

## Endodontic trends by South African Dental Association members: An online survey

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### Abstract

**Aim:** The aim of the study is to determine the techniques and materials used by South African dental practitioners who perform endodontic treatment in private practice and evaluate their compliance to the 2006 European Society of Endodontology (ESE) quality guidelines.

**Materials and Methods:** An online survey was distributed to all dentists registered with the South African Dental Association ( $n = 3191$ ) and prosthodontists registered with the Academy of Prosthodontics ( $n = 61$ ), practicing in South Africa. Fourteen subject areas related to endodontic materials and techniques were assessed. Responses were evaluated using simple descriptive and analytical statistics.

**Results:** The overall response rate was 7% ( $n = 215/3252$ ; specialist prosthodontists 18% and general dentists 6%). Sixty-three percent of respondents ( $n = 122/193$ ) did not routinely use rubber dam. The use of rubber dam and magnification was positively correlated with postgraduate endodontic qualifications ( $P < 0.05$ ). Antibiotic prescription for irreversible pulpitis without systemic involvement was reported in an average of 31% of cases. Formaldehyde-containing sealers were used by 5% ( $n = 9/193$ ). The majority of respondents (89%,  $n = 171/191$ ) used sodium hypochlorite as a primary irrigant. Cold obturation techniques (82%,  $n = 159/193$ ) were preferred over warm techniques (18%,  $n = 34/193$ ), with the single-cone technique the most popular (58%,  $n = 112/193$ ). Almost half preferred steroid-containing medicaments (48%,  $n = 92/193$ ).

**Conclusion:** Surveyed practitioners largely complied with the 2006 ESE guidelines. Notable exceptions including low rubber dam use, inappropriate antibiotic prescription, and the continued use of formaldehyde-containing medicaments and sealers were reported. Improved compliance to established guidelines may be achieved through the use of these results when planning educational activities.


**Keywords:** Endodontics, guidelines, materials, survey, techniques

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### INTRODUCTION

The objectives of endodontic treatment, namely mechanical removal of infected and inflamed tissue, chemical disinfection of the canal system, and obturation

the empty space, are well known and remain unchanged.<sup>[1]</sup> In modern practice, a plethora of materials and techniques are available to assist the clinician in achieving these objectives.

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In 2006, the European Society of Endodontology (ESE) published guidelines for endodontic treatment which outline the standard of care for clinical endodontics according to scientific evidence and continue to represent current good practice.<sup>[2]</sup> It has been reported that dentists from different countries do not necessarily follow these guidelines.<sup>[3,4]</sup> The American Association of Endodontists has also published a guide to clinical endodontics; however, this guide is not well detailed with regard to techniques and materials used in nonsurgical therapy.<sup>[5]</sup> Due to advances in endodontic technology and equipment in recent decades,<sup>[6]</sup> there may be differences in the way dentists approach endodontic treatment.

Endodontics as a dental specialty does not exist in South Africa;<sup>[7]</sup> therefore, all endodontic treatment is performed by both general dental practitioners (GDPs) and specialist prosthodontists (SPs).

The current techniques and materials used by GDPs and SPs to perform endodontic treatment are unknown. Specific South African endodontic treatment guidelines could not be found. The only investigation which previously reported on endodontic trends in South Africa was conducted by Naidoo in 2006.<sup>[8]</sup> It was found that South African dentists generally conformed to the 1994 ESE guidelines; however, these have now been superseded.<sup>[2]</sup>

This study aimed to determine the endodontic techniques and materials used by GDPs and SPs in South Africa. The objectives were to determine:

- Common trends utilized by South African GDPs and SPs
- Extent of adherence to the 2006 ESE guidelines.

## MATERIALS AND METHODS

A survey was designed using an online platform (Qualtrics), and a link was electronically mailed to 3191 South African GDPs registered with the South African Dental Association (SADA). Sixty-one members of the Academy of Prosthodontics of South Africa (APSA) were contacted to allow for the inclusion of SPs. The survey consisted of multiple-choice and multiple-response questions, allowing for quantitative assessment the following topics:

- Demographics (gender, age, province, qualifying university, and years of experience)
- Practice type
- Instrumentation
- Irrigants
- Medicaments
- Obturation methods (including sealers)

- Pharmacological prescription
- Rubber dam/isolation
- Working length determination
- Magnification
- Cone-beam computed tomography (CBCT) use
- Single-visit endodontics
- Endodontic retreatment and surgery
- Financial reward and enjoyment of endodontics.

