



## Qualitative Assessment of Root Canal Treatment Risk Factors Failures among Patients at the Specialist Dental Center in Najran: A Clinical Survey

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### Abstract:

**Aim:** To evaluate the quality of previous root canal treatment (RCT) among patients seeking retreatment in order to determine the actual reason for the failures. **Materials and Methods:** Survey was conducted between January and March 2018, among the patients seeking endodontic retreatment at the Dental Specialist Center in Najran City, KSA. Fifty patients with complaints to their RCT tooth were randomly selected for the study. All the patients were thoroughly examined clinically and teeth were radiographed. All the examinations were done by the same person. Attempt was made to correlate the presenting signs and symptoms to the quality of the past treatment. A well prepared questionnaire was used to record the details of the clinical and radiographic examination. The data collected was used to evaluate the qualification and competency of the clinician to provide RCT of acceptable international standards. **Result:** In the clinical part, 54% of cases reported with pain, 30% of intact fillings and sign of failure symptoms after few months from the RCT. In the radiographic part, most of cases presented with good obturation, high percentage of peri-apical radiolucency, overfilled, apical and internal resorption. Upto 6% were registered in cases with presence of broken instrument or perforations. All standard deviations were high. **Conclusion:** The survey revealed very strong correlation between failures of endodontic treatment (FET) and disregard for the fundamental basics among the clinicians. Proper clinical training in dental schools and continuing dental education programmes would certainly improve the quality of RCT provided to the public.

**Key words:** Root canal treatment, Endodontic failures, Clinical survey

### Introduction:

Intra-radicular micro-organisms are the essential etiological agents of apical periodontitis.<sup>1</sup> The primary goal of endodontic treatment is to eliminate or reduce the microbes from root canal space by chemo-mechanical preparation and to prevent re-infection and promote periapical healing by hermetically sealing the root canal space.<sup>2</sup> RCT has become very predictable with remarkably high degree of success. A lot of credit for this success goes to the understanding of the modern concepts in microbiology, innovative use of science and technology and excellence in training.<sup>1,2</sup>

However, for various reasons, complete bone healing or reduction of the apical radiolucency may not occur in all RCT teeth. Cases of unresolved post-treatment

peri-apical radiolucency are commonly referred to as 'endodontic failures' (EF). Recent publications reported failure rates of 14%-16% for initial root canal treatment.<sup>3</sup> Some of these patients are symptomatic and seek assistance, but most remain asymptomatic. It is generally acknowledged that most failures occur when treatment procedures have not reached a satisfactory standard for the control and elimination of infection. Even when the highest standards are met and the most careful procedures followed, failures still occur because of the anatomical complexity of the root canal system.<sup>4</sup> Common problems that may lead to EF include poor case selection, inadequate aseptic control, errors in access cavity design, missed canals, inadequate instrumentation and obturation, and leaking temporary or permanent fillings.<sup>5</sup>

The lengths of root canal filling (RCFs) from the radiographic apex, the density and the taper of the RC preparation are parameters used to assess the quality of RCF.<sup>6</sup> According to European Association of Endodontists, a satisfactory RCT shows a tapered canal from crown to apex, completely filled with no space between canal filling and canal wall. In addition, any obturation shorter than 0-2 mm from the radiographic apex is considered unacceptable.<sup>7</sup> Studies have reported high prevalence of peri-apical lesions in endodontically treated teeth with inadequate RCFs.<sup>8</sup> Research has also confirmed that endodontic RCFs that are extruded beyond the apex and those which are non-homogenous with voids between the fillings increase the risk of endodontic treatment failures.<sup>9</sup> A published study of 1.5 million ETT found a 97% survival rate at 8 years.<sup>10</sup>

The etiology of failure in well obturated teeth might be more likely related to extra radicular infection, cystic lesions, foreign body reactions, and undiagnosed infractions, conditions that might not respond favorably to retreatment.<sup>11</sup> The former, commonly referred to as 'technical errors' are very well avoidable if there is enough emphasis on the quality of training imparted to the dental students.

