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*Original article*

# Current Trends in Endodontic Clinical Practice in Tripoli, Libya: A Cross-Sectional Study

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**Abstract**
Root canal therapy (RCT) is typically performed in Tripoli, Libya, by general dental practitioners (GDPs), who are more widely available and less expensive than endodontists. Concerns have been expressed about the quality of RCTs performed by GDPs, presumably due to a lack of equipment or experience, so this study aims to evaluate current endodontic practices in Tripoli, Libya. A cross-sectional study was conducted using a questionnaire distributed to 250 randomly selected Libyan dentists in Tripoli, with 212 fully validated completed responses (84.8% response rate). The data was collected and statistically analyzed. The study sheds light on the current situation of endodontic care in Tripoli, Libya, highlighting both progress and ongoing problems. While many dentists use current techniques, such as electronic equipment to evaluate root canal length (81%) and newer bioceramic sealants (40%), significant gaps exist. For example, only 63% of practitioners habitually utilize rubber dams, a vital step in infection management, and antibiotics are frequently provided inadvertently (9% for pain alone). Traditional treatments, such as cold fillings for canal sealing (43%), remain superior to newer methods, while diagnostic processes, such as canal identification (60% rely solely on visual inspection), are variable. These worries, together with common errors in determining canal length (26%) and sealing canals (20%), lead to a compelling need for training, especially because over half of the dentists questioned are young (57% with ≤5 years' experience). To fill these gaps, we recommend hands-on workshops on advanced instruments (e.g., magnification devices), updated infection control measures, and more specific antibiotic use guidelines. By resolving these issues, Tripoli's dentistry community may better match worldwide standards, resulting in safer, higher-quality care for patients.
**Keywords.** Endodontic, General Dental Practitioners, Equipment, Bioceramics, Diagnostic.

## Introduction

Root canal therapy (RCT) aims to maintain tooth health and function, alleviate pulp inflammation, and prevent periapical tissue issues [1]. It is considered a difficult procedure by dental practitioners for a variety of reasons, including the different shape and configuration of the root canal system, precise identification and widening of all canals without procedural errors, accurate working length determination, and the maintenance of adequate irrigation and perfect obturation [2].

Previous questionnaire surveys were conducted in both developed and developing countries, including the United Kingdom (UK) [3], Hong Kong (HK) [4], North Jordan [5], and Belgium [6]. In India [7] and Sudan [8], general dental practitioners (GDPs) and endodontists tend to rely on what they were taught in dental school and may not incorporate new technology and materials into their everyday practice. Others may use technologies without scientific validity.

In Libya, a country facing substantial healthcare challenges, it is crucial to understand how general dental practitioners' approach endodontic treatment to identify potential areas for improvement and standardization. Limited resources and disparities in training opportunities pose challenges for consistent, high-quality dental care in many parts of the country, impacting patient outcomes and overall healthcare quality. A 2017 study conducted in Benghazi, Libya, revealed that general dental practitioners in the city predominantly relied on conventional endodontic techniques, with limited adoption of newly introduced technologies and methods [9]. This tendency was largely attributed to a lack of expertise and limited recognition of modern endodontic advancements in daily practice. Such findings suggest that barriers to professional development may limit the quality and effectiveness of endodontic care offered by general practitioners in Libya. The absence of training in new techniques and limited access to the latest technology restricts the ability of practitioners to adopt more effective, evidence-based approaches.

Despite these insights, there is limited research on endodontic practices among general dentists in Tripoli, the capital city. Given that healthcare infrastructure and access to continuing education resources may differ between cities, an investigation into the attitudes, techniques, and trends among general dental practitioners in Tripoli is warranted. Differences in city-level healthcare infrastructure could influence the level of exposure and adherence to endodontic advancements among practitioners in Libya.

This study aims to address this gap, assessing the current state of endodontic treatment practices in Tripoli and identifying potential areas for professional development to enhance dental care quality in the region. In this way, the findings from the 2017 study help establish a basis for examining whether similar trends exist in Tripoli, thus justifying the importance of this study.

## Methods


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***Study Design***
A cross-sectional survey was conducted, on the questionnaire was administered over three months, beginning in March 2025 and finishing in May 2025. The questionnaire was distributed randomly to 250 general dentistry practitioners in Tripoli, Libya. A total of 212 forms, fully completed, were returned. The Questionnaire

***Data collection***
The questionnaire, created using a literature search and expert feedback, included closed-ended and multiple-choice questions about demographic information such as age, gender, years of experience, and educational background. Questions about the importance of endodontic therapy in general practice, acquaintance with current recommendations, and commitment to continued professional development. Endodontic techniques include detailed inquiry into commonly utilised methods and materials like cavity preparation, instrumentation techniques, irrigation protocols, obturation methods, and favored materials. Items that assess the most recent trends in endodontic therapy, any perceived issues, and the effect of patient demand and technological advancements on treatment alternatives. Before being widely circulated, the survey was piloted with a small group of practitioners to ensure its clarity and usefulness.