Only practitioners performing endodontic treatment in private practice were included in this study. Public sector practitioners and career academics were excluded from the study. This was due to the fact that not all South African public sector practitioners have access to endodontic facilities and career academics are required to adhere strictly to established treatment guidelines at all times.

Descriptive statistical analysis was conducted on collected data. Responses were expressed as percentages of the total number of responses. The Statistical Package for the Social Sciences version 22 (IBM Corp., Armonk, NY, USA) was used for data analysis. The Chi-square test was used to determine the association between categorical variables, and the significance value was set at 0.05.

This cross-sectional observational study was approved by the Research Ethics Committee of the Faculty of Health Sciences, University of Pretoria (Protocol number 331/2018).

## RESULTS

The survey was sent to 3191 SADA members and 61 APSA members (combined total,  $n = 3252$ ). By the closing date, 215 responses were received with an overall response rate of 7% ( $n = 215/3252$ ). The response rate of SPs was 18% ( $n = 11/61$ ). Twenty-one respondents (10%,  $n = 21/215$ ) indicated that they did not perform endodontic treatment in private practice and were excluded from the analysis. One was disqualified due to invalid responses in multiple questions. The remaining 193 respondents (90% of total respondents) were included and evaluated.

### Demographics and practice type

Respondents included 182 GDPs (94.3%,  $n = 182/193$ ) and 11 SPs (5.7%,  $n = 11/193$ ). Of these, 46.1% ( $n = 89/193$ ) were male and 53.9% ( $n = 104/193$ ) were female. Years in practice and date of qualification were broadly distributed. A mean of 10.8 years of private practice experience was reported by respondents.

Responses were received from all nine South African provinces. All local dental schools were represented.

Two respondents (1.0%,  $n = 2/193$ ) completed their undergraduate training abroad. SPs from the Universities of Pretoria, Stellenbosch, Western Cape, and Witwatersrand responded.

Respondents holding postgraduate qualifications in endodontics (including postgraduate diploma and/or MSc) numbered 33 (17.1%,  $n = 33/193$ ). Table 1 summarizes practice type as it relates to postgraduate education in endodontics.

### Instrumentation

The majority of respondents (91%,  $n = 176/193$ ) used a combination of both endodontic hand files and engine-driven instruments while 5% ( $n = 9/193$ ) used only hand files and another 5% ( $n = 9/193$ ) reported to use only engine-driven instruments. Of those who used engine-driven systems (rotary or reciprocating files), 24% ( $n = 44/184$ ) preferred reciprocating instruments and 76% ( $n = 140/184$ ) used rotary instruments. The majority (82%,  $n = 150/184$ ) of those who reused engine-driven files reported preparing an average of 7.3 canals before discarding these instruments. A glide path was prepared by nearly all respondents (97%,  $n = 188/193$ ) while 2% ( $n = 3/193$ ) did not prepare a glide path and 1% ( $n = 2/193$ ) did not know what a glide path was.

### Irrigants

A wide variety of primary irrigating solutions were used by respondents. The bulk of respondents (89%,  $n = 171/191$ ) reported using sodium hypochlorite (NaOCl). Irrigants primarily used by respondents are summarized in Table 2.

The most common concentrations of NaOCl used were 1% and 3% solutions used by 45% ( $n = 83/184$ ) and 40% ( $n = 73/184$ ) of respondents, respectively. "Full-strength" concentrations (approximately 6% NaOCl) were used by 11% ( $n = 20/184$ ) of respondents while the remainder were unsure of the concentration they were using.

Ethylenediaminetetraacetic acid solutions were routinely used by 62% ( $n = 120/193$ ) to remove the smear layer. Viscous chelators were routinely used by 86% ( $n = 166/193$ ) during instrumentation.

Chlorhexidine (CHX) was used by 38% ( $n = 73/191$ ) of respondents as a secondary irrigant. Two more respondents used CHX as a primary irrigant (1.0%,  $n = 2/193$ ) [Table 2]. Nearly, one quarter of respondents (23.3%,  $n = 45/193$ ) used saline or ethanol as a rinse before or after using other irrigating solutions.