The qualities of RCTs performed by graduate and senior students in Saudi Arabia (SA) were evaluated. The acceptable quality of RCTs has been reported in different cities in SA cities,<sup>12,13,14,15</sup> but an unacceptable quality of RCTs has been obtained in some colleges, Al Farabi<sup>16,17</sup> and KSU<sup>18</sup> in Riyadh City. However, the quality of RCTs has been rarely compared and investigated among specialists, and general practitioners.<sup>19,20,21</sup>

All around the world, endodontics is considered a speciality, but simple root canal procedures like treatment of anteriors is included into the undergraduate curriculum in most dental

schools. As a result, general practitioners are increasingly involved in providing RCT to the public. There was a growing concern in the high number of 'endodontic failures' reporting at the outpatient department (OPD) of the Dental Specialist Center in Najran. A questionnaire based survey was designed to study the exact causes of these failures. The objective of the study was to critically analyze the data derived from the clinical study, to identify the causes of ETFs and then use it for improving the quality of patient care.

### Materials and Methods:

The study was planned to be a clinical survey based on a carefully designed questionnaire which was to be used while screening the patients in the outpatient department of the Dental Specialist Centre, Najran city, Saudi Arabia. The questionnaire was prepared in English using simple, layman terms for the convenience of the patients. Clinicians were instructed to translate it into Arabic for the benefit of the non-English speaking population. The questionnaire used is presented in the results (**Table I, II and Figure IA, B**). Patients with complaints regarding previous root canal treated tooth only were brought under the purview of this study. Each patient with a complaint was scrutinized thoroughly using the questionnaire based on certain clinical and radiographic criteria. Even though some of the questions have quantitative data, only the qualitative part was deliberated upon as the ultimate objective was to assess the quality of the past endodontic treatment and determine the cause of failure. The clinical and radiographic criteria and classification of failures and successes mentioned in Löst C<sup>7</sup> were followed during evaluation of the patients.

### Results:

The data collected in response to the questionnaire was primarily qualitative.

Qualitative analysis was done with the help of software Kwik Survey. The standard deviation (SD) was found to be high. In addition, the current survey had two parts- one based on certain clinical criteria and the second based on radiographic criteria. The only inclusion criteria was complaints in relation to root canal treated tooth.

Regarding the clinical findings, fifty eight percent (58%) of the cases surveyed had full coverage restoration; out of this, 2% reported with dislodged crowns. Thirty percent (30%) of patients presented with intact fillings whereas 8% reported partial or complete loss of filling material. Tooth fracture was the reason for 2% of failures. Fifty four percent (54%) of the patients presented with pain of varying intensity. Thirty four percent (34%) had accompanying swelling too, twenty percent (20%) had pain alone and 12% had sinus tract. Around 34% of failed cases remained asymptomatic (**Table I**). Sixty two percent (62%) of the failed root canal treatments were reported one to five years after treatment. Eighteen percent (18%) reported back within the first year. In approximately 80% of the surveyed cases, complaint appeared within the first 10 years (**Table I**).

In Table I, our survey revealed that nearly 30% of the treatment was provided by the general practitioners. It would be much more considering the fact that around 66% of the patients were not sure of the qualification of their clinician. Only two percent (2%) of the surveyed knew that they were being treated by a specialist. Fifty six percent (56%) of the surveyed cases were completed in multiple visits and 44% in a single appointment. Around 90% of the cases were finished in 2-3 visits. However, it was difficult to find a correlation between the number of appointments and the specialization of the clinician. The SD is shown in Table I.

In relation to the radiographic findings- in the current study, 96% teeth had poorly

obtured canals (yes), while the remaining 4% were good obturation (**Figure IA**). Inability to negotiate curved canal is often cited as a reason for failure; in the present survey, 76% of the canals were straight (yes), devoid of any curvature (**Figure IB**).

