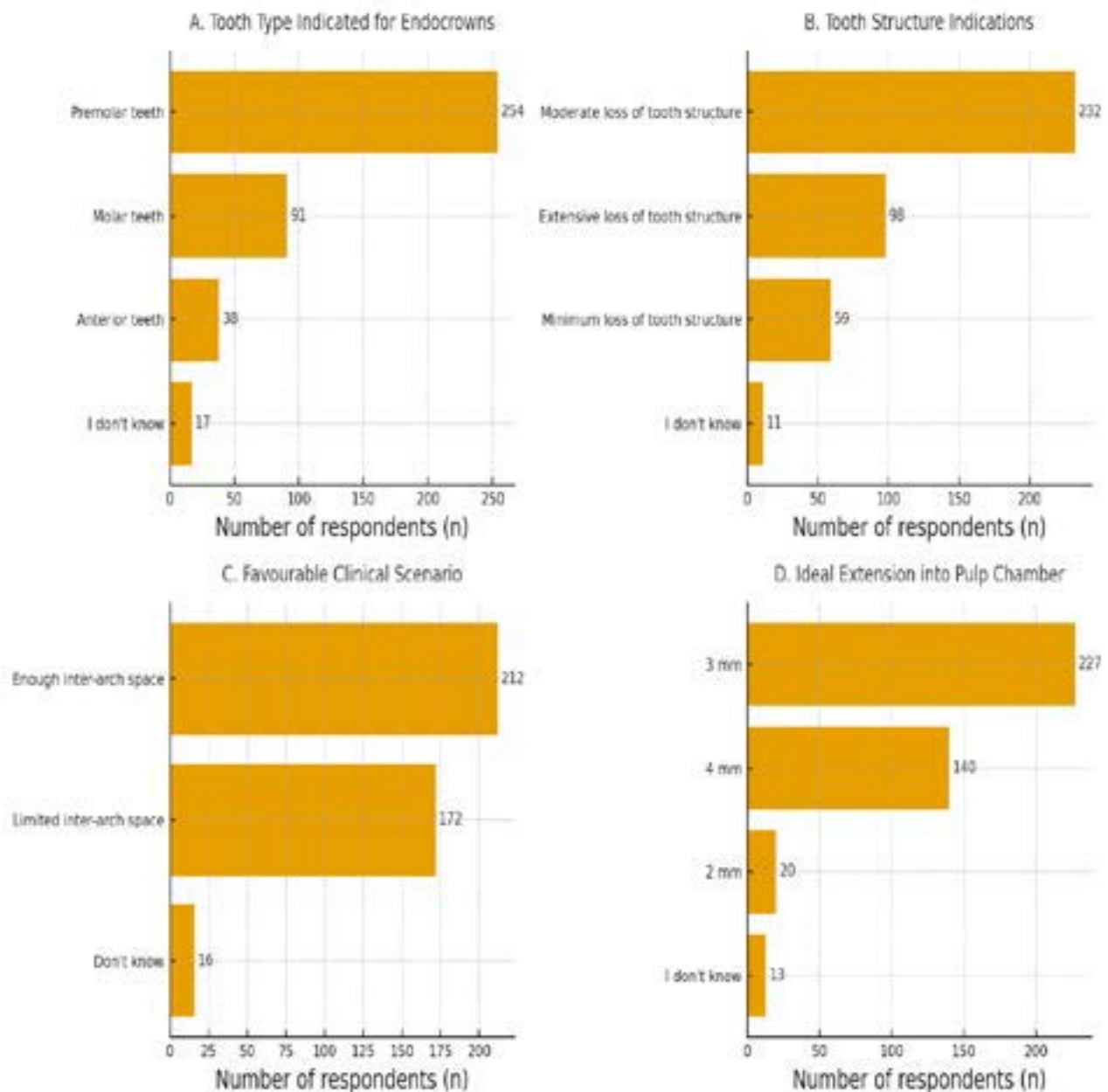## Knowledge of Indications and Case Selection for Endocrowns

