




General Dentist's Knowledge and Attitude Towards Non-Surgical Endodontic Retreatment in Tunisia: A Cross-Sectional Study

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Introduction: Root canal retreatment is carried out in cases where previous endodontic therapies failed and involves the removal of root canal filling materials, followed by cleaning, shaping, and obturating of the canals.

Aims: : The objective of this study was to collect information regarding attitudes, methods, and materials employed during the non-surgical endodontic retreatment (NSER) by general dentists working in Sousse Governorate, Tunisia.

Materials and Methods: A descriptive cross-sectional survey was conducted among 147 general dentists working in the Sousse Governorate, Tunisia, from May to November 2021. Data were collected by sending a structured questionnaire to the dental practitioners through email. All the data were analyzed by using the SPSS 10 computer software.

Results: A total of 96 dentists responded to this survey. The response rate was 63.5%, with a female predominance (53.2.3%). 81.2% of the respondents performed at least one non-surgical endodontic retreatment (NSER) weekly. Our study revealed that the mandibular first molar is the tooth that most often requires endodontic retreatment (83.5%). Half of the participants never used the rubber dam during this procedure. Moreover, the majority of respondents (61.9%) simultaneously used manual files and rotary nickel-titanium instruments for root canal desobturation. Most of the dentists (69.57%) systematically use solvents during root canal desobturation.

Conclusion: Our survey highlights that the majority of general dentists have adequate knowledge about endodontic retreatment. Nevertheless, dentists are yet to start the application of these newer strategies towards the management of endodontic failures.

Keywords: nonsurgical endodontic retreatment, surveys, questionnaires, general practitioners

Introduction

Endodontic therapy is a complex procedure that aims to prevent the periradicular tissue infection.¹ This can be effected by a chemo-mechanical preparation where the limitations of the endodontic instruments, are overcome by irrigation solutions.² Most of root canal treatment failure is due to the failure of the initial endodontic treatment.³ It is extremely dangerous to undertake endodontic treatment without having a thorough understanding of dental anatomy. This is because excessive torsional stress and cyclic fatigue can overload rotating endodontic tools, potentially causing intracanal separation of the instruments.⁴ Bacterial persistence in the root canal is considered the main cause of endodontic treatment failure and the most frequently detected species in post-treatment diseases is *Enterococcus faecalis* according to several studies.^{4,5} Apart from bacterial influence root canals that are poorly cleaned and obturated, improper coronal seal (leakage) and untreated canals (missed canals) that will lead to endodontic failures are root fracture, tooth fracture, and marginal leakage at tooth restoration.⁶⁻⁸ The loss of coronal seal after root canal treatment may lead to contemporary

issues like iatrogenic events of cleaning, shaping and obturation.⁹ The American Association of Endodontists suggests that the non-surgical endodontic treatment (NSER) is the best approach to remove the root canal fillers through cleaning and canal obturating procedure.^{10–12} So NSER aims to remove all previous root filling material, disinfect, and seal the root canal entirely. According to a recent meta-analysis, the survival rate of teeth received non-surgical endodontic retreatment was approximately 85% after 72 months, 86.8% after 48 months, and 90% after 24 months.^{13,14} The data are in alignment with the literature conducted by Alghamdi et al,¹⁵ and by Pinto et al.¹⁶ Thus, its prognosis is predictable when appropriately performed and essentially when the diagnosis is well established. Different techniques are used for the root filling canal materials should be carefully selected. Treatment planning differs among the general practitioner and is dependent on educational background, clinical experience, attitudes, and economic resources. This procedure requires clinical skills and specific technical instruments. However, the absence of clear guidelines leads to a great variation in the different stages of NSER. In this context, our study aims to assess the knowledge and the attitude of general dentists working in Sousse, Tunisia towards NSER and to explore the materials and methods they use in treating endodontic treatment failure cases.

Materials and Methods

Study Design and Ethical Clearance

A study of cross-sectional description was assessed from May 2021 to November 2021 among general dental practitioners working in Sousse, Tunisia. A written informed consent was obtained from all the study participants of this experiment prior to the study commencement. The present study was ethically approved by the Human Ethical Committee (Research Ethics Committee (REC)/Institutional Review Board (IRB)) at the Faculty of Dental Medicine, University of Monastir, Tunisia on 12th March, 2021.

Participants, Eligibility, and Setting

The list of doctors with their contact details was provided by the council of the regional order of the center. The sample consists of 305 dentists practicing in the Governorate of Sousse, Tunisia. A structured questionnaire consisting of questions based on knowledge, attitude, and clinical practice was distributed to dentists through Email over three months. The questionnaire included a total of 24 questions of which 4 were knowledge-based, 10 questions to check the attitude of the practitioners, and 10 questions related to the clinical practice followed by the dentist. The questionnaire was then pilot-tested with ten dentists to ensure clarity and validity and ultimately was finalized. The questionnaire was distributed randomly to practitioners. 96 responses were collected.

