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From Pulp Preservation to Root Canal Therapy: Exploring Decision-Making in Pulpal Disease Management

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A B S T R A C T

Background: Timely and accurate diagnosis of pulpal disease is essential for determining appropriate treatment ranging from conservative pulp preservation techniques to root canal therapy (RCT). Understanding dentists' clinical choices and their diagnostic rationale helps improve patient outcomes and guides evidence-based practice. **Objective:** This study aimed to evaluate the diagnostic and therapeutic decision-making approaches used by dentists in managing pulpal disease, with a focus on the preference for pulp-preserving techniques versus root canal treatment. **Methods:** A structured, validated questionnaire was distributed to licensed dental practitioners. A total of 329 responses were collected. The questionnaire assessed diagnostic methods, treatment preferences, use of advanced tools, and clinician confidence levels. Data were analyzed using descriptive statistics and percentages. **Results:** The most commonly used diagnostic tools were thermal testing (76.3%), evaluation of spontaneous pain (68.1%), and radiographic imaging (61.4%). Conservative treatments were preferred: 34.3% selected indirect pulp capping and 24.3% opted for partial pulpotomy. Root canal therapy was chosen by 14.9% of respondents. While 51.1% expressed high confidence in their diagnostic decisions, 13% reported uncertainty. **Conclusion:** The findings highlight a growing shift among dentists toward conservative, biologically oriented management of pulpal disease, supported by modern diagnostic techniques and evolving clinical guidelines. Despite this positive trend, variability in confidence and adoption of diagnostic tools suggests a need for continued professional development and standardized protocols.

1 Introduction

Pulpal diseases remain a significant clinical challenge in everyday dental practice, requiring accurate diagnosis and appropriate treatment planning to maintain tooth function and prevent further complications. The dental pulp is a highly specialized tissue responsible for tooth vitality, defense, and sensory function. When affected by caries, trauma, or restorative procedures, the pulp may develop inflammatory changes that range from reversible

inflammation to irreversible damage, depending on the severity and duration of the insult (Rechenberg & Zehnder, 2014). Therefore, choosing the correct management strategy is a critical component of clinical decision-making in dentistry.

In recent years, substantial progress has been made in diagnostic technologies and bioactive materials, leading to increased interest in conservative approaches such as vital pulp therapy (VPT). Modern bioceramic materials, calcium-silicate cements, and improved clinical protocols have expanded the indications for VPT, allowing it to be successfully used in both immature and mature permanent teeth—even in cases of early irreversible pulpitis (Aguilar & Linsuwanont, 2011; Taha et al., 2017). This shift reflects a broader movement toward minimally invasive, biologically based treatment planning and the preservation of the natural tooth structure whenever feasible.

Despite these advances, deciding between pulp preservation procedures and root canal treatment (RCT) remains complex. Clinical decision-making is frequently influenced by symptoms, radiographic findings, the degree of pulpal inflammation, tooth restorability, patient expectations, and—importantly—the clinician's training and confidence in using contemporary VPT techniques (Patel et al., 2022). While RCT is the conventional option for managing necrotic pulp and symptomatic irreversible pulpitis, it is technique-sensitive and its long-term success depends on several operator- and treatment-related factors (Ng et al., 2011).

Additionally, knowledge of oral pathology is essential for understanding the biological basis of pulpal and periapical diseases. Histopathological conditions such as chronic pulpitis, internal resorption, periapical granulomas, and radicular cysts do not always correlate directly with clinical symptoms, which complicates the diagnostic process (Nair, 2006). As a result, evidence-based clinical decision-making has become increasingly important, especially as new treatment philosophies emerge.

Although several studies have evaluated diagnostic accuracy and treatment outcomes in endodontics, limited research has examined how dentists actually make decisions in real clinical settings—particularly in relation to the growing acceptance of VPT. There remains a need to assess current practice patterns, clinicians' confidence, and the factors guiding the choice between conservative pulp treatment and traditional RCT.