Figure 3. Knowledge of indications and case selection

Figure 4 shows that a chamfer finish line was the most common choice (215/400; 53.8%), followed by shoulder (105/400; 26.3%) and butt joint (68/400; 17.0%), with 12 respondents (3.0%) uncertain. The majority agreed that endocrowns should be minimally invasive (369/400; 92.2%) and that a ferrule effect was necessary (369/400; 92.2%). Nanocomposite resin was the preferred restorative material in 280 of 400 responses (70.0%), compared with lithiumdisilicate (66/400; 16.5%), zirconia (35/400; 8.8%), and feldspathic porcelain (5/400; 1.3%), while 14 respondents (3.5%) did not know. Glass ionomer cement (197/400; 49.2%) and adhesive resin cement (169/400; 42.2%) were the most frequently cited cements. CAD/CAM was recognized as the fabrication technique by 352 respondents (88.0%), and debonding was considered the most common failure mode by 368 of 391 dentists (94.1%).
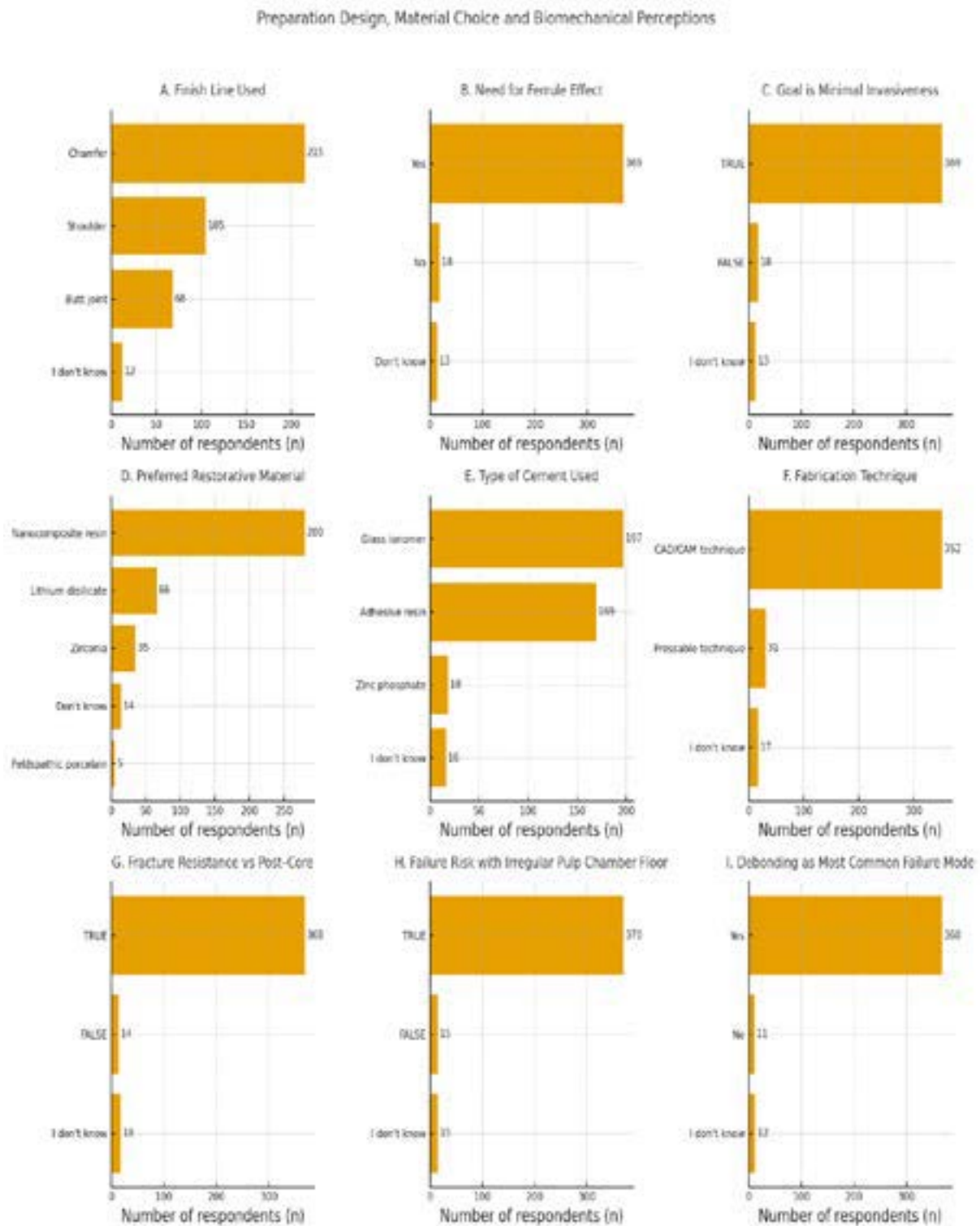
Figure 4. Preparation design, materials and biomechanical perceptions

