

# Endodontic knowledge, attitudes and referral patterns in Australian general dentists

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## ABSTRACT

**Background:** General dental practitioners often perceive root canal treatments as complex, and specialist referrals are commonplace in general dental practice. Therefore, the aim of this study was to better understand the knowledge of Australian general dentists and their attitudes regarding endodontics in general, and specifically (RCT), to highlight barriers and facilitating factors in the provision of endodontic care.

**Methods:** A combined paper-based and online survey was sent to general dental practitioners. The questionnaire consisted of 27 items, presented as checkboxes and in Likert scale format. Responses were tabled and statistically contrasted using Chi-square tests and linear regression analysis.

**Results:** A significant proportion of surveyed dentists were not confident in their ability to provide endodontic care, specifically root canal treatments (RCT). Confidence depended on factors, such as time in practice, participation in continuing professional development as well as fear of litigation and type of treatment. Other factors such as the availability of appropriate instruments and referral options, had comparatively little impact on practitioner confidence.

**Discussion:** While almost all general dental practitioners (GDPs) surveyed in this study believe RCT is important for improving the long-term retention of a tooth, just over half of the GDPs say they feel confident in their knowledge and provision of root canal treatment procedures.

**Keywords:** Confidence, endodontic knowledge, referral patterns.

**Abbreviations and acronyms:** CPD = continuing professional development; GDP = general dental practitioners; MB2 = second mesiobuccal canal.

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## INTRODUCTION

Endodontics is an important component of general dental practice in that it encompasses diagnosis and treatment of often painful diseases associated with the dental pulp and the associated periradicular tissues.<sup>1</sup> Endodontic care includes treatment of inflamed pulps, necrotic and infected pulps, teeth with pulpless and infected root canal systems and root-filled and infected root canal systems.<sup>2</sup> It is aimed towards long-term retention of the natural dentition in a disease-free state, principally by removing and disinfecting areas of contamination in the pulp space.<sup>1</sup> Although general dental practitioners (GDPs) are trained to complete endodontic procedures, including root canal treatment of molars, the provision of these services is often complex and can be frustrating and difficult. Challenges in root canal treatment are more likely if adequate knowledge and skills are lacking, or if the

appropriate instruments and tools are not available, and hence GDP referrals of patients to an endodontist for management are common.<sup>3</sup> Referrals might occur prior to any treatment or following the commencement of treatment. In cases of difficulties with diagnosis, complex root canal anatomy, root resorption, retreatment or apical surgery, referral might occur before any clinical intervention, whereas perioperative procedural mishaps lead to referral after the commencement of treatment.<sup>3–5</sup>

In 2020, 178 specialist endodontists were registered in Australia, while there 24 406 registered GDPs, meaning access to a specialist endodontist for all GDP's was limited, particularly in a rural setting.<sup>6</sup> To further compound this issue, reports show that as the remoteness of one's location increases, their oral health status decreases, meaning patients in a rural setting might present with more advanced and severe dental issues.<sup>7</sup> If the availability of root canal

treatment is reduced, the sole treatment option for a patient might be tooth extraction, which not only impacts a patient's oral health but their general health as well, in both a physiological and psychological manner.<sup>7</sup> To reduce both perceived and real barriers to endodontic care, increasing Australian GDPs knowledge, skills and confidence in the provision of more complex endodontic care, while facilitating access to specialist treatment by an endodontist, are important goals.

The retention of the natural dentition through root canal therapy provided by both GDPs and endodontists is an effective treatment measure, with success rates of up to 98% at 1 year, and 86% at 10 years.<sup>5,8,9</sup> If the patient wishes to retain their natural dentition and root canal treatment is indicated, every effort should be made to prevent loss of dentition and its negative effects on patients' wellbeing.<sup>10</sup>

Therefore, the aim of this study was to better understand the knowledge of Australian general dentists and their attitudes regarding endodontics in general, and specifically (RCT), to highlight barriers and facilitating factors in the provision of endodontic care.

