

Survey of endodontic practice among dentists in Lagos, Nigeria.

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Abstract

Objective: To determine the knowledge and practice of dental surgeons in Lagos State on technical aspects of endodontic treatment.

Methods: This cross-sectional study of dentists in Lagos State utilised a structured self-administered questionnaire with 61 item questions to obtain information on socio-demographic characteristics; general approach to endodontic treatment; and technical aspects such as cleaning, shaping and obturation of root canals. **Results:** The commonest mode of isolation was cotton wool rolls (73%) while none of the respondents used an apex locator in working length determination. Seventy-seven percent use sodium hypochlorite as the irrigant of choice while gates-glidden bur was the most common (84%) rotary instrument used. The participants that were less than 25 years and those aged between 35-44 years as well as Consultants/Principal dental officers had the best practice in endodontics. Likewise, those that had practiced for 16-20years had better practices in endodontics. **Conclusions:** Majority of the respondents had poor knowledge scores while 41.16% had poor practices. There is a need for continuous professional development in the aspect of Endodontics among dentists in Nigeria. Access to funds and appropriate technologies which are cost effective will also encourage Nigerian dentists to embrace modern and up to date technologies in their endodontic practice.

Endodontics is the branch of Dentistry concerned with the morphology, physiology and pathology of the dental pulp and the peri-radicular tissues. Extensive caries, periodontal infection or trauma, allows bacterial toxins and waste products to enter the root canal system, which eventually results in pulpal death and peri-radicular infection¹. Since the root canal system is isolated from the body's immunological system, the necrotic pulpal tissue provides a nidus of infection and irritation to the peri-radicular tissues. The objective of root canal treatment is to remove the pulpal tissue and to create sufficient space for irrigation, medication and subsequently root filling. It is also essential to preserve the integrity of the pulp chamber and root canal, avoid iatrogenic damage to the root structure and supporting tissues, facilitate root filling, and preserve sound root dentin so as to maintain the long-term function of the tooth².

Endodontics is an exacting discipline, and the procedure is one of the most technically demanding in general dental practice³. It requires careful planning and timely execution of restorative treatment. The success rates of root canal treatment, which can be assessed by complete resolution of periapical pathology, varies from 31-100%⁴. There is a body of evidence demonstrating, in most populations, a high frequency of technically defective root fillings, a high prevalence of periapical radiolucency in root filled teeth, and a strong correlation between the two^{5,6}. Factors such as the type and severity of periapical pathology, the kind and location of the affected root canal⁷, the method used in assessing the status of the affected root canal⁸, and the

expertise of the operator⁹ all potentially impact the success or failure of endodontic treatment.

Since the outcome of endodontic treatment is associated with operator factors such as the dentists' knowledge, attitudes, skills¹⁰ and their attitude to the procedural aspects of the endodontic treatment, it is imperative that the perception of operators on this dynamic discipline is assessed. Most studies in Nigeria and other developing countries have investigated the attitude of dental practitioners on some aspects of endodontic treatment but very few studies have explored their perception on all aspects of endodontic practice¹³⁻¹⁵. The aim of this study was thus to determine the knowledge and practice of dental surgeons in Lagos State on the technical aspects of endodontic treatment.

Materials and methods

This cross-sectional self-administered questionnaire-based study was conducted among dentists in Lagos, Nigeria. This comprised of dentists working at the Lagos University Teaching Hospital, Surulere and the Lagos State University Teaching Hospital, Ikeja from February through May 2015.

Study Setting and location

Lagos University Teaching Hospital, Surulere (LUTH) is one of the foremost tertiary referral centres in Nigeria with over 760 bed spaces. The Lagos State University Teaching Hospital, (LASUTH), Ikeja, Lagos, Nigeria, is also a tertiary health facility situated in the capital of Lagos State. It is a multi-specialist hospital with a bed complement of 741.

Sampling Method

A simple random sampling technique using the balloting method was used to determine the study participants using the nominal roll of doctors in each clinic as the sampling frame. Selected participants were screened for eligibility by set inclusion and exclusion criteria and those that met this criteria and were willing to give their informed consent were included in the study.

Sample size

The sample size was calculated using a formula for cross sectional studies: $N = Zpq/d^2$. Using the prevalence of 89% for practice from a reference study,¹⁶ a sample size of 77 was determined. One hundred and twenty questionnaires were distributed during the study period and 100 of them were returned appropriately filled. The questionnaires were distributed by hand to the selected participants in the clinic on each day and they were collected by the investigator on the same day after checking if they were appropriately filled.

Inclusion and exclusion criteria

Dental Surgeons that were registered with the Medical and Dental Council of Nigeria who were practicing in Lagos State were included in the study. Those who were unwilling to give their consent were excluded from the study. A verbal informed consent was obtained from all the participants after explaining the nature of the study to them.

Data collection

A structured self-administered questionnaire was used for data collection. The participants were asked to answer 61 item close-ended questions, which were subdivided into 3 main parts. socio-demographic information; general approach to endodontic treatment; and cleaning, shaping and obturation of root canals. The first part sought for information regarding the age and gender of the respondents as well as number of years in practice, employment status and the weekly number of working hours.