### Medicaments

Many different intracanal medicaments were reportedly used by respondents. Most respondents showed a preference for either steroid-containing medicaments or calcium hydroxide. Responses are displayed in Table 3.

### Obturation methods

Both cold (82%,  $n = 159/193$ ) and warm obturation techniques (18%,  $n = 34/193$ ) were reported to be used by respondents. The most popular methods were the single-cone technique (58%,  $n = 112/193$ ) and cold lateral condensation (23%,  $n = 44/193$ ). The most popular warm technique used was warm vertical condensation (10%,  $n = 19/193$ ), followed by carrier-based obturation (6%,  $n = 11/193$ ). The remainder used continuous wave condensation (2%,  $n = 4/193$ ) and paste filler only (2%,  $n = 3/193$ ). A variety of different sealers, as listed in Table 4, were used.

### Pharmacological prescription

The most common analgesic prescribed (48%,  $n = 93/193$ ) was a combination of paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), and an opioid. Approximately one-third (32%,  $n = 62/193$ ) prescribed a combination of paracetamol and NSAIDs while 16% ( $n = 30/193$ ) prescribed only NSAIDs. The remainder prescribed a combination of paracetamol and an opioid (2%,  $n = 4/193$ ), paracetamol alone (2%,  $n = 3/193$ ), or opioids alone (1%,  $n = 1/193$ ).

**Table 1: Practice types and postgraduate endodontic training**

Category	Respondents (%)	Respondents with postgraduate training (%)
General dental practice	172 (89.1)	22 (12.7)
Specialist prosthodontist practice	11 (5.7)	5 (45.5)
General dental practice focused on endodontics	10 (5.2)	6 (60.0)
Total	193 (100)	33 (17.1)

**Table 2: Irrigants primarily used by respondents**

Irrigant of choice	Respondents (%)
NaOCl	171 (89.1)
Local anesthetic solution	6 (3.1)
EDTA	7 (3.7)
Chlorhexidine	2 (1.0)

NaOCl: Sodium hypochlorite, EDTA: Ethylenediaminetetraacetic acid

**Table 3: Intracanal medicaments**

Medicament	Respondents (%)
Steroid-containing medicaments	92 (47.7)
Calcium hydroxide	68 (35.2)
Cresophene	13 (6.7)
Iodine-potassium iodide or other iodine-containing medicaments	4 (2.1)
No medicament	5 (2.6)
Total	193 (100)

Respondents indicated prescribing antibiotics to patients diagnosed with irreversible pulpitis, with no signs of systemic involvement, in an average of 31% of cases. Table 5 summarizes the antibiotics which were reportedly most frequently prescribed to both nonpenicillin-allergic and penicillin-allergic patients.

### Rubber dam/isolation

A rubber dam was routinely used by only 37% ( $n = 71/193$ ) of respondents. A significant number of those who reported routine use of rubber dam had postgraduate qualifications as compared to those who did not have additional qualifications ( $P < 0.05$ ). Of those who did not use rubber dam, the following reasons were provided:

- Patients do not like it (27%,  $n = 33/122$ )
- Belief that adequate isolation without rubber dam is achievable (27%,  $n = 33/122$ )
- Inadequate training and experience (15%,  $n = 18/122$ )
- Placement takes too long (12%,  $n = 15/122$ )
- Fees are too low to justify its use (12%,  $n = 14/122$ )
- Not available at practice (5%,  $n = 6/122$ ).

### Working length determination

A combination of radiographs and apex locators was used to determine the working length of a root canal by 58% of respondents ( $n = 112/193$ ). A combination of tactile sensation and radiographs was used by 22% ( $n = 42/193$ ) while 16% ( $n = 31/193$ ) used only radiographs and 4% ( $n = 8/193$ ) only an apex locator.

### Magnification

Approximately two-thirds (61%,  $n = 118/193$ ) reported using no magnification when performing endodontic treatment. Of those who used magnification, 22% ( $n = 42/193$ ) reported using magnifying loupes with a

light source, 11% ( $n = 22/193$ ) used loupes without a light source, and 6% ( $n = 11/193$ ) used operating microscopes. A significant number of those with postgraduate qualifications in endodontics used magnification devices compared to those who did not have any postgraduate qualifications ( $P < 0.05$ ).

