ORIGINAL ARTICLE

Prevalence and Associated Factors of Endodontic Treatment Failure among Patients in Saudi Arabia

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Abstract

Introduction: Endodontic treatment failure is one of the most common challenges in dentistry. Root canal therapy aims to eliminate bacterial infection and preserve natural teeth, with reported success rates ranging from 86% to 98%. However, treatment failure can still occur due to multiple factors, most notably missed canals, especially in molars with complex root anatomy. Other common causes include open apices, inadequate obturation, and persistent periapical radiolucency. Studies from Saudi Arabia have associated treatment failures with technical errors, operator inexperience, and limited utilization of advanced imaging modalities, such as cone-beam computed tomography. Despite observed high failure rates in some areas, national-level data remains limited, and few studies have explored patient-centered aspects, such as symptoms, satisfaction, and follow-up care. This underscores the need for research evaluating the prevalence and contributing factors of endodontic treatment failure using structured, patient-focused questionnaires. **Objectives:** This study aims to evaluate the self-reported prevalence of endodontic treatment failure among patients in Saudi Arabia based on their symptoms, personal experiences, and perceived treatment outcomes. It also seeks to identify patient-reported factors associated with perceived treatment failure, including pain persistence, swelling, and treatment satisfaction. **Materials and Methods:** A cross-sectional study was conducted in Saudi Arabia between July and December 2025 using a structured questionnaire distributed online via social media platforms. The target population included both Saudi citizens and residents, male and female, aged 18 years or older, who had previously undergone non-surgical root canal treatment and agreed to participate by completing the questionnaire. Participants were excluded if they were under 18 years of age, non-residents of Saudi Arabia, or declined to participate. 384 was the minimum sample size of participants to achieve a 95% confidence level with a 5% margin of error. **Results:** The mean age of participants was 33.2 ± 11.4 years; 57.1% were female, 79.8% were Saudi nationals, and 48.3% resided in the Western region. The most recent root canal treatment was reported as >3 years ago by 34.9%, and molars were the most commonly affected teeth (67.9%). Failure symptoms appeared within 2 years in 64.6% of cases, 48.1% reported being informed by a dentist that the treatment failed, and 75.7% reported retreatment (50.9%) or extraction (24.8%). The most frequently identified causes were inadequate root canal filling (35.4%) and periapical infection (25.3%), followed by absence of a permanent crown (19.4%). Advanced tools were reported as not used in 65.6%, and rubber dam use was absent or uncertain in 63.5%. Post-treatment symptoms were common (chewing discomfort 36.4%, persistent pain 32.0%, abscess/swelling 30.5%), with symptoms lasting >1 month in 23.0%; dissatisfaction was reported by 52.7%. Retreatment was significantly associated with age (P = 0.002), nationality (P = 0.001), and smoking (P = 0.034), while awareness was significantly associated with age (P = 0.0001), region (P = 0.006), and smoking (P = 0.0001).

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Conclusion: Self-reported endodontic treatment failure and post-treatment symptoms were frequent in this Saudi Arabian sample, with patient-identified technical and post-treatment care factors (notably inadequate filling, periapical infection, and lack of crown coverage) and substantial dissatisfaction, indicating multiple potentially modifiable quality-of-care targets.

Key words: Endodontic treatment failure, prevalence, risk factors, Saudi Arabia

INTRODUCTION

Endodontics is a dental specialty focused on the health, diseases, and treatment of the tooth pulp and the tissues surrounding the root, integrating both biological understanding and clinical care.[1] In addition, endodontics is a widely accepted dental treatment that aims to eliminate bacterial infections and preserve natural teeth, with success rates estimated between 86% and 98%.[2] Endodontic therapy failure occurs when clinical signs and radiographic evidence indicate that the treatment did not eliminate the infection or restore periapical health.[3] This condition remains a significant clinical problem worldwide. It is frequently reported as one of the most common causes of persistent dental infection and tooth loss.[4] One major factor in failure is missed canals, especially in molars and pre-molars with complex anatomy, which are frequently undetected during treatment.[5]

The most common causes of endodontic failure in completed root canal therapy (RCT) cases were open apices (23.7%) and missed canals (15.8%).[6] On the other hand, inadequate obturation and missing canals were found to be among the most common causes of endodontic failure, especially in molars.[7] The most common radiographic finding associated with failure was periapical radiolucency, observed in 49.2% of cases.[8]

