

Original article

## Prevalence of Root Canal–Treated Teeth Assessed by Orthopantomography in Tripoli, Libya

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### ABSTRACT

Spread of dental caries through hard dental tissue results in pulpal and periapical infections that require Root canal treatment (RCT). This procedure is widely used; however, limited epidemiological data exist regarding the distribution of RCT in Tripoli, Libya. This study aimed to evaluate the prevalence and distribution of root canal–treated teeth among patients in Tripoli, Libya, and to evaluate trends in distribution with regard to age, gender, and tooth type. A retrospective cross-sectional study was conducted using 72 orthopantomograms (OPGs) collected from patients attending private dental clinics for routine dental care. Patient demographics, number of RCT-treated teeth, and their type and anatomical distribution were extracted and analysed using descriptive and inferential statistics. Of the 72 patients, a total of 108 RCTs were identified, with 62.5% of patients having at least one RCT-treated tooth. The number of RCT teeth increased significantly with age ( $p < 0.001$ ). Posterior teeth, particularly first molars and premolars, were the most affected teeth (72.2%). The upper arch showed a higher prevalence of RCT (59.3%) compared to the lower arch. Females exhibited a higher prevalence (67.4%) and mean number of RCT teeth than males, but the difference was not statistically significant. There was a high prevalence of root canal–treated teeth among patients in Tripoli. Prevalence increased significantly with age, with posterior teeth shown to be most susceptible. Early preventive strategies and improved oral health awareness are crucial to reduce the burden of endodontic disease.

### Introduction

Root canal treatment (RCT) is a vital endodontic procedure for preserving natural teeth by removing infected pulp, disinfecting the canal system, and sealing it with biocompatible materials, thereby preventing infection spread and tooth loss (1, 2). Dental caries is the primary cause of pulpal infection, and if untreated, it progresses to irreversible pulpitis and apical periodontitis, necessitating RCT (3-5). Epidemiological studies indicate that 5–15% of adult teeth receive RCT, with up to 40% of adults having at least one treated tooth, though prevalence varies globally due to socioeconomic factors and healthcare access (7-11). Panoramic radiography (OPG) is essential for epidemiological screening, enabling efficient assessment of root-filled teeth and associated oral conditions across large populations (12-14). Molars and premolars show significantly higher RCT rates than anterior teeth due to their complex anatomy, deep fissures, caries susceptibility, and masticatory stress, highlighting the need for targeted prevention and treatment planning (8-11, 14). The current study aims to provide insights into the prevalence of root canal treatment of adult patients in Tripoli, Libya. It also identifies the most affected tooth type and whether females or males were more affected.

### Methodology

#### Study Design

This study is a retrospective cross-sectional observational study aimed at evaluating the prevalence of root canal-treated teeth among a sample of 72 patients who attended private dental clinics for routine dental care in Tripoli, Libya. The focus of the study was to identify potential patterns related to patient demographics (age and gender) and the anatomical location of the treated teeth in terms of the jaws and the right and left sides.

#### Data Collection and Sample Selection

A dataset of 72 OPGs was extracted from patients' records. All available OPGs at the time of the study were included and no inclusion or exclusion criteria were applied. Following careful examination of the radiographs by at least 3 dental examiners, the following variables were extracted from the dataset for each patient:

**Demographics:** Age and Gender (Male/Female).

**Clinical Data:** Number of root canal treated teeth for each patient.

**Anatomical position of the root canal treated teeth:** Arch distribution (Upper/Lower), Side distribution (Right/Left), and Tooth Type using FDI World Dental Federation notation (which uses a 2-digit system to label teeth).

### Data analysis

Extracted information was entered in a spreadsheet and analysed using descriptive statistical tools as follow:

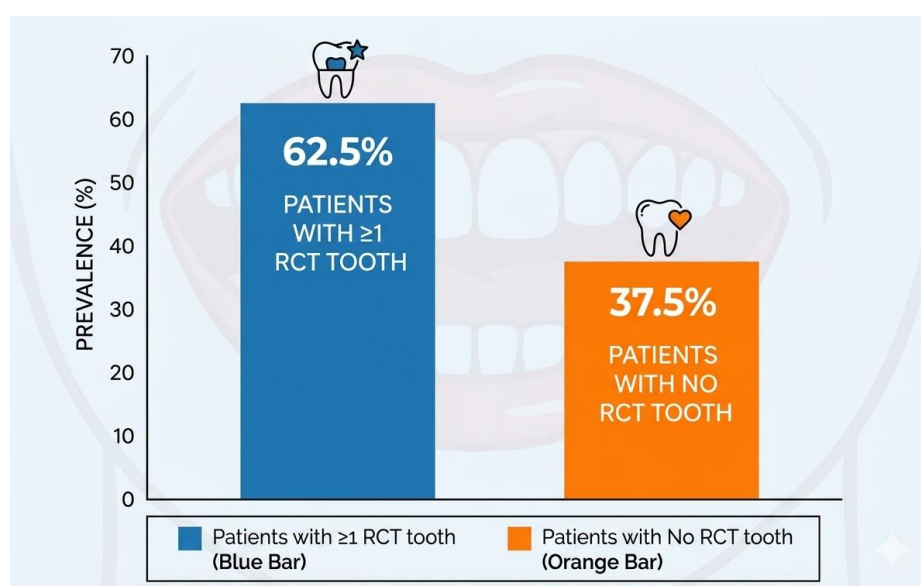
**Quantitative variables** (Age, number of RCT teeth) were presented as means and ranges.

**Categorical variables** (Gender, Tooth Type, Arch) were expressed as frequencies and percentages.

## Results

### Prevalence of Root Canal-Treated Teeth

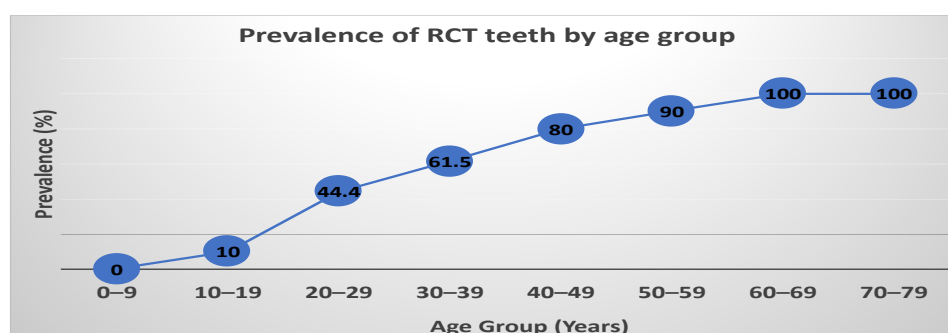
Out of 72 patients, 45 patients (62.5%) had at least one root canal-treated tooth. The total number of RCT teeth identified across all patients was 108. The number of RCT teeth per patient ranged from 0 to 12, with a mean of 1.5 teeth per patient (SD = 2.1) (Figure 1).



**Figure 1: Prevalence of root canal treated (RCT) teeth among the study population:** Bar chart showing the prevalence of patients with at least one root canal treated (RCT) tooth among patients. 45 patients (62.5%) had at least one RCT tooth, whereas 27 patients (37.5%) had no history of root canal treatment. The blue bar represents patients with  $\geq 1$  RCT tooth, and the orange bar represents patients without RCT teeth.

### Distribution by Age

The prevalence of RCT teeth increased progressively with age. No RCT teeth were observed in patients under 10 years. Prevalence rose from 10% in the 10–19 years age group to 100% in patients aged 60 years and above. The mean number of RCT teeth per patient also increased with age, from 0.1 in the youngest group to 5.8 in patients aged 60+ years (Figure 2).



**Figure 2: Prevalence of root canal treated (RCT) teeth according to age group**

### Distribution by Arch (Upper vs. Lower)

Among the 108 RCT teeth, the upper arch was more affected than the lower arch. The upper arch accounted for 64 RCT

teeth (59.3%), while the lower arch accounted for 44 RCT teeth (40.7%) (Figure 3).