## METHODS AND MATERIALS

Approval for the present study was obtained from the Human Research Ethics Committee of The University of Queensland. The study was carried out in Australia via an online questionnaire posted to Australian online dental forums and peer discussion, and a paper-based version with identical questions handed out in person at local and national meetings via a scannable QR code. Only Australian general dentists registered with the Dental Board of Australia were included in the survey ([Supplemental Material](#)), whilst students and registered dental specialists were excluded.

A search of the relevant literature was carried out as a basis for the study, and the survey questionnaire was structured similarly to those used in previous studies with similar designs.<sup>2-4</sup> Four general dentists pilot tested the questionnaire for ease of use and time spent answering the questions.

A required sample size of 96 was calculated based on 24 406 registered general dentists at the time of this study in Australia, a 95% confidence interval and a 10% margin of error. Descriptive statistics were used for initial analysis (SPSS 28, IBM Australia Ltd, Sydney, NSW, Australia), with prevalence and the univariate associations between a categorical outcome and the variables under examination were evaluated using Pearson's chi-squared test, or if small numbers were included, Fisher's exact test was used. A linear regression model was constructed to further explore

relationships in the data. A cut off of  $P \leq 0.05$  was considered to be statistically significant with a 95% confidence interval.

## RESULTS

A total of 152 responses were obtained from dentists invited to participate in the survey, with 80 identifying as men (52.63%) and 72 women (47.3%). The hybrid delivery of the survey, using digital platforms and interaction in person, resulted in a distribution among the states in eastern Australia. About 50% of respondents were from Queensland, with New South Wales, Victoria and South Australia evenly contributing the other half of the responses. The majority (82%) were from urban and suburban areas with the remainder from rural areas.

Tables 1-3 present summaries of numerical results; the findings indicate that the majority of dentists did provide endodontic care in their practice (94.4%), with 69.1% have also received extra training or continuing professional development (CPD) in endodontics. More than half of the dentists that provide root canal treatment have <5 years of experience (54.4%); only 22.1% of the respondents had >10 years of clinical practice experience.

General dentists' confidence in their knowledge of root canal procedures is shown in Table 2. Of those dentists that provide endodontic care, only a small percentage (14.7%) were very confident in providing this type of care, whereas over one third were either confident or somewhat confident (39.7% and 38.2% respectively).

With respect to clinical situations, Table 3 lists general dentists' confidence in varying endodontic procedures. Regarding root canal treatment of anterior teeth and premolars, the majority of survey participants described themselves as either very confident (48.33% and 29.17%, respectively) or confident (45.83% and 56.67%, respectively) in treating these teeth. Confidence levels were significantly lower when treating upper and lower molars, with only 4.17% of dentists feeling very confident in treating upper molars, and 10.83% feeling very confident treating lower molars. Many dentists were not confident treating teeth with pulp chamber/root canal calcification or root curvatures (60.83% and 45%, respectively).

When confidence in endodontic knowledge was compared against confidence level in treating the clinical situations stated in Table 3; a correlation existed between higher confidence in endodontic knowledge and higher confidence in treating these clinical situations. This included providing a diagnosis ( $P < 0.001$ ) RCT of the anterior dentition ( $P < 0.001$ ), RCT of premolars ( $P < 0.001$ ), RCT of maxillary molars ( $P < 0.001$ ), RCT of mandibular molars ( $P < 0.001$ ),