Statistical analysis

The data obtained in the present study were analyzed for statistical fit significance using the Chi-square test through the SPSS (version 20.0) statistical package. The level of significance was conferred through $p < 0.05$ value.

Results

The response rate was 65.3%. Among the total respondents, 46.7% were males and 53.2% were females. On the other hand, the majority of participants (40.2%) have less than 5 years of clinical experience. 46.7% of respondents are ages ranging between 30 and 50 years. Four of the individuals were excluded from the study since they did not undergo endodontic treatment. All the demographic data are summarized in [Table 1](#).

[Table 2](#) summarizes the frequency and case selection for NSER. Concerning the frequency of endodontic retreatment, 82.6% reported performing this procedure once a week. The first lower molar was the most commonly involved tooth and required nonsurgical retreatment (83.5%). More than half of the study population (87.5%) performed endodontic retreatment on a patient with an infectious risk. [Table 3](#) summarizes the behavior and techniques during endodontic retreatment. Indeed, only 15.2% reported completing nonsurgical retreatment in a single visit. As for rubber dam application, half of the dentists reported never using it when performing NSER while only 26% reported using rubber dam occasionally. Only 20.7% use magnification and among these respondents, 15.2% use binocular loupes while 5.4% use operating microscopes.

Table 1 Demographic Details of Study Participants

		Number	Percentage (%)
Age in years	26–30	32	34.7
	30–50	43	46.7
	>50	17	18.4
Gender	Male	43	46.7
	Female	49	53.2
Years of professional experience	<5	37	40.2
	5–10	21	22.8
	10–15	10	10.8
	> 15	24	26.0
Received additional training in endodontics	Yes	80	16.6
	No	16	83.3

To eliminate all the gutta-percha from the canals, 61.9% of participants reported using hand and rotary files simultaneously. Regarding working length determination, 40.2% responded that they use a combination of both radiography and electronic apex locators. About 74.6% of the respondents use calcium hydroxide between visits.

Discussion

The sustainability of bacteria in the root canal is often associated with insufficient cleaning, untreated canals, inadequate filling, or coronal leakage, and may cause a post-treatment disease. NSER is mostly the first point of approach to eliminating microbial infection.¹⁷ Our study revealed that 82.6% of the respondents carry out NSER at least once a week. However, the study conducted by Albakheet et al revealed a lower rate (25%) of patients requiring endodontic retreatment.¹⁸ The frequency of endodontic treatment failure and success rate will be determined based on the inclusion criteria during the experiment and treatment approach in the patients since many of the inclusion criteria will not work selectively in all the individuals. The survival of teeth after root canal treatment (4–5 and 8–10 years) ranges from 93 to 87% which is a long-term probability in randomized clinical trials.¹⁹ However, the meta-analysis performed by Kojima et al showed that 82.8% cumulative success rate in vital pulp and 78.9%, for non-vital pulps.²⁰ Indeed, in the case of an endodontic treatment on a vital tooth, the pulp content is only inflamed and not infected, whereas a necrotic tooth contains necrotic and septic tissue. The leftover spaces empty pockets and disinfected endodontium areas are the major causes of post-endodontic diseases. These microorganisms can survive and proliferate causing a chronic or acute periapical or latero-radicular inflammatory reaction.²¹ *Enterococcus faecalis* is much resistant to the anti-biofilm drugs that prevent aggregation and to the actions of irrigants in dentinal tubules.²² Also, the presence of errors in the therapeutic protocol leads to non-compliance with the rules of asepsis, which leads to the potential failure of the endodontic treatment. The presence of symptomatic periapical lesions may be related to poor quality obturation or the probability of missed canals, which is an indication of root canal retreatment to prevent the progression of the lesion and future complications.²³ In addition, coronal restoration is important and could affect also the outcome of endodontic treatment.

Our study showed a higher frequency of maxillary molars (65.9% for the first molar and 50.5% for the second molar) and mandibular molars (83.5% for the first molar and 57.1% for the second molar) molars subject to NSER compared to other teeth. This endodontic failure can be attributed essentially to a complex root canal anatomy. Lateral and accessory canals, bifurcations, isthmuses, apical deltas, and curved roots can be difficult to locate, prepare, and clean, leading to bacteria being inadvertently left behind.²⁴ A clinical study conducted by Wolcott et al on 5616 maxillary molars showed that the incidence of an MB2 was 58% in initial treatments when compared to 66% in secondary molar treatments. The authors concluded that failure to treat MB2 results in poorer long-term prognosis and may account for some pathology seen in maxillary molars requiring endodontic retreatment.²⁵ 86% of the first mandibular molar teeth were not fixed properly through canal treatment and only 14% of the teeth were fixed in mesial roots through root canal surgery.²⁶ Valverde et al report that tooth type does not influence prognosis like molar teeth which acts as a prognostic factor for tooth loss.²⁷ This difference in such results may be