***Statistics analysis***
The data were uploaded to Excel and analyzed using SPSS version 25, which employed descriptive statistics (frequency and percentage). Participation was voluntary, anonymous, and based on electronic informed consent, with all data maintained secure and secret.

## Results
This cross-sectional study gives a comprehensive review of endodontic operations among general dental practitioners in Tripoli, Libya, with responses from 212 participants representing a diverse spectrum of clinical experiences. The study discovered that the overall response rate was 84.8%, implying that the study was representative of practitioners.

***Demographic Characteristics***
The majority of respondents were female (68.9%), with males representing 31.1%. Most practitioners were within the 21–30 years age group (48.1%), followed by those aged 31–40 years (35.8%), 41–50 years (15.6%), and a small proportion aged 51–60 years (0.5%). Regarding professional experience, 57.1% had 0–5 years in practice, 12.7% had 6–10 years, and 30.2% reported more than 10 years of experience. In terms of educational level, 16.5% held a certificate, 66.0% a bachelor's degree, 14.2% a master's degree, and 3.3% a doctoral degree (Figure 1).

***Root canal treatment practices***
A substantial proportion of practitioners (75.5%) reported always performing root canal treatment (RCT), while 17.0% performed RCT only in emergencies, and 7.5% never performed the procedure. The majority (83.5%) treated all types of teeth, whereas 11.8% treated anterior and premolar teeth, and only 2.4% treated anterior or molar teeth exclusively.
Regarding the number of visits for RCT, 62.3% performed both single and multiple visit treatments, 32.1% preferred multiple visits, and 5.7% performed RCT in a single visit. Flare-ups between appointments were most commonly managed with intracanal medicaments (34.0%) and analgesics (30.7%), followed by occlusal reduction (12.3%), referral to a specialist (13.2%), and antibiotics (9.9%) (Table 1).


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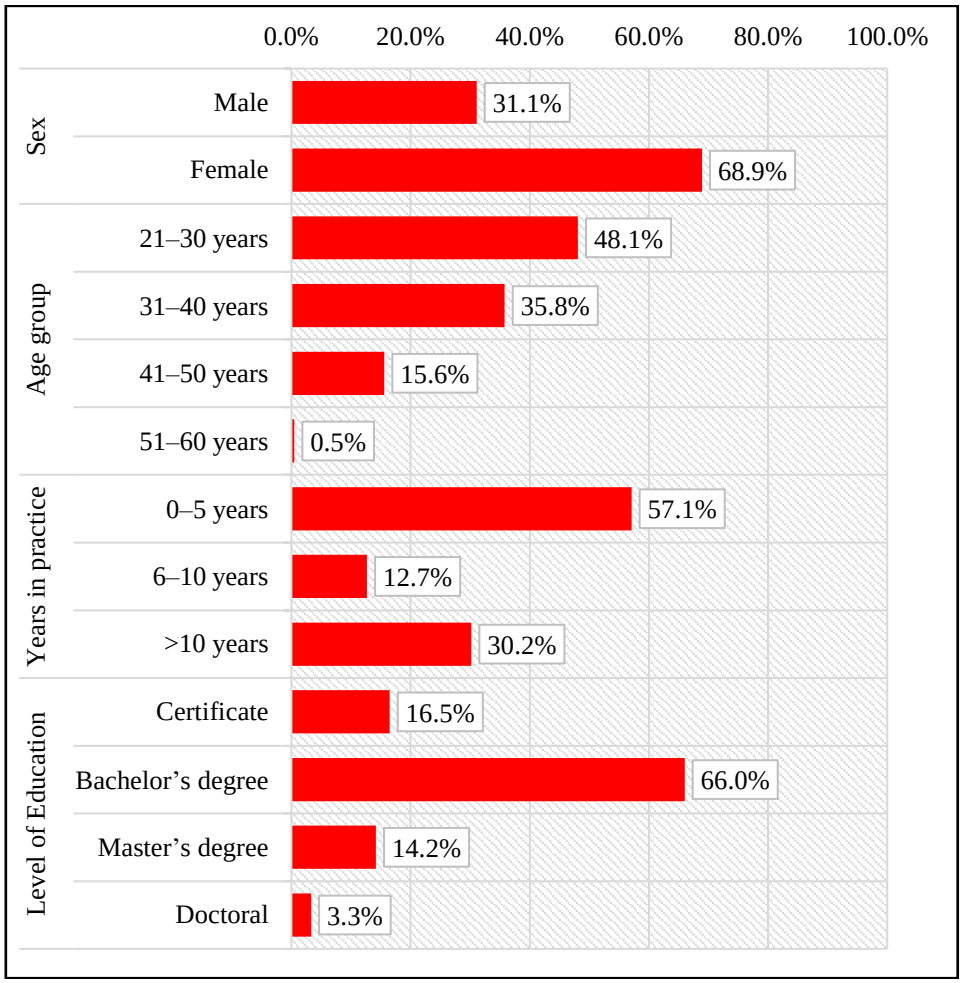


