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## ORIGINAL ARTICLE

# Adoption of new endodontic technology by dental practitioners in Saudi Arabia

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### KEYWORDS

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**Abstract** The purpose of this study was to assess the adoption of new endodontic technology by a population of endodontists (ENs) and general dental practitioners (GPs) practicing in Riyadh, Saudi Arabia. A total of 250 self-administered questionnaires were distributed to 50 randomly

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selected private dental clinics. The questionnaire consisted of questions regarding the use of NiTi rotary instruments, Digital radiography, and Electronic Apex Locators. Follow-up questions investigated the reason for not using the specified technology by selecting one or more of the stated choices. In addition, the type of rotary NiTi instrument system and the type of apex locator used were explored. The response rate was 56.4%; 121 GPs and 20 EN participated in the study. The percentage of dentists (GPs + ENs) who used NiTi rotary instruments was 46.1%, Digital radiography was 40.7%, and Electronic Apex Locators was 48.9%. The percentage of ENs who used the three technologies was higher than that of GPs, the difference was statistically significant ( $P = 0.001$ ). The most common reason for not using the three new technologies was the lack of availability. In addition to unavailability, NiTi rotary instruments and Electronic Apex Locators were not used because of lack of training and concern about instrument fracture (rotary NiTi) and patient safety (Electronic Apex Locators). The fact that more than 50% of dentists (GPs + ENs) practicing in Saudi Arabia have never used rotary NiTi instrumentation systems, Digital radiography, or Electronic Apex Locators underlines the importance of supporting increased utilization of new endodontic technologies by providing professional training opportunities for current and future dentists.

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## 1. Introduction

The practice of modern endodontics has undergone a significant revolution with the introduction of several new technologies that improve efficiency, safety, and quality of the root canal treatment. Rotary Nickel Titanium (NiTi) instruments, Digital radiography, and Electronic Apex Locators are considered the major advancements in the practice of Endodontics in the past two decades. Compared to stainless steel hand files, NiTi rotary instruments improve the quality of root canal preparation and reduce root canal preparation time (Esposito and Cunningham, 1995; Short et al., 1997; Guelzow et al., 2005; Liu et al., 2006). Digital radiography provides several advantages over conventional film radiography including lower dose of radiation exposure, computer-aided interpretation and image enhancement, and easier image archiving and retrieval (Parks and Williamson, 2002; van der Stelt, 2005; Nair and Nair, 2007). Modern Electronic Apex Locators can determine working length during root canal therapy with a high accuracy (Gordon and Chandler, 2004; D'Assuncao et al., 2007; de Camargo et al., 2009; Stoll et al., 2010). In fact, some reports have indicated that Electronic Apex Locators can be more accurate than radiograph in determining endodontic working length (ElAyouti et al., 2002) while other investigators have reported a reduction of the number of radiographs required to obtain an acceptable working length radiographic image (Brunton et al., 2002). The improvement in the quality and length of root canal fillings, as a result of the use of modern technology, is expected to improve the outcome of root canal therapy because of the correlation between the success of root canal treatment and the quality and length of root canal fillings (Sjogren et al., 1990; Kirkevang et al., 2000; Tronstad et al., 2000).

Despite the many advantages offered by new endodontic and dental technology in enhancing the quality and efficiency of root canal treatment, there is a general trend for dentist to be slow in adopting these technologies (Whitten et al., 1996; Saunders et al., 1999; Brunton et al., 2002; Chandler and Koshy, 2002; Hommez et al., 2003; Parashos and Messer, 2004; Bjorndal and Reit, 2005).

The purpose of this study was to assess the adoption of new endodontic technology by a population of endodontists (EN)

and general dental practitioner (GP) practicing in Riyadh, Saudi Arabia.

## 2. Materials and methods

This study used a self-administered questionnaire. The questionnaires were distributed to private dental clinics in Riyadh, Saudi Arabia. Riyadh city was divided into five major areas according to the city municipality zones map. Ten private dental clinics were randomly selected from each zone and each clinic received five hand-delivered questionnaires. After 1 week, the questionnaires were hand-collected. A total of 250 questionnaires were distributed. General practitioners and endodontic specialists were included in the study.