**Table 1. Factors influencing the decision to provide endodontic care**

		Provide endodontic care		Total	Chi-square value
		Yes	No		
Received additional training in endodontics	Yes	94 (69.1%)	42 (30.9%)	136 (94.4%)	$\chi^2 = 0.123$ df = 1 P = 1.000
	No	6 (75%)	2 (25%)	8 (5.56%)	
	Total	100 (69.4%)	44 (30.6%)	144	
Years of practice	<5 years	74 (54.4%)	1 (12.5%)	75	$\chi^2 = 5.653$ df = 2 P < 0.05
	5–10 years	32 (23.5%)	3 (37.5%)	35	
	>10 years	30 (22.1%)	4 (50%)	34	
	Total	136	8	144	
Confidence in endodontic procedures	Very confident	20 (14.7%)	1 (12.5%)	21	$\chi^2 = 15.977$ df = 3 P < 0.001
	Confident	54 (39.7%)	1 (12.5%)	55	
	Somewhat confident	52 (38.2%)	2 (25%)	54	
	Not confident	10 (7.4%)	4 (50%)	14	
	Total	136	8	144	
Concern of risk of litigation	Very concerned	16 (12%)	3 (37.5%)	19	$\chi^2 = 34.161$ df = 6 P < 0.001
	Moderately concerned	79 (59.4%)	0 (0%)	79	
	Not concerned	38 (28.6%)	5 (62.5)	43	
	Total	133	8	141	

**Table 2. Confidence in various clinical situations in endodontics**

	Confidence in endodontic procedures				Total
	Very confident	Confident	Somewhat confident	Not confident	
Identifying complex cases	20 (16.67%)	63 (52.5%)	32 (26.67%)	5 (4.17%)	120
Treatment of anterior dentition	58 (48.33%)	55 (45.83%)	7 (5.83%)	0 (0%)	120
Treatment of premolars	35 (29.17%)	68 (56.67%)	16 (13.33%)	1 (0.83%)	120
Treatment of upper molars	5 (4.17%)	38 (31.67%)	36 (30%)	41 (34.17%)	120
Treatment of lower molars	13 (10.83%)	51 (42.5%)	41 (34.17%)	15 (12.5%)	120
Treating teeth with calcification	3 (2.5%)	14 (11.67%)	30 (25%)	73 (60.83%)	120
Treating teeth with root curvatures	2 (1.67%)	14 (11.67%)	50 (41.67%)	54 (45%)	120

treatment of teeth with calcification ( $P < 0.001$ ) and treating teeth with root curvatures ( $P < 0.01$ ).

Furthermore, dentists' confidence in their knowledge of root canal treatment procedures increased as their years of experience did, with almost half of the dentists who felt 'very confident' having over 10 years' experience (47.6%). The inverse was also true, whereby the 42.9% of dentists who did not feel confident had <5 years' experience (Table 3). Male dentists had a higher level of confidence in their knowledge of RCT procedures compared to females. Furthermore, most general dentists stated that the instruments and tools available to them were sufficient to provide clinically sound treatment regardless of their confidence in providing RCT.

When evaluating the concern of litigation resulting from RCT amongst dentists', almost two thirds of dentists were moderately concerned about the risk of litigation (59.4%). Of those dentists that did not provide RCT, 37.5% were very concerned about the risk of litigation that could result from clinical activity. General dentist's confidence in root canal treatment procedures also appears to relate to their concern with the risk of litigation that might arise from RCT, with

the percentage of those who were 'not concerned' with the risk of litigation decreasing as confidence decreased.

Confidence in a dentists' knowledge of root canal procedures was also compared to whether they have received professional development in this area of clinical practice. Moreover, regardless of confidence level, the majority of dentists had received some form of CPD training specific to root canal treatment and endodontics in general. Nevertheless, 97.7% of dentists providing root canal treatment and 75% of dentists not providing this type of treatment would value additional CPD training in Endodontics.

When looking at the impact of access to local specialist endodontists, most surveyed dentists had access to a local specialist for referral (93.4%), and all dentists in this sample (100%) that did not provide root canal treatment were able to refer to an endodontist.