***Figure 1. Demographic Characteristics of participants***

***Table 1. Root Canal Treatment Practices***

| Category | Count | Percentage |
|---|---|---|
| **Do you still perform RCT?** | | |
| Always | 160 | 75.5% |
| Emergency only | 36 | 17.0% |
| Never | 16 | 7.5% |
| **Type of teeth treated** | | |
| Anterior only | 5 | 2.4% |
| Anterior and premolars | 25 | 11.8% |
| Molars | 5 | 2.4% |
| All teeth | 177 | 83.5% |
| **Number of visits for RCT** | | |
| Single visit treatment | 12 | 5.7% |
| Multiple visit treatment | 68 | 32.1% |
| Both | 132 | 62.3% |
| **Flare-up management** | | |
| Occlusal reduction | 26 | 12.3% |
| Antibiotic | 21 | 9.9% |
| Intracanal medicament | 72 | 34.0% |
| Analgesic | 65 | 30.7% |
| Refer to the specialist | 28 | 13.2% |

### *Diagnostic and Procedural Approaches*

For pulp vitality assessment, a combination of tests was most frequently used (49.1%), with the cold test (40.6%) being the most common single method. Pre-operative radiographs were routinely taken by 84.9% of practitioners, while 15.1% did so occasionally.

Most respondents (68.9%) did not use any magnification device during RCT, whereas 26.4% used dental loupes and 4.7% used a dental operating microscope. Rubber dam isolation was the preferred method (62.7%), followed by cotton rolls (25.9%) and saliva ejectors (10.4%).


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For access cavity preparation, round burs were most commonly used (65.1%), with straight fissure burs (17.0%), tapered burs (6.6%), and other types (11.3%) also reported. Canal location was primarily performed visually (60.4%), with 27.8% using a combination of methods (Table 2).

***Table 2. Diagnostic and Procedural Approaches***

| Category | Count | Percentage |
|---|---|---|
| **Pulp vitality assessment** | | |
| Hot test | 13 | 6.1% |
| Cold test | 86 | 40.6% |
| Electrical pulp testing | 9 | 4.2% |
| Combination of the above | 104 | 49.1% |
| **Pre-operative radiograph** | | |
| Always | 180 | 84.9% |
| Sometimes | 32 | 15.1% |
| Never | 0 | 0.0% |
| **Magnification device** | | |
| No | 146 | 68.9% |
| Dental loupes | 56 | 26.4% |
| Dental operating microscope | 10 | 4.7% |
| **Isolation method** | | |
| Rubber dam | 133 | 62.7% |
| Cotton roll | 55 | 25.9% |
| Saliva ejection | 22 | 10.4% |
| None | 2 | 0.9% |
| **Access cavity preparation** | | |
| Round | 138 | 65.1% |
| Straight fissure | 36 | 17.0% |
| Tapered bur | 14 | 6.6% |
| Others | 24 | 11.3% |
| **Canal location method** | | |
| Visual only | 128 | 60.4% |
| DG-16 explorer | 18 | 8.5% |
| Magnification dyes | 2 | 0.9% |
| CBCT Magnification | 5 | 2.4% |
| Combination of above | 59 | 27.8% |

### *Working Length Determination and Canal Preparation*

The majority (81.1%) determined working length using both electronic apex locators and radiographs, while 9.0% used apex locators alone, 8.5% relied solely on radiographs, and 1.4% used tactile sensation. Pulp extirpation was most frequently performed with K-files (46.7%), followed by rotary files (33.5%), barbed broaches (15.6%), and H-files (4.2%). Both manual and rotary instrumentation were used by 63.7% of practitioners for cleaning and shaping, while 30.7% used rotary alone and 5.7% manual alone (Figure 2).

### *Irrigation and Obturation Techniques*

A combination of irrigants was preferred by 62.3% of respondents, with sodium hypochlorite being the most common single irrigant (36.3%). Side-vented needles were the most frequently used irrigation needle type (70.3%), followed by closed-ended dual side-vented needles (19.8%) and open-ended needles (9.9%).