The second part obtained information on general aspects of endodontic treatment such as undergraduate endodontic training, attendance of update courses, choice of antibiotics, and frequency of endodontic procedures, the overall predictability of endodontic treatment and the expected retention rate. The third part asked specific information on the technical aspects such as the mode of sterilisation, use of radiographic techniques, methods of isolation, techniques of root canal preparation, methods of determination of the working length, preference of root canal irrigants, root canal obturation techniques, choice of sealant, temporary filling material used, and choice of final restoration.

The right responses were assigned a score of 1 while wrong responses were given a score of 0. The respondents were categorized as having either 'good' or 'poor' knowledge about endodontic treatment based on their responses to the 34 knowledge and 21 practice questions. Obtaining a score <17 was classified as 'poor' while ≥ 17 as 'good' in the knowledge category while practice scores of <11 was classified as 'poor'; and ≥ 11 was classified as 'good'.

Data analysis

Data was entered into the Microsoft Excel software and analyzed using SPSS (Statistical package for social sciences) for Windows (version 20, Chicago, IL). Frequency distribution tables were generated for all variables and measures of central tendency and dispersion were computed for numerical variables. Since the data were normally distributed, descriptive statistics including means, standard deviations, and percentages were used to summarize the demographic variables. The Chi square test was used to determine the level of association between variables. A 95% confidence interval and a 5% level of significance was adopted.

Results

Socio-demographic characteristics

Table I, describes the socio-demographic distribution of study participants. Descriptive analysis showed that majority (62%) of respondents were between 25-34 years of age and had practiced for between 0-5 years (49%). Slightly over a quarter of the participants (26%) work for more than

Table I: Demographic and professional characteristics of participants

Variable	Frequency	Percentage ^a
Age group (Years)	< 25	2.0
	25-34	62.0
	35-44	31.0
	45-54	4.0
	≥ 55	1.0
Marital status	Single	48.0
	Married	52.0
Professional experience (Years)	0-5	49.0
	6-10	29.0
	11-15	16.0
	16-20	4.0
	>20	2.0
Practice hours per week	<10	15.0
	10-20	15.0
	21-30	9.0
	31-40	26.0
	≥ 41	35.0
Perform endodontic treatment as undergraduate	Yes	76.0
	No	24.0
How adequate the undergraduate Endodontic curriculum is	Inadequate	37.0
	Slightly adequate	29.0
	Adequate	34.0
Practice on extracted teeth for endodontic before treating patients	Yes	65.0
	No	35.0
Frequency of root canal treatment	Once	21.0
	Twice	41.0
	Thrice	27.0
	Four times	11.0

Table II. Response details on antibiotic use and success of endodontic treatment

Variable	n (%)
Conditions which respondent will prescribe antibiotics (Multiple answer)	Acute pulpitis
	19(19.0)
	Acute apical abscess
	81(81.0)
	Chronic apical abscess with sinus tract
	69(69.0)
	Chronic apical periodontitis
	38(38.0)
	After all root canal treatment
	28(28.0)
	In patient with fever and malaise
	30(30.0)
	In patient with diffused swelling
When respondents will prescribe antibiotics prophylactically (Multiple answer)	70(70.0)
	In patient with swelling and difficulty in swallowing
	64(64.0)
	In two visit root canal treatment
	17(17.0)
	In retreatment
	10(10.0)
	If patient insist
	1(1.0)
	In prolonged root canal treatment
The expected retention rate of teeth 5-10 years after endodontic treatment	10(10.0)
	Always before every root canal treatment
	20(20.0)
	Only before endodontic surgery
	26(26.0)
	HIV+ patients
	37(37.0)
	HBS+ patients
	21(21.0)
	Non-controlled diabetic patients
If relapse occur, when to expect it to occur frequently	64(64.0)
	Congenital Heart disease
	70(70.0)
	Mitral valves prolapse
	48(48.0)
	Prosthetic joint in past 2 years
	43(43.0)
	History of cancer and radiotherapy
	28(28.0)
	More than 90%
Placing coronal coverage after completion of endodontic treatment in premolar and molar for long term tooth retention	19(19.0)
	70%-80%
	55(55.0)
	less than 60%
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	26(26.0)
	Within 3 years after
	76(76.0)
	4-6 years after
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	19(19.0)
	>6 years after
	5(5.0)
	Not important
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	4(4.0)
	Somewhat important
	6(6.0)
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	Very important
	90(90.0)
	Yes
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	57(57.0)
	No
	18(18.0)
Perspective of endodontic treatment as predictable procedure with long -term tooth retention rate	No opinion
	25(25.0)