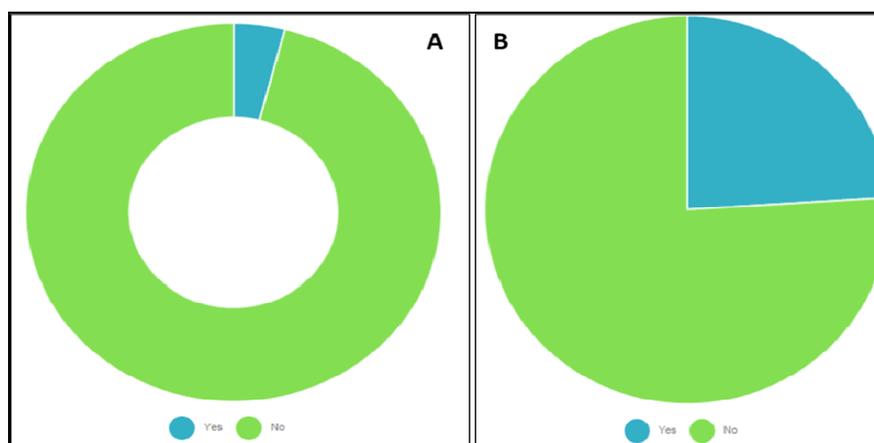
In the other radiographic factors, around 90% had showed amount of voids. Eighty two percent (82%) of the cases surveyed had short obturation, out of which 5% was within the permissible limit of 1mm short of apex. Overfilled canals were far fewer at 12%. Approximately 20% of the failures were attributed to a missed canal (**Table II**).

Thorough radiographic examination ruled out calcification of canal as the reason for failed treatment in 88% of cases and pulp stones were not present in any of the cases surveyed. Peri-apical radiolucency is almost always associated with failure of root canal treatment. Ninety eight percent (98%) of the cases had peri-apical radiolucency associated with roots, out of which 70% of the cases surveyed had radiolucency of size more than 2 mm. Thirty percent (30%) of the lesions were small in size, often less than 2 mm. These cases pose a challenge to the clinician's diagnostic skills.

Apical root resorption was present in 14% of cases and internal resorption in one percent cases. Twelve percent (12%) of cases showed furcation involvement and 10% showed endodontic-periodontic etiology. None of the failed teeth were associated with root fracture. A procedural error as serious as broken instrument inside the canal was very evident in 6% of the radiographs, perforation was responsible for 4% of failed RCT. Among the cases indicated for retreatment, 14% of the cases were anticipated to undergo a peri-apical surgery in the near future (**Table II**). The SD is shown in Table II.

**Table I:** Clinical criteria

Restoration status	Full crown	Dislodged crown	Intact filling	Broken filling	Completely dislodge filling	Fractured tooth	SD
	29(58%)	1 (2%)	15 (30%)	3 (6%)	1 (2%)	1 (2%)	10.5
Clinical finding	Pain	Swelling	Swelling & pain	Sinus tract	Swelling & sinus tract		SD
	27(54%)	0 (0%)	17 (34%)	6 (12%)	0 (0%)		10.53
Time from RCT	< 6 months	6 months-1year	1Year-5 years	5-10 years	> 10 years		SD
	1 (2%)	8 (16%)	31 (62%)	6 (12%)	4 (8%)		10.36
Degree of practitioner	GP	Specialist	Not sure				SD
	15(30%)	2 (4%)	33 (66%)				12.71
Number of visits	Single visit	Multiple visits					SD
	22(44%)	33 (56%)					3

**Figure I:** Percentage of the obturated canal (A), curved canal (B)**Table II:** Radiographic criteria

Criteria	Yes	No	SD
Presence of voids	45 (90%)	5 (10%)	20
Adequate length of obturation	41 (82%)	9 (18%)	16
Over filled canal	6 (12%)	44 (88%)	16
Missed canal	10 (20%)	40 (80%)	21
Calcified canal	44(88%)	6 (12%)	16
Presence of pulp stone	0 (0.00%)	50 (100%)	25
Presence of peri-apical radiolucency	49 (98%)	1 (2%)	24
Apical root resorption	7 (14%)	43 (86%)	18
Internal resorption	1 (2%)	49 (98%)	24
Furcation involvement	6 (12%)	44 (88%)	19
Cases with perio-endo lesion	5 (10%)	45 (90%)	20
Root fracture	0 (0.0%)	50 (100%)	25
Presence of broken instrument	3 (6%)	47 (94%)	22
Presence of perforation	2 (4%)	48 (96%)	23
Cases need periapical surgery	7 (14%)	43 (86%)	18