Al-Nazhan *et al*. (2017) found that 6.2% of teeth had apical periodontitis, mainly due to poor-quality root canal treatment and restorations. They concluded that technical errors were the main cause of failure.[9] Tabassum and Khan (2016) reviewed common causes of endodontic failure, highlighting microbial infection, missed canals, and poor technique. They emphasized that most failures are preventable with proper clinical standards.[10] Iqbal *et al*. (2021) evaluated 90 patients with endodontic failure at Aljouf University. Underfilled (33.3%) and missed canals (17.7%) were the most common causes. Failures were most frequent in maxillary molars and were mainly done by general practitioners (78.8%). Key factors included operator inexperience and lack of specialist referral.[11] Recent studies estimate that 40–50% of RCT-treated teeth develop apical periodontitis when more sensitive imaging techniques, such as cone-beam computed tomography are used. However, most local clinics still rely on traditional radiography, leading to underdiagnosis. In addition, few studies compare treatment failure across different regions or sectors (public vs. private) in Saudi Arabia. Most research to date has prioritized radiographic outcomes while overlooking patient-reported symptoms, satisfaction, and follow-up care.

Objectives

This study aims to evaluate the self-reported prevalence of endodontic treatment failure among patients in Saudi Arabia based on their symptoms, personal experiences, and perceived treatment outcomes. It also seeks to identify patient-reported factors associated with perceived treatment failure, including pain persistence, swelling, and treatment satisfaction.

MATERIALS AND METHODS

Study design

A cross-sectional study was conducted in Saudi Arabia between July and December 2025. To include participants from various regions of Saudi Arabia, the study invited male and female individuals aged 18 years and above. A convenience sampling method was employed, and the questionnaire was distributed online via social media platforms.

Sample size

Data collection for this study commenced in July 2025 and continued until December 2025. A minimum sample size of 384 participants was required to achieve a 95% confidence level with a 5% margin of error. This number was determined using a standard sample size calculation formula, where the confidence level and the acceptable margin of error are critical components:

$$n=Z2\times P\times(1-P)d2n=d2Z2\times P\times(1-P)$$

Where:
n = required sample size
Z = z-value corresponding to the 95% confidence level (1.96)
P = estimated prevalence of knowledge (0.50)
Q = 1 – P = 0.50
d = acceptable margin of error (0.05)

Using these values:

$$n=(1.96)2\times0.50\times0.50(0.05)2=3$$
$$84n=(0.05)2(1.96)2\times0.50\times0.50=384$$

Therefore, the minimum calculated sample size needed for this study was 384 participants.

Inclusion and exclusion criteria

Inclusion criteria encompassed male and female Saudi citizens aged 18 years or older who consented to participate in the study, completed the questionnaire, and had undergone non-surgical root canal retreatment. Exclusion criteria included individuals with cognitive impairments, pregnant women, those under 18 years of age, non-residents of Saudi Arabia, and individuals who declined to participate.

Method for data collection, instrument

Data for this study were collected using a structured, self-administered questionnaire specifically designed to assess the prevalence and associated factors of endodontic treatment failure. To ensure clarity and inclusivity, the questionnaire was prepared in both Arabic and English, accommodating participants from diverse linguistic backgrounds.

The finalized questionnaire comprised seven comprehensive sections. It began with the Informed Consent section, which provided a concise explanation of the study's purpose and included a consent question. The Demographic Information section followed, gathering data on age, gender, region of residence, chronic health conditions, and smoking status. The Treatment History section assessed participants' experiences with root canal treatments, including any history of treatment failure. The Post-treatment Follow-up section evaluated the adequacy of follow-up care and the presence of any symptoms following treatment. The Technical Aspects section explored procedural details, such as the types of instruments used, rubber dam application, and treatment duration. The Patient Satisfaction section measured participants' satisfaction with their treatment experience and communication with the dental practitioner. Finally, the Health Awareness section assessed the participants' understanding of the importance of post-endodontic care and the role of crowns after RCT. Several questions were adapted, with permission and necessary modifications, from two previously published studies investigating factors associated with root canal treatment failure in different populations.[12-16] These validated sources provided a reliable foundation for tailoring the questionnaire content to meet the specific objectives and context of the present study.

Pilot test

20 individuals were requested to complete the questionnaire once it was distributed to them. This was done to test the simplicity of the questionnaire and the feasibility of the study. The pilot study's data were not included in the study's final data.