### Cone-beam computed tomography use

CBCT was reportedly used for the completion of an average of 4% of endodontic cases.

### Single-visit endodontics

The respondents completed endodontics in one visit (start to finish) in an average of 19% of cases.

### Endodontic retreatment and surgery

More than two-thirds (68%,  $n = 131/193$ ) performed endodontic retreatments and only 12% ( $n = 24/193$ ) performed their own endodontic surgery, such as apicectomies. The majority of respondents (72%,  $n = 139/193$ ) believed that a retrograde fill should always be performed during apical surgery.

### Financial aspects and enjoyment of endodontics

The majority of respondents found endodontic treatment to be financially rewarding (62%,  $n = 120/193$ ) while 77% ( $n = 148/193$ ) reported to enjoy performing endodontic treatment.

## DISCUSSION

The overall response rate of this survey was considered to be low; however, the response rate was similar to that of previous South African surveys which assessed similar sized target groups.<sup>[9-11]</sup> Although the response rate of SPs appeared to be much higher than that of GDPs at 18%, the significantly smaller sample size should be kept in mind. The broad distribution of gender, age, experience, qualifying university, and geographical area of the respondents was a positive finding. Although the distribution of respondents per province was not equal, this distribution was found to resemble that of South African dental practitioners as determined by Bhayat and Chikte.<sup>[7]</sup>

**Table 4: Endodontic sealers used**

Sealer type	Respondents (%)
Resin based	71 (36.8)
Calcium hydroxide	60 (31.1)
Zinc oxide eugenol	30 (15.5)
Bioceramic sealer	9 (4.7)
Medicated sealer	9 (4.7)

**Table 5: Antibiotic agents prescribed**

Nonpenicillin allergic		Penicillin allergic	
Agent	Respondents (%)	Agent	Respondents (%)
Amoxicillin with clavulanic acid	64 (33.2)	Clindamycin	132 (68.4)
Amoxicillin and metronidazole	56 (29.0)	Erythromycin	35 (18.1)
Amoxicillin with clavulanic acid and metronidazole	36 (18.7)	Metronidazole	12 (6.2)
Amoxicillin	27 (14.0)	Erythromycin and metronidazole	4 (2.1)
Clindamycin	8 (4.1)	Clindamycin and metronidazole	3 (1.6)
Erythromycin	1 (0.5)	Azithromycin	2 (1.0)
Azithromycin	1 (0.5)	Other agents	5 (2.6)
Total	193 (100)	Total	193 (100)

South African GDPs and SPs are employed in either the public or private sector; however, most endodontic treatment is rendered in private practices. The majority of public sector clinics offer a limited range of dental services and many do not offer endodontic treatment. The results of this study should therefore be interpreted with caution, as the responses may not necessarily represent the views of all South African dentists, which has been estimated to be as high as 6125.<sup>[7]</sup> It is uncertain how many of the total number of dentists reported by Bhayat and Chikte qualified to participate in our study. South African dentists in the public sector, retirees still registered with the Health Professions Council of South Africa, and those practicing in foreign countries may all be included in this estimated figure.

A general trend toward compliance with the 2006 ESE guidelines was observed.<sup>[2]</sup> Some notable exceptions included the routine use of rubber dam, antibiotic prescription for nonsystemic conditions, and the use of formaldehyde-containing sealers and medicaments.

Less than half the participants in the present study routinely performed endodontic treatment with rubber dam isolation. This number is considerably lower than the 53% of South Africans who reported routine rubber dam use by Naidoo in 2006.<sup>[8]</sup> The use of rubber dam is considered essential to prevent the introduction of additional microbiological contaminants into the canal system. It also serves to protect the patient from aspiration and ingestion of instruments and to prevent leakage of irrigants into the oral cavity.<sup>[2]</sup>

Studies from several countries have demonstrated that not all GDPs use rubber dam during endodontic treatment.<sup>[12-20]</sup> Usage rates, however, varied from the complete absence of routine rubber dam use<sup>[19]</sup> to usage rates high as 76%.<sup>[16]</sup> The results of the present study are comparable to that of previous investigations from other countries.<sup>[14,15,17,18]</sup>

Rubber dam usage has been demonstrated to be more frequent among younger dentists as compared to their older counterparts.<sup>[15,16]</sup> Regardless of the reason for avoiding the use of rubber dam, the threat of adverse incidents and the potential for litigation is ever present.<sup>[21]</sup> Knowledge of the reasons for the avoidance of rubber dam use may assist educators in improving teaching and training<sup>[13]</sup> and allowing them to place further emphasis on the importance of routine use.

