Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 18s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Assessment of the Knowledge, Attitude, and Practice of Root Canal Treatment Among Pediatric Dentists

Dr. Monal Karkar, Dr. Sandeep Kumar Swarnkar, Dr. Rajashree Anannya Dutta, Dr. Priyam Pratim Saikia, Dr. Apoorvi Verma Baghel, Dr. Manishi Tiwari

[1]Senior Lecturer, Department of Oral and Maxillofacial Surgery, Rural Dental College, Pravara Institute of Medical Sciences, Loni, Maharashtra, India, monalk81290@gmail.com

[2]Reader, Department of Pediatric & Preventive Dentistry, Maharana Pratap College of Dentistry & Research Centre, Gwalior, Madhya Pradesh, India sandeepswarnkar98@gmail.com

[3]Lecturer, Department of Pediatric and Preventive Dentistry, Government Dental College, Silchar, Assam, India dranannyadutta@gmail.com

[4]Post Graduate, Department of Pediatric & Preventive Dentistry, Maharana Pratap College of Dentistry & Research Centre, Gwalior, Madhya Pradesh, India pratimsaikiapriyam@gmail.com

[5]Post Graduate, Department of Pediatric & Preventive Dentistry, Maharana Pratap College of Dentistry & Research Centre, Gwalior, Madhya Pradesh, India apoorviverma1423@gmail.com

[6] Consultant Pediatric Dentist, Gwalior, Madhya Pradesh, India mtiwari675@gmail.com

Corresponding author –
Dr. Sandeep Kumar Swarnkar,
sandeepswarnkar98@gmail.com

Cite this paper as: Dr. Monal Karkar, Dr. Sandeep Kumar Swarnkar, Dr. Rajashree Anannya Dutta, Dr. Priyam Pratim Saikia, Dr. Apoorvi Verma Baghel, Dr. Manishi Tiwari, (2025) Assessment of the Knowledge, Attitude, and Practice of Root Canal Treatment Among Pediatric Dentists. *Journal of Neonatal Surgery*, 14 (18s), 394-400.

ABSTRACT

Background: Root canal treatment (RCT) is vital in pediatric dental care to preserve primary and young permanent teeth. Despite its significance, variations in pediatric dentists' knowledge, attitude, and practice (KAP) can influence treatment outcomes. This study aimed to assess the current status of KAP regarding RCT among pediatric dental practitioners.

Aim: To evaluate the KAP of root canal treatment among pediatric dentists and identify factors influencing their clinical decision-making.

Methods: A cross-sectional, questionnaire-based study was conducted among 216 pediatric dentists. A structured and validated online questionnaire was distributed, covering demographic data and specific questions related to RCT KAP. Descriptive statistics, Chi-square tests, t-tests, ANOVA, and Spearman's correlation were used for data analysis. A p-value < 0.05 was considered statistically significant.

Results: Most participants (52.3%) demonstrated moderate knowledge of RCT, while 30.1% showed good knowledge. Most respondents acknowledged the importance of RCT but cited behavioral challenges and anatomical complexity as obstacles. Clinical practice patterns revealed acceptable use of resorbable materials and apex locators, though only 47.7% attended regular continuing education programs. Statistically significant correlations were found between knowledge and both attitude ($r = 0.42$, $p < 0.001$) and practice ($r = 0.39$, $p < 0.01$), indicating that improved knowledge positively influenced professional behavior.

Conclusion: While pediatric dentists generally maintain a positive attitude toward RCT, gaps in knowledge and practice remain. Continuous education and structured training programs are essential to enhance clinical competency and ensure standardized care in pediatric endodontics.

Keywords: Attitude, Knowledge, Pediatric dentists, Practice, Root canal treatment

1. INTRODUCTION

Dental caries remains one of the most prevalent chronic diseases affecting children worldwide. When left untreated, it often progresses to pulpal involvement, requiring endodontic intervention [1]. Root canal treatment (RCT) is a critical therapeutic procedure aimed at preserving decayed or traumatized teeth, especially in the pediatric population where early tooth loss can have significant developmental and functional consequences [2]. In pediatric dentistry, RCT is not only a technical challenge but also an emotional and behavioral one, due to the unique anatomical, psychological, and compliance-related aspects of treating young patients [3]. Given the complexity and importance of endodontic procedures in children, it becomes imperative to evaluate pediatric dentists' knowledge attitude practice (KAP) related to RCT to ensure high standards of care [4].

