ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 10 | October - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

KNOWLEDGE, ATTITUDE AND PRACTICES REGARDING USE OF ELECTRONIC APEX LOCATORS AMONGST GENERAL DENTAL PRACTITIONERS AND ENDODONTISTS IN NAGPUR CITY: A QUESTIONNAIRE-BASED STUDY.

Dental Science

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ABSTRACT

Aim - To evaluate the knowledge, attitude, and practices regarding use of Electronic Apex Locators (EALs) among dentists in Nagpur city. **Methodology-** A self-administered web-based closed-ended questionnaire was conducted among dentists in Nagpur city. The participants comprised a total of 263 Dental Professionals, including General Dental Practitioners (GDPs) and Endodontists. The survey assessed their preferred methods for working length determination, training in its use, availability of EALs, perceived benefits, accuracy, and barriers to adoption of EALs. Data were analysed using descriptive statistics. **Results -** A total of 263 dental practitioners participated, including 113 endodontists and 150 GDPs. It was found that EALs were the most preferred method for working length determination, with higher usage among endodontists compared to GDPs. Most participants reported receiving adequate EAL training, with slightly higher proportions among endodontists compared to GDPs. More endodontists had access to EALs than GDPs, and they found it vital and more accurate in Root Canal Treatments. Among factors influencing EAL use, GDPs focused more on cost and training barriers, while endodontists focused on clinical efficiency. Despite this, the majority of participants recommended EALs to colleagues, with endodontists showing higher support compared to GDPs. **Conclusion-** EALs are preferred by many dental professionals to determine working length due to their accuracy. While some GDPs recognize the benefits of EALs, their adoption is restricted by cost, training gaps, and maintenance concerns. Continued education and improved accessibility may enhance their use in clinical practice.

KEYWORDS

Electronic Apex Locator, Working Length, Endodontics, Radiographs, Apex Determination

INTRODUCTION

An essential step of Root Canal Treatment is the determination of the precise length at which biomechanical preparation should stop, ideally correlating with the biological endpoint of the root canal. (1)

Apical constriction (AC) is the narrowest part that marks the transition from pulpal to periodontal tissue. It is usually located 0.5–2 mm coronal to the radiographic apex (RA), which is the tip of the root visible on an X-ray. The goal of accurate working length determination is to confine the obturating material as close as possible to AC.(2)

The common methods to determine Working Length are Radiography and Electronic Apex Locators. Traditionally, only radiographs were used to determine the working length. The periapical status of the tooth, root canal anatomy, and the proximity of adjacent anatomical structures can be assessed on radiographs. But these are only a 2-D representation of a 3-D structure. They may lead to image distortion, magnification, superimposition, etc.(3)

Electronic Apex Locators (EALs) are devices that are based on the concept that the electrical impedance of oral mucosa and periodontal membrane is the same at 6.5 k-ohms. These have become the standard of care in root canal treatment because of their accuracy.(4) Many researchers believe that a good EAL alone is enough to determine accurate working length, without the aid of radiographs. Whereas others believe that a combination of both these methods is important to maximize the accuracy of the measurement.(5)

However, adoption of their use by General Dental Practitioners (GDPs) has been slow, as their accuracy in clinical scenarios has often been questioned. With the introduction of newer generation apex locators, their clinical use is gradually becoming more popular.(6)

There is a scarcity of literature on the knowledge, attitudes, and practices regarding Electronic Apex Locators among general dentists and endodontists in Nagpur city. This study aims to assess these aspects among practitioners in the region.

MATERIALS AND METHODS

Study Design and Population

A questionnaire study was conducted on the dentists based in Nagpur city who routinely perform Root Canal Treatments. The study population consisted of practicing endodontists, and GDPs in Nagpur city. The duration of the study was 1 month, and a total of 263 responses were collected.

Data Collection

After approval by the Institutional Ethics Committee, 263 dentists based in Nagpur city who routinely performed root canal treatment were asked to fill out a questionnaire in Google Forms format, consisting of 12 relevant questions, which were approved by a subject expert. The requested information included their knowledge about the importance of correct working length determination, different methods dentists use for the determination of working length, their attitude towards the use of EALs in their daily clinical practice, etc. The data collected using Google Forms was converted to an MS Excel sheet.

RESULTS

263 dentists who routinely performed root canal treatments participated in the study, comprising 57% (150) GDPs and 43% (113) endodontists. Among the respondents, 17.87% of GDPs and 8.75% of endodontists preferred radiographs, while the majority, 68% (102 out of 150) of GDPs and 77% (87 out of 113) of endodontists, preferred Electronic Apex Locators to determine the working length. A minority (1.52%) of the respondents used methods such as tactile sensation and paper points.