Calcium hydroxide was the predominant intracanal medicament (81.6%), with smaller proportions using chlorhexidine iodine (11.8%), triple antibiotic paste (4.7%), and potassium iodide (1.9%). For obturation, cold lateral condensation was the most widely used technique (42.9%), followed by the single cone technique (39.6%). Other techniques included warm vertical compaction (9.0%), injectable gutta-percha systems (5.2%), continuous wave compaction (1.9%), hydraulic condensation (0.9%), and thermophilic methods (0.5%). The majority preferred to cut gutta-percha at the orifice level (67.5%) (Table 3).


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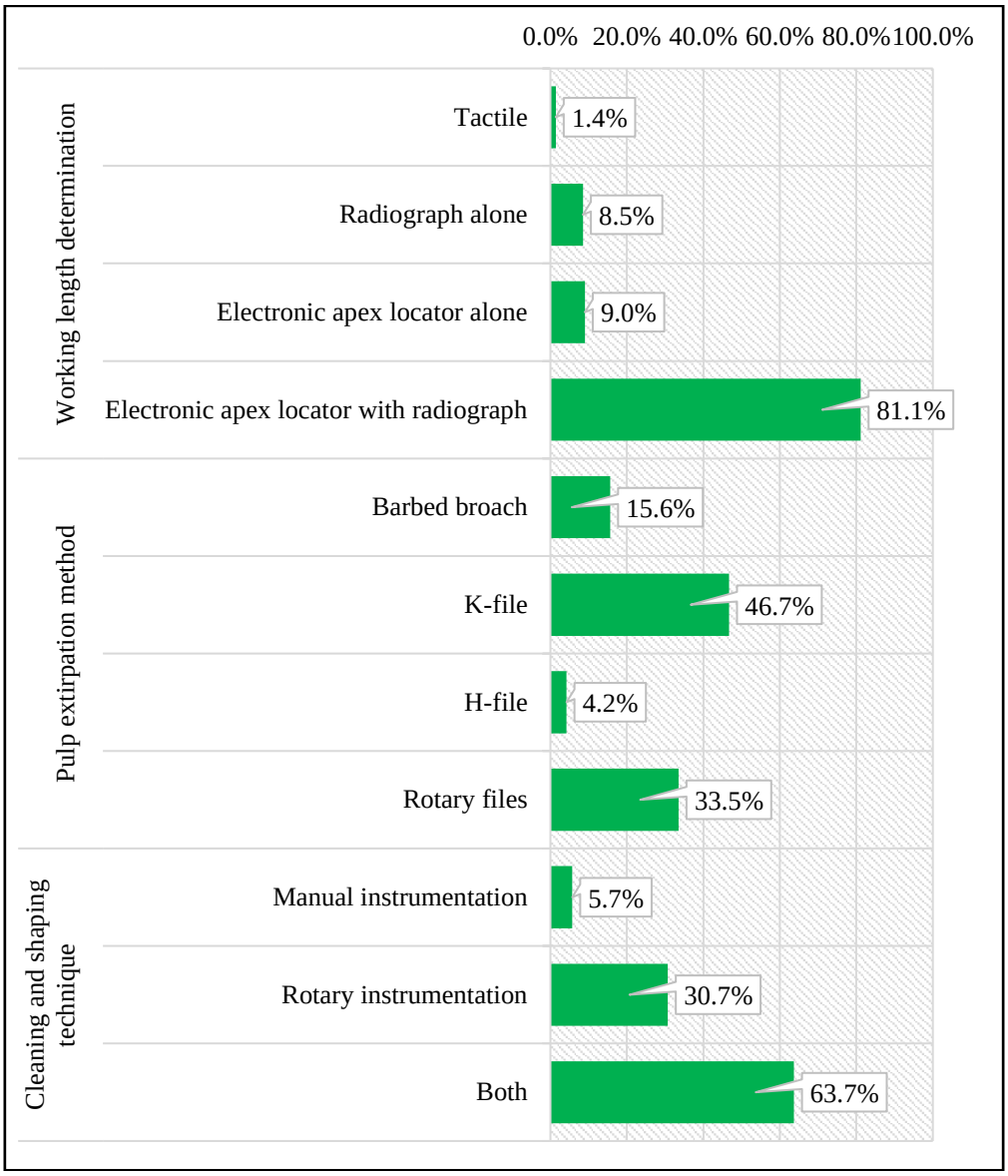