Analysis and entry method

Data were input into the computer using the "Microsoft Office Excel Software" program (2016) for Windows. For statistical analysis, the data were then transferred to the Statistical Package of Social Science Software (SPSS) application, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). Descriptive statistics were used to summarize the numerical variables for baseline characteristics. For categorical variables, frequencies and percentages were calculated. The Chi-square test was used to identify associations between categorical variables.

RESULTS

Table 1 displays various demographic parameters of the participants with a total number of 387. The mean age was 33.2 ± 11.4 years and there was a relatively even distribution by age group, although participants aged 24 years or less

Table 1: Sociodemographic characteristics of participants (*n*=387)

Parameters	No.	Percent
Age (Mean: 33.2, Std: 11.4)		
24 or less	105	27.1
25–30	99	25.6
31–40	84	21.7
41 or more	99	25.6
Gender		
Female	221	57.1
Male	166	42.9
Nationality		
Saudi	309	79.8
Non-Saudi	78	20.2
Region of residence		
Northern region	32	8.3
Southern region	82	21.2
Central region	78	20.2
Eastern region	8	2.1
Western region	187	48.3
Chronic disease		
Hypertension	17	4.4
Asthma	8	2.1
Immunocompromised condition	3	0.8
Anemia	4	1.0
Diabetes	29	7.5
Hepatitis B	6	1.6
Other	11	2.8
None	316	81.7
Smoking		
No	289	74.7
Yes, currently	64	16.5
Yes, previously	34	8.8

were slightly predominant (27.1%). Females were the largest group (57.1%). Most of the participants were Saudi nationals (79.8%) and lived predominantly in the Western region (48.3%), followed by the Southern and Central regions. Most of them reported no chronic diseases (81.7%); diabetes was the most common disease (7.5%). Most of the subjects were non-smokers (74.7%), while present smokers were 16.5%.

As shown in Figure 1, among 387 participants, the most recent root canal treatment occurred more than 3 years ago in 34.9%, 1–3 years ago in 28.4%, 6–12 months ago in 19.9%, and within the past 6 months in 16.8%.

Table 2 shows detailed information of root canal treatment history and failure-related parameters. Over two-thirds of respondents had two or more treatments (68.7%), with 36.7% reporting more than 3. The last time they were treated was over 3 years ago in 34.9%. Molars were the most affected (67.9%). The failure symptoms became apparent within 2 years in 64.6%. Nearly one-half were referred for failure by a dentist (48.1%), and 75.7% were retreated (50.9%) or extracted (24.8%). Most of the treatments were done in private clinics (79.1%). Inadequate filling (35.4%) and periapical infection (25.3%) were the most common reasons identified.

As shown in Figure 2, among 387 participants, manual files were used in 31.3%, combined rotary and manual instrumentation in 31.0%, rotary files alone in 10.1%, while 27.6% were unsure about the instrumentation used.

Table 3 describes participants' reports on technical aspects, follow-up care, satisfaction, and awareness associated with root canal treatment. Advanced tools were reported not used in most cases (65.6%) and no rubber dam isolation in or uncertain in 63.5%. Manual or mixture instrumentation predominated (62.3%). Over half of them did not go for follow-up visits (51.7%) and 60.7% did not have permanent crown coverage. Post-treatment symptoms were prevalent, especially chewing discomfort (36.4%), and constant pain (32.0%). Symptoms were longer than a month in 23.0%. Dissatisfaction was observed to be high (52.7%), limited explanation of procedures (40.3%), and poor awareness levels (73.7%).

Table 4 shows that undergone retreatment of a previously treated tooth has a statistically significant relation to age (P = 0.002), nationality (P = 0.001), and smoking (P = 0.034). It also shows a statistically insignificant relation to gender and region of residence.

Table 5 shows self-awareness regarding root canal treatments has a statistically significant relation to age (P = 0.0001), region of residence (P = 0.006), and smoking (P = 0.0001). It also shows a statistically insignificant relation to gender and nationality. Participants aging 24 or less and non-smokers believed to have better awareness than others.

