

# Single visit root canal treatment: A prospective study

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## Abstract

**Objectives:** The aim was to determine the success rate of single visit root canal treatment (RCT) and thus encourage clinicians to offer this treatment option appropriately.

**Materials and Methods:** This was a longitudinal clinical study involving all teeth of the secondary dentition except third molars in the upper and lower jaws. Teeth having irreversible pulpitis, pulp necrosis or periapical periodontitis were included in the study. RCT and obturation was done at a single visit. The patients were monitored over 6 months.

**Results:** Forty-five teeth were treated in 21 females and 24 males, aged 18-56 years (34.4+/-12.7). Preoperatively, pain was present in 84.4%, tenderness to percussion in 53.3%, and periapical radiolucency in 24.4% teeth. Forty percent had irreversible pulpitis and 60% had apical periodontitis. Post-operatively, pain reduced to 51.1% on day 1, 15.5% at 1 week, and 0% for the rest of the period. Tenderness to percussion reduced to 15.6% at 1 week and 0% by 1 month. Periapical radiolucency reduced to 9.5% at 6 months. Favorable outcome of 33.3% was recorded on day 1 and increased to 90.5% at 6 months. Six months success rate for teeth which had irreversible pulpitis was 100% and 83.3% for apical periodontitis. The mean time needed to complete a single visit RCT ranged from 77 min for a tooth having one canal to 132 min for one having four canals.

**Conclusion:** Single visit RCT is a viable treatment option for teeth having irreversible pulpitis or apical periodontitis irrespective of tooth type or number of canals.

**Clinical Significance:** A lot of patients are lost to follow-up visits for teeth requiring RCT once the pulp is extirpated at the first visit due to cessation of pain, subsequently leading to treatment failure. Single visit endodontics eliminates the need for follow-up visits and improves treatment prognosis.

**Key words:** Pain, periapical radiolucency, single-visit endodontics, tenderness

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## Introduction

The tooth is a vital component of the oral cavity and within it lays the pulp tissue, which is sterile. Pulpal diseases have been associated with bacterial contamination and the effects of their toxins.<sup>[1]</sup> Bacterial contamination could be via a break in the tooth structure due to dental caries, trauma, toothwear, and iatrogenic causes or from the periodontium via accessory and lateral root canals.<sup>[2-4]</sup> Pulpal and periapical lesions are classified on clinical basis as reversible pulpitis, irreversible pulpitis, pulp necrosis, periradicular periodontitis, and periradicular abscess.<sup>[5]</sup>

Root canal treatment (RCT) is a standard component of dental therapy and is performed on most teeth with success rates ranging from 30 to 98%.<sup>[6-9]</sup> Studies have shown that most clinicians complete their RCT in multiple visits.<sup>[10-12]</sup> However, in the last few decades over 70% of schools in all geographic areas and various researchers have been reported to advocate for single visit RCT.<sup>[5,13-18]</sup>

In a developing country like Nigeria, there is increasing dental awareness with more people desiring to keep their

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teeth. This has resulted in an increasing patient load, but an inadequate number of dentists skilled in endodontics to treat them. Most RCT are carried out in the restorative dentistry department of dental schools and a few private hospitals and patients have to travel long distances to access them.<sup>[2]</sup> The appointment dates for treatment are often far from date of first presentation and as a result patients are lost to treatment once the pain ceases. In addition, inter-visit dressings are sometimes lost with resultant recontamination of canals. These result in reduced patient acceptance of treatment and dissatisfaction, as many man hours are lost.

The essence of this prospective clinical study is to find out the success rate of single visit RCT in this environment and hence encourage clinicians to render this treatment option to patients when it is indicated.

## Materials and Methods

This is a longitudinal study of patients requiring RCT who attended the Restorative Dentistry Clinics of the Lagos University Teaching Hospital (LUTH) in Lagos State, southwest Nigeria. Ethical clearance was obtained from the Research and Ethics committee of the hospital. Mandibular and maxillary teeth except third molars were treated in 45 consecutive adult patients of 18 years and above who fulfilled the inclusion criteria. Patients were admitted into the study if the offending tooth was a permanent one with closed apex, had irreversible pulpitis, pulp necrosis, traumatic pulpal exposure or periapical periodontitis (with none or radiolucency not more than 1 mm), had a favorable root morphology (no excessive curvature), and is restorable after RCT. A tooth was excluded if it had been previously root treated, required surgical endodontic treatment or had periodontal pathology such as furcation involvement. A tooth was also excluded if it was associated with dentoalveolar abscess or swelling or if the patient had compromising medical conditions such as diabetes mellitus. Informed and written consent was granted by patients prior to treatment.

