

## OUTCOME OF ROOT CANAL RETREATMENT PERFORMED IN SINGLE VISIT. A COHORT RETROSPECTIVE STUDY

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### ABSTRACT

**Introduction:** The purpose of this retrospective study was to assess the outcome of endodontic retreatment performed in single visit.

**Methods:** Retreatments were identified from the pool of patients treated in Dubai Health Authority (DHA) endodontic clinics between 2018 and 2019. The cases included were retreated in a single visit and followed up for at least 6 months. Data were retrieved from 139 cases and a template was created to collect demographic, procedural, clinical and radiographic information. Short term flare up and long term clinical and radiographic outcome were assessed, in addition to calculation of tooth survival. Moreover, the preoperative apical status and quality of root canal filling were studied as prognostic factors and were analyzed for their impact on the outcome.

**Results:** Data from 127 patients, where 99 cases from women and 40 cases from men with a mean age of 46.5 years, showed that flare up occurred in 2.9% of the cases; a success rate of 92.1% and survival rate of 94%. Statistical analysis did not discern an association between the quality of the previous root canal filling and outcome of retreatment. Conversely, there was an association between the presence of a preoperative apical periodontitis and outcome of treatment ( $p=0.006$ )

**Conclusion:** Single visit endodontic retreatment performed by specialists on asymptomatic teeth is a predictable therapy with a high incidence of healing and tooth retention.

**KEY WORDS:** cohort, outcome, retreatment, retrospective study, single visit, survival.

### INTRODUCTION

In cases where nonsurgical retreatment is decided, clinicians must be able to provide patients with information about the prognosis of the proposed treatment, based on the best available data (1, 2).

Outcome studies of endodontic retreatment vary considerably in design, treatment protocols, methodology as well as in recall rates and duration of the observation periods (1-4).

Studies comparing the short term sequels of end-

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odontic retreatments were inconclusive. Yoldas et al. found that 2-visit endodontic retreatment with intracanal medication, reduces postoperative pain of symptomatic teeth and decreases the number of flare-ups compared to 1-visit retreatments<sup>(3)</sup>. Conversely, Hepsenoglu et al found that postoperative pain incidence in single-visit retreatments was less than that in multiple-visits in asymptomatic cases<sup>(4)</sup>.

For longer follow ups, systematic reviews concluded that the majority of clinical studies published on the outcome of endodontic retreatment from 1970 to 2008 had a low level of evidence (LOE)<sup>(1,5)</sup>. Prospective studies on nonsurgical retreatment performed in multiple visits reported success rates ranging from 6%–93%<sup>(6-9)</sup>; in addition to significant volumetric reduction in periapical radiolucencies with predictable 4-year outcome<sup>(9)</sup>. Clinical and radiographic findings revealed the overall healed rate was 81%; and that 89%<sup>(10)</sup> to 93% of the teeth were asymptomatic and fully functioning at 4- to 6 years<sup>(11)</sup>. While the retrospective study by Curtis *et al.* concluded complete healing of only 41.2% for retreatments reviewed after 1–4 years<sup>(12)</sup>. Recently, Toia et al found that endodontic retreatment in one or 2 visits exhibited equally favorable periapical healing at 18 months<sup>(13)</sup>. On the other hand, the outcome of endodontic retreatment performed in single visit was investigated in 2 studies only, in which the overall success rate ranged from 84.9% to 90.9%<sup>(14,15)</sup>.

It is thus becoming obvious that there is no clear consensus as to which cases are candidates for single visit endodontic retreatment and no solid answer about the expected outcome.

### **Aim**

The aim of the present study was to assess retrospectively the clinical and radiographic outcome of root canal retreatment performed in single visit by specialists at the endodontic clinics of Dubai Health Authority (DHA).

## **MATERIALS AND METHODS**

This retrospective study was approved by the Ethics Committee of the Medical Education and Research Department of Dubai Health Authority (resolution number DSREC-01/2021\_11) and was also registered in the [ClinicalTrials.gov](https://clinicaltrials.gov) database (NCT04746482).

