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Assessment of Knowledge and Practices Regarding Root Resorptions: A Cross-Sectional Study of Dental Practitioners in the Casablanca-Settat Region

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Abstract

Background/Objectives: Root resorption is a pathological process that can compromise tooth prognosis if not properly diagnosed and treated. This study aimed to evaluate the knowledge, diagnostic approaches, and management practices concerning root resorptions among dental practitioners in the Casablanca-Settat region of Morocco. Methods: A descriptive cross-sectional study was conducted among 304 dentists using a structured questionnaire distributed in both paper and online formats. The survey collected demographic information, diagnostic methods, types of resorptions encountered, treatment strategies, and perceived challenges. Data were analyzed using descriptive and univariate statistics, with significance set at $p < 0.05$. Results: Most practitioners (96.7%) relied on 2D radiography (periapical or panoramic) as the main diagnostic tool, while 31.2% used CBCT for complex cases. The most frequently reported types were inflammatory internal resorption (68.5%), inflammatory external resorption (42.4%), and cervical external resorption (32.6%). Hybrid obturation with MTA was the preferred treatment for perforating internal resorptions, whereas surface external resorptions were managed by eliminating causative factors. Reported difficulties included limited training (33.7%) and poor patient motivation (67.0%). Conclusions: Dentists in the Casablanca-Settat region demonstrate good awareness of root resorption diagnosis and treatment. However, discrepancies between local practices and international standards persist, particularly in the use of advanced imaging and modern biomaterials. Continuous professional development and standardized clinical guidelines are needed to optimize patient outcomes and align national practices with evidence-based international protocols.

Keywords

Root Resorption, Diagnosis, Treatment

1. Introduction

The primary objective of this study is to explore the phenomenon of root resorption in permanent teeth, which is a clinical challenge in dentistry. Root resorption is a pathological process that can compromise both functionality and longevity of teeth. It occurs due to an inflammatory response triggered by factors such as trauma, infections, or orthodontic treatments. Unlike in primary dentition, where resorption facilitates natural tooth exfoliation, in permanent teeth it becomes a destructive process requiring intervention [1].

Root resorption can be classified into two main categories based on its location:

- Internal resorption, which begins inside the root canal, is typically caused by pulp inflammation or trauma, leading to the progressive destruction of dental tissues from the interior outward.
- External resorption: often linked to periodontal infections or trauma, starts on the outer surface of the root and progresses inward [2].

A comprehensive understanding of the clinical manifestations of root resorption is essential for effective management. These manifestations range from reversible, superficial forms to deep, irreversible resorptions that threaten the viability of the tooth. The complexity of this condition demands a personalized approach, as the progression of resorption depends on the extent and location of the damage, as well as the timeliness of the diagnosis [3].

In the cellular activity, odontoclasts play a pivotal role in the resorption process. These cells, similar to osteoclasts responsible for bone resorption, specifically degrade dental tissues like cementum and dentin. Their activation is influenced by inflammatory mediators, with their functionality including the formation of resorption lacunae on dentin surfaces. Despite being smaller and possessing fewer nuclei compared to osteoclasts, odontoclasts share several functional similarities [4].

The management of root resorption represents a major challenge for dentists. Early-stage resorption is often asymptomatic, making timely diagnosis difficult. In addition, the clinical signs can mimic those of other dental pathologies, complicating the diagnostic process. Without early intervention, the progression of root resorption can lead to advanced stages, where tooth restoration becomes either highly complex or impossible.

To address these challenges, a deeper understanding of the mechanisms behind root resorption, as well as the available diagnostic and therapeutic tools, is essential. This research focuses on evaluating the knowledge and practices of dentists in the Casablanca-Settat region of Morocco regarding various types of root resorption, including inflammatory internal resorption, replacement resorption, cer-

vical external resorption, and transient apical breakdown.

The objective of this study is to provide an overview of the therapeutic approaches employed by these practitioners and to identify potential gaps in current clinical practices. By doing so, the research aims to propose practical recommendations to enhance diagnostic protocols, optimize therapeutic interventions, and ultimately improve the quality of care provided to patients suffering from root resorption.

2. Materials and Methods

This is a cross-sectional descriptive study conducted using a questionnaire survey of dentists practicing in the Casablanca-Settat region. The survey spanned a period of four months and ten days, from July 24, 2024, to September 15, 2024.

a) Sample Description:

A total of 304 dentists participated in the study, with 173 responding via paper questionnaires and 131 via an online form.

b) Inclusion Criteria:

- Dentists practicing in the Casablanca-Settat region.
- Dentists registered with the National Council of the Order of Dentists.
- Dentists who voluntarily agreed to participate in the study.

c) Exclusion Criteria:

- Dentists refusing to respond to the questionnaire.
- Dentists who were unreachable during the survey period.

d) Survey Support:

We began with an introduction to present and explain the aim of the study.