***Figure 2. Working Length Determination and Canal Preparation***

***Table 3. Irrigation, Obturation, and Medicament Use***

| Category | Count | Percentage |
|---|---|---|
| **Irrigation solution** | | |
| Sodium hypochlorite | 77 | 36.3% |
| EDTA | 1 | 0.5% |
| Chlorohexidine | 2 | 0.9% |
| Hydrogen peroxide | 0 | 0.0% |
| Combination of above | 132 | 62.3% |
| **Irrigation needle type** | | |
| Side-Vented Needles | 149 | 70.3% |
| Open-Ended Needles | 21 | 9.9% |
| Closed-Ended Needles (Dual Side-Vented) | 42 | 19.8% |
| Notched Needles | 0 | 0.0% |
| Laser-Activated Needles | 0 | 0.0% |
| **Intracanal antibacterial medicament** | | |
| Calcium Hydroxide | 173 | 81.6% |
| Triple Antibiotic Paste | 10 | 4.7% |
| Chlorhexidine Iodine | 25 | 11.8% |
| Potassium iodide (IKI) | 4 | 1.9% |
| **Obturation method** | | |
| Cold lateral condensation | 91 | 42.9% |
| Warm vertical compaction | 19 | 9.0% |


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| | | |
|---|---|---|
| Continuous wave compaction | 4 | 1.9% |
| Single Cone technique | 84 | 39.6% |
| Thermophilic | 1 | 0.5% |
| Injectable Gutta-Percha systems | 11 | 5.2% |
| Hydraulic condensation | 2 | 0.9% |
| **Coronal level for cutting gutta-percha** | | |
| At the orifice level | 143 | 67.5% |
| Below the orifice | 57 | 26.9% |
| To the pulp chamber level | 12 | 5.7% |

***Sealers and Antibiotic Prescriptions***

Bio ceramic-based sealers were the most commonly used (40.1%), followed by resin-based (25.9%), zinc oxide eugenol (13.7%), calcium hydroxide-based (12.3%), and MTA-based sealers (8.0%). Antibiotics were most frequently prescribed in cases of swelling (83.0%), with much lower rates for pain (9.0%), sinus tract opening (6.6%), and percussion sensitivity (1.4%). When asked about steps most prone to error, working length determination was cited most often (25.5%), followed by obturation (19.8%), diagnosis (14.2%), mechanical instrumentation (13.7%), access cavity preparation (9.4%), irrigation (11.3%), and medication (6.1%). These findings provide a detailed snapshot of current endodontic practices among general dental practitioners in Tripoli, highlighting both adherences to established protocols and areas where further professional development may be beneficial (Table 4).

***Table 4: Additional Clinical Practices***

| Category | Count | Percentage |
|---|---|---|
| **Coronal level for cutting gutta-percha** | | |
| At the orifice level | 143 | 67.5% |
| Below the orifice | 57 | 26.9% |
| To the pulp chamber level | 12 | 5.7% |
| **Type of sealer used** | | |
| Zinc oxide eugenol sealer | 29 | 13.7% |
| Resin-based sealer | 55 | 25.9% |
| Calcium hydroxide-based sealer | 26 | 12.3% |
| MTA-based sealer | 17 | 8.0% |
| Bio ceramic-based sealer | 85 | 40.1% |
| **Antibiotic prescription indications** | | |
| Pain | 19 | 9.0% |
| Percussion | 3 | 1.4% |
| Sinus tract opening | 14 | 6.6% |
| Swelling | 176 | 83.0% |
| **The step most prone to error** | | |
| Diagnosis | 30 | 14.2% |
| Access cavity preparation | 20 | 9.4% |
| Working length determination | 54 | 25.5% |
| Mechanical instrumentation | 29 | 13.7% |
| Irrigation | 24 | 11.3% |
| Medication | 13 | 6.1% |
| Obturation | 42 | 19.8% |

## Discussion

With the advent of new materials, instruments, and techniques, the quality of endodontic treatment has improved, resulting in a higher success rate. New technology allows for surgical or non-surgical endodontic treatment to save teeth with guarded prognosis that were previously extracted. RCT performed without first establishing a precise diagnosis and without suitable instruments, knowledge of the root canal system architecture, or procedures results in unpredictable consequences. Endodontic treatment of any tooth is a complex technique since its effectiveness is dependent on the accurate cleaning, shaping, and obturation of a canal utilizing the appropriate instrumentation and careful asepsis protocol [10].

This cross-sectional study provides an overview of endodontic procedures among general dentistry practitioners in Tripoli, Libya, including responses from 212 participants who represent a broad range of clinical experiences. The study found that the overall response rate was 84.8%, indicating that the study was typical of practitioners. This figure is similar to Bubteina and Shakeer's results (88.23%) [9] and higher than prior studies performed in Western countries with superior communication infrastructure [3, 11, 12, 13]. However, this percentage is lower than that of Flemish dentists (99.4%) [14].