### **Study cohort**

Potential subjects were retrospectively identified using a database containing all patients who were at least 18 years of age and who had received retreatment in the endodontic clinics of DHA between January 2018 and December 2019.

The eligible cases were included in the study only if the subjects age was ranging from 18 to 70 years, the root canal retreatment was performed in single visit, and followed up for at least 6 months.

### **Data collection into a recording sheet:**

A standardized data collection form was filled for each patient based on clinical notes and available radiographs, and recorded the following:

- Demographic information: age, gender, and nationality
- Tooth-related information: tooth type and location, preoperative condition, and presence or absence of apical periodontitis, and the time of the most recent follow-up.
- Treatment related information: method of removal of the previous root canal filling, size of apical preparation, irrigation regimen, material and technique of root canal filling, and postoperative restoration.

The teeth were tracked in the database during the entire period, and outcome criteria were applied blindly because none of the investigators were aware that the data would be used for an outcome analysis in the future. Moreover, the percentages of teeth that were retained or underwent additional

procedures such as apical surgery and extraction were also recorded (10).

### Clinical Examination Information

Data were collected from the clinical notes of the patient in SALAMA database (<https://www.citrix.com/products/citrix-workspace/>). Clinical information included assessments of pain which was scored using the Wong Baker FACES grading scale, swelling, sinus tract, tenderness to palpation or percussion, mobility, and the coronal restoration.

### Radiographic assessments

The status of the periapical tissues and the quality of the existing root canal fillings were determined by 2 calibrated independent observers (RH and HH) on periapical radiographs.

#### A. Periapical index (PAI)

For each tooth, the condition of the periapical tissue was assessed radiographically using the PAI. The index consists of 5 categories, numbered 1-5 (16) as follows:

PAI 1: normal periapical structure

PAI 2: small changes in the bone structure not pathognomonic of apical periodontitis

PAI 3: changes in the bone structure with minimal loss characteristic of apical periodontitis

PAI 4: well-defined apical radiolucency characteristic of apical periodontitis

PAI 5: severe periodontitis with exacerbating features and bone expansion

The PAI scores were then dichotomized to reflect the absence ( $PAI \leq 2$ ) or presence ( $PAI > 2$ ) of apical periodontitis (16). Those teeth with multiple root canals were scored based on the root canal with the highest PAI score.

#### B. Quality of root canal filling

The quality of the existing root canal fillings was determined using 3 criteria as follows (17):

- Length of root canal filling: root filling ending  $\leq 2$  mm from the radiographic apex, root filling ending  $> 2$  mm from the radiographic apex, or root filling at the radiographic apex (flush).
- Density of root canal filling: the presence or absence of voids in the root filling or between the root filling and root canal walls.
- Taper of the root canal filling: the presence or absence of consistent taper from the orifice to the apex.

Finally, the technical quality of the root canal fillings was considered acceptable if the root filling ended  $\leq 2$  mm from the radiographic apex with no voids visible within the material or between the material and the root canal walls and consistent taper from the orifice to the apex. In contrast, the technical quality of the root canal fillings was considered unacceptable when one or more of the aforementioned parameters were absent<sup>(17,18)</sup>.

### Retreatment Procedures

Endodontic retreatment of all cases was conducted by endodontic specialists according to the contemporary standards of endodontic therapy. Each patient was anesthetized with Lidocaine hydrochloride + 1:100000 mg/mL epinephrine (Octocaine 100; Novocol Pharmaceutical, Ontario, Canada). Rubber dam isolation was followed by removal of the previous coronal restorations and/or existing caries. Old root canal fillings were removed using D-Protaper files (Dentsply Maillefer, Ballaigues, Switzerland), with or without solvents. Apical patency was achieved in all root canals and working lengths were determined using Root-Zx II electronic apex locator (J. Morita Corp, Osaka, Japan). Instrumentation was then performed with Pro-Taper Next rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) to a minimum size of X3, and the root canals were irrigated with 2% NaOCl (Cerkamed, Stalowa Wola, Poland), with or without 17% EDTA (Henry Schein, Melville, USA).

Canals were dried with paper points and obturated with gutta-percha and Sealapex root canal sealer (Dentsply, Tulsa, OK) using lateral compaction technique.