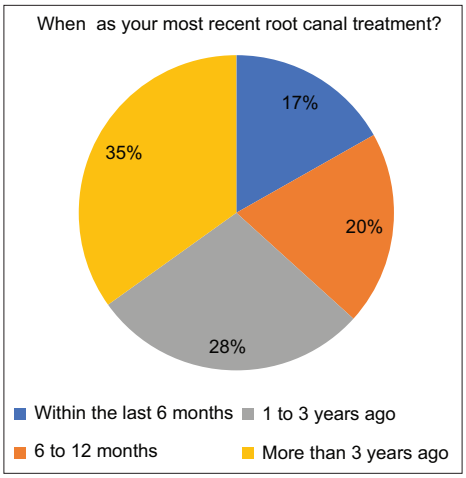

Figure 1: Illustrates most recent root canal treatment among participants

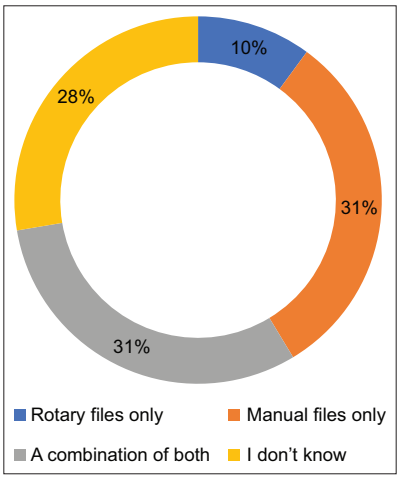

Figure 2: Illustrates type of instrumentation used to prepare the root canals among participants

DISCUSSION

The present study investigated the self-reported prevalence of endodontic failure cases and related factors in a sample of patients of 387 in Saudi Arabia who underwent non-surgical root canal treatment. The aim of the present study was to evaluate patient-centered aspects of failure of treatment, such as symptoms, satisfaction, and dimensions related to follow-up care, which are not evaluated in studies that primarily focus on the radiographic outcomes of treatment. The major findings revealed that about half of the participants showed the rate of treatment failure according to symptoms and their perceived outcome, such that inadequate filling of root canal canals (35.4%) and periapical infection (25.3%) are the most frequent findings for treatment failure. Notably, 50.9% of patients required retreatment, while 24.8% required tooth extraction, which indicates a considerable clinical and patient-centered burden of endodontic treatment failure in this population.

Comparison with existing literature pays multiple significant consistencies, as well as novel insights. A retrospective

Table 2: Parameters related to treatment history and causes of failure (*n*=387)

Parameter	No.	Percent
How many root canal treatments have you received in your lifetime?		
One	121	31.3
From 2 to 3	124	32.0
More than 3	142	36.7
When was your most recent root canal treatment?		
Within the past 6 months	65	16.8
6–12 months	77	19.9
1–3 years ago	110	28.4
More than 3 years ago	135	34.9
What type of tooth was affected by the failed treatment?		
Incisors	55	14.2
Canine	31	8.0
Pre-molar	119	30.7
Molar	263	67.9
How long after the treatment did failure symptoms appear?		
<1 year	130	33.6
1–2 years	120	31.0
2–3 years	37	9.6
3–4 years	34	8.8
5 years and more	66	17.1
Have you ever been told by a dentist that your root canal treatment failed?		
No	183	47.3
Yes	186	48.1
Not sure	18	4.7
Have you ever had to undergo retreatment (a second root canal) or extraction of a previously treated tooth?		
No	94	24.3
Yes, retreatment	197	50.9
Yes, extraction	96	24.8
Where you did endodontic treatment?		
Government clinic	81	20.9
Private clinic	306	79.1
What reasons were identified as the cause of treatment failure? (Select all that apply)		
Inadequate root canal filling	137	35.4
Overfilled canal	69	17.8
Missed canal	44	11.4
Instrument fracture	40	10.3
Root perforation	41	10.6
Periapical infection	98	25.3
No rubber dam	3	0.7
Absence of a permanent crown	75	19.4
Other	5	1.3
I don't know	16	4.1
Who performed your root canal treatment?		
General dentist	127	32.8
Endodontic specialist	72	18.6
I'm not sure	188	48.6

cohort study published in 2024 on 175 cases of endodontic failure found that extra canals left untreated were present in 21.7% of the total endodontic failure cases, and that there was a significantly larger prevalence of extra canals in cases of short-term failure (36.9%) than in cases of long-term failure (6.4%).[15] The present study found a missed canal in 11.4% of cases, which is less than the percentage stated in recent literatures, though the patient-reported methodology may be an underestimated cause compared to radiographic and clinical assessment. Inadequate obturation was recorded in 35.4% of the present study participants, which is very similar to historical data results, which indicate that poor quality obturation is one of the most prevalent causes of treatment failure. A review done by Tabassum and Khan[16] highlighted that inadequate root canal obturation, underfilling or overfilling, and persistence of bacterial infection in canals are the main reasons for success and that 65% of cases of endodontic failure exhibited poor-quality obturation and 42% of them had untreated canals. The authors highlighted a vast majority of failures are preventable with the following standard clinical principles, being in resonance with the findings in the present study, where technical factors were the predominant cause.