75.2% endodontists believed EAL is vital in determining the working length, as compared to 74% of GDPs. 80.5% of endodontists reported receiving training in the use of EAL, as compared to 78.6% GDPs. Among the participants, 66.3% of endodontists and 68.6% GDPs have EALs in their clinics. 80% of both endodontists and GDPs believed that EALs reduce radiation exposure. Regarding affordability, 60% of endodontists consider EALs affordable, compared to only 50% of GDPs.

Among endodontists, 56.6% and among GDPs, 59.3% stated that

EALs do not require frequent maintenance. Also, 65.4% endodontists and 68% GDPs reported that patients were comfortable with the use of EALs. Over 68.1% of endodontists and 76.7% of GDPs agree that EALs provide accurate readings in open apices. When asked about the impact of low battery levels on EAL accuracy, 59.2% Endodontists and 65.3% GDPs agreed that low battery levels affect the accuracy of EALs. Among the factors affecting EAL use, "All factors combined" was most frequently cited by both Endodontists (38.05%) and GDPs (37.33%), followed by complex tooth anatomy (27.43% vs. 24.67%), personal preference (22.12% vs. 23.33%), and availability of the device (12.39% vs. 14.67%). A large majority recommended EAL use to colleagues, with 86.73% of Endodontists and 83.33% of GDPs responding "Yes.". Table 1 summarizes the descriptive statistics for the answers to the questionnaire survey and Figure 1 gives a graphical representation of some of the key findings.

Table 1 -Descriptive Statistics for the Answers to the Questionnaire

Association between qualification and responses					
Questions	Qualification: Endodontist	Qualification: General Dental Practitioner	Total	Chi-square value	P-value
Q1: Methods to determine working length					
A	23(8.75)	47(17.87)	70(26.62)		
B	87(33.08)	102(38.78)	189(71.86)	5.319	0.045*
C	3(1.14)	1(0.38)	4(1.52)		
Total	113(42.97)	150(57.03)	263(100)		
Q2: Is EAL vital?					
No	28(10.65)	38(14.45)	66(25.1)		
Yes	85(32.32)	112(42.59)	197(74.9)	0.011	0.918
Total	113(42.97)	150(57.03)	263(100)		
Q3: Adequate training in EAL?					
No	22(8.37)	32(12.17)	54(20.53)		
Yes	91(34.6)	118(44.87)	209(79.47)	0.137	0.711
Total	113(42.97)	150(57.03)	263(100)		
Q4: Have EAL in clinic?					
No	38(14.45)	47(17.87)	85(32.32)		
Yes	75(28.52)	103(39.16)	178(67.68)	0.155	0.694
Total	113(42.97)	150(57.03)	263(100)		
Q5: EAL reduces radiation?					
No	21(7.98)	27(10.27)	48(18.25)		
Yes	92(34.98)	123(46.77)	215(81.75)	0.015	0.903
Total	113(42.97)	150(57.03)	263(100)		
Q6: Are EALs affordable?					
No	45(17.11)	74(28.14)	119(45.25)		
Yes	68(25.86)	76(28.9)	144(54.75)	2.353	0.125
Total	113(42.97)	150(57.03)	263(100)		
Q7: Do EALs require frequent maintenance?					
No	64(24.33)	89(33.84)	153(58.17)		
Yes	49(18.63)	61(23.19)	110(41.83)	0.193	0.661
Total	113(42.97)	150(57.03)	263(100)		
Q8: Are patients comfortable with EAL?					
No	39(14.83)	48(18.25)	87(33.08)		
Yes	74(28.14)	102(38.78)	176(66.92)	0.184	0.668
Total	113(42.97)	150(57.03)	263(100)		
Q9: Are EALs readings accurate in open apices?					
No	36(13.69)	35(13.31)	71(27)		
Yes	77(29.28)	115(43.73)	192(73)	2.377	0.123
Total	113(42.97)	150(57.03)	263(100)		
Q10: Does low battery affect EAL accuracy?					
No	46(17.49)	52(19.77)	98(37.26)		
Yes	67(25.48)	98(37.26)	165(62.74)	1.006	0.316
Total	113(42.97)	150(57.03)	263(100)		
Q11: Factors affecting EAL use					
A	31(11.79)	37(14.07)	68(25.86)		
B	14(5.32)	22(8.37)	36(13.69)		
C	25(9.51)	35(13.31)	60(22.81)	0.485	0.922
D	43(16.35)	56(21.29)	99(37.64)		
Total	113(42.97)	150(57.03)	263(100)		
Q12: Recommend EAL to colleagues?					
No	15(5.7)	25(9.51)	40(15.21)		
Yes	98(37.26)	125(47.53)	223(84.79)	0.575	0.448
Total	113(42.97)	150(57.03)	263(100)		