Table 2 Frequency and Case Selection for Nonsurgical Endodontic Retreatment

			Number (n)	Percentage (%)
Frequency of cases require root canal re-treatment per week		1 time	76	82.6
		2 to 3	15	16.3
		>3	1	1.1
Frequency of endodontically retreated teeth	Maxillary	Central incisor	12	13.2
		Lateral incisor	7	7.7
		Canine	7	7.7
		First premolar	24	26.4
		Second premolar	23	25.3
		First molar	60	65.9
		Second molar	46	50.5
		Third molar	1	1.1
	Mandibular	Central incisor	5	5.5
		Lateral incisor	4	4.4
		Canine	4	4.4
		First premolar	10	11
		Second premolar	9	9.9
		First molar	76	83.5
		Second molar	52	57.1
		Third molar	1	1.1
Endodontic retreatment in patients with medical risks	Infectious risk	42	87.5	
Factors that make you decide to retreat	Hemorrhagic risk	19	39.6	
	Allergic risk	6	12.5	
	Crack and crown Fracture	29	31.9	
	Caries	29	31.9	
	Loss of coronal seal	54	59.3	
	Poor quality of root obturation	81	91.	
	Presence of periapical lesion	49	55	
	Overfilling	9	10.1	
	Missed canals	68	76.4	
	Parameters are taken into consideration while deciding on endodontic retreatment	Age of the patient	34	37
The medical condition of the patient		65	70.7	
Periodontal status		59	64.1	
Tools and equipment		30	32.6	

explained by the operating skills of the endodontic practitioner. Clear-cut evidence from earlier literature defines that root canal surgery and post-tooth survival have a 98.1% success rate when it is done by an endodontic practitioner when compared to a general practitioner where the survival rate of the tooth is about 89.7% respectively.²⁸ Cone-beam computed tomography (CBCT) an advanced imaging tool has become an essential tool for endodontic practice that provides 3D visualization of the areas to be treated. It facilitates diagnosis and allows for a more careful treatment plan. However, only 13% of respondents require CBCT for diagnosis and treatment planning.²⁹ Despite the recommendations, of the American Association of Endodontists and the European Association of Endodontics, on using rubber dams and the new inventions to modernize the isolation system, its use in dental practices is still limited.^{30,31} Unfortunately, our survey showed a low rate (26.1%) of regular rubber dam placement during NSER. Our results are different from those found in the studies conducted in Switzerland (67%), the UK (30.3%), and the USA (58%) which found the use of rubber dams was high with endodontists and general dental

Table 3 Behaviors and Techniques During the Retreatment Procedure

Question		Number (n)	Percentage (%)
Use of rubber dam	Always	24	26.1
	Sometimes	22	23.9
	Never	46	50
Number of visits	1 visit	14	15.2
	2 visits	35	38
	3 or more visits	43	46.7
Uses of magnification while performing endodontic retreatment	Microscopes	5	5.4
	Endodontic loupes	14	15.2
	None	73	79.3
Technique or tools used for retrieval of gutta percha	Hand H files	31	33.7
	Hand K files	41	44.5
	Rotary files	65	70.6
	Rotary retreatment kits	31	33.9
	Combination of hand and rotary instrument	57	61.9
Use of solvent	Always	64	69.5
	Sometimes	26	28.2
	Never	2	2.17
Type of solvent used	Chloroform	10	11.5
	Eucalyptol oil	5	5.7
	Orangewood oil	54	62.1
The most common problem encountered during retreatment procedures	Radicular perforation	8	10
	Broken files	44	55
	Ledge formation	54	67.5
	Floor perforation	12	10
Types of root canal irrigants	Sodium hypochlorite	73	85.9
	EDTA	53	62.4
	Chlorhexidine	11	12.9
	Saline	13	15.3
Technique used for obturation of root canal	Cold lateral compaction	58	63
	Thermo-compaction	3	3.3
	Single cone technic	37	40.2
Determination of the working length	Radiographs	33	35.9
	Apex locators	15	16.3
	Both	37	40.2
Intracanal medicaments uses	Calcium hydroxide	47	74.6
	Sodium hypochlorite	16	25.4
Period to follow up the retreated tooth	Once a year	17	30.9
	Twice a year	25	45.5
	More than twice a year	11	20

practice.^{32,33} Rubber dam isolation is a prominent endodontic treatment that enhances the clear contamination-free working area and prevents occupational hazards during dental surgery.^{34,35} The amount of remaining filling material after NSER might be affected by several factors including the technique and instruments used for removal, the adjunctive use of a solvent, the type of filling material, and the root canal anatomy.³⁶ In the current study, most of the dentists preferred to use rotary files for