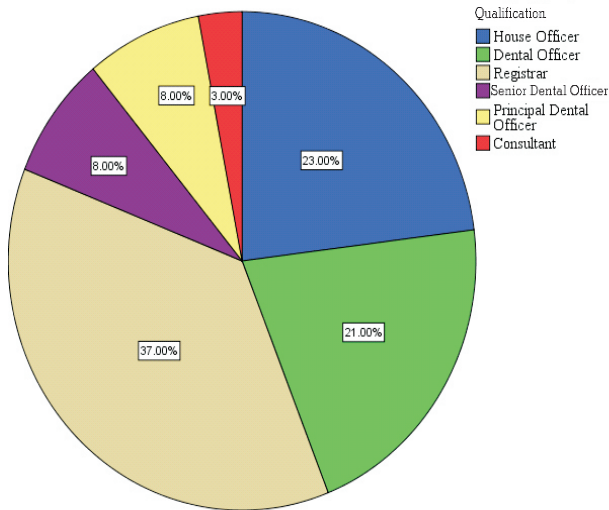


Fig. 1, Professional Status of the respondents.

41 hours in a week and over a third (41 %) did two endodontic treatments weekly. Majority (76%) performed RCT as undergraduate students but felt that their undergraduate endodontic curriculum was inadequate. Slightly over a third (37%) of the respondents were Registrars while Consultants were the least in the sample (3%). (Fig. 1)

Continuous dental education

Fig. 2 shows the time interval between the last endodontic update attended by respondents at the time of administering the questionnaire. Most of the respondents had not gone for

Table III: Responses on diagnosis and root canal preparation

Variable	Frequency (%)
mode of sterilization	
Boiling	4(4.0)
Dry heating	5(5.0)
Autoclave	95(95.0)
Glass bead sterilizer	3(3.0)
Mode of protective wear used	
Apron	38(38.0)
Face mask	91(91.0)
Head cap	12(12.0)
Protective eye wear	66(66.0)
Means of diagnosis	
Mirror	43(43.0)
Digital radiography	55(55.0)
IOPA - Xray	52(52.0)
Pulp tester	32(32.0)
Mode if isolation	
Cotton rolls	73(73.0)
Rubber dam	35(35.0)
Suction	50(50.0)
Others	4(4.0)
Working length determination	
Arbitrary	22(22.0)
Radiograph	61(61.0)
Metallic scale/ Endogauge	37(37.0)
Apex locator	0(0)
Working length	
1 st tug back/Tactile stop	35(35.0)
0 mm from radiographic apex	12(12.0)
0.5-1mm from radiographic apex	67(67.0)
Hand file used	
Stainless steel	32(32.0)
K-file	80(80.0)
Hand Protaper	4(4.0)
H File	6(6.0)
Rotary system, used	
Gate-Glidden drills	84(84.0)
Protaper hero	19(19.0)
Others	1(1.0)
Biomechanical preparation technique	
Crown down	37(37.0)
Hybrid step back	66(66.0)
Circumferential ultrasonic	3(3.0)
Others	4(4.0)
Retrieval of fracture instruments	
Ultrasonic	16(16.0)
By-pass the instrument	29(29.0)
Apical surgery	50(50.0)
Retrograde Obturation	16(16.0)

any update in over 2 years while only 21% had participated in any endodontic update in the last three months.

Prophylaxis and expected rate of success for RCT.

Of the participants, 81% indicated that they would prescribe antibiotics for an acute apical abscess while 70% stated that they would prophylactically give antibiotics in patients with congenital heart disease. Only 19% expected retention rate of 90% after 5-10 years following endodontic treatment, while 76% expected a relapse in endodontic treatment to occur within 3 years. Majority (90%) were of the opinion that coronal coverage after completion of endodontic treatment in premolars and molars was very important for

Table IV. Responses on canal irritants, medicaments, obturation and tooth restoration

Irrigant	Normal saline	68(68.0)
	Water	1(1.0)
	Hydrogen peroxide	18(18.0)
	Sodium hypochlorite	77(77.0)
	Chlohexidine	9(9.0)
Intracanal medication	Formocresol	30(30.0)
	Corticosteroid paste	10(10.0)
	Calcium hydroxide paste	89(89.0)
	Others	6(6.0)
Sealer	Eugenol based sealant	39(39.0)
	Calcium hydroxide based sealant	35(35.0)
	Resin based sealant	41(41.0)
Obtuturating material	Sealer paste	9(9.0)
	Gutta Percha	91(91.0)
	Silver cone	6(6.0)
	Resilon	2(2.0)
	Protaper	4(4.0)
Obtuturing technique	Single cone technique	15(15.0)
	Vertical condensation	16(16.0)
	Lateral condensation	77(77.0)
Temporary filling material	Zinc oxide eugenol	84(84.0)
	Cavit	16(16.0)
	IRM	15(15.0)
Post-obturation restorative material	Composite	64(64.0)
	Amalgam	76(76.0)
	Miracle mix	2(2.0)
Crown Placemnt after RCT	Always	28(28.0)
	Sometime	53(53.0)
	Commonly	17(17.0)
	Never	3(3.0)
Post and core used	Customized cast post	14(14.0)
	Bonded fiber post	19(19.0)
	Metallic screw post	63(63.0)
	Others	13(13.0)
Reason for endodontic referral	Retrieval of silver point	6(6.0)
	Surgical intervention	44(44.0)
	Post retrieval	34(34.0)
	Curved root canal	24(24.0)
	Large apical lesion	23(23.0)
	Calcified canal	28(28.0)