The vast majority of respondents reported the use of appropriate antibiotic agents in both penicillin- and nonpenicillin-allergic patients. An unacceptably high rate

of antibiotic prescription for patients diagnosed with pulpitis without signs of systemic involvement was seen. As antibiotic resistance is of growing concern, dentists should be mindful of their role in effective antibiotic stewardship.<sup>[22]</sup>

A small number of respondents reported the routine use of formaldehyde-containing sealers and intracanal medicaments.<sup>[23]</sup> The use of these sealers and medicaments is no longer recommended due to concerns surrounding both their mutagenic potential and decreased biocompatibility.<sup>[24]</sup>

Although almost all the respondents reported using NaOCl as an irrigating solution, some avoided its use completely. Guidelines recommend the use of an irrigant with the ability to disinfect root canals and dissolve organic debris.<sup>[2]</sup> NaOCl is the only recommended irrigant with the ability to dissolve residual pulp tissue.<sup>[25]</sup> Reasons for avoiding NaOCl were not reported; however, the fear of potential NaOCl accidents may be a contributing factor.

A small number of respondents indicated the use of paste fillers as the sole means of obturation of root canals. While this technique is fast and convenient, the ESE guidelines recommend that both a semi-solid material, such as gutta-percha, in combination with a sealer should be used for routine obturation.<sup>[2]</sup> Working length may be difficult to control when paste fillers are used alone or with a lentulo spiral filler, leading to overextrusion of the sealer. Paresthesia in the distribution of the mental nerve has been reported with the use of this technique.<sup>[26]</sup>

The adoption of magnification and the use of CBCT were positive findings. Loupes and operating microscopes are invaluable resources, especially in the presence of unusual canal or pulp chamber anatomy. The increased use of magnification for endodontic treatment should therefore be encouraged.<sup>[27]</sup> Similarly, the use of three-dimensional CBCT scan allows for a better understanding of canal anatomy preoperatively.<sup>[28]</sup> It is expected that the adoption of this imaging modality will become more common place.<sup>[29]</sup>

Single-visit endodontics was performed by less than one-fifth of respondents. It is known that endodontic treatment can be routinely completed in one visit if the root canal system can be made sufficiently free of microorganisms and bacteria. This is often possible in teeth with vital pulps; however, in necrotic cases, multiple visits may still be required for adequate disinfection.<sup>[30]</sup> The decision to perform single-visit endodontics should always be made on an individual basis as appropriate to each case.

Endodontics as an independent specialty does not exist in South Africa.<sup>[7]</sup> It was therefore unsurprising that the majority of GDPs indicated performing endodontic retreatment. Only a small number of GDPs, however, indicated routinely performing endodontic surgery. This may be attributed to the fact that dental implants have become a good alternative to replace a tooth with a poor prognosis. The decision to perform retreatment and endodontic surgery or extract a tooth and replace with an implant may, however, be a complex issue and should be tailored to the individual.<sup>[31]</sup>

The majority of respondents indicated enjoying performing endodontic treatment. This finding is in agreement with the earlier South African study by Naidoo.<sup>[8]</sup> The fact that more than half the respondents indicated considering endodontic treatment to be financially rewarding was a positive finding. It has been previously demonstrated that financial incentives may affect professional behavior. Tickle *et al.* found that dentists more readily extracted teeth if the financial incentives to perform endodontic treatment did not correspond to the time and cost involved with performing such treatment.<sup>[32]</sup>

## CONCLUSION

Within the limitations of this study, it appears that the use of endodontic materials and techniques by the majority of South African GDPs and SPs surveyed is similar and in line with the 2006 guidelines recommended by the ESE. Of concern is the overuse of unnecessary antibiotic therapy and a low overall use of rubber dam. These findings, along with those of Naidoo in 2006, suggest that South African GDPs and SPs tend to conform to the latest available endodontic guidelines. Educators may use the results of this survey when planning, teaching, and training opportunities to address the shortcomings found in clinical practice and to improve education and endodontic training at the undergraduate level.

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## Conflicts of interest

There are no conflicts of interest.

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