Figure 5 shows that, in the past year, 240 of 390 respondents (61.5%) had cemented between 6 and 10 endocrowns, 117 (30.0%) fewer than 5, 12 (3.1%) more than 10, and 21 (5.4%) none, revealing considerable clinical use. Perceived fracture risk was mostly a concern: 235 of 400 dentists (58.8%) believed endocrowns always increased fracture rate and 142 (35.5%) believed they sometimes did, while "never" and "I don't know" were reported by only 9 (2.2%) and 14 (3.5%) respectively. For most participants, preparation steps were more difficult than for conventional crowns (366/391; 93.6%) and the preparation and impression was considered more techniquesensitive (367/391; 93.9%). Moreover, 365 of 386 (94.6%) agreed that appropriate adhesive procedures enhance fracture resistance and bonding strength while 7 (1.8%) disagreed and 14 (3.6%) were uncertain.

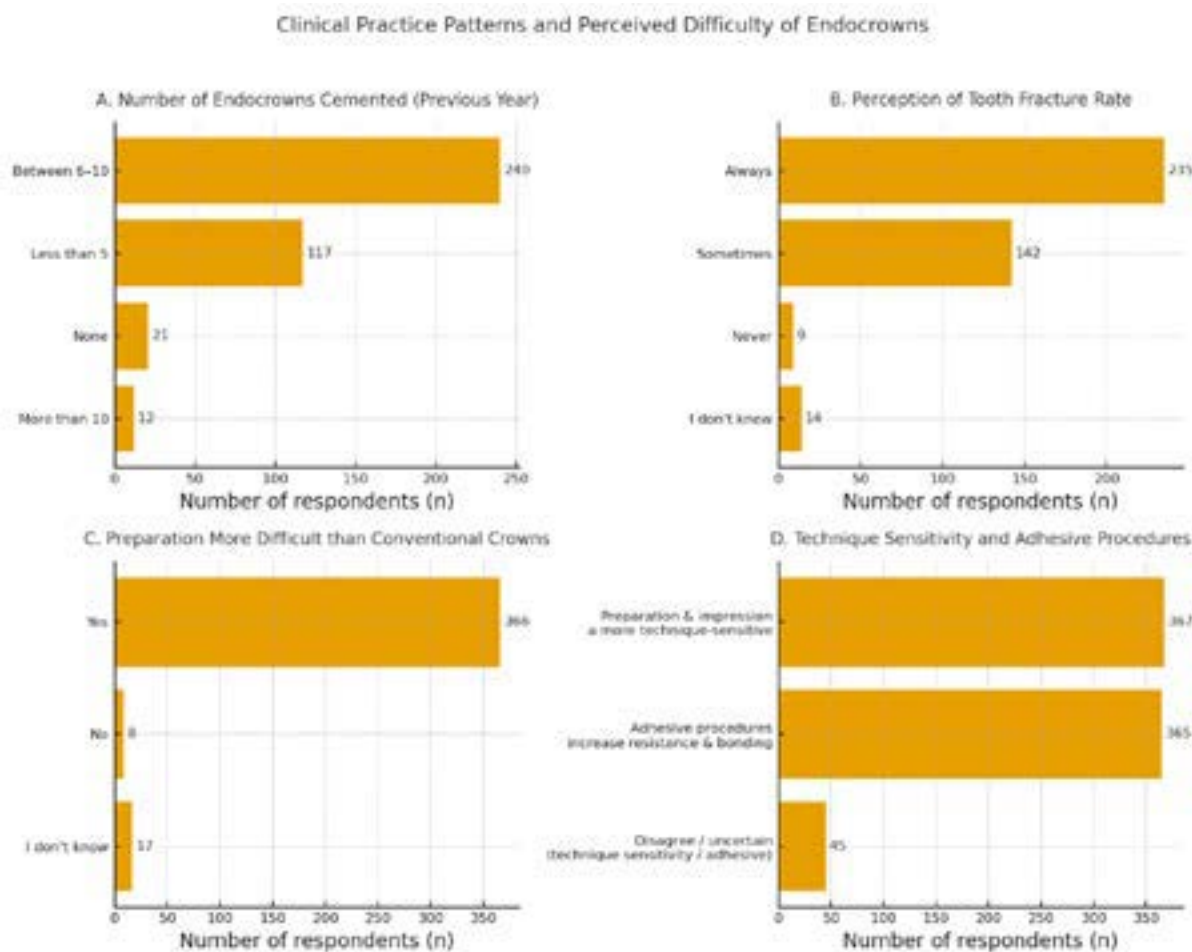Effect of Bioactive Materials on Dentiny….