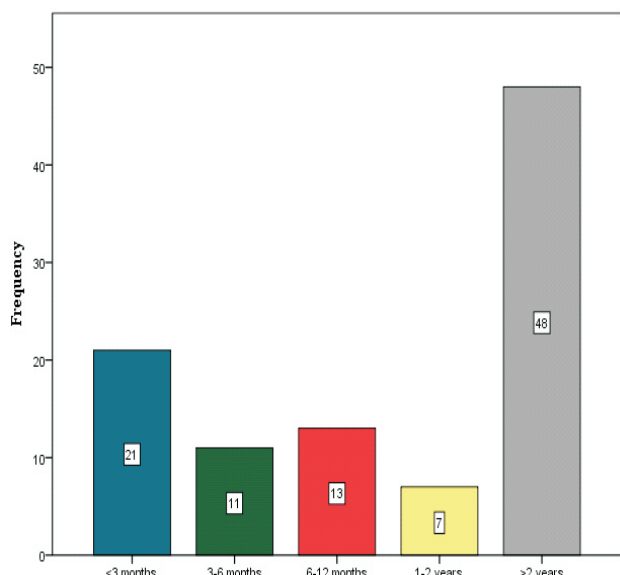


Fig. 2, Duration since the last endodontic update was attended by the participants.

Table V. Relationship between respondents knowledge of endodontics and socio-demographic variables

	Knowledge of treatment outcome and antibiotics use		Total n=100(%)	Statistic
	Poor n=32(%)	Good n=68(%)		
Age group (Years)				
< 25	0(0.0)	2(2.0)	2(2.0)	$\chi^2=5.235$ df=4 P-value = 0.264
25-34	18(18.0)	44(44.0)	62(62.0)	
35-44	11(11.0)	20(20.0)	31(31.0)	
45-54	1(1.0)	3(3.0)	4(4.0)	
≥55	0(0.0)	1(1.0)	1(1.0)	
Marital status				
Single	12(12.0)	36(36.0)	48(48.0)	$\chi^2=2.079$ df=1 P-value = 0.149
Married	20(20.0)	32(32.0)	52(52.0)	
Qualification				
House officer	4(4.0)	19(19.0)	23(23.0)	$\chi^2=9.284$ df=5 P-value = 0.098
Dental officer	10(10.0)	11(11.0)	21(21.0)	
Registrar	12(12.0)	25(25.0)	37(37.0)	
Senior dental officer	6(6.0)	2(2.0)	8(8.0)	
Principal dental officer	3(3.0)	5(5.0)	8(8.0)	
Consultants	1(1.0)	2(2.0)	3(3.0)	
Professional experience (Years)				
0-5	11(11.0)	38(38.0)	49(49.0)	$\chi^2=8.076$ df=4 P-value = 0.089
6-10	12(12.0)	17(17.0)	29(29.0)	
11-15	5(5.0)	11(11.0)	16(16.0)	
16-20	2(2.0)	2(2.0)	4(4.0)	
>20	0(0.0)	2(2.0)	2(2.0)	
Practice hours per week				
<10	8(8.0)	7(7.0)	15(15.0)	$\chi^2=4.796$ df=4 P-value = 0.309
10-20	3(3.0)	12(12.0)	15(15.0)	
21-30	2(2.0)	7(7.0)	9(9.0)	
31-40	9(9.0)	17(17.0)	26(26.0)	
≥41	10(10.0)	25(25.0)	35(35.0)	

long-term tooth retention, more than half (57%) believes that endodontic treatment was a predictable procedure with a long-term tooth retention rate (Table II).

Sterilisation and working length determination.

Autoclaving (95.0%) was the commonest mode of sterilisation among the respondents while 91.0% use facemask as a type of protective wear. Radiographic evaluation (61.0%) was the most frequently used method for working length determination followed by the use of a metallic scale (37.0%), while none of the respondents use an apex locator. The working length was taken 0.5mm from the radiographic apex by 67% of the study participants while the gates-glidden bur was the most common rotary instrument

Table VI. Association between the practice of the respondents and their socio-demographic variables