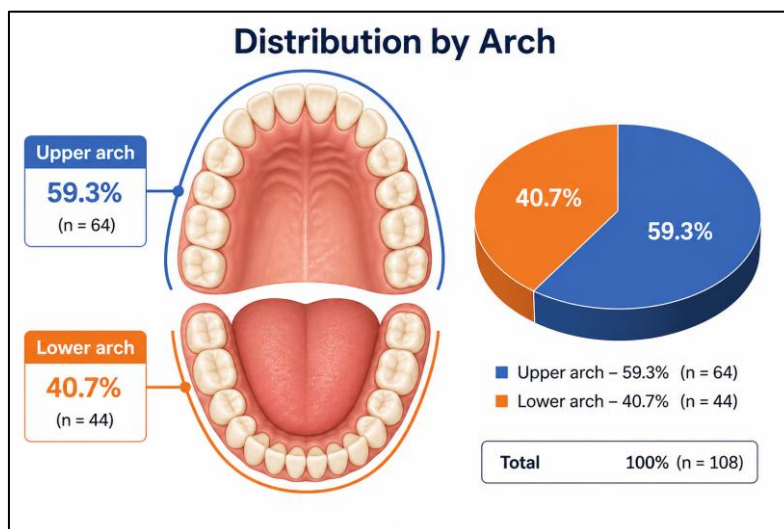


Figure 3: Distribution of root canal treated (RCT) teeth by dental arch

#### ***Distribution by Side (Right vs. Left)***

The distribution between right and left sides was nearly balanced. The right side accounted for 55 RCT teeth (50.9%), and the left side accounted for 53 RCT teeth (49.1%) (Figure 4).

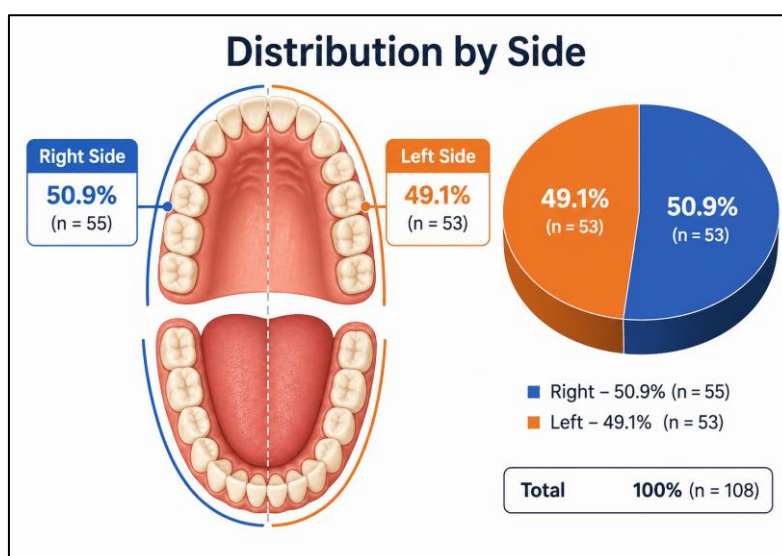


Figure 4: Distribution of root canal treated (RCT) teeth by arch side

#### ***Distribution by Tooth Type (Most Affected Teeth)***

The most frequently root canal-treated individual tooth was the upper right first molar (tooth #16), accounting for 6 RCT teeth (5.6% of all RCT teeth). This was followed by the upper right second premolar (tooth #15) with 5 RCT teeth (4.6%). Posterior teeth (premolars and molars) collectively constituted the majority of RCT teeth (78 teeth, 72.2%), while anterior teeth (incisors and canines) accounted for 30 teeth (27.8%) (Figure 5).