The technical quality of root canal treatment has a great effect on long-term treatment. According to Ray and Trope's landmark study looking at the correlation between the technical quality and apical periodontitis,[17] inadequately rootfilled teeth were found to be associated with apical periodontitis in 68.6% of the cases versus only 14% of the adequately rootfilled teeth, showing the importance of obturation has a lot to do with protecting the patient from apical periodontitis ($P < 0.001$). While the present study failed to conduct a detailed radiographic quality analysis, the high rate of insufficient fillings as prescribed by independent patient (35.4%) indicated where technical deficiencies are prevalent in the treatment population. Furthermore, the result that 25.3% of participants found infection of the periapical region to be a cause of failure is consistent with microbiological literature, which shows that bacterial persistence, especially in uninstrumented canals and accessory canals, and anatomical complexities,

Table 3: Participants' report on technical aspect of the procedure, follow-up care, satisfaction, and health awareness (*n*=387)

Parameter	No.	Percent
Were advanced tools used during the procedure (e.g., microscope)?		
No	254	65.6
Yes	71	18.3
Not sure	62	16.0
Was a rubber dam used during the procedure?		
No	194	50.1
Yes	141	36.4
Not sure	52	13.4
What type of instrumentation was used to prepare the root canals?		
Rotary files only	39	10.1
Manual files only	121	31.3
A combination of both	120	31.0
I don't know	107	27.6
How long did the treatment session take?		
<30 min	106	27.4
30–60 min	130	33.6
More than 1 h	65	16.8
I don't remember	86	22.2
Did you attend a follow-up visit after treatment?		
No	200	51.7
Yes	187	48.3
Was the treated tooth covered with a permanent crown?		
No	235	60.7
Yes	152	39.3
After your root canal treatment, did you experience any of the following symptoms? (Select all that apply)*		
Persistent pain	124	32.0
Abscess or swelling	118	30.5
Discomfort while chewing	141	36.4
Bad taste or smell from the treated tooth	100	25.8
No symptoms	95	24.5
How long did your symptoms last after the treatment?		
<1 week	74	19.1
1–4 weeks	79	20.4
More than 1 month	89	23.0
On-going (still experiencing symptoms)	51	13.2
I had no symptoms	94	24.3
How satisfied are you with your root canal treatment experience?		
Very satisfied	61	15.8
Satisfied	122	31.5
Dissatisfied	151	39.0
Very dissatisfied	53	13.7
Did the dentist explain the treatment plan and potential complications to you?		
Yes, thoroughly	81	20.9
Partially	150	38.8
No	156	40.3
Are you aware of the importance of placing a crown after root canal treatment?		
No	193	49.9
Yes	194	50.1
Do you know the importance of using a rubber dam during dental treatment?		
No	239	61.8
Yes	148	38.2
How would you rate your awareness regarding root canal treatments?		
Good	102	26.4
Moderate	140	36.2
Limited	145	37.5

*More than 1 answer

such as isthmuses and dentinal tubules, are a major cause of treatment failure.[10]

The role of operator experience was found as an important factor in the present study. Of interest, 48.6% of the participants were unsure of the type of care they received (controller - general dentist/specialist), with 32.8% of patients receiving care by general dentists and only 18.6% of patients receiving care by endodontic specialists. Among the situations that required retreatment or extraction, retreatment or extraction was treated by a large proportion by general practitioners. A 2016 study conducted from Saudi Arabia assessing the results of endodontic failure at Aljouf University from 90 patients reported that 78.8% of endodontic failure cases were treated by general practitioners, with underfilling (33.3%) and missed canals (17.7%) as prominent reasons for all failed cases.[11] The failure of the treatment, the authors concluded, had a lot to do with operator inexperience and lack of referral from specialists. This finding is especially useful in the case of the present Saudi Arabian population, in which most endodontic therapy (79.1%) was performed in private clinics. The differences in outcomes between practitioners with different levels of experience indicate a need to focus on training, advanced access to technology,