	Practice		Total n=100(%)	Statistic
	Poor n=51(%)	Good n=49(%)		
Age group (Years)				
< 25	2(4.1)	0(0.0)	2(2.0)	$\chi^2=4.284$ df=4 P-value = 0.369
25-34	35(35.0)	27(27.0)	62(62.0)	
35-44	14(14.0)	17(17.0)	31(31.0)	
45-54	2(2.0)	2(2.0)	4(4.0)	
≥55	0(0.0)	1(1.0)	1(1.0)	
Marital status				
Single	23(23.0)	25(25.0)	48(48.0)	$\chi^2=3.451$ df=1 P-value = 0.553
Married	28(28.0)	24(24.0)	52(52.0)	
Qualification				
House officer	10(10.0)	13(13.0)	23(23.0)	$\chi^2=9.739$ df=5 P-value = 0.083
Dental officer	15(15.0)	6(6.0)	21(21.0)	
Registrar	18(18.0)	19(19.0)	37(37.0)	
Senior dental officer	2(2.0)	6(6.0)	8(8.0)	
Principal dental officer	3(3.0)	5(5.0)	8(8.0)	
Consultants	0(0.0)	3(3.0)	3(3.0)	
Professional experience (Years)				
0-5	27(27.0)	22(22.0)	49(49.0)	$\chi^2=4.584$ df=4 P-value = 0.333
6-10	12(12.0)	17(17.0)	29(29.0)	
11-15	9(9.0)	7(7.0)	16(16.0)	
16-20	1(1.0)	3(3.0)	4(4.0)	
>20	0(0.0)	2(2.0)	2(2.0)	
Practice hours per week				
<10	7(7.0)	8(8.0)	15(15.0)	$\chi^2=9.483$ df=4 P-value = 0.050
10-20	16(16.0)	9(9.0)	25(25.0)	
21-30	6(6.0)	3(3.0)	9(9.0)	
31-40	19(19.0)	7(7.0)	26(26.0)	
≥41	23(23.0)	12(12.0)	35(35.0)	

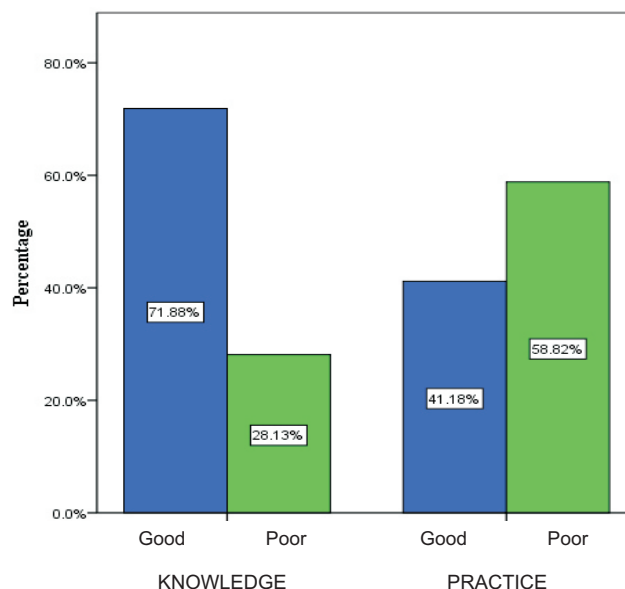


Figure 3: Distribution of knowledge and practice scores among the respondents.

used. Cotton wool rolls was the mode of isolation used by most participants (73%) (Table III).

RCT procedure and tooth restoration.

Sodium hypochlorite was the irrigant of choice for majority (77%) of the study participants while calcium hydroxide paste was the commonest (89%) intra-canal medicament. Obturation of root canals using gutta-percha (91%) and eugenol based sealant (39%) with lateral condensation (77%) was the method preferred by most of the dentists. For the temporary restoration, Zinc Oxide eugenol was the most commonly (84%) used material while amalgam (76%) was the most frequently used material for the final restoration. Only 28% of the respondents always place a crown after the root canal treatment (Table IV).

Knowledge and practice scores.

Most of the respondents had poor knowledge scores while 41.18% had poor practice scores. Those aged below 25 years and between 45-54 years had the best knowledge of endodontic treatment (Fig.3) Similarly, Consultants, Registrars and Dental Officers had better knowledge than other categories of Dental Surgeons while those that had practiced for 0-5 years and those that worked for 10-20 hours in a week had better knowledge than other categories (Table V).

The participants that were aged between 35-44 years and Consultants/Principal dental officers also had the best practice scores. Similarly, those that had practiced for 16-20 years/above 20 years and those that work less than 10 hours a week had better practice scores (Table VI) There was a

Table VII. Test of association between the knowledge and practice of the respondents

	Knowledge		Total n=100(%)	Statistic
	Poor n=32(%)	Good n=68(%)		
Practice				$\chi^2=8.206$ df=1 P-value = 0.004
Poor	23(71.9)	28(41.2)	51(51.0)	
Good	9(28.1)	40(58.8)	49(49.0)	

statistically significant association between poor knowledge and poor practice scores among the study participants ($p < 0.005$), Table VII.