The survey used an individual, anonymous questionnaire comprising 22 questions.

The questionnaire was structured into three main sections:

- General information and professional experience: including variables such as gender, sector of activity, type of diploma, years of experience, whether they practice endodontics, and frequency of encountering root resorption cases.
- Diagnosis and management of root resorptions: covering tools and techniques for diagnosis, types of resorptions treated, and proposed treatments.
- Therapeutic decision-making and challenges faced: addressing factors influencing therapeutic choices, collaboration with endodontic specialists, and difficulties encountered.

e) Data Collection:

- The survey was distributed in two formats: paper (delivered in person or left with receptionists) and an online Google Form.
- Initial response time of two weeks was extended to seven weeks in some cases.
- A follow-up campaign of phone calls and visits was conducted to ensure maximum participation.

f) Data Entry and Statistical Analysis

Data were initially entered into Excel for cleaning and preliminary processing. Statistical analyses were then performed using Jamovi (version 2.4). Descriptive

statistics were used to summarize the data. Univariate analyses were conducted to explore associations between variables. Categorical variables (binary questions and multiple-choice items) were compared using Pearson's chi-square test, and Fisher's exact test was applied when expected cell counts were < 5. Stratified analyses were also performed according to practitioners' characteristics (e.g., specialty, years of experience). Statistical significance was set at $p < 0.05$.

3. Results

- A survey was conducted among a sample of 304 dentists to gather information related to the study topic. A meticulously designed three-page questionnaire was distributed to 382 dentists, either in paper format or online, allowing us to collect 304 responses between July 24, 2024, and September 15, 2024.
- Among the 304 dentists surveyed, 162 practitioners (53.3%) were female, and 142 practitioners (46.7%) were male. In terms of practice sector, 66 practitioners (21.7%) worked in the university sector, 212 (69.7%) practiced in the private sector, and 16 (5.3%) worked in the public sector. Additionally, 5 dentists (1.6%) worked in both the university and private sectors, and another 5 (1.6%) worked in both the university and public sectors.
- When it comes to qualifications, 187 practitioners (61.5%) were general practitioners, 56 (18.4%) had private training courses in endodontics, 19 (6.3%) held a University Diploma in endodontics, 19 (6.3%) were endodontists, and 23 (7.6%) had qualifications in other specialties. The distribution of experience among the surveyed dentists showed that 50 practitioners (16.4%) had less than one year of experience, 91 (29.9%) had between 1 and 5 years, 55 (18.1%) had between 6 and 10 years, and 108 (35.5%) had 10 or more years of experience. (Table 1)

Table 1. Statistical breakdown of dentist characteristics by gender, practice sector, qualifications, and years of experience.

	Count	%
Gender		
Female	162	53.3
Male	142	46.7
Practice sector		
University	66	21.7
Private sector	212	69.7
Public sector	16	5.3
University and private sectors	5	1.6
University and public sectors	5	1.6
Type of diploma		
General practitioners	187	61.5

Continued

University diploma in endodontics	56	18.4
Private training courses in endodontics	19	6.3
Endodontists	19	6.3
Other specialists	23	7.6
Years of practice		
<1	50	16.4
1 to 5	91	29.9
6 to 10	55	18.1
≥10	108	35.5

- In terms of endodontic practice, 276 practitioners (90.8%) practiced endodontics, while 28 (9.2%) did not.
- Regarding the frequency of encountering dental resorption cases, 33 practitioners (10.9%) reported encountering such cases daily, 39 (12.8%) weekly, 120 (39.5%) monthly, and 112 (36.8%) annually. There were differences in these frequencies based on the practitioners' specialties. General practitioners most often encountered these cases monthly (36.4%) or annually (36.9%), while those with private training courses in endodontics encountered them monthly (44.6%) or annually (41.1%). Practitioners with a university diploma saw cases annually (47.4%) or monthly (31.6%), and the endodontists frequently encountered them monthly (52.6%). (Table 2)
- For diagnosing dental resorptions, the vast majority (96.7%) of practitioners used 2D radiography (periapical and panoramic), while 31.2% used CBCT, 42.8% relied on the clinical diagnosis of a pink spot, and 19.2% considered gingival involvement as a sign of root resorption. The use of these diagnostic tools varied by specialty: 97.2% of general practitioners, 94.6% of those with private training courses in endodontics, and 100% of those with a university diploma or specialists used 2D radiography. However, CBCT was used more frequently by specialists with a university diploma or specialists (55.6% and 66.7%, respectively). (Table 2)
- Regarding the types of resorptions encountered, the most frequently reported were inflammatory internal resorption (68.5%), inflammatory external resorption (42.4%), cervical external resorption (32.6%), surface external resorption (22.5%), transient apical breakdown (18.1%), and replacement internal resorption (12.3%).
- Treatment approaches for non-perforating internal resorptions included abstention and monitoring (22.1%), root canal treatment with cold lateral condensation (46.4%), root canal treatment with heated gutta-percha (41.7%), and vertical hot condensation (5.1%). (Table 2)
- For perforating internal resorptions, treatments included abstention and monitoring (8.0%), root canal treatment with cold gutta-percha (16.3%), hybrid