Cavit (Filtek, 3M ESPE, St. Paul, MN, USA) was used as base material to seal the canal orifices, followed by glass ionomer cement (Filtek Ultimate, 3M ESPE) or IRM (Dentsply De-Trey, Konstanz, Germany). Patients were subsequently sent back to their referring dentists for a permanent coronal restoration.

All of the root canal retreatments were performed in a single visit. Only those patients with at least 6 months of clinical and/or radiographic follow-up were included in the study.

### Follow up

Patients' charts were revised till their last dental visit and the most recent one was recorded; and the time was calculated to determine the follow up period in months.

#### Clinical and Radiographic Evaluation <sup>(19)</sup>

Data documenting pain scores, the presence of a swelling, sinus tract, sensitivity to percussion, and radiographic scoring were collected in the recording sheet.

### Outcome Assessment

**A. Short term outcome (Flare up):** pain scores were revised in patients' records for a week after treatment; and swelling was also recorded as present or absent during the same period.

#### **B. Long term outcome**

The treatment outcomes were classified into 3 categories according to the following definitions:<sup>(8, 19)</sup>

1. Healed: asymptomatic, functional, and normal periapical tissue with an intact periodontal ligament space and lamina dura or a slightly wid-

ened periodontal ligament.

2. Nonhealed: symptomatic, non functional, and/or the emergence of new periapical radiolucency or unchanged or enlarged periapical radiolucency.
3. Healing: Teeth that are asymptomatic and functional and periapical radiolucency still present but reduced in size.

The outcome assessment was further split as follows: both healed and healing cases were considered success, while nonhealed cases were considered failure <sup>(8, 19)</sup>.

**C. Survival:** Teeth were recorded as functional when absence of any signs or symptoms was noted, independently of the PAI score <sup>(7)</sup>.

**D. Prognostic factors:** The presence/absence of apical periodontitis, and the quality of root canal filling were analyzed to determine their influence on treatment outcome <sup>(19)</sup>.

### Statistical analysis

The obtained data were imported to SPSS Statistics for Windows software (Version 25.0; IBM Corp, Armonk, NY). Continuous data were presented as mean, standard deviation (SD), median, minimum and maximum values; while categorical data were presented as frequencies (N) and percentages (%). Wilcoxon signed rank test was used for comparisons of preoperative and postoperative pain. Associations between binary categorical variables, namely, obturation quality and presence of apical periodontitis with outcome were examined using Chi square test and Fisher's exact test which was used when more than 20% of the expected frequencies values were less than 5. When there was evidence of association, statistical significance between subgroups was evaluated by post hoc z test with Bonferroni correction.

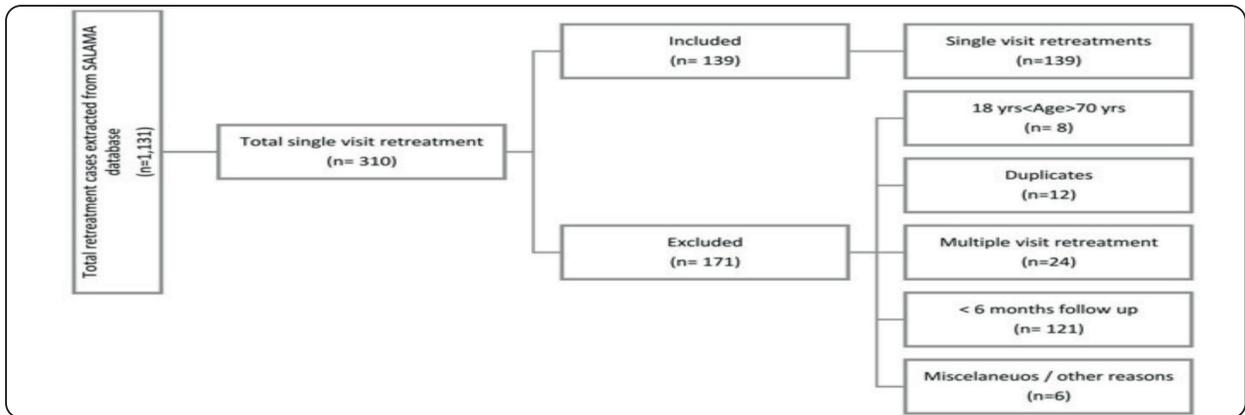


Fig. (1) Flowchart describing the enrollment process of the study.