Discussion

The goal of root canal treatment is to preserve the tooth as a functional unit within a functioning dentition. This is achieved through chemo-mechanical cleaning, debridement, and shaping of the root canals, obturation of the root canal system, followed by placement of a leak-resistant coronal restoration. Endodontics is one of the most technically challenging clinical procedures. The survey indicates that most of the respondents adhered to traditional methods of endodontics rather than evidenced based guidelines or recent advances. Most of the participants in the present study viewed their undergraduate endodontic curriculum as inadequate even though most of them performed root canal treatment and also practiced on models while in school. This perception was possibly reflected in the pattern of antibiotic prescription by the respondents where a significant number indicated that they will give antibiotics for some conditions where it was clearly not indicated. Majority of the respondents in the present study however agreed that the probable retention rate of teeth 5-10 years after endodontic treatment was high. This may reflect contemporary opinions that endodontic management provides excellent service to patients by preserving the natural dentition for prolonged periods of time. This is also well supported by evidence documented in the literature revealing a high retention rate of teeth after initial endodontic treatment irrespective of the etiology, specific treatment technique, tooth group, or special patient characteristics^{17,18}.

Most of the participants also viewed endodontic treatment as a predictable procedure with long-term tooth retention rate and agreed that coronal coverage is a necessity following completion of endodontic treatment in premolars and molars for long term tooth retention. This is in line with the findings of Salehrabi and Rotstein¹⁷ who found that most teeth extracted after initial endodontic treatment had no full coronal coverage. Likewise, Aquilino et al.¹⁹ found that endodontically treated teeth without full coronal coverage were lost at a rate six times greater than fully covered teeth. In addition, Vire²⁰ reported that about 60% of extractions of endodontically treated teeth occurred due to either restorative or prosthetic failure and coronal fractures. Therefore, the quality of both the root canal treatment and the coronal restoration plays an important role in long-term endodontic treatment outcomes^{21,22}.

There was an acceptable level of compliance with proper sterilisation techniques by most of the respondents, while only 35% use rubber dam during endodontic treatment. Even though this percentage was higher than 18% reported in a previous Nigerian study¹⁶, it still falls short of internationally accepted guidelines. The routine use of rubber dam is ideally recommended for all nonsurgical endodontic procedures. However, despite being considered an essential part of the endodontic curriculum in undergraduate dental schools, the routine use of rubber dam in general dental practice is far

from widespread²³. The main reasons cited for not using rubber dam by dental practitioners include cost, difficulty of use and patient discomfort²³. The prevalence of rubber dam use routinely by dentists was reported to be 20%, 59% and 57% in United Kingdom²⁴, United States²⁵ and New Zealand²⁶ respectively.

Accurate determination of root canal length is crucial to achieve successful root canal treatment²⁷. In the present study, over sixty percent of the respondents relied on radiographs to determine the working length for the root canal which was taken 0.5-1mm from the radiographic apex. However, none of the respondent use the apex locator for this purpose while 22% of the participants determine the working length arbitrarily. Udoye et al.¹³ had similarly observed that 70% of their respondents use radiographs to determine working length. Radiographic methods to determine working length have shortcomings and often can be inaccurate. A working length that is erroneously established beyond the apical constriction may lead to overfilling. In contrast, determining working length short of the constriction may lead to inadequate debridement and/or disinfection of the root canal system, resulting in delayed healing or failure²⁸.

The Gates glidden bur which is a traditional rotary instrument for the preparation of the coronal two-third of the canal was the most frequent form of rotary system used by the respondents. There was a low response to recent advances in rotary systems by the survey participants with less than 20% of them using the Pro-taper hero or other forms of rotary systems. This was in contrast to a survey of Australian dentists, by Parashos et al.³³, who found that while hand instrumentation was still the most popular method of preparing root canals, the majority of endodontists (64%) and an increasing number of general practitioners were using rotary NiTi instruments. Although the clinical outcome studies on nickel-titanium instruments are still sparse, the available clinical trials indicate that the use of rotary systems will lead to a reduced incidence of errors and possibly to improved clinical outcomes³⁴. There is a need to increase both the acceptance of rotary instruments and the training of Nigerian dentists on its use. In this study, the step back technique was also the commonest method used by the respondents to prepare the root canal. Pre-enlarging the coronal region of the canal prior to completing apical preparation however has several advantages, including straighter access to the apical region, enhanced tactile control, as well as improved irrigant penetration and suspension of debris. Studies have shown that crown-down technique produce fewer canal blockages, less apically extruded debris, and a reduced incidence of apical transportation when compared to step-back techniques^{35,36}. More than seventy percent of participants in this study use sodium hypochlorite (NaOCl) as the irrigant while calcium hydroxide paste was the commonest intra-canal medicament which is in agreement with previous studies^{13,15}. The wide acceptance of sodium hypochlorite for endodontic irrigation is due principally to its anti-microbial and tissue dissolving capabilities, as well as the low cost and ready availability of this material. The use of calcium hydroxide as an intracanal

medicament between visits has been shown to enhance disinfection following use of NaOCl. This synergism has beneficial effects for the chemo-mechanical preparation of the canal system. Most of the previously used materials are no longer recommended as intracanal medicaments because they have powerful tissue toxicity, combined with allergenicity and mutagenicity.