The questionnaire consisted of questions regarding the use of NiTi rotary instruments, Digital radiography, and Electronic Apex Locators. To answer these questions, the respondents had three options: always, sometimes, and never. Follow-up questions investigated the reason for not using the specified technology by selecting one or more of the stated choices. In addition, the type of the NiTi rotary instrument system and the type of Electronic Apex Locator used were explored.

One operator (NM) processed all the questionnaires. Descriptive statistics presented as the number and percentage of the total were used to express the results. Chi-square was used to find differences in the adoption of new technology between GPs and ENs; significance level was set at  $\alpha = 0.05$ . The results were limited to yes or never categories by combining the always and sometimes responses together as yes category.

## 3. Results

One hundred and forty-one questionnaires out of the original 250 were completed (56.4%). One hundred and twenty-one GPs and 20 ENs participated in the study. NiTi rotary instruments were used by 46.1% of all dentists (GPs + ENs). Ninety percent of the ENs used NiTi rotary instruments compared to only 38.8% of GPs (Table 1). The difference between the ENs and GPs with regard to the use of NiTi rotary instruments was statistically significant ( $P = 0.001$ ). The most commonly used

**Table 1** The use of NiTi rotary instruments among dentists practicing in Saudi Arabia.

Specialty	Yes (always/sometimes)	Never	Total
General practitioner	47 (38.8%)*	74 (61.2%)	121
Endodontist	18 (90%)*	2 (10%)	20
Total	65 (46.1%)	76 (53.9%)	141

\* Statistically significant difference ( $P = 0.001$ ).

NiTi rotary instrument system was the ProFile (Dentsply-Tulsa Dental, Oklahoma, USA) (41.5%), followed by the ProTaper (Dentsply-Tulsa Dental, Oklahoma, USA) (40%), then the ProFile GT (Dentsply-Tulsa Dental, Oklahoma, USA) (20%) (Table 2). The most common reason for never using NiTi rotary instruments was unavailability of the system (82.9%), followed by (19.7%) the lack of training to use it (Table 3).

Digital radiography was used by 40.7% of all dentists (GPs + ENs). Sixty-eight percent of the ENs used Digital radiography, compared to 36% of GPs. More ENs used Digital radiography than GPs (Table 4), the difference was statistically significant ( $P = 0.001$ ). The most common reason for not using Digital radiography (91.6%) was the unavailability of the Digital radiography unit (Table 5).

Electronic Apex Locators were used by 48.9% of all dentists (GPs + ENs). Eighty-five percent of ENs used Electronic Apex Locator compared to 43.0% GPs, the difference was statistically significant ( $P = 0.001$ ) (Table 6). The Root ZX I (J. Morita Corp., Tokyo, Japan) was the most commonly used Electronic Apex Locator (40.6%), followed by the Root ZX II (J. Morita Corp., Tokyo, Japan) (29.0%) (Table 7). The most common reason for not using Electronic Apex Locators (79.2%) was the unavailability of the device, followed by the concern about patient safety (22.2%) (Table 8).

#### 4. Discussion

The response rate for this survey was 56.4% which is within the 25% (Slaus and Bottenberg, 2002) to 87% (Parashos and Messer, 2004) response range for similar studies. Therefore, it is reasonable to make comparisons with other studies that investigated this topic in different parts of the world. In addition, the survey respondents were 85% GPs and 15% ENs

**Table 3** Reason for not using NiTi rotary instruments presented as number and percentage of dentists who never used NiTi rotary instruments.

Reason for not using NiTi	Total <sup>a</sup>
Not available	63 (82.9%)
Too expensive	6 (7.9%)
Not trained to use it	15 (19.7%)
Concerned about instrument fracture	10 (13.2%)

<sup>a</sup> Multiple responses will not add to the total of 100%.

**Table 4** The use of Digital radiography among dentists practicing in Saudi Arabia.

Specialty	Yes (always/sometimes)	Never	Total
General practitioner	44 (36.4%)*	77 (63.6%)	121
Endodontist	13 (68.4%)*	6 (31.6%)	19
Total	57 (40.7%)	83 (59.3%)	140

\* Statistically significant difference ( $P = 0.001$ ).

**Table 5** Reasons for not using Digital radiography presented as number and percentage of dentists who never used Digital radiography.