**RESULTS**

Figure 1 shows the flowchart describing the enrollment process, and Table 1 summarizes the demographic characteristics for the present study. One hundred thirty nine teeth from 127 patients were included for analysis, with a mean age of 46.5 years ( $\pm 12.1$  years) and mean follow up time of 18.8 months ( $\pm 8.8$  months). Almost half of the cases were premolars (48.9%), followed by anteriors (30.2%), and the least were molars (20.86%).

The cases studied were asymptomatic as evidenced by the preoperative mean pain score ( $0.08 \pm 0.45$ ), negative to palpation and percussion, and displaying no mobility. The radiographic examination revealed unacceptable root canal fillings in 76.3%, and absence of apical periodontitis in 61.8% (Table 2) of the cases.

TABLE (1) Demographic characteristics of the study population

| n=139         |           | n  | %     |
|---------------|-----------|----|-------|
| <b>Gender</b> | Male      | 40 | 28.8  |
|               | Female    | 99 | 71.2  |
| <b>Tooth</b>  | Anteriors | 42 | 30.2  |
|               | Premolars | 68 | 48.9  |
|               | Molars    | 29 | 20.86 |

TABLE (2) Frequency of preoperative PAI and incidence of preoperative apical periodontitis

| Preoperative PAI | Frequency | Percentage | Preoperative apical periodontitis n (%) |
|------------------|-----------|------------|-----------------------------------------|
| 1                | 63        | 45.3%      | 86 (61.8%)                              |
| 2                | 23        | 16.5%      | Absent                                  |
| 3                | 31        | 22.3%      |                                         |
| 4                | 16        | 11.5%      | 53 (38.2%)                              |
| 5                | 6         | 4.3%       | Present                                 |

**Outcome findings**

**Short term (Flare up):** After one week of completion of treatment, swelling occurred in only 2.9% of the cases; while the postoperative mean pain score ( $0.14 \pm 0.78$ ) did not significantly change from the preoperative one ( $p = 0.62$ ).

**Long term outcome**

The overall success rate was 92.1%; where 72.4% healed, 19.7% were categorized as healing, and 7.1% non healed.

The survival rate was 94.2% (8 teeth extracted) where the extraction rates were 1.4% at 6-12 months, increased to 2.16% from 1 to 2 years, and remained stable after 2 years (2.16%). One case did not show up for more than a year, and was retreated

after 17 months and excluded from the final outcome analysis.

**D. Prognostic factors:**

**Preoperative quality of obturation and outcome:**

93.3% of the cases with unacceptable preoperative quality of obturation showed a higher success rate than failure; while from those with acceptable preoperative quality of filling, 90.9% were successful and 9.1% failed. Nonetheless, Fisher’s exact test did not discern an association between the preoperative quality of obturation and outcome ( $p = 0.702$ ) (Table 3).

**Preoperative apical periodontitis and outcome:**

Fisher’s exact test revealed an association between the presence of preoperative apical periodontitis and outcome ( $p = 0.006$ ). Healing occurred in teeth with and without preoperative apical periodontitis. However, cases exhibiting

success (97.7%) were significantly higher than failure cases in patients without preoperative apical periodontitis. Likewise, the rate of success was significantly higher (84.6%) in teeth retreated with pre-existing apical periodontitis compared to failed cases (Table 4).