Therefore, the present study aims to investigate dentists' decision-making approaches in the management of pulpal diseases, with a focus on understanding the transition from vital pulp therapy to root canal therapy. Identifying these patterns is essential for improving clinical education, strengthening evidence-based practice, and supporting the global movement toward more conservative and biologically driven dental care

2 Materials and Methods

2.1 Study Design and Setting

This was a descriptive, cross-sectional, questionnaire-based study conducted to assess dentists' clinical decision-making regarding the management of pulpal diseases, particularly the shift between vital pulp therapy (VPT) and root canal treatment (RCT). The study was carried out in Sirte, Libya, and targeted dentists practicing in different regions across the country.

The study adhered to the ethical principles of the Declaration of Helsinki and received approval from the Research Ethics Committee of Sirte University (Approval No:05. S, U.2025). Participation was voluntary, and informed consent was obtained electronically from all respondents.

2.2 Questionnaire Description

A **structured, closed-ended questionnaire** was used as the primary data collection tool. The questionnaire was **self-developed** based on themes identified from current literature on clinical decision-making in pulpal disease management. To ensure clarity and relevance, the draft questionnaire underwent **content validation** by a panel of experts in restorative dentistry and oral pathology.

A **pilot study** was conducted on **20 dentists** to assess the clarity and reliability of the items. Internal consistency was evaluated using **Cronbach's alpha**, which demonstrated acceptable reliability ($\alpha = 0.81$). Data from the pilot study were not included in the final analysis.

The final questionnaire consisted of **10 closed-ended items**, organized into four sections:

1. **Demographic information** (age, sex, qualifications, and years of experience)
2. **Diagnostic approach**
3. **Treatment preferences**
4. **Clinical confidence and training**

2.3 Sampling Strategy and Sample Size Calculation

The target population included licensed **general practitioners and dental specialists** actively practicing at the time of the study. Inclusion criteria were:

- Licensed dentists practicing in Libya
- Willingness to participate
- Completion of the full questionnaire

Exclusion criteria included:

- Incomplete responses
- Duplicate entries
- Non-practicing dentists

Sample size was determined using an online **sample size calculator (Raosoft/G*Power)** with a confidence level of **95%**, a margin of error of **5%**, and an estimated response distribution of **50%**, yielding a minimum required sample size of **n =** 384. The final sample exceeded this requirement. The final number of respondents (n = 329) approached this requirement and was considered adequate for the study's analytical purposes.

2.4 Data Collection Procedure

The questionnaire was distributed electronically using Google Forms. The survey link was circulated via professional dental forums, academic mailing lists, and social media platforms commonly used by healthcare professionals. Data collection was conducted over a six-month period in 2025.

2.5 Data Analysis

Completed responses were exported to **Microsoft Excel**, cleaned for duplicates or incomplete entries, and subsequently analyzed using **SPSS version 28.0**.

- **Descriptive statistics** (frequencies, percentages) were calculated for demographic variables and response patterns.
- **Inferential statistics** were used to assess associations between variables, such as the relationship between **years of experience** and **diagnostic or treatment preferences**, using the **Chi-square test** (or Fisher's exact test when appropriate).
  A p-value < 0.05 was considered statistically significant.

No personal identifiers were collected to ensure privacy and confidentiality.

3 Results

3.1 Participant Demographics

Among the participants, **41.3% (n = 136)** had less than 5 years of clinical experience, **34.0% (n = 112)** had 5–10 years, and **24.6% (n = 81)** had more than 10 years of experience. Regarding specialties, **58.7% (n = 193)** were general practitioners, **21.9% (n = 72)** were restoratives, and **19.4% (n = 64)** were from other specialties. Table 1.