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This demographic trend may explain both the high level of clinical engagement in endodontic therapy and the varying degrees of adherence to contemporary standards. A substantial majority of practitioners reported routinely performing root canal treatment (RCT) and treating all types of teeth, suggesting that endodontics is a central component of general dental practice in Tripoli. The majority of the participants in this study were young and early-career dentists, with more than half having less than 5 years of experience practicing dentistry. The received postgraduate training in endodontics indicates that young practitioners are becoming more interested in postgraduate study in this field. This finding was consistent with previous research conducted in Romania [15] and New Zealand [16], which found a high level of interest in endodontics training, also similar to findings reported in a study by Bogari et al. [17] in which most study participants were freshly graduated. On the other hand, the results of the present study were in contrast to the results of other studies [18-20]; they stated that dental practitioners had >10 years of work experience.

Diagnostic protocols were broadly compatible with global standards. Nearly 85% of responders collected pre-operative radiographs consistently, and roughly half used a combination of pulp vitality tests, which improves diagnostic reliability. Dental pulp tests, such as cold tests and the electronic pulp test (EPT), have been widely used to aid in endodontic diagnosis [21]. According to the findings of the current study, the most common approach for assessing pulp vitality was a combination of tests (49.1%), with the cold test (40.6%) being the most popular single method. These findings were consistent with Bogari DF et al.'s study, which found that the cold pulp test combined with an EPT may accurately assess pulp vitality rather than using either alone [18]. In their study, they found that 42.8% of GDPs used the cold test to support their diagnosis of teeth that needed RCT, while 55.5% thought that percussion was a reliable method for diagnosing RCT. Additionally, only 21.4% of GDPs used perio-probe to determine the depth of a pocket surrounding the pretentious tooth before starting the procedure. A positive percussion test result may cause irritation at the periapical area [22].

In terms of magnification during RCT, the naked eye can only see clearly. up to the pulp chamber's floor and canal orifice [23]. Furthermore, natural vision declines with ageing [24, 25]. Magnification can reduce age-related visual impairment, making it crucial for successful endodontic operations [23, 26]. The poll found that 31.1% of respondents were aware of their visual impairment and used magnification devices, with 26.4% utilising dental loupes and 4.7% using a dental operating microscope. These findings were similar to those of a previous study conducted in 2017 in Romania [27], which discovered that the vast majority of GDPs did not use magnification in their regular practices. On the other hand, these findings were lower than those of a prior study conducted in Romania in 2024 [15]. This low adoption rate contrasts with practices in more resource-rich regions and may reflect restricted access to equipment or inadequate training in its use.

Rubber dams are advised for endodontic isolation to improve sight, minimise instrument aspiration, and protect GDPs from polluted aerosols. Rubber dam isolation, which is considered a standard of care, was used by 62.7% of dentists, above the percentage recorded in comparable regional research and indicating an increasing awareness of infection management in endodontics. These findings were fairly consistent with previous research in which 74% of Croatian dentists [28], 60% of dentists in the United Kingdom [29], and 57% of general dentistry practitioners in New Zealand [30] reported commonly employing rubber dams in endodontic therapy. It was discovered that continuing education course participants appear to be encouraged to utilise rubber dams. The current study's findings were greater than Bubteina and Shakeer's results [9], which showed that only 11.3% of respondents used rubber dam isolation during endodontic procedures. The current findings were relatively high when compared to a survey of Belgian general dental practitioners [14], which revealed that only 3.4% of practitioners employed rubber dams as an isolation strategy during root canal procedures. Also, the present study demonstrated higher results when compared to research conducted in Nepal [31], which claimed that only 10.97% of GDPs use rubber dams regularly and did not meet the norms of endodontic principles. The findings of this study are remarkably compatible with those of prior studies [6, 8]. Also similar to the findings of Gaikwad A. et al. [32], who surveyed 178 dentists and discovered that 86.4% performed RCT in posterior teeth solely. Their study found that cotton rolls were the most commonly used isolation method (74.6%), with only 3.2 percent of practitioners using rubber dams during an endodontic procedure, indicating that the majority of practitioners did not follow the required quality standard guiding principles for rubber dams.

CBCT utilisation is modest in Libya, with variations depending on clinic type and quantity of teeth treated. This remains below the 90% found among specialists in developed countries [33]. Encouragingly, CBCT utilisation rises with CE and the number of teeth treated. The main reason for not employing CBCT appears to be its inaccessibility; thus, there is plenty of room to grow the use of this technology in Libya. The majority of doctors completed canal location visually; these findings are consistent with prior research in the Kingdom of Saudi Arabia (2022) [34] and recent research from Croatia (2025) [28].