The decision to not provide root canal treatment did not appear to be affected by the availability of a nearby specialist for referral, with 100% of those providing root canal treatment feeling that not having a local specialist did not impact their willingness to provide root canal treatment. Conversely, of those

**Table 3. Factors impacting confidence in providing root canal treatment procedures**

		Confidence in knowledge of endodontic procedures				Total	Chi-square value
		Very confident	Confident	Somewhat confident	Not confident		
Years practice	<5 years	6 (28.6%)	31 (54.4%)	34 (61.8%)	6 (42.9%)	77	$\chi^2 = 19.374$ df = 6 $P < 0.004$
	5–10 years	5 (23.8%)	9 (15.8%)	16 (29.1%)	6 (42.9%)	36	
	>10 years	10 (47.6%)	17 (29.8%)	5 (9.1%)	2 (14.3%)	34	
	Total	21	57	55	14	147	
Gender	Men	15 (71.4%)	35 (61.4%)	23 (41.8%)	5 (35.7%)	78	$\chi^2 = 8.920$ df = 3 $P < 0.003$
	Women	6 (28.6%)	22 (38.6%)	32 (58.2%)	9 (64.3%)	69	
	Total	21	57	55	14	147	
Concern of risk of litigation	Very concerned	2 (9.5%)	1 (1.9%)	9 (16.7%)	7 (50%)	19	$\chi^2 = 34.161$ df = 6 $P < 0.001$
	Moderately concerned	6 (28.6%)	35 (67.3%)	33 (61.1%)	5 (36.7%)	79	
	Not concerned	13 (61.9%)	16 (30.8%)	12 (22.2%)	2 (14.3%)	43	
	Total	21	52	54	14	141	
Access to instruments to provide sound endodontics	Yes	18 (90%)	47 (92.2%)	45 (86.5%)	7 (70%)	117	$\chi^2 = 4.075$ df = 3 $P = 2.54$
	No	2 (10%)	4 (7.8%)	7 (12.5%)	3 (30%)	16	
	Total	20	51	52	10	133	
Additional training in endodontics	Yes	15 (71.4%)	43 (75.4%)	33 (60%)	11 (78.6%)	102	$\chi^2 = 3.862$ df = 3 $P = 0.277$
	No	6 (28.6%)	14 (24.6%)	22 (40%)	3 (21.4%)	45	
	Total	21	57	55	14	147	

general dentists unwilling to provide this type of treatment, almost one third (31.1%) stated limited access to a specialist did impact their willingness to provide endodontic care ( $P = 0.061$ ).

A substantial number of general dentists believed in the long-term clinical success of root canal treatment, regardless of whether they provide such treatment or not, with 95.6% of those that did and 87.5% of those that did not provide this treatment modality believed in the long-term clinical success of root canal treatment.

This is also reflected in the opinion of general dentists regarding the importance of retaining a patient's natural dentition, with 91% of dentists providing root canal treatment considering this to be 'very important', and 100% declining to provide such a treatment considering saving natural teeth to be 'very important' as well.

A multiple regression analysis was employed to predict confidence in endodontics, and specifically complex root canal treatment such as for maxillary molars, from the variables surveyed in this study. The overall model showed a statistically significant association [ $F(12, 106) = 11.773$ ,  $P < 0.01$  and  $R^2 = 0.523$ ] of increased confidence in providing root canal treatment with greater years in practice ( $P < 0.01$ ), additional CPD obtained ( $P < 0.05$ ), use of magnification ( $P < 0.05$ ) and with less fear of litigation risk ( $P < 0.05$ ).

## DISCUSSION

The present study examined attitudes, referral patterns and provision of endodontic care in Australian general dentist practitioners (GDPs). No study has been done to date that observes confidence in root canal

procedures amongst GDPs to query potential barriers and enablers in the provision of root canal treatment.

Whilst the primary clinical goal of root canal treatment is to eliminate infection, pain and inflammation, in the long-term this treatment aims to support life-long preservation of the natural dentition. This is relevant, since pulpal and periapical diseases are very common, with reports indicating a prevalence of >30% of the population, with an even larger number likely affected by subclinical disease.<sup>2,11</sup>

A GDP's skill, knowledge and confidence in root canal treatment ensures population equity in the provision of quality endodontic care, avoids unnecessary dental emergencies with resulting hospitalizations, especially in more rural areas, where immediate access to an endodontist might not be available.<sup>12</sup> Early loss of a patient's natural dentition carries several oral and general health implications, and recent reports show that as the remoteness of one's location increases, their oral health status decreases.<sup>6,7,13</sup> The study by Liu *et al.*<sup>13</sup> specifically showed that quality of life is reduced when endodontic care is needed, whilst the provision of root canal treatment improves a patient's quality of life. Therefore, the preservation of the natural dentition through the provision of quality endodontic care is paramount to helping combat health inequalities and improving the overall health of the population.