Table 1. Demographic Characteristics of the Participants

Category	Response	n	Percentage (%)
Years of Experience	< 5 years	136	41.3%
	5–10 years	112	34.0%
	> 10 years	81	24.6%
Specialty	General practitioner	193	58.7%
	restorative	72	21.9%
	Other	64	19.4%

3.2 Diagnostic Preferences

When identifying pulpal disease, the most relied-upon diagnostic indicators were thermal test response (30.4%, n = 251), spontaneous pain (27.1%, n = 224), and radiographic findings (24.5%, n = 202). Only 11.9% (n = 98) reported routinely using pulp vitality tests, and 6.2% (n = 51) used CBCT in diagnosis. Figure 1

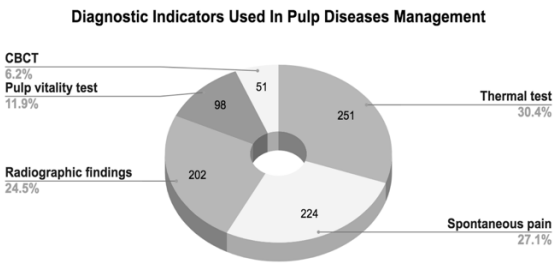

Figure.1. *Diagnostic indicators used*

3.3 Treatment Preferences

For deep carious lesions in vital teeth, the majority preferred indirect pulp capping (34.3%, n = 113), followed by partial pulpotomy (24.3%, n = 80), and full pulpotomy (19.8%, n = 65). Only 14.9% (n = 49) opted for immediate root canal therapy, while 6.7% (n = 22) chose direct pulp capping. Figure 2.

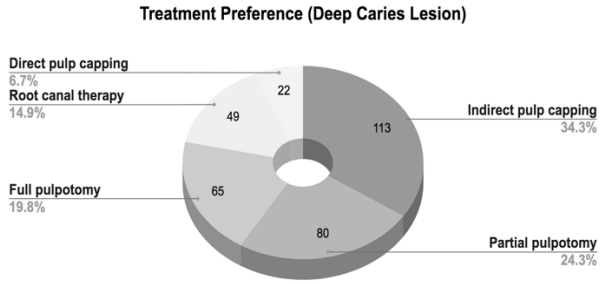

Figure.2. *Treatment preferences of deep lesion.*

Regarding management of early irreversible pulpitis in mature teeth, 47.1% (n = 155) considered vital pulp therapy, while 33.7% (n = 111) did not, and 19.1% (n = 63) responded "depends on case." Table.3

The main reasons for choosing root canal therapy over pulp preservation included better long-term outcome (38.9%, n = 128), uncertain diagnosis (26.4%, n = 87), and lack of training in VPT (20.4%, n = 67). Patient preference was cited by 14.3% (n = 47).

Table 3. Management Approach and Reasons for Treatment Choice

Category	Response	n	Percentage (%)
Management of Early Irreversible Pulpitis	VPT considered	155	47.1%
	VPT not considered	111	33.7%
	Depends on case	63	19.1%
Reason for Choosing RCT	Better long-term outcome	128	38.9%
	Uncertain diagnosis	87	26.4%
	Lack of training in VPT	67	20.4%
	Patient preference	47	14.3%

3.5 Clinical Confidence and Training

In terms of diagnostic confidence, 51.1% (n = 168) reported being very confident in distinguishing reversible from irreversible pulpitis, 35.9% (n = 118) were somewhat confident, and 13.0% (n = 43) were not confident. Figure.3

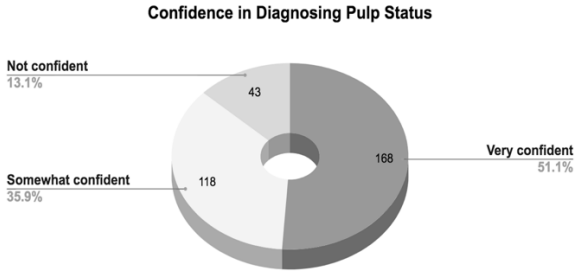

Figure.3*. Confidence in diagnosing pulp status*

Only 39.8% (n = 131) of respondents reported having received formal training in vital pulp therapy (VPT) techniques. Despite this, a substantial majority (82.4%, n = 271) expressed interest in pursuing continuing education related to conservative pulp management.