**Discussion:**

Endodontics, like other dental procedures are skill oriented and skills could be developed and nurtured by proper training based on strong fundamental principles. The alarming rate at which retreatment cases were approaching the Dental Specialist Centre, Najran City demanded a study into the reason for failed endodontic treatment. It was decided to use a questionnaire based study which ruled out a retrospective study, though it would have given a bigger sample to study. This prospective study was based on the patients examined at the outpatient department of the center. The only inclusion criteria was complaints in relation to root canal treated tooth. Teeth retreated in the past were excluded from the study.

Post-endodontic restoration is indispensable for successful root canal treatment as coronal microleakage and tooth fracture are two of the main reasons for the failure. Full coverage restorations are the restoration of choice in root canal treated posterior teeth as it would reinforce the already weakened tooth and minimize microleakage. In the present study, most of the cases have been well restored. In the present study, only 10 % could be attributed to restorative failure and 2% to tooth fracture. A whopping 88% of failures were found on well restored teeth; this definitely suggest endodontic failure.

Patients realize that RCT has failed when pain, swelling or both appear. Painful swelling is often indicative of an acute condition and such patients often seek emergency intervention. About 20 % had only pain of varying intensity. Some patients had sinus tract in relation to the root canal treated tooth (12%) and some were absolutely asymptomatic (34%). Diagnosis is relatively easy when the tooth is symptomatic, much more complicated when the patient is asymptomatic and emphasizes the role of periodic review and thorough clinical and radiographic

examination. In 46% of cases, the diagnosis was purely incidental, based on radiographic findings alone. A comparison with past radiographic records would have been very helpful. Most often it is not available and as a result clinician has to correlate the clinical and radiographic findings.<sup>22</sup>

Treatment failure could be immediate or delayed. Proper case selection almost always ensures the long term prognosis of the treatment. Immediate complaints in relation to a RCT tooth could be a case of poor case selection or endodontic mishaps. Eighteen percent (18%) of failures were reported within the first year, this is actually in agreement with the findings of many similar studies in the past.<sup>19,20,23</sup> This is alarming as poor clinical skill is the primary reason for immediate failures. Even long term prognosis is questionable, if the clinicians don't keep up to the international standard of care as evident from the total high percentage (80%) of failure between six months and 10 years.

Dental schools, around the world have incorporated routine root canal procedures in the undergraduate curriculum. RCTs are provided by the general practitioners too, increasingly so, in developing countries with shortage of specialists. Most general practitioners are competent in handling anterior teeth, but may find the posterior teeth challenging. General practitioners should select their cases with caution and seek consultation from the specialist when they anticipate complications.<sup>24</sup> A dignified, professional referral system would improve the quality of care provided to the patients. The present survey failed to draw any relevant data since the majority of the patients screened (66%) could not give a positive feedback on whether they were treated by a specialist or not. This was in agreement with the finding of studies<sup>19,20,21</sup> in regarding to the number of treated patients by general practitioner and specialist.

In the past, studies have shown that specialists tend to finish the treatment in single appointments whereas multiple appointments were preferred by the general practitioners. However, this conclusion could not be reached in the present study even though around 90% of the cases were finished in 2- 3 visits; this agreed with study by Al-Fouzan KS.<sup>20</sup> The present study failed to find a correlation between the number of appointments and the specialization of the clinician.<sup>25</sup>

Regarding the radiographs quality- it was indispensable for this study as they assessed many radiographic criteria.<sup>17,18</sup>