Table 4: Relation between Undergone retreatment of a previously treated tooth and socio-demographic characteristics

Parameters	Undergone retreatment of a previously treated tooth		Total (n = 387)	P-value
	No	Yes		
Gender				
Female	52	169	221	0.687
	55.3%	57.7%	57.1%	
Male	42	124	166	
	44.7%	42.3%	42.9%	
Age				
24 or less	26	79	105	0.002*
	27.7%	27.0%	27.1%	
25–30	17	82	99	
	18.1%	28.0%	25.6%	
31–40	33	51	84	
	35.1%	17.4%	21.7%	
41 or more	18	81	99	
	19.1%	27.6%	25.6%	
Nationality				
Saudi	64	245	309	0.001*
	68.1%	83.6%	79.8%	
Non-Saudi	30	48	78	
	31.9%	16.4%	20.2%	
Region of residence				
Northern	9	23	32	0.111
	9.6%	7.8%	8.3%	
Southern	13	69	82	
	13.8%	23.5%	21.2%	
Central	23	55	78	
	24.5%	18.8%	20.2%	
Eastern	0	8	8	
	0.0%	2.7%	2.1%	
Western	49	138	187	
	52.1%	47.1%	48.3%	
Smoking				
No	66	223	289	0.034*
	70.2%	76.1%	74.7%	
Yes, currently	23	41	64	
	24.5%	14.0%	16.5%	
Yes, previously	5	29	34	
	5.3%	9.9%	8.8%	

*P-value was considered significant if $\leq$ 0.05

and referral protocols as a specialist, to help improve the endodontic treatment success rate.

Post-treatment symptoms were extremely widespread in the present study, where 75.5% of the participants reported having experienced at least one symptom after treatment. Persistent pain (32.0%) and discomfort while chewing (36.4%) were the most frequent, followed by abscess or swelling (30.5%) and unpleasant taste or smell (25.8%). In 36.2% of cases, the symptoms were present for more

Table 5: Self-awareness regarding root canal treatments in association with socio-demographic characteristics

Parameters	Self-awareness regarding root canal treatments		Total (*n*=387)	*P*-value
	Good or moderate	Limited		
Gender				
Female	143	78	221	0.308
	59.1%	53.8%	57.1%	
Male	99	67	166	
	40.9%	46.2%	42.9%	
Age				
24 or less	80	25	105	0.0001
	33.1%	17.2%	27.1%	
25–30	71	28	99	
	29.3%	19.3%	25.6%	
31–40	45	39	84	
	18.6%	26.9%	21.7%	
41 or more	46	53	99	
	19.0%	36.6%	25.6%	
Nationality				
Saudi	199	110	309	0.131
	82.2%	75.9%	79.8%	
Non-Saudi	43	35	78	
	17.8%	24.1%	20.2%	
Region of residence				
Northern	26	6	32	0.006
	10.7%	4.1%	8.3%	
Southern	53	29	82	
	21.9%	20.0%	21.2%	
Central	40	38	78	
	16.5%	26.2%	20.2%	
Eastern	2	6	8	
	0.8%	4.1%	2.1%	
Western	121	66	187	
	50.0%	45.5%	48.3%	
Smoking				
No	196	93	289	0.0001
	81.0%	64.1%	74.7%	
Yes, currently	27	37	64	
	11.2%	25.5%	16.5%	
Yes, previously	19	15	34	
	7.9%	10.3%	8.8%	

**P*-value was considered significant if ≤0.05.

than 1 month. A 2013 narrative review of patient-centered endodontic outcomes said that disease of pulpal origin usually causes moderate but not severe pain.[18] However, root canal treatment should have dramatic effects of pain reduction within the 1st week of treatment. The fact that a substantial number of subjects in one-third to one-half in the present study population continued to have substantial pain and other symptoms implies that either incomplete treatment success was achieved, or delayed healing occurred. This is in contrast to normal expectations, where the majority of the discomfort during the post-treatment phase should have disappeared after 7 days. The long symptom duration noted

could relate to the fact that early endodontic failure or poor response to treatment occurred in many of the study subjects, and is consistent with the large proportion of subjects who reported perceived failure of treatment.