**DISCUSSION**

The number of visits needed for treatment is becoming one the patients’ most asked questions, and maybe one of their decisive factors to undergo treatment. Single-visit treatment is more prevalent nowadays (20); however, when retreatment is indicated, the type of practice influences the decision-making process (2), where the level of training and experience of the operators is an important consideration (5). Half of the retreatment studies were performed by general practitioners and students (5, 10, 21); therefore, the aim of the present study was to assess, retrospectively, the short and

TABLE (3) Frequency (N), percentage (%), and result of Fisher’s exact test for association of preoperative quality of obturation and outcome

| Outcome                                      |                     | Success          | Failure   | P - Value |
|----------------------------------------------|---------------------|------------------|-----------|-----------|
| Preoperative quality of obturation (N = 138) | <b>Acceptable</b>   | N<br>30<br>90.9% | 3<br>9.1% | 0.702     |
|                                              | <b>Unacceptable</b> | N<br>98<br>93.3% | 7<br>6.7% |           |

Table (4). Frequency (N), percentage (%), and result of Fisher’s exact test for association of preoperative apical periodontitis and outcome:

| Outcome                                             |                | Success                       | Failure                 | P - Value |
|-----------------------------------------------------|----------------|-------------------------------|-------------------------|-----------|
| <b>Preoperative apical periodontitis</b><br>N = 138 | <b>Absent</b>  | N<br>84 <sup>a</sup><br>97.7% | 2 <sup>b</sup><br>2.3%  | 0.006*    |
|                                                     | <b>Present</b> | N<br>44 <sup>a</sup><br>84.6% | 8 <sup>b</sup><br>15.4% |           |

*Percentages are calculated within the preoperative apical periodontitis.*

*Different superscript letters indicate statistical significance by post hoc z test with Bonferroni correction*

long term outcomes of teeth retreated in single visits exclusively by specialists.

Moreover, the majority of investigations were conducted in hospital or school setting, with few being conducted in private practice<sup>(5, 20)</sup>; while the site of operation in the present study was the endodontic clinics in DHA ensuring standardized operational procedures, using current techniques and materials, as well as homogenous patient pool, and consistent information collection and data retrieval.

Thus, an excel sheet was created to gather all the needed information: starting from patients' demographics, through preoperative clinical and radiographic condition of the included cases, procedural steps, then short and long term outcome criteria. This tool, though very much conforming to the recently suggested template by Azarpazooch *et al*<sup>(20,22)</sup>, it was tailored at the time of the investigation for clear standardized recording of the research data<sup>(22)</sup>.

The data collected revealed homogenous demographics in terms of ethnicity and age range. The sheet also allowed clear extraction of the diagnosis or reason for retreatment where the majority of cases were asymptomatic, with no procedural errors, and mostly free of apical periodontitis with defective root canal fillings. Furthermore, the recording sheet proved the standardization of the procedural methods performed in DHA clinics, where the same technique of removal of gutta percha, rotary instrument used, apical size preparation, irrigation regimen, obturation material and technique are followed.

We found that flare up did not exceed 3% of the studied cases one week after treatment, corroborating with previous findings<sup>(4,23)</sup>; where the patients remained asymptomatic, with no reporting of swelling or any other signs of discomfort.

Assessment of clinical outcome measures

related to the absence of pain or swelling may be completed at short follow-up periods of one to two weeks. However, radiographic healing is a clinician-centered end-point relating to patients' disease and has been the focus of the guidelines of the European Society of Endodontology (ESE) 2006<sup>(24, 25)</sup> and a bulk of studies<sup>(26, 27)</sup> throughout the years to assess the presence and course of apical periodontitis after treatment<sup>(28)</sup>; and it is better observed at longer time points<sup>(27, 28, 29)</sup>.

This is why the cases were included in the present study only if they were followed up for at least 6 months, and the results showed that the mean follow up time was 18.8 months; which is in line with the guidelines by the ESE<sup>(18, 24, 25)</sup>, most randomized controlled trials (20), the average healing time reported in previous studies<sup>(9)</sup>, and because any additional intervention is usually recognized with the 1st 2 years after retreatment<sup>(10)</sup>.

Both the Wong Baker FACES and PAI<sup>(16)</sup> are basic well-validated tools used in a broad range of studies for pain and radiographic assessment respectively<sup>(29, 31)</sup>. This, in addition to other examination parameters; namely, the response to palpation and percussion, presence or absence of sinus tract, and the status of the periodontal ligament, constituted the final clinical and radiographic picture at the end of the evaluation period, and allowed clear categorization of the cases into "healed", "healing", or "unhealed".