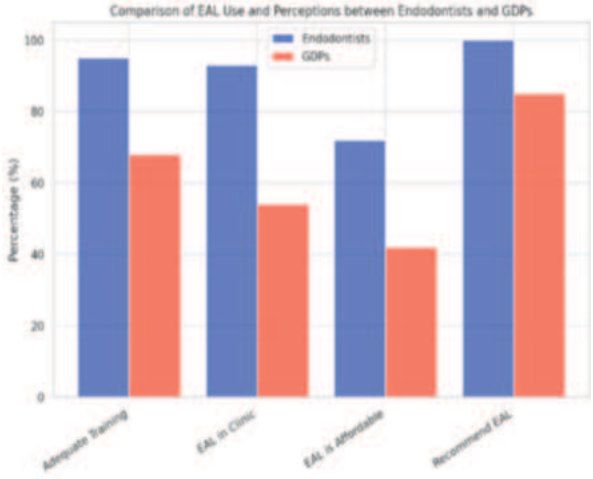

Figure 1 -Comparison of EAL use and Perceptions Between Endodontists and GDPs

DISCUSSION

Accurate determination of working length is a critical factor in the success of endodontic treatment, as it directly influences the effectiveness of cleaning, shaping, and obturation of the root canal system. Traditionally, radiographs have been the primary method for measuring working length, but advancements in technology have led to the widespread use of Electronic Apex Locators (EALs).(7)

Despite their advantages, EAL adoption varies significantly between General Dental Practitioners (GDPs) and Endodontists. Endodontists, being specialists in root canal therapy, are more likely to have access to and training with EALs. Whereas, GDPs may face some challenges. Understanding these differences is important for identifying barriers to EAL use and finding ways to increase their use across all levels of dental practice.

The present study aimed to assess the knowledge, attitude, and practices influencing the use of EALs among endodontists and GDPs.

In the present study, the association between specialization (Endodontist vs. General Dental Practitioner) and the use of EALs was found ($p<0.005$). Endodontists predominantly relied on EALs (76.9%), followed by radiographs (20%). However, among GDPs, 31.3% relied on radiographs, and 68% use EALs. A study by Raoof M. et al., (2014) surveyed Iranian GDPs on the use of radiographs and EALs during root canal treatment. Most GDPs relied on radiographs for working length determination, though some also used EALs in combination. They concluded that frequent radiograph use is a concern and emphasized the need for wider adoption of modern techniques.(8) Similarly, another study by Rushton et al. (2013) found that apex locators were used more often by endodontists (86.4%) than by GDPs (53.2%).(6)

In the present study, 75.2% of endodontists and 74.6% GDPs acknowledged EALs as essential in RCT. Use of EALs has simplified and shortened the time taken for RCT and consequently improved their outcomes. They provide improved accuracy compared to radiographs, increase efficiency, and reduce the treatment time. They can be particularly valuable when the apical part of the canal is superimposed by any anatomic structure. Modern EALs can also detect suspected periodontal or pulpal perforations.(9,10)

The present study found notable differences between the two groups in both access to and training in EAL use. While 66.3% of endodontists had an EAL in their clinics compared to 68.6% of GDPs, 80.5% of endodontists reported sufficient training versus 78.6% of GDPs. These gaps highlight the need for improved access and targeted educational workshops for GDPs to increase their use of EALs in root canal treatments.