Typically, a GDP is not expected to complete highly complex root canal treatments and specialist referral should be utilized where required and appropriate. Looking at referral patterns, access to endodontists was unproblematic for respondents, with >90% having access to a local specialist. Interestingly, access to an endodontic specialist did not impact the decision to provide treatment, which underlines the importance

general dentists ascribe to root canal treatment. All general dentists not providing root canal treatment had access to an endodontist for referral, and 93% of those who provided such treatment had access to an endodontist. Moreover, limited access to a specialist had minimal impact on the decision to provide root canal treatment.

In keeping with previous studies,<sup>14</sup> issues with diagnosis were a common reason for referral mentioned in this survey. Almost two thirds of participating GDPs felt confident in endodontic diagnoses, whilst one in four were very confident in providing a diagnosis. Furthermore, the present study found a statistically significant relationship between diagnostic confidence and confidence in providing root canal treatment.

Molar root canal therapy is often cited as a reason for referral to an endodontist; root canal treatment for molars might be complex due to difficulty locating second mesiobuccal canals (MB2), problems with access and overall anatomical complexity.<sup>15–17</sup> Missed anatomy has been noted as a common reason for GDP referral to an endodontist, however, this study found that one in three GDP's will complete an upper molar root canal procedure after failing to locate an MB2 canal, despite its incidence being as high as 93% in upper first molars and 60% in upper second molars.<sup>15–18</sup> Conversely, half of the respondents will stop and refer the case to an endodontist.

Fractured endodontic instruments are an additional cited reason for referral<sup>3,18</sup> and the current study reflects this, with 87% of surveyed dentists opting to refer in these circumstances, rather than continue treatment themselves. Among treatment mishaps, instrument fracture appears to be a small percentage of referred cases.<sup>14,15</sup> Only 10% of the surveyed GDP's offered retreatments to their patients, and this is well reflected as a reason for referral in the literature.<sup>3,19</sup>

It might be assumed that graduating dentists will possess a certain degree of knowledge and clinical competence in endodontics. Australian undergraduate education guidelines for this field of dentistry were recently updated in 2021<sup>20</sup>; these guidelines describe competencies that undergraduate curriculums should teach towards so that graduating dentists can provide safe and equitable care to patients. Per these guidelines, upon graduation dentists should be competent in diagnosis and treatment of endodontic disease, and be aware of pathways for specialist referral. Consequently, GDPs should be confident in their ability to provide endodontic care to the level of minimally to moderately complex cases as per the AAE assessment guidelines.<sup>20,21</sup>

Some studies have suggested that when undergraduate students self-perceived confidence levels in endodontics are assessed, only a minority consider

themselves very confident in various aspects of endodontic care.<sup>22</sup> The results of the present study further indicate the desired competencies of graduate dentists might not necessarily be reflected in the practicing GDP population based on the confidence levels of those surveyed. This finding clearly indicates the need for well-prepared CPD and post-graduation training for GDPs to overcome issues associated with undergraduate endodontic training, and to ensure the provision of endodontic care to patients is equitable, even in rural settings where specialist access might be limited.<sup>20</sup> Indeed, of the dentists surveyed in this study that provided root canal treatment, over two thirds had received additional training or professional development in endodontics since graduating. Interestingly, three in four dentists that chose not to provide endodontic care had received additional training in endodontics, whilst a similar percentage of GDPs who were 'not confident' in endodontic procedures had also received additional training following graduation. Even with additional training in endodontics, half of the surveyed dentists still lack confidence in their knowledge and provision of root canal treatment. Most dentists in a survey by Ree *et al.*<sup>4</sup> felt a need for referring endodontic cases to specialists. As mentioned, reasons for referral are often related to practical aspects of case difficulty but in a survey by Barnes *et al.*,<sup>23</sup> where participants were encouraged to add personal remarks on referral decision making, aspects such as 'ability', 'clinical result' and 'success rate' of the specialist endodontist were cited as decisive factors. These comments underline the lack of self-assurance in the clinician's own abilities in treating certain endodontic cases.