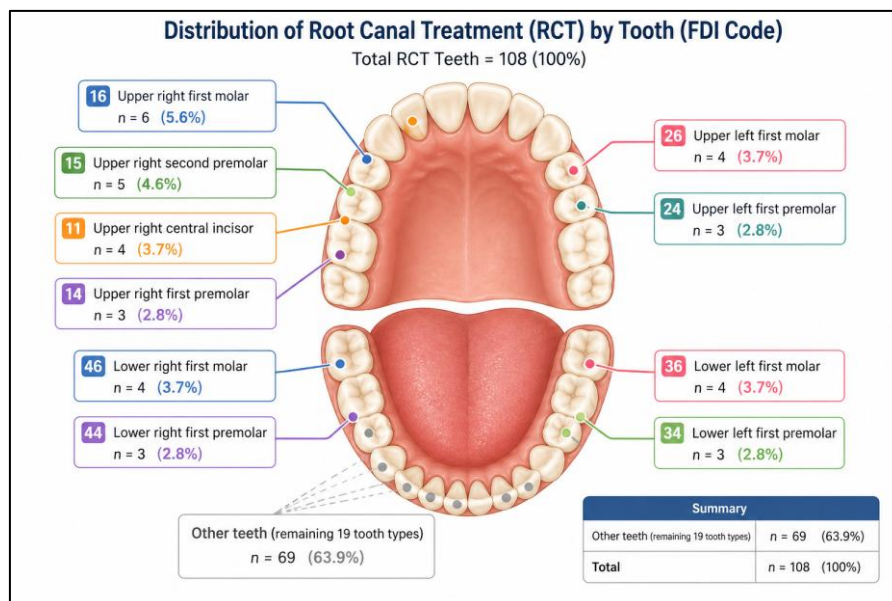


Figure 5: Distribution of root canal treatment (RCT) by individual tooth type (FDI Code)

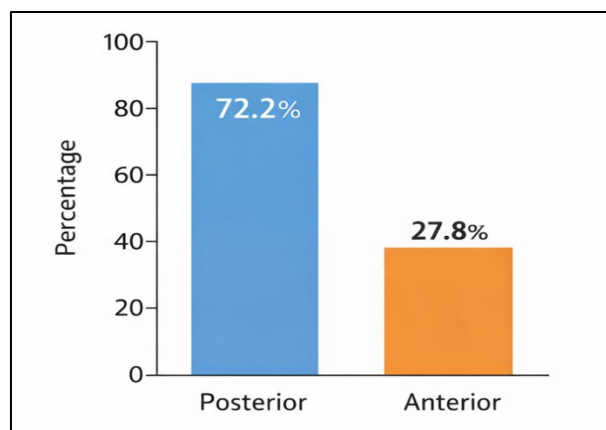


Figure 6: Distribution of root canal treated (RCT) teeth by region (Posterior vs. Anterior)

#### Distribution by Gender

Females showed higher prevalence and more extensive RCT involvement than males. Among 43 females, 29 (67.4%) had at least one RCT tooth, compared to 16 out of 29 males (55.2%). Females also had a higher total number of RCT teeth (72 teeth, 66.7% of all RCT teeth) compared to males (36 teeth, 33.3%). The mean number of RCT teeth per patient was 1.7 for females and 1.2 for males (Figure 7).

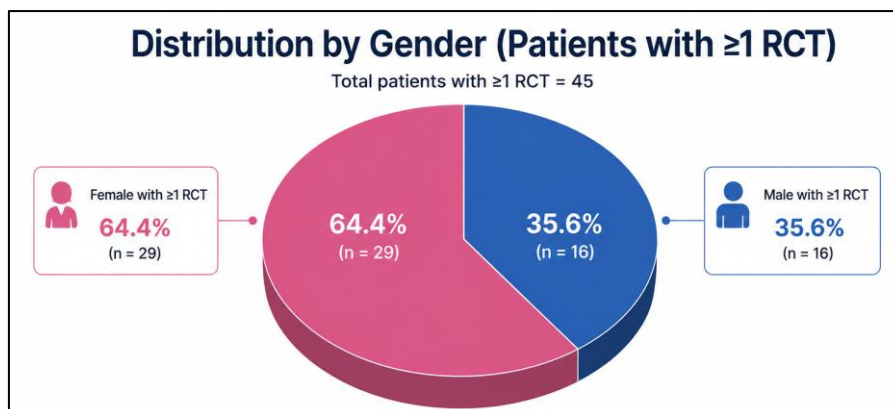


Figure 7: Gender distribution among patients with root canal treated (RCT) teeth

## Discussion

Our findings show a relatively high prevalence of RCT (62.5%). This high frequency of RCT can be attributed to the progression of dental caries which eventually lead to infection of the pulp tissue (5). Progression of dental caries to irreversible pulpitis or necrotic pulp may indicate delay in dental intervention due to masked symptoms or low dental health awareness among the included population. Furthermore, in the light of advances in modern dentistry, dentists prefer preserving natural teeth over extraction and replacement whenever possible. Generally, RCT is considered more practical and less invasive long-term option compared to implants in which surgical procedures and maintenance are usually required (15). Additionally, due to increase in life expectancy, more people keep their teeth for longer periods which means more dental interventions (16). Finally, nowadays, RCT is more accessible and predictable due to advances in instruments, materials and equipment. These involve the use of rotary instruments, apex locators and magnification allowing dentists to perform RCT more efficiently resulting in its higher frequency in clinical settings.