obturation with vertical hot condensation and MTA (67.4%), and tooth extraction (27.5%).

- These treatment preferences varied by practitioner specialty: general practitioners preferred hybrid obturation (63.1%), while dentists with private training courses in endodontics favored it even more (69.6%). For those with a university diploma, 83.3% used hybrid obturation. (Table 2)
- For surface external resorptions, most practitioners (74.3%) opted for eliminating the causative agent with follow-up, while 15.9% preferred abstention and monitoring, and 9.8% chose tooth extraction. Similarly, for cervical external resorptions, 56.5% of practitioners favored a combined surgical approach and endodontic treatment, while 17.4% chose abstention and monitoring, and 17.0% selected endodontic treatment.
- Regarding inflammatory external root resorptions, the majority of practitioners (57.2%) used root canal obturation with MTA in case of perforation, 18.8% opted for endodontic treatment, and 15.6% considered revascularization for immature teeth. These treatment choices also varied by specialty, with general practitioners (54.0%) and endodontic specialists (57.1%) showing the highest preference for MTA obturation. (Table 2)
- Finally, in terms of therapeutic decision-making, factors influencing the treatment choices of practitioners included cost (67.0%), patient motivation (79.7%), availability of materials (29.3%), and the practitioner's skills and knowledge (49.3%). Collaboration with endodontic specialists was reported by 40.6% of practitioners for the management of resorption cases, while 59.4% did not collaborate with specialists. The most significant challenges faced by practitioners in managing dental resorptions included the lack of patient motivation (67%), difficulty in diagnosis (35.1%), and insufficient training (33.7%).

Table 2. Statistical comparison of frequency of encountering dental resorption cases and diagnostic tools and treatment approaches for non-perforating internal resorptions and treatment approaches for perforating internal resorptions, and treatment approaches for inflammatory external root resorptions stratified by type of diploma.

	General practitioners	Private training courses	University diploma	Endodontits	Other specialities
	Count (%)	**Count (%)**	**Count %**	**Count (%)**	**Count (%)**
Frequency of encountering dental resorption cases					
Daily	24 (12.8)	2 (3.6)	1 (5.3)	4 (21.1)	2 (8.7)
Weekly	26 (13.9)	6 (10.7)	3 (15.8)	2 (10.5)	2 (8.7)
Monthly	68 (36.4)	25 (44.6)	6 (31.6)	10 (52.6)	11 (47.8)
Yearly	69 (36.9)	23 (41.1)	9 (47.4)	3 (15.8)	8 (34.8)
Diagnostic tools					
2D Radiography (periapical and panoramic)	171 (97.2)	53 (94.6)	18 (100)	14 (93.3)	11 (100)