Failure to acquire a correct working length frequently causes apical perforation, underextension, or overextension of the obturating materials into the periradicular area [35]. It is evident that radiographic methods have inherent flaws, such as the apical foramen cannot be traced on a standard radiograph [36], but the electronic apex locator has the advantage of being able to locate the apical foramen [37]. It was recommended to employ both the electronic apex locator (EAL) and conventional radiography to determine


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working length in an efficient and precise manner [38]. Working length determination techniques in the current study were exceptionally strong: more than 81% used both apex locators and radiographs, which is consistent with best-practice guidelines. These findings were congruent with a study conducted in a study of Jouhar et al. [34], which revealed that 79.2% of respondents preferred using both a radiograph and an apex finder to precisely measure working length. In the Kingdom of Saudi Arabia's study [35], they revealed that the majority of practitioners (63%) employed both apex locators and periapical x-rays for measuring working length. In contrast to previous data from Bubteina and Shakeer's study [9], the current findings revealed that 6% of respondents utilised EAL in conjunction with traditional radiographs, while only 3.3% used EAL in conjunction with digital radiographs. Also, in the Gaikwad survey [32], half of the participants take radiographs before surgery, whereas more than half of the dentists take one radiograph to determine the working length, and 22.9% do not take any radiographs at all in Omari's study [5].

Cleaning and shaping the canal is a sensitive stage that must be completed precisely. To have a successful RCT. Manual K-files were the most prevalent instrument for pulp extraction, but rotary files were also used regularly. Nearly two-thirds of respondents used a hybrid approach to instrumentation, which included both manual and rotary systems, demonstrating a balanced application of traditional and contemporary technology. In contrast to Bubteina and Shakeer's study [9], the current findings revealed that 50% of respondents used a combination of K-files and Hedström files for canal preparation, 38% utilised K-files, and only 3.3% used a combination of K-files and reamers for the mechanical preparation procedure.

The current study showed a higher prevalence than the results of Jouhar et al. [34], which showed that 96.28% used stainless steel hand files, but only 28.04% and 13.41% of GDPs used hand and rotary nickel-titanium files, respectively, which were the same results as observed in a study by Shrestha et al. [41], Mehta et al. [35], and Iqbal et al. [42]. Rotary nickel-titanium files speed up RCT preparation, minimise canal transportation, and preserve tooth structure more effectively [43].

Irrigation is crucial for root canals due to the presence of auxiliary canals and microorganisms. An ideal irrigant should have both antibacterial and tissue-dissolving characteristics [42]. Irrigation practices in the current study indicated widespread use of sodium hypochlorite, either alone (36.3%) or in combination with other agents (62.3%), and the majority use of side-vented irrigation needles (70%), indicating a strong awareness of safe irrigation techniques. Because of its strong antibacterial and tissue disintegrating properties, sodium hypochlorite is regarded as the best and most popular root canal irrigant [43]. A study of Gaikwad, A. et al. [32] revealed that the majority of general dentistry practitioners utilised a combination of normal saline and hydrogen peroxide solutions as canal irrigants. Barbakow discovered a common use of hydrogen peroxide and sodium hypochlorite solutions as canal irrigants [44].

Similarly, in the current investigation, calcium hydroxide was the most widely utilised intracanal medicament (81%), consistent with its proven efficacy in canal disinfection. Calcium hydroxide is regarded as the standard intracanal treatment for inter-appointment dressing [45], and its usage should be encouraged among general dental practitioners in developing countries due to its efficacy against the majority of canal pathogens [46]. In Flemish [14], Dutch [47], and North Jordan investigations [5], 86.2%, 63%, and 64.6% of respondents used calcium hydroxide, respectively. In contrast to the present results, the previous survey [48] showed that 38% of respondents used calcium hydroxide. Despite the fact that calcium hydroxide is recognised as a standard intracanal medicament for interappointment dressing, it was used only by 11.5% of the study of Gaikwad, A. et al. [32].

Obturation procedures revealed that cold lateral condensation is still the most commonly utilised way (42.9%); however, the single-cone technique is also becoming more popular (39.6%). This trend could be affected by the increased use of rotary systems, which are generally paired with matched-taper cones. The present results differ from Bubteina and Shakeer's [9] findings, with 64% of respondents using lateral condensation, followed by 16% using a single cone in combination with lateral condensation if they utilised both hand instruments and rotational techniques in canal preparation.