Figure 5. Clinical practice patterns and perceived difficulty

According to Table 1, there is an indication that uptake of endocrowns increases with experience. Dentists with ≤5years of experience adopted endocrowns in 88.9% of cases (144/162), compared to 98.2% (223/227) among those with 610 years and 100% (11/11) among those with >10 years of experience. The $\chi2$test revealed a statistically significant adoption gradient across experience categories: $\chi2 = 16.56$, df = 2, p < 0.001.

Clinical experience (years)	Adopted ≥1, n	Adopted ≥1, %	No adoption (0), n	No adoption, %	Row total n	Row % adopted	Row % no adoption	Pearson χ^2 (df)	pvalue
≤ 5 years	144	36.0	18	4.5	162	88.9	11.1	16.56 (2)	<0.001
6–10 years	223	55.8	4	1.0	227	98.2	1.8		
> 10 years	11	2.8	0	0.0	11	100.0	0.0		
Total	378	94.5	22	5.5	400	94.5	5.5		

Table 1. Association between clinical experience and endocrown adoption

As can be seen from Table 2, not only adoption but also the intensity of endocrown use is strongly related to clinical experience. While for dentists with ≤5 years usage was more evenly distributed between the categories <5 and 610 cases, dentists with 610 or >10 years were concentrated in the higher use categories (especially 610 cases per year). This pattern of use intensity across experience groups demonstrated highly significant association (χ^2=51.86, df=6, p<0.001).

Clinical experience (years)	None, n	None, %	< 5, n	< 5, %	6– 10, n	6–10, %	> 10, n	> 10, %	Row total n	Pearson χ^2 (df)	pvalue
≤ 5 years	16	9.9	70	43.2	72	44.4	4	2.5	162	51.86 (6)	<0.001
6–10 years	6	2.6	45	19.8	170	74.9	6	2.6	227		
> 10 years	0	0.0	5	45.5	4	36.4	2	18.2	11		
Column totals	22		120		246		12		400		

Table 2. Association between clinical experience and intensity of endocrown use

As shown in Table 3, endocrown adoption did not vary significantly by gender, level of education or workplace, as indicated by insignificant chisquare tests for these predictors (p = 0.66, 0.88, and 0.72 respectively). In contrast, knowledge level was associated with adoption: the percentage of dentists with low knowledge (0–3) who adopted was 81.8%, compared with 94.1% for moderate (4–6) and 96.5% for high (7–9) knowledge groups, yielding a significant association (χ^2 = 8.23, df = 2, p = 0.016).

Predictor	Category	Adopted ≥1, n	Adopted ≥1, %	No adoption, n	No adoption, %	Row total n	Pearson χ² (df)	pvalue
Gender	Female	188	94.0	12	6.0	200	0.19 (1)	0.66
	Male	190	95.0	10	5.0	200		
Level of education	Undergraduate (BDS)	195	94.7	11	5.3	206	0.02 (1)	0.88
	Postgraduate (MDS)	183	94.3	11	5.7	194		
Workplace	Private	224	94.9	12	5.1	236	0.65 (2)	0.72
	Government	146	94.2	9	5.8	155		
	Unemployed	8	88.9	1	11.1	9		

Table 3. Bivariate associations between dentist characteristics and endocrown adoption

The results of logistic regression (Table 4), after adjusting for other variables in the model, indicated that having 6–10 years of clinical experience remained an independent predictor of endocrown adoption (adjusted OR 4.50, 95% CI 1.50–13.50, p = 0.007). For every additional one point knowledge score, there was a higher likelihood of adopting endocrown (adjusted OR 1.40, 95% CI 1.05–1.90, p = 0.026). Gender, level of education, and workplace did not show significant independent effects.