As the deficiency in follow-up care found in this study warrants special attention. Over half the participants (51.7%) did not show up for follow-up visits after initial treatment and 60.7% did not have permanent crown coverage placed on treated teeth. These disconnects in post-treatment care are linked to failure risks. A 2014 nationwide population-based study showed that the survival rate among teeth treated with rubber dam isolation was 90.3%, which was significantly greater than that of teeth without rubber dam isolation (88.8%) at a mean follow-up of 3.43 years.[19] While the use of a rubber dam was not specifically evaluated in the present study as an outcome measure, the fact that 63.5% of participants were unsure of or did not receive rubber dam isolation may indicate that infection control measures, such as isolation and later protection with irreversible restorations, may be less than optimal. It is of particular concern that the absence of protective crown coverage was noted in 60.7% of cases because the coronal leakage has been a well-documented treating cause of treatment but fake. Ray and Trope's seminal work established that the quality of coronal restoration plays an important role in the prognosis of endodontic treatments, although the quality of the root filling was found to be paramount.[17] Advanced tools and technologies were not utilized by this population to an adequate degree: 65.6% of the participants reported the use of advanced tools (like operative microscopes) not used to perform the treatment and 50.1% reported no use of rubber dam isolation. These technical limitations likely contributed for a high failure rate that was seen.

Patient satisfaction and communication lacunae are another important dimension. Overall, 52.7% of the participants were dissatisfied with their treatment experience, which is a considerable number. Examination of correlates of satisfaction revealed a limited explanation of procedures (reported by 40.3% of patients) as one of the major factors. Further, we found a significant number of patients (73.7%) to have limited knowledge about root canal treatments, indicating a lack of patient education. A comprehensive narrative review of patient-centered endodontic outcomes showed that the level of satisfaction with root canal treatment is extremely high – often 8.6 on a 10-point scale – when quality standards are met and pain is minimized.[18] However, the feeling of satisfaction is deeply affected by patient education and communication. The authors emphasized that dentists must accurately inform and educate the patients about technical, practical, and psycho-social aspects of treatment to reduce anxiety and fear and for optimizing treatment outcomes. The overall lower results of the present study (47.3% satisfied or very satisfied) with regard to international literature may mirror the communication gaps published: As patients were found to receive thorough explanation of treatment plans and possible complications in only 20.9% of the cases, and did not know the importance of crown placement after treatment in 49.9% of cases, the patient-centered outcomes suffer substantially.

The relationship that exists between awareness and the success of treatment is reflected in the statistical findings. Univariable analysis showed that self-awareness with regard to root canal treatments significantly correlated with age ($P = 0.0001$), area of residence ($P = 0.006$), and smoking ($P = 0.0001$). Younger participants (aged 24 or less) and non-smokers had better awareness. This suggests that specific health education programs, especially those that highlight the importance of post-treatment restoration and follow-up care and smoking cessation, may have a meaningful effect in this population. Furthermore, the fact that the awareness results for geographic region differed significantly ($P = 0.006$) suggests that implementation of region-specific educational programs coordinated through public health channels may be warranted.

The present study suffers from a number of important limitations. First, the cross-sectional approach using retrospective self-report by patients provides subjective rather than objective clinical assessment of failure. Patient perceptions of "failure" may not be in exact correspondence to radiographic evidence of treatment inadequacy; for instance, patient perception of failures may have been attributed by some participants to the initial treatment when subsequent reinfection or coronal leakage were responsible. Second, the convenient sampling methodology through social media may be introducing selection bias, since the participants who have been adversely treated may be more motivated to be involved in the study research on treatment failure. Third, the study does not provide detailed data on pre-operative periapical status, timing and quality of post-treatment restoration, antibiotic use, and patient compliance with follow-up recommendations – all of which are factors that affect endodontic outcomes.

CONCLUSION

The present research is valuable patient-centered evidence on the prevalence and perceived causes of endodontic treatment failure in Saudi Arabia. The results highlight the key importance of multidisciplinary quality improvement that addresses the performance of operator training and specialization, the use of isolation and advanced technologies, protocol-driven follow-up care with timely permanent restoration, and improved patient education and communication. Implementation of these evidence-based practices may have the potential to significantly impact the rate of endodontic treatment failure or patient satisfaction and oral health-related quality of life in this population.

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ETHICAL APPROVAL

The study was fully explained to all participants, and it was emphasized that participation was voluntary. Written informed consent was obtained from each participant before enrollment. All collected information was securely stored and used exclusively for research purposes.

INFORMED CONSENT

Written informed consent was obtained from all study participants.

DATA AND MATERIALS AVAILABILITY

All data generated or analyzed during this study are included in this published article.

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