Proper history (medical and dental), examination, investigations (periapical radiograph and pulp testing using 1,1,1,2-tetrafluoroethane), diagnosis, and treatment planning preceded treatment in all patients. Carious teeth were restored appropriately and occlusal adjustment carried out. Local anesthesia was administered appropriately and timing of the procedure commenced using a stopwatch. Rubber dam was placed to isolate the tooth. Access cavity was made using a high speed drill and removal of the pulp chamber roof done at slow speed. Coronal pulp was removed, the canals located, and then pulp and necrotic tissue extirpated from the canals. Canals were cleaned to at least a size 25 file at the estimated working length obtained from the diagnostic periapical radiograph before the radiographic determination of the corrected working

length.<sup>[19]</sup> The coronal two-third of the root canal or up to the point of initial curvature was then prepared employing the crown down technique using Gates Glidden drills on a slow speed handpiece and the apical one-third of the root canal was prepared employing the stepback technique using hand-held stainless steel and/or nickel titanium k-files. Files were precurved as appropriate before insertion into a canal. Copious irrigation was carried out in between drills and files using 0.5% sodium hypochlorite solution alternating with normal saline solution. Circumferential filing was done all around the walls of the root canal and a rasping motion used to smoothen the canal walls, thus achieving a smooth tapering canal joining the coronal two-third and apical one-third of the canal.

The canals were dried with paper points on completion of the cleaning and shaping. The cold lateral compaction technique was employed for obturation using gutta percha cones and AH26 root canal sealer. The master cone radiograph was taken prior to obturation to confirm that it was at the correct working length. Excess gutta percha was cut off using heated excavator and the coronal canal orifice sealed with compatible dental cement before restoring the tooth back to function with amalgam, glass ionomer, or composite and where indicated patients returned at another visit for a crown or post-retained crown.

Teeth having preoperative marked tenderness to percussion were relieved from occlusion. Patients were then booked for review appointments of 1 day, 1 week, 1 month, 3 months, and 6 months. No systemic medications were given, but patients were instructed to take mild analgesics (1,000 mg acetaminophen) in the event of any unbearable pain. However, a telephone number was given to patients to call at any time in the event of any complaints.

At the post-obturation review appointments, patients were assessed and data collected. Patients were reviewed for pain, swelling, mobility, tenderness to percussion, and periapical radiolucency. Pain assessment was done using the universal pain assessment tool; Faces scale.<sup>[20]</sup> Pain was recorded as no pain, mild, moderate, severe, or worse possible pain as appropriate. Swelling was recorded as absent, present, persisting (same size), decreasing, or increasing. Tooth mobility was assessed using the Miller's index<sup>[21]</sup> and recorded as Grade 1 (up to 1 mm of movement in a horizontal direction), Grade 2 (>1 mm of movement in a horizontal direction), or Grade 3 (excessive horizontal movement or vertical movement). Tenderness to percussion was assessed as being absent or present. A ruler was used for linear measurement of any periapical radiolucency.<sup>[22]</sup> Periapical radiolucency was recorded as absent, present, persisting (same size), decreasing, or increasing. The same criteria were used to record the preoperative status of each tooth before commencing treatment.

The assessment of overall outcome of treatment was done after obtaining the above data using the criteria for success as outlined by the European Society of Endodontology 2006.<sup>[23]</sup> The outcome was recorded as favorable, uncertain, or unfavorable. The outcome was adjudged favorable when postoperatively there was absence of pain, swelling, and other symptoms, no sinus tract, no loss of function, and radiological evidence of a normal periodontal ligament around the root. The outcome was uncertain if radiographs reveal that a lesion had remained the same size or had only diminished in size. An unfavorable outcome occurred when the tooth was associated with signs and symptoms of infection or a radiologically visible lesion had appeared subsequent to treatment or a preexisting lesion had increased in size or signs of continuing root resorption were present.

The sample size of 45 teeth was derived using the formula for sample size calculation by Araoye 2004.<sup>[24]</sup> The calculations were carried out at a confidence level of 95% and estimated error of  $\alpha = 0.05$ , and  $P$  value of 90% that is derived from the success rate recorded by Londhe and Garge 2007.<sup>[25]</sup> A sample size of 41.8 was calculated and this was adjusted upward to 45 subjects to take care of patient attrition from the study. Chi-square test was performed on the results at alpha level of 0.05.