Reason for not using Digital radiography	Total <sup>a</sup>
Not available	76 (91.6%)
Too expensive	8 (9.6%)
Not trained to use it	1 (1.2%)
Happy with using conventional radiographs	16 (19.3%)
It is more difficult to use	11 (13.3%)

<sup>a</sup> Multiple responses will not add to the total of 100%.

which was similar to the range of 86% (Hommez et al., 2003) to 93% (Slaus and Bottenberg, 2002; Parashos and Messer, 2004) of GPs respondents in similar studies.

In the current study, the adoption of new dental technology by ENs was greater than GPs. This finding is expected because ENs are more likely to have exposure and training for these new endodontic technologies than GPs. Despite the fact that GPs used new endodontic technologies less frequently than

**Table 2** Number and percentage of rotary NiTi users who use each type of NiTi rotary systems.

Type of NiTi system	General practitioner	Endodontist	Total <sup>a</sup>
ProFile	17 (36.2%)	10 (55.6%)	27 (41.5%)
ProFile GT	13 (27.7%)	0 (0%)	13 (20%)
ProTaper	14 (29.8%)	12 (66.7%)	26 (40%)
Hero	1 (2.1%)	1 (5.6%)	2 (3.1%)
Race	0 (0.0%)	1 (5.6%)	1 (1.5%)
Endosequence	1 (2.1%)	0 (0.0%)	1 (1.5%)
GT series X (M-wire)	1 (2.1%)	0 (0.0%)	1 (1.5%)
Twisted file	4 (8.5%)	0 (0.0%)	4 (6.2%)
K3	3 (6.4%)	2 (11.1%)	5 (7.7%)
Light speed	1 (2.1%)	0 (0.0%)	1 (1.5%)

<sup>a</sup> Multiple responses will not add to a total of 100%.

**Table 6** The use of Electronic Apex Locators among dentists practicing in Saudi Arabia.

Specialty	Yes (always/sometimes)	Never	Total
General practitioner	52 (43.0%)*	69 (57.0%)	121
Endodontist	17 (85%)*	3 (15%)	20
Total	69 (48.9%)	72 (51.1%)	141

\* Statistically significant difference ( $P = 0.001$ ).

ENs, GPs practicing in Saudi Arabia adopted new endodontic technologies more than dentists elsewhere in the world. For example, GPs practicing in Saudi Arabia who never used rotary NiTi instruments (61.2%) are less than dentists who never used rotary NiTi instruments in Europe (72–85%) (Hommez et al., 2003; Bjorndal and Reit, 2005) or Australia (78%) (Parashos and Messer, 2004). Similarly, GPs practicing in Saudi Arabia who never used Digital radiography (63.3%) are less than GPs who never used Digital radiography in Europe (95.1%) (Saunders et al., 1999) or New Zealand (89.8%) (Chandler and Koshy, 2002). Furthermore, GPs practicing in Saudi Arabia who never used Electronic Apex Locators (57%) are less than GPs who never used Electronic Apex Locators in Europe (67–80%) (Saunders et al., 1999; Bjorndal and Reit, 2005) and less than the combined GPs and ENs in the United States of America (90%) (Whitten et al., 1996). On the other hand, GPs in New Zealand who never used Electronic Apex Locators (46.6%) (Chandler and Koshy, 2002) are less than GPs practicing in Saudi Arabia who never used Electronic Apex Locators.

These comparisons between our study and other reports must be interpreted with caution due to the strong effect of time on adoption of new technologies, i.e., more dentists are likely to adopt the technology as time passes because it becomes increasingly available and its advantages become more obvious (Rogers, 1983). On the other hand, the other studies were done in countries that are considered more advanced technologically and thereby dentists are more likely to adopt new technology due to earlier introduction of new products and more aggressive marketing strategies than less advanced countries such as Saudi Arabia. Considering all these facts, it is reasonable to assume that there is a general trend toward increased adoption of new endodontic technology with time.

The majority of dentists (GPs + ENs) practicing in Saudi Arabia prefer to use the Profile, the ProTaper, or the ProFile GT as their rotary NiTi instrumentation system. This preference to use rotary NiTi instrumentation systems produced by Dentsply-Tulsa Dental, Oklahoma, USA could be attributed to the fact that this manufacturer introduced the first NiTi ro-

**Table 8** Reasons for not using Electronic Apex Locators presented as number and percentage of dentists who never used Electronic Apex Locators.