The first criterion checked was the quality of obturation. Canals obturated to the working length with densely radiopaque obturation with minimal or absence of voids was considered ideal. This was closed to the results gained by other studies.<sup>11,14,17</sup> Loosely obturated canal with abundant voids is the result of poor obturation technique. Our survey showed that 96% of the cases had extremely poor obturation and approximately 90% had voids; similar results were recorded by other studies<sup>14,15,17,21</sup>. This survey would have revealed much more if the patients were asked whether radiographs were taken during the past treatment. It is evident that in many cases radiographs were not taken to verify the working length during the procedure as evident from the high percentage of cases associated with short obturation. This highlights the ignorance and negligence on the part of the clinicians. It was also evident that clinicians are perhaps more alert against overfilling since it almost always produces 'acute' symptoms<sup>12,14,26</sup>

Extra canals or even extra roots may go unnoticed during the root canal procedure. In the present study, 20% of failures are attributed to the missing canals and 8% to an extra root. Modern radiographic and tomographic techniques, when used judiciously are often helpful in identifying

these aberrations. Root curvature is often mentioned by the clinicians as another reason for failure. Curvatures exceeding 35° is often considered to be non-negotiable. Twenty four percent (24%) of the canals surveyed had negotiable curvature as evident from the radiographs. This was in agreement with previous results.<sup>15,16,17,18</sup> Availability of flexible Ni Ti files and pre-curving techniques would be sufficient to negotiate most of the curved canals<sup>7</sup>. Failure to negotiate curvature is an indicator of the incompetency of the clinician.<sup>15,16,17,18</sup>

Pulp stones obstruct the entry of instruments into the canal and calcification is one of the several reasons for short obturation. Modern technology is used well to remove the pulp stone and negotiate calcified canals.<sup>6</sup> Most of the calcified canals are deemed negotiable if patiently instrumented. None of the teeth included in the survey had amount of pulp stone or calcification.

Peri-apical radiolucency of various sizes is often associated with failed root canal treated teeth. This is not always correct as it is almost impossible to determine whether the radiolucency is an indication of an active lesion or a healing lesion. Peri-apical scar attributed to fibrous healing of peri-apical lesion is also seen as radiolucency. The size of the lesion and nature of its margins could be suggestive of the nature of lesion in some cases, but not always. Correlation with clinical symptoms is absolutely important in distinguishing between an aggressive and healing lesion.<sup>21,27</sup> In the present study, 98% of the cases were associated with periapical radiolucency and 30% of those lesions were less than 2mm in size. These lesions are difficult to diagnose too. Apical root resorption and internal root resorption are consequence of chronic inflammatory process. In the present survey, their presence was not. Furcation involvement and endodontic-periodontic etiology were found in 12 and 10% of cases respectively.

Sometimes, the failure is attributed to not addressing the periodontal problem satisfactorily.

Perforations, root fracture and separated instruments are some of the more common causes of failure. All three were found in the survey, but not of any large amount. Similar results were recorded by studies.<sup>14,16,28</sup> It is imperative to add here that all these are well avoided if the clinician follows the basics of RC procedure. Among the retreated cases, it was anticipated that surgical endodontics would have to be resorted in 14% of cases. Such cases have to be periodically monitored and surgically intervened at the earliest.<sup>7</sup>

Analyzing the results of the study, it could be concluded that RCT remains a predictable procedure as long it is meticulously done. The undergraduate curriculum should emphasize on the clear understanding of the biologic basis of peri-apical inflammation and biomechanical methods of disinfecting the canal. The importance of getting the fundamentals like working length determination and disinfection of canal should never be discounted. High standards of training during the undergraduate years would certainly improve the quality of RCT provided to the society. At the same time, the service of a specialist endodontist should be sought if the general practitioner feels that he is incompetent to manage certain cases.

### Conclusions:

Within the limitations of the study, it could be concluded that procedural errors mainly contribute to failure of root canal treatment. Endodontic procedures remain highly predictable when the clinician is properly trained and if he keeps himself updated on all the advances in the speciality. In the clinical part, more than half of cases were reported with pain or their sign of failure symptoms after few

months. In the radiographic part, most of cases presented with good obturation, but high percentage of peri-apical radiolucency, overfilled, apical and internal resorption. Upto 6% were registered in cases with presence of broken instrument or perforations.

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