## Results

A total of 45 teeth; nine anterior, 22 premolars, and 14 molars, were treated and reviewed over a 6 months period. The study involved 45 patients; 21 females and 24 males whose ages ranged from 18 to 56 years ( $34.4 \pm 12.7$  years). Preoperative pain was associated with 38 (84.4%) teeth, there were no associated mobility or swelling. Twenty-four (53.3%) teeth were tender to percussion and periapical radiolucency was seen in 11 (24.4%). Irreversible pulpitis (including pulp necrosis) was diagnosed in 18 teeth, while 27 (60%) had apical periodontitis [Table 1].

Patients reported for reviews 1 day, 1 week, 1 month, 3 months, and 6 months postoperative. Postoperative pain incidence of 51.1% which consisted of mild and moderate pain was recorded at day 1. The incidence decreased to 15.5% at 1 week and by 1 month through to 6 months there was 0% pain incidence. The postoperative periapical radiolucency incidence remained the same as the preoperative incidence of 24.4% from day 1 through to 1 month when it reduced to 22.7% and reduced further to 14.3% at 3 months. The total incidence of radiolucency reduced to 9.5% (four teeth) at 6 months and of these, three teeth had reducing radiolucency while one tooth had increasing radiolucency. Tenderness to percussion was recorded in 24 (53.3%) teeth on postoperative day 1. This reduced to 15.6% at 1 week, at 1 month incidence reduced to 0%, and remained so

**Table 1: Preoperative signs of study patients**

	Anteriors	Premolars	Molars	Total
<b>Pain</b>				
None	4	2	1	7 (15.6)
Mild	1	3	0	4 (8.9)
Moderate	3	12	6	21 (46.7)
Severe	0	5	7	12 (26.7)
Worst possible	1	0	0	1 (2.2)
<b>Tenderness to percussion</b>				
Absent	8	9	4	21 (46.7)
Present	1	13	10	24 (53.3)
<b>Periapical radiolucency</b>				
Absent	7	16	11	34 (75.6)
Present	2	6	3	11 (24.4)
<b>Diagnosis</b>				
Irreversible pulpitis + necrosis	7	7	4	18 (40.0)
Apical periodontitis	2	15	10	27 (60.0)
<b>Total</b>	<b>9</b>	<b>22</b>	<b>14</b>	<b>45 (100)</b>

The numbers in brackets refer to percentage of the total number of subjects

through to 6 months. Postoperative swelling and mobility incidence of 0% was recorded throughout the study period [Table 2]. One patient and then two patients were lost to review at 1 and 3 months review periods, respectively, these brought the number of subjects to 42 at the end of the study [Table 2].

The overall postoperative outcome showed a favorable outcome of 33.3% on day 1. The favorable outcome increased with time to 90.5% over the 6 months review period. The mean time taken to complete the RCT, in minutes, was 77, 96, 119, and 132 for teeth having one, two, three, and four canals, respectively [Table 3].

## Discussion

RCT has become a standard component of dental therapy today and can be performed on any tooth. It has become a highly predictable and successful phase of dental practice.

There are no universally accepted criteria for assessing the success of RCT. Various criteria have been put forward. The criteria for successful outcome of single visit RCT have been limited in most studies. Postoperative pain and postoperative flare-up rate being the measure used for success or failure of treatment.<sup>[12,24-30]</sup> True evaluation of success will require a total assessment of clinical and radiographic outcomes of the treatment. In this study, outcome was evaluated on the basis of assessment of clinical and radiographic outcomes, using the criteria for success by the European Society of Endodontology, 2006.<sup>[23]</sup> While most other studies had a short review period of less than 3 months, with a few having a review period of more than 3 months, the present study reviewed the patients for 6 months.

**Table 2: Postoperative signs over 6 months review period**

	Baseline (N=45)	Day 1 (N=45)	1 week (N=45)	1 month (N=44)	3 months (N=42)	6 months (N=42)
<b>Pain</b>						
None	7 (15.6)	22 (48.9)	38 (84.4)	44 (100)	42 (100)	42 (100)
Mild	4 (8.9)	15 (33.3)	6 (13.3)	0	0	0
Moderate	21 (46.7)	8 (17.8)	1 (2.2)	0	0	0
Severe	12 (26.7)	0	0	0	0	0
Worst possible	1 (2.2)	0	0	0	0	0
<b>Tenderness to percussion</b>						
Absent	21 (46.7)	21 (46.7)	38 (84.4)	44 (100)	42 (100)	42 (100)
Present	24 (53.3)	24 (53.3)	7 (15.6)	0	0	0
<b>Periapical radiolucency</b>						
Absent	34 (75.6)	34 (75.6)	34 (75.6)	34 (77.3)	36 (85.7)	38 (90.5)
Present	11 (24.4)	0	0	0	0	0
Persisting	0	11 (24.4)	11 (24.4)	4 (9.1)	2 (4.8)	0
Reducing	0	0	0	6 (13.6)	4 (9.5)	3 (7.1)
Increasing	0	0	0	0	0	1 (2.4)
<b>Total</b>	<b>45 (100)</b>	<b>45 (100)</b>	<b>45 (100)</b>	<b>44 (100)</b>	<b>42 (100)</b>	<b>42 (100)</b>