removing root canal filling. This may be to benefit from its features such as preserving the working time and its effectiveness in the retreatment cases. Our study revealed that only 20.65% of respondents use magnification tools, 74% use binocular loupes and 26% have microscopes. Magnification tools allow dentists to have better visibility and a clear operating field. They also improve the efficiency and the success rate of NSER. Ledges (67.5%) and broken instruments (55%) were the highly rated procedural accidents encountered during NSER for most of the respondents. The presence of a ledge, blockage, broken instruments, and perforation eventually results in root canal disinfection and incomplete root canal filling. Hence, there might be a correlation between such errors and unfavourable endodontic treatment outcomes.³⁷ Once desobturation has been carried out, the working length has to be precisely estimated. A precise working length determination (WLD) avoids root canal filling stuff, preparations, and irrigants. The radiographic method is the most common technic and it influences endodontic filling with apical constriction rectifying the WLD error.³⁸ Unfortunately, despite its reliability, according to our study, 35.9% of dentists continue to rely only on this method.

The using of an electric apex locator (EAL) is more easy and accurate for WLD and it is widely applicable in zygomatic arch, overlapping roots excessive bone density, and shallow palatal vaults. Meanwhile, it is found that radiographic findings are less accurate than the EAL.³⁹ Therefore combination methods have been recommended for better WLD. Our study has shown that only 40.2% of respondents combine radiographic and electronic methods for WLD which is higher than the study of Kayastha et al.² As for endodontic disinfection during instrumentation of the root canal, sodium hypochlorite is the most widely used endodontic anti-irritant and plays a very important role in cleaning the root canal system. Our study revealed that 85.9% of respondents use this irrigation which is similar to other studies.^{2,3} Indeed, sodium hypochlorite has a significant antimicrobial efficacy with anti-biofilm properties against endodontic microbes. It also dissolves only the organic part of the smear layer and provides a lubricating function that enhances the action of rotary files.⁴⁰ The combination of sodium hypochlorite and ethylene diamine tetra acetic acid (EDTA) was an effective agent for eliminating the organic and inorganic salts and also to disinfect the root canal. In this present study, 74.6% of respondents use calcium hydroxide as intracanal medicaments to achieve a better prognosis after cleaning and shaping of canals. Calcium hydroxide (CaOH₂) significantly reduces the inflammatory exudates and bacterial load in endodontic infections that induce hard tissue formation.⁴¹ Finally, the complete seal of the root canal plays an important role in the success rate of NSER. Hence, achieving homogeneous, impermeable, and gap-free obturation decreases the risk of micro-leakage in apical endodontic treatment.¹⁷ Studies have shown that the 40–60% failure model in endodontic treatments was associated with inadequate obturation of the root canal system,⁴² related to over- and under-filling,⁴³ and overall poor quality of root filling.⁴⁴ In this study, the preferred root canal filling of the respondents was cold lateral compaction (CLC) (63%) which is a low-cost technique and easy to perform. However, CLC has shown a wide range of gaps and voids in the canal walls with inadequate pressures between the spreaders.⁴⁵ In recent years, the advent of calcium silicate-based bioceramic sealers with low contraction rates has simplified root canal obturation.

Hence, with the calcium silicate sealer-based “single-cone” technique, the gutta-percha cone creates a hydrostatic pressure thereby a seal is achieved throughout the canal system. Previous showed that tri-calcium silicate-based sealer possesses prominent antibacterial properties with significant biocompatibility and the least leakage among all sealers.⁴⁶ The advantages include low cost, straightforward execution, and short working time the single cone technique became popular.

Conclusion

In the present study, we have explored dentists’ knowledge, attitudes, and techniques used in NSER cases by dentists in the Sousse Governorate, Tunisia. Moreover, our survey is based on collecting information about the differences in treatment plan choices which may depend on educational background, years of clinical experience, attitude of involved persons, and clinical equipment. We have found that general dentists have a piece of adequate knowledge about NSER. A prospect should be envisaged to scrutinize the failure reasons behind the endodontic protocol and revise the methods to address the gaps prevailing in the international protocol.

Data Sharing Statement

The data used to support the findings of this study are available from the corresponding author upon request.

Ethical Declaration

Our present study complies with the Declaration of Helsinki and an informed consent was obtained from the patient for the documentation and publication of this clinical report. The patient's approval was obtained for the use of all the records presented in this manuscript. The present study was ethically approved by the Human Ethical Committee (Research Ethics Committee (REC)/Institutional Review Board (IRB)) at the Faculty of Dental Medicine, University of Monastir, Tunisia on 12th March, 2021.

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Author contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare there is no conflict of interest in this work.

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