Predictor	Category / coding	β (demo)	SE (demo)	Adjusted OR (demo)	95% CI for OR (demo)	Wald pvalue (demo)
Clinical experience	6–10 years vs ≤ 5 years	1.50	0.56	4.50	1.50 – 13.50	0.007
	> 10 years vs ≤ 5 years	1.10	1.18	3.00	0.30 – 30.00	0.350
Gender	Male vs Female	0.18	0.55	1.20	0.40 – 3.50	0.742
Level of education	Postgraduate vs Undergraduate	0.10	0.51	1.10	0.40 – 3.00	0.853
Workplace	Private vs Government	0.26	0.50	1.30	0.50 – 3.50	0.597
	Unemployed vs Government	−0.22	1.04	0.80	0.10 – 6.00	0.831
Knowledge score (0–9)	Per 1point increase	0.34	0.15	1.40	1.05 – 1.90	0.026

Table 4. Multivariate logistic regression model for predictors of endocrown adoption

As shown in Table 5, the multivariable model showed acceptable explanatory power and calibration. It resulted in Nagelkerke's R² of 0.38, with an AUC of 0.78 and a nonsignificant Hosmer–Lemeshow test, χ² = 6.21, p = 0.623, reflecting high overall classification accuracy, 95.3% driven by high sensitivity, 98.0%, but modest specificity, 40.0%. In this final reduced model, both 6–10 years of experience, OR 4.80, 95% CI 1.80–12.80, p = 0.002, and a higher knowledge score, OR 1.45 per point, 95% CI 1.10–1.90, p = 0.008, remained statistically significant predictors of endocrown adoption.

Component	Measure / Predictor	Value (demo)
Model performance indices	−2 Log likelihood	120.8
	Cox & Snell R²	0.09
	Nagelkerke R²	0.38
	Hosmer–Lemeshow χ² (df = 8)	6.21
	Hosmer–Lemeshow pvalue	0.623
	Overall classification (%)	95.3
	Sensitivity (%)	98.0
	Specificity (%)	40.0
	Area under ROC curve (AUC)	0.78
	Adoption prevalence (%)	94.5

Table 5. Overall performance of the logistic regression model and final reduced model

DISCUSSION

The results showed that endocrowns were already integrated into selfreported clinical practice among dentists in Saudi Arabia, but that adoption patterns and use intensity were no- tuniform and were more strongly associated with experience and knowledge than with demographic or workplace variables. This distribution suggests that implementation gaps are more likely to be driven by training exposure, procedural familiarity, and confidence with adhesive workflows rather

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than by practice setting alone. The predominance of CAD/CAM fabrication implies that digital restorative pathways were commonly available and operational; yet, the concurrent perception of high technique sensitivity and greater difficulty indicates that availability did not automatically translate into consistent technical execution.

The frequent mention of debonding as a failure mode, together with strong emphasis on adhesive protocol importance, indicates clinicians recognize bonding centrality but still face uncertainty regarding steps that optimize bonding predictability, such as substrate management, isolation, cement selection, and procedural sequencing. Persistent fracturerelated concerns suggest heterogeneous caseselection heuristics and biomechanical understanding, potentially influencing how clinicians balance endocrown indications against alternative restorations. These results support future efforts to: (i) implement structured continuing professional development focusing on case selection, preparation geometry, and cementation protocols; (ii) develop pragmatic checklists and decision aids tailored to everyday clinical workflows; and (iii) conduct followup evaluations after training or guideline dissemination to assess improvements in knowledge and perceived barriers over time.

The current survey would thus suggest that endocrown use has become widely adopted into selfreported clinical practice amongst dentists in Saudi Arabia. However, adoption rates and the intensity of annual use remain differentially distributed in an orderly fashion, most prominently based on clinicians' experience and knowledge levels. This finding is consistent with previous national observations of non-uniform approaches to restoring endodontically treated teeth in Saudi Arabia, based on practitionerlevel differences in training exposure and restorative concepts [11]. Similar variability in knowledge, attitudes, and practices about postendodontic restorations has also been described in northern Saudi cohorts and serves to reinforce the interpretation that clinician factors remain key determinants of how newer restorative concepts are adopted and applied [12].