Continued

CBCT	44 (25)	19 (33.9)	10 (55.6)	10 (66.7)	3 (27.3)
Clinical diagnosis of a pink cervical discoloration (pink spot)	66 (37.5)	21 (37.5)	15 (83.3)	10 (66.7)	6 (54.5)
Gingival involvement	28 (15.9)	12 (21.4)	3 (16.7)	7 (46.7)	3 (27.3)
Treatment approaches for non-perforating internal resorptions					
Abstention and monitoring	42 (23.9)	9 (16.1)	8 (44.4)	1 (6.7)	1 (9.1)
Root canal treatment with cold lateral condensation	84 (47.7)	33 (58.9)	4 (22.2)	3 (20.0)	4 (36.4)
Root canal treatment with heated gutta-percha	67 (38.1)	23 (41.1)	8 (44.4)	11 (73.3)	6 (54.5)
Vertical hot condensation	8 (4.5)	1 (1.8)	1 (5.6)	3 (20.0)	1 (9.1)
Treatment approaches for perforating internal resorptions					
Abstention and monitoring	14 (8)	7 (12.5)	1 (5.6)	0 (0)	0 (0)
Root canal treatment with cold gutta-percha	32 (18.2)	8 (14.3)	3 (16.7)	0 (0)	2 (18.2)
Hybrid obturation with vertical hot condensation and MTA	111 (63.1)	39 (69.6)	15 (83.3)	14 (93.3)	7 (63.6)
Tooth extraction	44 (25)	22 (39.3)	7 (38.9)	3 (20)	0 (0)
Treatment approaches for inflammatory external root resorptions					
Root canal treatment	38 (**21.6**)	**11 (19.6)**	**2 (11.1)**	**0 (0)**	**1 (9.1)**
Root canal obturation with MTA in case of perforation	95 (**54**)	**32 (57.1)**	**15 (83.3)**	**9 (60)**	**7 (63.6)**
Revascularization for immature teeth	14 (8)	**3 (5.4)**	**0 (0)**	**0 (0)**	**3 (27.3)**
Root canal treatment or revascularization for immature teeth	26 (**14.8**)	**10 (17.9)**	**1 (5.6)**	**6 (40)**	**0 (0)**

4. Discussion

Root resorption is a frequent pathological process encountered in dental practice, characterized by the progressive loss of dental hard tissues due to various physiological or pathological stimuli. [1] [2]. This study, the first of its kind conducted among Moroccan dentists, adopts a descriptive cross-sectional methodology to explore practitioners' understanding and management of root resorption. The lit-

erature search for similar studies revealed two studies, one by Martins *et al.* in Brazil and the United States [5], which investigated the prevalence and management of root resorptions, and another by Makedonas and Hansen in Sweden [6] and Greece, focusing on diagnostic techniques and treatment strategies. Other studies have primarily addressed the classification of resorptions, the role of radiographic tools in diagnosis, and the outcomes of various therapeutic approaches. The aim of this study is to describe practitioners' knowledge of root resorption, their diagnostic approaches, technical preferences, and the methods employed for its management.

Our main findings on root resorption revealed that 68.5% of practitioners frequently encountered internal inflammatory resorptions, making it the most common type in our sample. External inflammatory resorptions followed, reported by 42.4% of practitioners, while cervical resorptions were noted by 32.6%. These variations highlight the importance of accurate diagnosis in identifying different resorptive lesions. Among the diagnostic tools used, 96.7% of practitioners relied on 2D radiography (retro-alveolar or panoramic), reflecting its accessibility and effectiveness for initial assessments. More advanced imaging, such as CBCT, was utilized by 31.2% of practitioners to obtain detailed three-dimensional views, particularly in complex cases.

In our study, 42.8% of practitioners reported relying on the "pink cervical spot" as a diagnostic indicator for identifying external cervical dental resorption. This clinical discoloration is traditionally associated with external cervical dental resorption because the underlying fibrovascular granulation tissue can become visible through a thinned cervical dentin surface [7]. However, despite its clinical usefulness, the pink cervical spot presents important diagnostic limitations. This sign is frequently absent in the initial stages of external cervical dental resorption and tends to appear only when the resorptive process is already advanced, which reduces its sensitivity for early detection [7]. Furthermore, pink discoloration is not specific to external cervical dental resorption and may mimic other conditions such as internal dental resorption or deep carious defects, which highlights the importance of correlating this sign with radiographic findings rather than relying on it as a single diagnostic criterion [8].

In addition, although 19.2% of practitioners in our study also considered gingival involvement, this clinical observation is nonspecific and should be interpreted with caution. Overall, while the pink cervical spot may offer valuable clinical guidance, its variable presentation and limited reliability justify a combined clinical and radiographic approach when assessing suspected dental resorption.

Comparative international studies provide valuable context. In Sweden and Greece [6], reliance on 2D radiography was lower, at 47.1% and 32.3%, respectively, suggesting a greater use of advanced imaging in these regions. Similarly, studies from Brazil and the United States reported [5] external resorption as the most prevalent type, observed by 100% of American and 95% of Brazilian practitioners. These findings contrast with the Moroccan study, where internal inflammatory resorptions were more frequently diagnosed. Such differences may reflect

variations in patient populations, diagnostic protocols, or clinical experience.