Data analysis also revealed that posterior teeth, particularly second premolars and first molars, are the most commonly teeth requiring endodontic intervention. This higher susceptibility is related to several factors. Firstly, their posterior position in oral cavity makes oral hygiene measures less effective and more challenging to maintain good hygiene leading to higher caries susceptibility, and delayed detection and management. Secondly, the morphology of molars with the typical deep pits and fissures facilitates food retention, biofilm formation and carious lesions unlike the relatively flat surfaces of anterior teeth. These pits and fissures are hard to clean as they are often narrower than toothbrush bristles facilitating the colonization of *Streptococcus mutans* bacteria, the primary cause of dental caries and enable it to evade mechanical cleaning and initiate caries process (17). Furthermore, posterior teeth are continuously exposed to greater functional load and mastication forces making them more prone to enamel wear and cusp fractures. These factors may act as a portal for bacteria invasion of the pulp and subsequently requiring RCT (18). Finally, the early eruption of first molar (at the age of 6) subjects it to longer functional stress compared to other permanent tooth which erupt later. Thus, factors like complex anatomy, position, early eruption and mechanical fatigue makes the posterior teeth the most commonly teeth requiring endodontic treatment.

Another observation from our findings indicates that females showed a higher frequency of root canal treatment (RCT) compared to males. Females are typically having greater concern for their oral health. They are also more likely to keep regular dental check-ups, which in turns lead to early detection of dental caries and pulp inflammation. Therefore, females are more likely to receive endodontic treatment rather than tooth extraction (19). Hormonal changes that females undergo through different life stages are believed to impacts the periodontal tissue. Hormonal changes have shown to increase blood flow to the gingival tissues and alter saliva composition. Thus, reducing its effectiveness against bacteria and putting them under higher risk of dental caries (20). Furthermore, females are more sensitive to early dental pain leading to prompt treatment therefore, more RCT rates are recorded for females compared to males. There are some biological differences as well that may play a role such as differences in immune response, tissue sensitivity which can impact the progression of pulpal and periapical diseases. Finally, there a higher tendency of female to preserve their natural teeth through root canal treatment over extraction. This combination of behavioral and hormonal influences and early reporting all contributes to the higher frequency of RCT among females.

The findings of this study are clinically relevant in the field of endodontics and preventive dentistry. The assessment of RCT frequency and distribution among different population groups, particularly among females, can improve diagnostic accuracy and treatment planning. As highlighted, females are likely to seek early dental care and in this case, the affected teeth can be preserved with predictable, and successful treatment strategies (19). Understanding that hormonal fluctuation during puberty, pregnancy, and menopause is associated with increased risk of caries and pulp inflammation allow dentist to provide early preventive measures and monitoring at these periods. Overall, the high prevalence of RCT among patients in supports the need for increasing dental health awareness and encourage targeted prevention strategies and individualized treatment approaches. This may ultimately improve oral health outcomes and reduce the need for endodontic procedures (21).

The limitations of this study include the relatively small sample size which may limit generalisation of the finding to the general population. Additionally, the study utilised OPG radiographs which may not show all details accurately due to the two-dimensional nature of the image. The lack of inclusion and exclusion criteria may introduce some variability in the data. Lastly, as the study was conducted in private clinics only, not all regions or populations are represented. General hospitals may potentially show different frequency and distribution of RCT. Other factors such as oral hygiene habits, diet, and socioeconomic status were not included, although they may influence the need for root canal treatment.

## Conclusion

The results indicate a high prevalence of root canal-treated teeth among patients attending private clinics in Tripoli, Libya. The prevalence and the number of treated teeth increase with advancing age. Posterior teeth showed more tendency to have RCT particularly molars and premolars due to anatomical, positional, and force bearing factors. Females demonstrated a higher prevalence of RCT compared to men although the difference was not statistically significant. These findings emphasize need for early diagnosis and increased oral health awareness to prevent the progression of dental caries

to involve the pulp tissue requiring endodontic treatment. To generalise the finding to the wide population, further large-scale studies are required to provide a more comprehensive picture of RCT prevalence and distribution across various populations in Libya.

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