The results of a national pilot survey and related work on standards of care awareness similarly suggested that decisionmaking around postendodontic restoration can remain heterogeneous within the same health system, a finding which resonates with the experience- and knowledgerelated gradients in the present dataset [13]. Overall, these preceding Saudi surveys serve to underscore that high adoption does not of necessity translate into consistent technical execution or uniformly evidencealigned selection and afford a coherent backdrop for the observed knowledge-adoption association in the present study [14].

International survey evidence haslong indicated thatrestorative philosophies for endodontically treated teeth evolve over time but remain variable across clinicians and regions, reflecting a persistent gap between available techniques and their standardized implementation in everyday practice [15]. Accordingly, the present absence of a relationship between adoption and workplace or educational level is not unexpected and is compatible with data from Germany and Sweden showing that clinician decisionmaking is shaped by multiple interacting driverssuch as perceived biomechanical risk, familiarity with adhesive protocols, and procedural confidencerather than by a single structural determinant [16]. Patterns reported in Turkey from more recent national data similarly suggest that choices regarding postendodontic restoration remain sensitive to practitioner experience and training trajectories, supporting the inferencethat the diffusion of endocrowns would follow analogous diffusion dynamics [17]. Within this broader framework, the current findings may be interpreted as reflecting a relatively advanced stage of endocrown diffusion in Saudi practice, with remaining variability concentrated in technical confidence and protocol-level execution rather than in foundational awareness [18].

A striking feature of the response profile was the high report of CAD/CAM fabrication, which aligns with the historical development of the restorative modality of metalfree, monolithic restorations designed to function with adhesive retention principles and standardized manufacturing workflows [19]. Clinically, endocrowns are described as a conservative restoration that utilizes the pulp chamber for retention and distributes occlusal forces across a broad adhesive interface, an approach that naturally aligns with digital design and milling systems employed in contemporary practice [20]. Early clinical evaluations of adhesively placed CAD/CAM endocrowns supported the feasibility of this workflow when bonding protocols and preparation geometry were appropriately controlled, making the high reliance on CAD/CAM reported here consistent with the technique's intended delivery pathway [21].

However, the same survey responses indicated that many dentists perceived endocrowns as more techniquesensitive and challenging than conventional crown workflows, suggesting that the presence of digital fabrication capacity did not necessarily translate into uniform procedural control of isolation, surface treatment, and cementation steps that ultimately govern clinical predictability [2124]. The distribution of reported luting choices also implies incomplete standardization of cementation practices, and its consideration is of particular relevance given that the endocrown represents a fundamentally retentioncritical restoration, dependent on adhesive properties [25]. Foundational restorative guidance has emphasized that restoration planning for the endodontically treated tooth must be guided by remaining structure, resistance form, and stress distribution, and that the selected restoration must be appropriately matched with a retention strategy and sealing concept [2628].

Classic analyses of post placement and postendodontic restoration also emphasize the importance of the minimization of iatrogenic risk while maximizing predictability, through technique selection and execution appropriate for the structural scenario presented [29]. The present findings in the context of this overall framework support one implication with practice: while the endocrown may be seen to be broadly adopted, there is nonetheless a clear need for targeted training and calibration in the areas of case selection, preparation geometry, isolation, substrate management, and cement choice toward the minimization of technique variability and routine delivery aligned with contemporary evidence and biomechanical principles [28,29].

Limitations

This study had some limitations, including a crosssectional design that does not allow for causal inferences between practitioner characteristics and endocrown adoption. Convenience sampling and online distribution may have favored dentists who are more interested in restorative matters or who are enthusiastic about digital workflows. All results were based on selfreporting, and hence subject to recall bias and social desirability bias. Adoption could not be checked against the clinical records or objective quality indicators. Items had incomplete response denominators in

some cases, thus reducing precision for specific estimates and subgroup comparisons.

In this national survey of dentists from Saudi Arabia, the use of the endocrown was reported to be common, its adoption independently associated with higher knowledge and greater clinical experience than with gender, education level, or workplace category. The response profile suggested broad engagement with digital fabrication and adhesive concepts but also indicated persistent perceptions of technical difficulty and technique sensitivity, along with ongoing concerns about fracture risk and a dominant perception of debonding as the main failure mode. These findings support the need for standardized, skilloriented training and clearer decision frameworks to enhance consistency in endocrown selection and delivery in routine practice.

Acknowledgement:

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