Treatment approaches demonstrated considerable diversity among practitioners. Some favored conservative management for less severe cases, relying on techniques such as monitoring and minimally invasive procedures. Others adopted endodontic therapies, such as canal treatments with gutta-percha or calcium hydroxide, especially for internal resorptions. Surgical interventions were more common for advanced external resorptions or cases involving significant structural damage. Studies have emphasized the importance of tailored treatments, as the choice of therapy depends on the type, location, and progression of the resorption. For instance,

External cervical resorptions often required a combined surgical and endodontic approach to remove granulation tissue and restore structural integrity [9]-[15].

Discrepancies between Moroccan practices and international standards arise from several interrelated educational, structural, and economic factors.

The first—and most fundamental—concern relates to undergraduate training. In most Moroccan dental schools, root resorptions are addressed only briefly within a single-semester endodontics module, without dedicated clinical exposure or in-depth theoretical development. This limited curricular emphasis restricts students' familiarity with the different forms of resorption, modern diagnostic tools, and updated treatment principles, creating an early gap that later translates into clinical variability.

Beyond initial training, continuing education plays a decisive role. Access to structured, regular, and standardized professional development remains limited for many practitioners. As a result, exposure to recent technological advances, contemporary diagnostic approaches, and evolving concepts in root-resorption management is often insufficient. This lack of accessible lifelong learning opportunities perpetuates outdated clinical practices and widens the divergence from international recommendations.

Technological accessibility further contributes to these discrepancies. Although Cone-Beam Computed Tomography (CBCT) is available in several practices and imaging centers, its cost remains prohibitive for a significant proportion of patients. Consequently, clinicians often rely mainly on periapical radiographs, which—while valuable—do not match the diagnostic precision of CBCT for characterizing resorptive lesions. Additionally, other modern diagnostic and therapeutic technologies commonly used internationally are not yet routinely integrated into Moroccan private practices or academic institutions due to their high cost or limited availability. This technological gap directly affects diagnostic accuracy and treatment planning.

Economic factors inherent to the Moroccan healthcare system also play a major role. Because most dental care is delivered in the private sector, treatment costs are borne directly by patients. Some internationally recommended procedures—especially those that are more complex, time-consuming, or costly—may therefore be difficult to implement, even when clinically indicated. Practitioners must

often adapt their therapeutic decisions to patients' financial constraints, which contributes to differences between local practices and international guidelines.

Taken together, these factors highlight the need to standardize diagnostic and therapeutic protocols while ensuring that they remain adapted to local realities and resource availability. Strengthening access to structured and affordable continuing education, and promoting greater collaboration among practitioners, would help reduce the gap between international standards and regional practices. Ultimately, such efforts are essential to improving patient outcomes and ensuring the long-term preservation of dental and periodontal health.

5. Study's Limitations

This study has some inherent limitations that should be taken into account. As in most survey-based research, the findings rely on practitioners' self-reported information, which may not always correspond perfectly to their real-world clinical behavior. A certain degree of response bias is also possible, as participation may have been influenced by individual interest in the topic. Furthermore, the study sample primarily represents dentists from the Casablanca-Settat region, which, although an important academic and clinical center, does not encompass all practice settings in the country. Despite these considerations, the study offers meaningful insights into current diagnostic habits and contributes valuable information to the understanding of dental resorption management in the Moroccan context.

6. Conclusions

This study shows that Moroccan dentists possess a solid theoretical understanding of the diagnostic principles and clinical challenges associated with root resorption. However, a meaningful gap persists between current local practices and internationally recommended approaches, particularly regarding the use of contemporary diagnostic technologies and standardized treatment protocols. The variations observed across practitioners—especially between specialists, dentists with additional training, and general practitioners—highlight the need for more harmonized clinical practices. Strengthening access to specialized training and promoting continuous professional development would help bridge this gap, support accurate diagnosis, and ensure consistent and effective management of root resorption. Ultimately, enhancing diagnostic consistency and clinical decision-making is essential for achieving optimal long-term outcomes for patients.

7. Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Faculty of Dentistry, Mohammed VI University of Health Sciences, Casablanca, Morocco (Approval Code: EC/FMD/UM6SS/2025/04; Approval Date: April 2025). All participants provided written informed consent prior to inclusion, and data collection was conducted anonymously in compliance with institutional ethical standards.

Conflicts of Interest

The author declares no conflict of interest related to the publication of this manuscript.

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Abbreviations

The following abbreviations are used in this manuscript.

ESE	European Society of Endodontology
RST	Ridge Splitting Technique
IRB	Institutional Review Board
EC	Ethics Committee
UM6SS	Mohammed VI University of Health Sciences
FMD	Faculty of Dental Medicine
CBCT	Cone Beam Computed Tomography
MTA	Mineral Trioxide Aggregate
2D	Two-Dimensional Radiography