It is thus assumed that general dentists are seeking additional training but are not getting out of it what they consider is needed to improve their confidence and delivery of root canal treatment.

This in itself is an interesting finding as almost two thirds of surveyed GDPs said they did not believe Australian universities provide adequate training in endodontics. A thematic analysis of reasons provided for this belief indicated that more than one in two GDPs that felt their undergraduate training was inadequate and recalled that exposure to clinical cases was severely lacking. Other reasons included a lack of direction in the recognition of complex cases and when to consider referral, as well as how to manage complications or clinical treatment difficulties with calcified canals or root curvatures. This theme of inadequate training has been noted previously in a study involving British NHS dentists.<sup>14,24</sup> It appears that greater clinical exposure in a structured training environment could help overcome this obstacle, however, patient flow, clinical costs and patient motivation factors heavily into this.



In this study, multiple factors impacted a GDP's self-reliance. Confidence was strongly associated with years in practice, with more experienced GDPs feeling more confident in endodontics. Whilst more experienced GDPs might feel more at ease in endodontics, this does not necessarily translate into their decision to provide treatment, as 50% of GDPs that did not provide endodontic treatment had more than 10 years practice experience.

Furthermore, confidence was strongly associated with perceived risk of litigation associated with root canal mishaps, this is of significance, as a recent survey found that approximately nine in ten GDPs (89%) had a fear of being sued, with approximately three quarters of GDPs saying this fear impacted the services they offer and resulted in more referrals.<sup>25</sup> A structured approach to endodontic care could mitigate this fear, with case selection of treatments within the clinician's limitations, consistent patient communication and employment of predictable methods and techniques.<sup>26</sup> In that respect, general practitioners might benefit from further training in the provision of informed consent related specifically to root canal treatment so they can feel comfortable the patient is well informed of all risks carried by root canal therapy, protecting both the patient and the treating clinician.

The current study highlights that access to equipment does not appear to impact upon confidence, as majority of GDPs felt that their practice was well equipped to provide clinically sound treatment, regardless of their confidence level. Magnification is an important factor cited in the provision of root canal treatment,<sup>27–29</sup> and almost every GDP surveyed had magnification tools available to them, be it loupes or the operating microscope.

Not surprisingly, in this investigation, confidence in endodontics was strongly related to a various clinical situations including treatment of anterior teeth and premolars vs. molar teeth, as well as treating teeth with mineralization or root curvatures. Treatment of the anteriors or premolars did not appear to concern GDPs, whilst confidence in treating upper and lower molars, in particular teeth complex anatomies, decreased significantly.

In regard to demographics and the provision and confidence of root canal treatment, the present study found that confidence was also related to gender, with men being more confident compared to women. Similar findings have been noted in other studies, with women are more likely to refer to an endodontist.<sup>23,24</sup> This gender discrepancy has been suggested to possibly occur as women are more likely to engage in patient-centred communication and be more involved in the decision-making process with their patients.<sup>23</sup>

The limitations of the present study include not investigating in more detail why general dentists do

not provide root canal treatment at all. Also, while the overall number of participants might appear small, care was taken to sample broadly. However, a majority of GDPs surveyed were located in urban and sub-urban locations along the eastern seaboard, and hence the results of the present study might not necessarily reflect the current situation in more rural areas of Australia.

## CONCLUSION

This study is the first to investigate the attitudes and practice of endodontics provided by GDPs in Australia. It was found that GDP confidence in providing root canal treatment was influenced by the tooth to be treated and risk of litigation. While almost all GDPs surveyed believe RCT is important to improving the long-term retention of a tooth, just over half of the GDPs say they feel confident in their knowledge and provision of endodontic procedures.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**Data S1.** The questionnaire used with participants in this study.

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