Furthermore, the "healed" and "healing" cases were combined into one group: "success"; while the "unhealed" cases were considered unsuccessful. This is easier for conveying outcome information and is common approach among studies<sup>(5,8)</sup>. Based on this dissection of data, the success rate in the present study was 92.1% which compared favorably with previous findings<sup>(8, 9, 15)</sup>. However, it was higher than that reported by Ashraf *et al*<sup>(14)</sup>; possibly because the cases were performed by postgraduate students and followed up for up to 4 years.

Previous investigations identified several predictors for retreatment outcome, the most important of which were the preoperative periapical status and the quality of the root canal filling<sup>(2, 7, 8)</sup>. In fact, all retreatments in the present study were assigned due to presence of periapical lesions or defective root canal fillings. Therefore, the cohort retrospective study was suitable to establish a link between those 2 factors and the outcome; in addition to being an appropriate design to study exposures for which randomization and/or blinding is not possible for practical or ethical reasons<sup>(1, 30)</sup>.

The present study did not detect an association between the quality of preoperative root canal filling and retreatment outcome, although the percentage of successful cases was higher in teeth with unacceptable preoperative fillings, concurring the conclusion by de Chevigny *et al*<sup>(7)</sup>.

Radiographic inadequacy of the previous root canal treatment alone is sufficient to justify retreatment without the presence of AP, aiming at prevention of disease, especially when a new restoration is required; while there is a common agreement that the presence of apical periodontitis is an indication for retreatment.<sup>(5-7, 11, 19)</sup>

Our findings confirmed previous results<sup>(5, 7, 8, 11)</sup> showing a negative influence of preoperative AP on the outcome of endodontic retreatment; while endorsing retreatment of asymptomatic teeth in single visit<sup>(7)</sup>. This is in contrast with Curtis *et al*<sup>(12)</sup> who attributed lower healing rates to their inability to standardize the treatment protocols and materials; a factor that was overcome in the present investigation.

The favourable outcome measures for nonsurgical root canal treatment and retreatment were described by the ESE (2006) as “absence of pain, swelling and other symptoms, no sinus tract, no loss of function and radiological evidence of a normal periodontal ligament space around the root”<sup>(24)</sup>.

However, the mere lack of symptoms and retention of the tooth in the oral cavity in a normally functioning state represents a successful situation for the patient and might not elicit further treatment suggestions from the treating dentists. Moreover, insurance companies and dental public health bodies consider survival (presence or absence) of the tooth following treatment<sup>(10, 18, 25, 27, 29)</sup>; whether as procedure code in administrative databases, or asymptomatic presence of the tooth in the mouth<sup>(28)</sup> a goal to be achieved.

The calculated survival rate was 94% in the present study, where only 8 teeth were extracted due to fracture or prosthetic reason, coinciding with previous reports<sup>(7, 31)</sup>. This finding, though not an optimal measure for healing, it allows the tooth to be retained and is satisfactory to the patient as described by previous authors<sup>(5, 10, 11)</sup>. We would like to highlight that the clinics were suspended from March 2020 to July 2020 during the COVID-19 early phases of surge. This could have impacted the behavior of patients attending their follow up visits, and the dentists only performing the emergency procedures; which might have affected or underestimated the current findings.

The present study is the 1st in DHA endodontic clinics that sought to answer questions frequently asked by the patients around the proceedings and consequences of a suggested treatment plan. While patients' concerns are mainly related to pain, number of visits, and survival; clinicians always refer to radiographs to check out the condition of the periapical tissues as a sign of treatment efficiency.

With this regard and within the limitations of the present study, clinicians should be confident to undertake root canal retreatment in single visit in asymptomatic cases with defective root canal fillings and absent apical periodontitis; and inform patients that a high success rate and healing with an average survival of 18 months can be expected.

## CONCLUSION

It can be concluded that asymptomatic endodontically treated teeth will remain asymptomatic with weak possibility of flare up after single visit retreatment. Furthermore, 94% will be retained and functioning with high healing rate for at least a year and half.

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