In the present study, 81.4% endodontists and 82% GDPs agree that the use of EALs reduces exposure to ionizing radiation. The radiographic method has the disadvantages of radiation hazard, multiple exposures, which increase the overall radiation dose, and requires time for acquisition and processing. EALs function by measuring the electrical properties within the root canal to locate the apical constriction.(9) One of the advantages of EALs over radiography is the ability to measure the root canal length to the end of the apical foramen rather than the radiographic apex, potentially leading to more accurate treatment and reducing the need for retakes of radiographs.(11) A study by Kaur G. et al. (2024) found that the apical foramen was accurately located by apex locators when used correctly, and that only one preoperative radiograph was required. This procedure benefits patients who need to avoid repeated radiation exposure due to mental, medical, or dental conditions (12–14)

Cost was identified as a limiting factor for GDPs, with 50.6% considering EALs affordable, compared to 60.1% of Endodontists. The findings of this study align with existing observations, indicating that while EALs are widely recognized for their clinical benefits, their high cost is a significant barrier to adoption, particularly among GDPs and those in smaller practices. However, several manufacturers have introduced cost-effective, portable, and wireless EALs. (9)

The findings of the present study indicate that perceptions of maintenance of EALs vary between endodontists and GDPs. Among endodontists, 43.3% believe that EALs require frequent maintenance, whereas 56.6% believe minimal maintenance is required. Similarly, 40.6% of GDPs perceive EALs as requiring regular maintenance, with

59.3% stating otherwise. Previous studies have highlighted that the maintenance needs of EALs depend on factors such as battery life, calibration accuracy, and electrode integrity.(15) While modern EALs have improved in durability and reliability, some users may still experience inconsistencies in performance due to device calibration issues or environmental factors like moisture interference. Moreover, studies suggest that the perception of high maintenance may be linked to a lack of adequate training. Since EALs require proper handling and periodic calibration, clinicians who are not well-versed in device maintenance may be more likely to perceive them as requiring frequent upkeep.

Maintaining the effectiveness of electronic apex locators (EALs) relies on proper usage and awareness of factors affecting accuracy. Key considerations include ensuring stable readings, selecting appropriate file sizes, following the manufacturer's instructions, and periodically checking device function. Operators should also be mindful of potential electromagnetic interference, though modern devices are generally well-shielded. While traditional maintenance is minimal, consistent adherence to correct protocols ensures reliable performance.(9,10,14)

In the present study, 65.4% of endodontists and 68% GDPs reported that their patients were cooperative while placing the electrodes of EAL in their mouths. Electronic Apex Locators (EALs) enhance patient comfort during root canal procedures by reducing the need for multiple X-rays and minimizing procedure time. By accurately determining root canal length, EALs decrease the number of radiographs required (12), leading to a safer and more comfortable experience for patients. One study by Shiraz et al. (2024) mentioned a technique combining an apex locator (Root ZX) and a digital imaging system to reduce radiation dose during endodontic therapy. The "as low as reasonably practicable" (ALARP) principle should be followed. (9)

In the present study, among endodontists, a higher proportion (68.1%) acknowledge EAL accuracy compared to GDPs (76.6%). Shacham et al. (2020) examined EAL accuracy and stability in enlarged apical foramina and found that file size significantly impacts measurement accuracy. Their study concluded that snug-fitting files provide more stable and accurate readings in open apices. They also noted that apical diameters beyond 0.6 mm can lead to inaccurate EAL readings, reinforcing the need for supplementary techniques. (16)

According to the present study, a slightly higher percentage of endodontists (65.3%) than GDPs (59.2%) believe that battery levels impact accuracy. A study by Srivastava S et al. (2022) evaluated the Dentaport ZX apex locator under different battery conditions—full, half, and flashing modes. The findings indicated that while full and half-charged batteries provided consistent measurements, the flashing (low battery) mode resulted in significant inconsistencies. This suggests that low battery levels can adversely affect EAL accuracy. Another investigation compared the accuracy of EALs under low and full battery conditions. The study concluded that low battery levels might cause deviations in measurements, emphasizing the importance of ensuring battery levels during use.(17)

In the present study, among the factors affecting EAL use, “All factors combined” was most frequently cited by both Endodontists (38.05%) and GDPs (37.33%), followed by complex tooth anatomy (27.43% vs. 24.67%), personal preference (22.12% vs. 23.33%), and availability of the device (12.39% vs. 14.67%). Factors such as the type of tooth, position of the apical foramen, and pre-operative pulp status can influence EAL precision. For example, variations in canal anatomy or the presence of pulp inflammation may affect measurement outcomes.

In the present study, 100% of Endodontists and 83% of GDPs recommended the use of EALs. This highlights that EALs have good clinical value, reinforcing the importance of increasing accessibility and training to bridge the gap in use of EALs.

CONCLUSION

In conclusion, while EALs are valuable tools in modern endodontics for efficient and relatively accurate working length determination, it was observed that the endodontists used EALs more frequently than GDPs. Although technological advancements have improved the reliability of EALs, this study highlights the need for continued training, increased accessibility to affordable devices, and further research into optimizing their performance in complex cases.

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