Cold lateral condensation of gutta-percha was the most popular technique for obturation by the participants. This technique is widely used and still considered by some clinicians and researchers as the gold standard, despite the criticism that it does not produce a homogenous filling, leaving gaps and voids¹⁵. It is however a relatively simple and versatile technique that does not require expensive equipment. Previous studies had reported that the type of coronal restoration affects the success of endodontic treatment³⁹⁻⁴¹. On the contrary, other studies⁴²⁻⁴³ reported that the type of restoration had no significant influence on periapical healing after adjusting the results by preoperative periapical lesion. In this study, only 28% of the respondents claim to place a crown after the root canal treatment. Endodontically treated teeth fracture more often than vital teeth. Aquilino and Caplan¹⁹ reported that endodontically treated teeth with crowns had a survival rate six times greater than that of teeth without crowns. In view of these, there is a need to encourage dentists to adequately evaluate teeth that are grossly broken down and possibly crown them soon after endodontic treatment.

Majority of the respondents had poor knowledge while 41.16% had poor practice in endodontic treatment. The respondents aged below 25 years and between 35-44 years had better knowledge of endodontic treatment than other participants, while Consultants and Registrars had better knowledge than other categories of Dental Surgeons. Participants that had practiced for 0-5 years and those that worked for 10-20 hours in a week similarly had better knowledge than other categories of respondents. Registrars undergoing residency training possibly had better knowledge due to the regular continuing medical education associated with the training while years of experience and the need to update didactic teaching materials could also have been responsible for the better knowledge scores obtained by the Dental Consultants.

Similarly, participants that were aged between 35-44 years and Consultants/Principal Dental Officers had the best practice in endodontics. Likewise, those that had practiced for 16-20 years/above 20 years and those that work less than 10 hours a week had better practice in endodontics. This was possibly based on experience from years of dental practice. This was in contrast to previous studies^{3,23} where older dentists were observed to adhere to obsolete techniques and the use of outdated medicaments and devices in their endodontic practice. Association between the knowledge of the respondents and their clinical practice in endodontics also showed that respondents that had poor knowledge were also observed to have poor practice which was statistically significant.

Conclusion

In conclusion, the results of the study showed that most of the respondents adhered to traditional methods of endodontics rather than evidenced based guidelines or recent advances. They had an acceptable level of compliance with proper sterilisation techniques but low use of rubber dam and apex locator during endodontic treatment. Sodium hypochlorite was the commonest irrigant used, while amalgam, a near obsolete restorative material was used mainly as the definitive restorative material. There is a need for continuous professional development in endodontics among dentists in Nigeria on Evidence-based guidelines. Access to funds and appropriate technologies which are cost effective will also encourage Nigerian dentists to embrace modern and up to date technologies in their endodontic practice.

Conflict of interest/competing interest

The authors declare that there is no conflict of interest with the products mentioned in the manuscript.

References

1. Tzimpoulas NE, Alisafis MG, Tzanetakakis GN, Kontakiotis EG. A prospective study of the extraction and retention incidence of endodontically treated teeth with uncertain prognosis after endodontic referral. *J Endod* 2012;38:1326-1329.
2. Peters OA, Schonenberger K, Laib A. Effects of four Ni-ti preparation techniques on root canal geometry assessed by micro computed tomography. *Int Endod J* 2001;34:221-230.
3. Jenkins SM, Hayes SJ, Dummer PMH. A study of endodontic treatment carried out in dental practice within the UK. *Int Endod J* 2001;34, 16-22.
4. Ng Y-L, Mann V, Rahbaran S, Lewsey J and Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature—part 1. Effects of study characteristics on probability of success. *Int Endod J* 2007;40:921-939.
5. Dugas NN, Lawrence HP, Teplitsky PE, Pharoah MJ, Friedman S. Periapical health and treatment quality assessment of root-filled teeth in two Canadian populations. *Int Endod J* 2003;36:181-92.
6. Eriksen HM, Kirkevang LL, Petersson K. Endodontic epidemiology and treatment outcome: general considerations. *Endod Topics* 2002;2:1-9.
7. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. *Int Endod J* 1995;28:12-18.
8. Figini L, Lodi G, Gorni F, Gagliani M. Single versus multiple visits for endodontic treatment of permanent teeth: A cochrane systematic review. *J Endod* 2008;34:1041-047.
9. Alley BS, Kitchens GG, Alley LW, Eleazer PD. A comparison of survival of teeth following endodontic treatment performed by general dentists or by specialists. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004;98:115-118.
10. Anitha Rao SP, Jagadeesh Babu P, Apoorva K.