The numbers in brackets refer to percentage of the total number of subjects

**Table 3: Overall outcome of single visit treatment over 6 months review period**

Review period	Favorable	Uncertain	Unfavorable	Total
Day 1	15 (33.3)	30	0	45 (100)
1 week	29 (64.4)	16	0	45 (100)
1 month	34 (77.3)	10	0	44 (100)
3 months	36 (85.7)	6	0	42 (100)
6 months	38 (90.5)	3	1	42 (100)
<b>At 6 months review:</b>				
N=42				
<b>Tooth type</b>				
$(\chi^2=1.978, P=0.740)$				
Anteriors	9 (100)	0	0	9 (100)
Premolars	18 (85.7)	2	1	21 (100)
Molars	11 (91.7)	1	0	12 (100)
<b>Number of canals</b>				
$(\chi^2=3.439, P=0.752)$				
	13 (100)	0	0	13 (100)
	14 (82.3)	2	1	17 (100)
	9 (90.0)	1	0	10 (100)
	2 (100)	0	0	2 (100)
<b>Diagnosis</b>				
$(\chi^2=3.316, P=0.191)$				
Irreversible pulpitis	18 (100)	0	0	18 (100)
Apical periodontitis	20 (83.3)	3	1	24 (100)

The numbers in brackets refer to percentage of the total number in each category

Pain evaluation is the commonest clinical evaluation done in the assessment of success of single visit root canal therapy. In this study, on the first postoperative review day, most of the patients experienced a marked reduction of their preoperative pain level after the single visit RCT carried out

on them. The incidence of postoperative pain experience was 51.1% (23 teeth), which comprised of mild and moderate pain and none had severe pain. This result was similar to 54.2% gotten by Oginni and Udoe, 2004 at 1 day postoperative review, however, the slight difference could be as a result of the different pain rating scale (verbal pain rating scale) used by them.<sup>[18]</sup> El Mubarak and coauthors, 2010 using a visual analogue scale of 1-4 arrived at a 1 day postoperative severe pain incidence of 9.4% in contrast to the 0% postoperative severe pain incidence arrived at in this study.<sup>[12]</sup> The incidence of significant pain (moderate to severe pain) of 17.8%, is higher than 10–15.6% obtained by other studies.<sup>[26,27,31]</sup> This difference could be attributed to the more comprehensiveness of universal pain assessment scale used for evaluation in this study rather than the verbal pain rating scales used in these other studies. Also, these earlier studies had no clearly defined inclusion and exclusion criteria or detailed discussion on the kind of debridement procedure used for their studies.<sup>[26,27,31]</sup> Hence, the results from this study cannot be effectively compared to the results from their studies.

One week postoperative pain review in this study showed a decrease in the incidence of pain to 15.5% of which only 2.2% had moderate pain. This is higher than the incidence in the study by Ufomata, 1986 of 5% (using a verbal pain rating scale based on patients need for analgesics postoperatively)<sup>[14]</sup> and that by Al-Negrish and Hababeh 2006 of 3.7% (using a verbal pain rating scale).<sup>[32]</sup> It was, however, lower than that found by Odika, 1987 of 23.3%,<sup>[28]</sup> but similar to that recorded by Oginni and Udoe, 2004 of 16.3%.<sup>[18]</sup> The results of those studies were different from that noted in the present study possibly due to the differences in pain scales used, inclusion and exclusion criteria, and instrumentation techniques used.

All the patients reported pain free at 1 month review up to the end of the 6 months review period. This was comparable to the 0% obtained in some studies at 1 month review.<sup>[15,18]</sup> However, some studies have recorded pain persisting to the 6-month review period.<sup>[25,28]</sup> This could be as a result of differences in pain rating scales used, inclusion and exclusion criteria, or kind of debridement procedures used for their studies.

Only one study has been documented in this environment to evaluate the incidence of tenderness to percussion postoperatively in patients treated by the single visit RCT technique.<sup>[28]</sup> The incidence of tenderness to percussion noted in the present study, at 1 day postoperative review (53.3%) was comparable to the 57.5% incidence obtained in that study at same review period. However, the results in the present study (15.6, 0, and 0%) were lower than that study's results of 37.5, 10, and 7.5% tenderness to percussion at 1 week, 1 month, and 6 months reviews, respectively. The difference could be as a result of differences in inclusion criteria and preoperative diagnosis dispersion of teeth in the studies.