A root canal sealer is essential to seal the gap between the obturating core interface and dentinal walls and fill the vacuums and irregularities in the root canal, lateral, and accessory canals [6]. Lateral compaction of gutta-percha in combination with a root canal sealer is the most extensively recognized method. It is a comparatively simple and multipurpose procedure that has delivered good results and does not require costly equipment [49]. It was interesting to notice that bioceramic-based sealers were the most generally utilised in the present study (40.1%), followed by resin-based (25.9%) and zinc oxide eugenol (13.7%). These outcomes were higher than those reported by Bubteina and Shakeer's [9], with 45.3% of respondents still utilising zinc oxide eugenol root canal sealers. Furthermore, our findings differ from those of an Iranian study [50], whilst resin-based root canal sealers were the most popular in studies conducted in Flanders and Turkey [6,51]. Preferences for cutting gutta-percha at the orifice level, as well as the growing use of bioceramic-based sealers, indicate that many practitioners are transitioning to more modern, biologically friendly methods.

The majority of dentists provided numerous visits for endodontic treatment, including single-rooted, multiple-rooted, vital, and non-vital patients. Single-visit root canal therapy has various benefits, including lower flare-up rates, patient acceptance, shorter treatment time, lower costs for patients, possible profit for dentists, and less pain and trauma compared to multi-visit procedures [52.53]. However, without intracanal


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medication between sessions, bacterial elimination cannot be maximised consistently, thus jeopardizing healing potential [54]. However, there was no discernible difference in the effectiveness of root canal treatment in terms of radiological success between single and multiple visits [55]. The true inclination for many visits must be based on practice management, operator convenience, case complexity, weeping canal, or just habit [56]. In the current study, the results showed that 5.7% of the participants completed a single-visit root canal treatment, while 32.1% performed a multi-visit treatment. Although recent studies revealed that single-visit RCTs had gained popularity and increased reliability in endodontic teaching [51], the current findings are somewhat similar to the results in the study of Bubteina and Shakeer's [9], which reported that 50% of participants performed endodontic treatment in multiple visits rather than single visits. This outcome could be ascribed to a lack of professional experience in treating cases in a single treatment visit, or they may have preferred to wait until pain and other symptoms reduced before performing obturation sessions [6]. Another possible explanation is that the first visit is intended to ease discomfort and treat acute symptoms [39]. While the study of Gaikwad, A. et al. [32] showed that more than 70% of RCTs were conducted across three visits. Our findings differed from those of Saunders in 1999, et al. [57] conducted a study on general dental practitioners in Great Britain. In contrast to the present study, a US study [58] found a strong preference for single-visit endodontics, particularly in instances without apical periodontitis. Single-visit treatment is becoming more common and credible in preclinical endodontic training in America and Europe [59].

One of the most worrying discoveries is about antibiotic prescription. While the majority of antibiotics were recommended for swelling, which is a valid cause, some were also prescribed for illnesses such as sinus tract formation or isolated pain, which may not require systemic antibiotics. This emphasizes the need for better antibiotic stewardship and clinical decision-making education. Thus, practitioners should not ignore the scientific basis of antibiotic prescription and should not neglect the current guidelines for antibiotic prescription. When asked about the most error-prone steps in an RCT, participants most frequently mentioned working length determination, obturation, and diagnostic processes, indicating specific phases where improved training and assistance could greatly improve outcomes.

Overall, the survey reveals a dental staff that is engaged and largely aligned with global standards, but could benefit substantially from continuous education, increased access to current technology, and strengthened clinical guidelines. These findings are comparable with previous data from other Libyan cities and highlight the need for systemic investment in dental education and infrastructure to improve endodontic care across the country.

## Conclusion

This study provides a detailed insight into the endodontic treatment practices among general dental practitioners in Tripoli, Libya. The results demonstrate that while many practitioners adhere to fundamental diagnostic and procedural protocols—such as the routine use of pre-operative radiographs, apex locators, sodium hypochlorite irrigation, and calcium hydroxide medicaments—there remains variability in the adoption of advanced technologies and techniques. The continued use of cold lateral condensation, limited use of magnification devices, and inconsistent application of rubber dam isolation highlight areas where training and equipment access could be improved. Importantly, the data revealed concerning trends in antibiotic prescription practices, with a portion of respondents indicating use in clinical situations where antibiotics are not typically required. Additionally, the frequency of reported errors during critical stages of treatment, such as working length determination and obturation, underscores the need for enhanced clinical training and continuing education. Overall, this study underscores the need for targeted interventions to support general dentists in updating their endodontic practices. Investment in hands-on workshops, improved access to contemporary tools, and greater emphasis on evidence-based guidelines—particularly in infection control and antimicrobial stewardship—will be essential for standardizing and improving the quality of endodontic care in Tripoli and similar contexts.

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***Conflicts of Interest***

There are no financial, personal, or professional conflicts of interest to declare.

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