- Knowledge Regarding Technical Aspects of Endodontic Treatment. *IJAR* 2013;3(8):55-59.
11. Jenkins SM, Hayes SJ, Dummer PM. A study of endodontic treatment carried out in dental practice within the UK. *Int Endod J* 2001;34:16-22.
 12. Slaus G, Bottengerg P. A survey of endodontic practice amongst Flemish dentists. *Int Endod J* 2002;35:759-767.
 13. Udoeye CI, Sede MA, Jafarzadeh H, Abbott PV. A Survey of Endodontic Practices among Dentists in Nigeria. *J Contemp Dent Pract* 2013;14(2):293-298.
 14. Akpata ES. "Endodontic treatment in Nigeria," *Int Endod J* 1984;17(3):139-151.
 15. Al-Omari WM. "Survey of attitudes, materials and methods employed in endodontic treatment by general dental practitioners in North Jordan," *BMC Oral Health* 2004;4:1.
 16. Udoeye CI, Jafarzadeh H. Rubber dam use among a subpopulation of Nigerian dentists. *J Oral Sci*, 2010;52(2):245-249.
 17. Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: An epidemiologic study. *J Endod* 2004;30:846-850.
 18. Dugas NN, Lawrence HP, Teplitsky PE, Pharoah MJ, Friedman S. Periapical health and treatment quality assessment of root-filled teeth in two Canadian populations. *Int Endod J* 2003;36:181-192.
 19. Aquilino SA, Caplan DJ. Relationship between crown placement and the survival of endodontically treated teeth. *J Prosthet Dent* 2002;87:256-263.
 20. Vire DE. Failure of endodontically treated teeth: Classification and evaluation. *J Endod* 1991;17:338-342.
 21. Tronstad L, Asbjornsen L, Doving L, Pedersen I, Eriksen HM. Influence of coronal restorations on the periapical health of endodontically treated teeth. *Endod Dent Traumatol* 2000;16:218-221.
 22. Hommez GMG, Coppens CRM, De Moor RJG. Periapical health related to the quality of coronal restorations and root fillings. *Int Endod J* 2002;35:680-689.
 23. Whitworth JM, Secombe GV, Shoker K, Steele JG. Use of rubber dam and irrigant selection in UK general dental practice. *Int Endod J* 2000;33:435-441.
 24. European Society of Endodontology. Quality guidelines for endodontic treatment. *Int Endod J* 2006;39:921-930.
 25. Whitten BH, Gardiner DL, Jeanson BG, Lemon RR. Current trends in endodontic treatment: Report of a national survey. *J Am Dent Assoc* 1996;127:1333-1341.
 26. Koshy S, Chandler NP. Use of rubber dam and its association with other endodontic procedures in New Zealand. *NZ Dent J*. 2002;98:12-16.
 27. Leonard JE, Gutmann JL, Guo IY. Apical and coronal seal of roots obturated with a dentine bonding agent and resin. *Int Endod J*. 1996;29:76-83.
 28. Ingle JI, Bakland LK. *Endodontics*. 4th ed. Baltimore, Md: Williams and Wilkins; 1994:191-227.
 29. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature Part2. Influence of clinical factors. *Int Endod J*. 2008;41(1):6-31.
 30. Kojima K, Inamoto K, Nagamatsu K, Hara A, Nakata K, Morita I, Nakagaki H, Nakamura H. Success rate of endodontic treatment of teeth with vital and nonvital pulps. A meta-analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2004;97(1):95-99.
 31. Kazzi D, Horner K, Qualtrough AC, Martinez-Beneyto Y, Rushton VE. A comparative study of three periapical radiographic techniques for endodontic working length estimation. *Int Endod J* 2007;40(7):526-531.
 32. ElAyouti A, Weiger R, Lost C. The ability of root ZX apex locator to reduce the frequency of overestimated radiographic working length. *J Endod* 2002;28(2):116-119.
 33. Parashos P, Messer HH. The diffusion of innovation in dentistry: a review using rotary nickel-titanium technology as an example. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:395-401.
 34. Peters OA, Paque F. Current developments in rotary root canal instrument technology and clinical use: a review. *Quintessence Int* 2010;41:479-488.
 35. Weine FS, Kelly RF, Lio PJ. The effect of preparation procedures on original canal shape and on apical foramen shape. *J Endod* 1975;1:255-262.
 36. al-Omari MA, Dummer PM. Canal blockage and debris extrusion with eight preparation techniques. *J Endod* 1995;21:154-158.
 37. Naenni N, Thoma K, Zehnder M. Soft tissue dissolution capacity of currently used and potential endodontic irrigants. *J Endod* 2004;30:785-787.
 38. Baumgartner JC, Mader CL. A scanning electron microscopic evaluation of four root canal irrigation regimens. *J Endod* 1987;13:147-157.
 39. Cheung GS, Chan TK. Long-term survival of primary root canal treatment carried out in a dental teaching hospital. *Int Endod J* 2003;36:117-28.
 40. Fouad AF, Burleson J. The effect of diabetes mellitus on endodontic treatment outcome: data from an electronic patient record. *J Am Med Assoc* 2003;134:43-51.
 41. Farzaneh M, Abitbol S, Friedman S. Treatment outcome in endodontics: the Toronto study. Phases I and II: orthograde retreatment. *J Endod* 2004;30:627-33.
 42. Chugal NM, Clive JM, Spangberg LS. Endodontic treatment outcome: effect of the permanent restoration. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:576-82.
 43. Friedman S, Mor C. The success of endodontic therapy. Healing and functionality. *J Calif Dent Assoc* 2004;32:493-503.