Swelling and mobility were absent in all the teeth included in this study preoperatively. None of the teeth developed any postoperative swelling or mobility throughout the period of review. This is in contrast to the incidences arrived at in the study by Odika, 1987 of 2.5% incidence of swelling at both 1 week and 6 month review and 2.5% incidence of mobility at 1 week review.<sup>[28]</sup> The 0% mobility in this study at 1 and 6 months are same as those by that study at same review periods. The differences noted could be as a result of differences in inclusion criteria, preoperative diagnosis dispersion of teeth in the studies, and canal debridement methods.

Changes in the incidence of periapical radiolucency in this study were observed to have begun at the 1 month postoperative review and reduced gradually till the 6 month review. It reduced from 22.7% in the 1<sup>st</sup> month to 9.5% at 6 month review. In the course of this study none of the teeth without periapical radiolucency preoperatively developed any postoperatively. Only the study by Odika, 1987 was found in this environment to have evaluated periapical radiolucency.<sup>[28]</sup> The results of periapical radiolucency review obtained in this study could not be compared effectively with that study, as a result of the differences in the methods used in measuring periapical radiolucency.

Putting all the clinical and radiographic posttreatment review outcomes together and utilizing the criteria for success as outlined by the European Society of Endodontology, 2006 success rates of 33.3, 64.4, 77.3, 85.7, and 90.5% were arrived at 1<sup>st</sup> day, 1 week, 1 month, 3 months, and at 6 months postoperative reviews, respectively.<sup>[23]</sup> This showed a continuous increase in success rate with time over the 6 months postoperative review period. The teeth classified as

uncertain (7.1%), though not having any clinical symptoms, had periapical radiolucencies which were still reducing. The tooth with unfavorable outcome (2.4%) in this study, though not having any clinical symptoms, had slightly increased periapical radiolucency.

It was observed in this study that, teeth with single canal showed the least tendency for postoperative pain followed by teeth with two canals and then three canals. Teeth with four canals had the highest tendency to develop postoperative pain. Anterior teeth had the highest success rate at 6 months review of 100%, while that of premolars and molars were 85.7 and 91.7%, respectively. The success rate for premolars was lower than that of molars, this may be due to the difference in number of each tooth type included in this study (more premolars than molars) or unpredictability of canal anatomy which is more common in premolars.<sup>[33]</sup> Also, single canals being larger in size, in locations easier to access and clean compared to those with multiple canals have better outcome. Hence, single visit RCT can be carried out on all tooth type; but the success tends to be best with anterior teeth with single canal. This study showed a similar success rate trend in relation to tooth type with the study by Field and coauthors with success rates of 97.9, 86.2, and 87.3% for anterior teeth, premolars, and molar teeth, respectively.<sup>[29]</sup> However, comparison could not be made with their overall success rate of 89.2% or the success rate of 65% by Molander and coauthors, as a result of the different criteria for assessing outcome.<sup>[22]</sup>

The success rate (favorable outcome) in this study for teeth with preoperative diagnosis of irreversible pulpitis was found to be 100%, while those with apical periodontitis had a success rate of 83.3%. This showed a better treatment outcome for teeth having pulpitis without apical periodontitis, although this was not statistically significant. In the present study, no statistical significance was found between the outcome of treatment after review with age or sex or preoperative symptoms. Therefore, from this study single visit RCT can be said to be a viable option for patients, irrespective of age, sex, or preoperative symptoms (pain, tenderness to percussion, and periapical radiolucency).

Single visit RCT is a viable option in single- as well as multi-rooted teeth. The time taken to complete a single visit RCT in this study ranged from 77 min for tooth with a single canal to 132 min for tooth with four canals. The time taken to treat a tooth with four root canals is, thus, not four times the time taken to treat a tooth with a single canal. This is because there are several aspects of the treatment which are common to the canals such as giving of local anesthesia, placement of rubber dam, access cavity creation, removal of pulp tissue in the pulp chamber, and placement of final coronal restoration. Moreover, multi-visit RCT involves repetition of several clinical steps at each visit; this repetition is eliminated by single visit RCT. This study further buttresses

the belief that single visit RCT will not only help to save the patient's and doctor's time; but would also save cost, improve patient compliance, and improve practice management.

## Conclusion

Single visit RCT is a viable treatment option for teeth having irreversible pulpitis or apical periodontitis and in single or multi-rooted teeth, irrespective of age, sex, or preoperative symptoms such as pain, tenderness to percussion, or periapical radiolucency.

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