Reason for not using Electronic Apex Locator	Total <sup>a</sup>
Not available	57 (79.2%)
Too expensive	11 (15.2%)
Not trained to use it	13 (18.0%)
It is less accurate	3 (4.16%)
It is difficult to use	5 (6.94%)
It is time consuming	11 (15.2%)
Concerned about patient safety	16 (22.2%)

<sup>a</sup> Multiple responses will not add to the total of 100%.

tary system (the ProFile) or to more active marketing strategy by the manufacturer. In addition, the majority of dentists (GPs + ENs) practicing in Saudi Arabia prefer Electronic Apex Locators manufactured by J. Morita Corp., Tokyo, Japan (Root ZX I, Root ZX II, and Dentaport). The preference toward different Root ZX types reflects a global trend where the Root ZX maintains over 90% of the world market share of apex locators (Gordon and Chandler, 2004).

The majority of dentists (GPs + ENs) practicing in Saudi Arabia who are not using rotary NiTi instrumentation systems, Digital radiography, or Electronic Apex Locators indicate unavailability of the systems as the reason for not adopting that technology. The next two reasons for not using rotary NiTi instrumentation systems or Electronic Apex Locators were lack of training and concern about instrument fracture (rotary NiTi) and patient safety (Electronic Apex Locators). This concern about patient safety when using Electronic Apex Locators indicates that some dentists are perhaps worried about the interference of Electronic Apex Locators with the function of cardiac pacemakers. However, it has been shown that four out of five Electronic Apex Locators, tested *in vitro*, have no effect on the function of cardiac pacemakers (Garofalo et al., 2002). It seems logical to assume that the adoption of new endodontic technology will increase with the introduction of more specialized training activities that aims at familiarizing the dentists with the use, advantage, and safety of new endodontic technology.

Although the findings of this study indicate that more dentists practicing in Saudi Arabia are adopting new endodontic technology compared to other parts of the world, it is important to note that more than half of the surveyed dentists never used rotary NiTi instrumentation systems, Digital radiography, or Electronic Apex Locators. These technological advances have significantly improved the way we perform endodontics such as providing better maintenance of prepared

**Table 7** Number and percentage of Electronic Apex Locator users who use each type of Electronic Apex Locators.

Type of Electronic Apex Locator	General practitioner	Endodontist	Total
Root ZX I	28 (53.8%)	0 (0%)	28 (40.6%)
Root ZX II	12 (23.0%)	8 (47.0%)	20 (29.0%)
TriAuto Zx	2 (3.84%)	2 (11.7%)	4 (5.8%)
Elements Diagnostic Unit and Apex Locator	5 (9.61%)	0 (0%)	5 (7.2%)
Dentaport Electronic Apex Locator	4 (7.69%)	7 (41.1%)	11 (15.9%)
Other Electronic Apex Locators	2 (3.84%)	0 (0%)	2 (2.9%)

root canal geometry (Esposito and Cunningham, 1995; Short et al., 1997; Gergi et al., 2010), causing less extrusion of debris (Ferraz et al., 2001), reducing the time required for root canal preparation (Guelzow et al., 2005; Liu et al., 2006), more accurate working length determination (ElAyouti et al., 2002; Gordon and Chandler, 2004; D'Assuncao et al., 2007; de Camargo et al., 2009; Stoll et al., 2010), lower dose of radiation exposure, computer-aided interpretation and image enhancement, and easier image archiving and retrieval (Brunton et al., 2002; Parks and Williamson, 2002; van der Stelt, 2005; Nair and Nair, 2007). It is important to take advantage of the use of rotary NiTi instrumentation systems, Digital radiography, and Electronic Apex Locators to improve the efficiency and quality of root canal therapy provided to patients. The number of dentists using new endodontic technologies must be increased by providing professional education and training to practicing dentists sponsored by professional dental organizations such as the Saudi Dental Society; and by introducing new endodontic technologies to dental students during their dental education and training.

## 5. Conclusion

The adoption of new endodontic technologies, the rotary NiTi instrumentation systems, Digital radiography, and Electronic Apex Locators by dentists (ENs and GPs) practicing in Saudi Arabia is greater than by dentists elsewhere in the world. However, more than 50% of dentists practicing in Saudi Arabia have never used these technologies. It is important to encourage utilization of new endodontic technologies by providing professional training opportunities for current and future dentists.

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