Table 4. Training and Educational Interest Among Respondents (N = 329)

Category	Response	n	Percentage (%)
Received Training in VPT	Yes	131	39.8
	No	198	60.2
Interest in VPT Education	Yes	271	82.4

4. Discussion

This study provides valuable insight into dentists' clinical decision-making regarding the diagnosis and management of pulpal disease, revealing an increasing trend toward conservative, pulp-preserving strategies. The preference for diagnostic tools such as thermal testing (76.3%) and evaluation of spontaneous pain (68.1%) remains in agreement with well-established protocols that prioritize non-invasive tests for pulp vitality (Petersson et al., 1999; Mejare et al., 2012). Recent research continues to validate these tools as reliable first-line assessments in daily practice (Almubarak et al., 2023; Berman & Hartwell, 2020).

Radiographic evaluation was used by 61.4% of respondents, confirming its central role in periapical assessment. However, the relatively low use of Cone-Beam Computed Tomography (CBCT) (15.5%) indicates a potential gap between technology availability and routine implementation. This is consistent with findings by Patel et al. (2020), who noted that while CBCT enhances diagnostic accuracy—particularly in identifying hidden canal morphology and periapical lesions—its high cost and radiation dose remain limiting factors in general practice.

When considering treatment choices, a shift toward minimally invasive care was clear. Indirect pulp capping (34.3%) and partial pulpotomy (24.3%) were the most preferred options, reflecting a growing body of literature supporting vital pulp therapy (VPT) for managing deep carious lesions—even in cases previously classified as irreversible pulpitis. Studies by Aguilar & Linsuwanont (2011), and more recently by Elmsmari et al. (2022), provide compelling evidence for the long-term success of VPT, especially with modern bioceramic materials.

Only 14.9% of participants selected root canal therapy (RCT) as the first-line treatment, suggesting that the conventional approach is being increasingly reserved for cases of definitive pulpal necrosis or when conservative interventions are not feasible. This evolution in decision-making supports the endodontic community's shift away from overly aggressive treatment toward biologically respectful approaches (Careddu et al., 2023; Dummer & Chong, 2021).

In terms of clinician confidence, 51.1% reported high confidence in their diagnostic capabilities, whereas 13% expressed uncertainty. This disparity mirrors earlier findings from Alqaderi et al. (2021), who highlighted that diagnostic confidence is closely tied to clinical training, years of practice, and access to standardized diagnostic criteria. A lack of universal adoption of the AAE pulpal diagnostic terminology may further contribute to inconsistent interpretations and decision-making (AAE Consensus Conference, 2019).

Only 39.8% of respondents reported having received formal training in vital pulp therapy (VPT), yet 82.4% expressed interest in continuing education on conservative pulp management. This highlights a gap between existing training and practitioner motivation to adopt minimally invasive approaches (Alqaderi et al., 2021). Previous studies show that structured training improves confidence and consistency in VPT implementation (Aguilar & Linsuwanont, 2011; Elmsmari et al., 2022). The findings emphasize the need for targeted educational programs to bridge this gap and promote evidence-based, pulp-preserving strategies in routine practice (American Association of Endodontists Consensus Conference, 2019; Careddu et al., 2023).

4.1Limitations

This study is not without limitations. First, the self-reported nature of the questionnaire may introduce response bias. Second, the sample size, though substantial (n = 329), may not be representative of all dental practitioners across different regions. Third, specific clinical scenarios were not tested, limiting the ability to assess diagnostic accuracy in context.

4.2 Implications

The findings highlight the need for continuing education programs focusing on pulpal diagnosis and management. The low utilization of advanced diagnostics such as CBCT suggests a need to improve accessibility and clinical protocols for when their use is

justified. Additionally, variability in confidence levels underscores the necessity of standardized guidelines and training modules, particularly for less experienced practitioners.

5. Conclusions

Dentists are increasingly favoring pulp-preserving strategies in managing pulpal diseases, supported by traditional diagnostic tools such as thermal and pain testing. While this reflects a positive shift toward conservative care, the underuse of advanced diagnostics and variability in confidence levels suggest areas for further development in clinical training. Continued research and education are essential to refine clinical decision-making and enhance patient outcomes.

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Conflict of interest: The authors declare that there are no conflicts of interest

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