Pediatric endodontics involves procedures that are distinct from adult endodontics due to the differing anatomy of primary and developing permanent teeth. Primary teeth have thinner enamel, larger pulp chambers, and more tortuous root canals, all of which require specialized knowledge and adapted techniques for effective treatment. Moreover, these teeth play a vital role in speech development, mastication, and guidance for the eruption of permanent teeth [5]. Therefore, their preservation through endodontic therapy, when indicated, should be a priority in pediatric dental care. However, the clinical decision to perform RCT on primary or young permanent teeth is often influenced by the dentist's training, confidence, and interpretation of the evidence base surrounding treatment protocols [6].

While advancements in dental materials, instrumentation, and techniques have improved the predictability and success of pediatric RCT, the variability in clinical outcomes remains a concern. Literature suggests that a significant proportion of failures in pediatric endodontic treatment can be attributed to operator-related factors, such as insufficient debridement, under-filling or over-filling of canals, and lack of aseptic protocol adherence [7]. These errors often stem from gaps in foundational knowledge, outdated practices, or a lack of continuous professional development. Therefore, assessing the level of knowledge among pediatric dentists is critical to identifying areas where educational reinforcement is needed [8].

Attitudes toward endodontic procedures also play a pivotal role in shaping clinical behavior. Some pediatric dentists may avoid RCT in favor of extractions due to time constraints, perceived complexity, or a lack of confidence in their skills. Others may opt for minimally invasive treatments without fully considering long-term outcomes [9]. A dentist's attitude is influenced by multiple factors, including academic exposure during training, clinical experiences, perceived patient cooperation, and institutional guidelines. Negative or overly cautious attitudes toward RCT may contribute to under utilizing procedures that could preserve natural dentition and improve oral health outcomes in children [10].

Equally important is the actual practice of RCT among pediatric dentists. Best practices are guided by evidence-based clinical protocols, such as those advocated by the American Academy of Pediatric Dentistry (AAPD) and other professional bodies [11]. These include proper diagnosis through clinical and radiographic evaluation, appropriate case selection, meticulous cleaning and shaping of root canals, and obturation with resorbable materials in primary teeth. However, adherence to such guidelines varies across practitioners, and deviations may be due to clinical inexperience, lack of resources, or inconsistencies in postgraduate training. Evaluating practice patterns provides a window into real-world application and reveals whether theoretical knowledge is effectively translated into patient care [12].

Globally, several studies have attempted to explore KAP related to endodontic treatment, but most have focused on general dentists or endodontic specialists, often overlooking pediatric dentists as a distinct group. Pediatric dentists perform RCT themselves and often serve as the first point of contact for children requiring pulpal therapy [13]. Therefore, their competence and confidence in delivering RCT directly impact treatment outcomes. Moreover, as gatekeepers of pediatric oral health, they play a vital role in counseling parents, managing child behavior, and making informed decisions about pulp therapy options. Thus, there is a pressing need to assess their current status of KAP concerning RCT [14].

In countries where pediatric dentistry is rapidly evolving, understanding the barriers that limit the effective delivery of endodontic care is essential. These barriers may include lack of access to advanced training, limited continuing dental education opportunities, high patient load, and inconsistent application of clinical guidelines. An in-depth KAP assessment can help identify such gaps and offer data-driven insights for curriculum development, training programs, and policymaking. This is especially relevant in a landscape with growing emphasis on preventive and conservative management of oral diseases in children [15].

The present study aims to assess the KAP of root canal treatment among pediatric dentists. By identifying strengths and weaknesses in current approaches, this research seeks to contribute toward standardizing care, enhancing clinical decision-making, and ultimately improving the oral health outcomes of pediatric patients. The findings of this study are

expected to inform educators, professional associations, and policymakers in tailoring educational interventions and clinical guidelines that better support pediatric dental practitioners in their endodontic practice.

2. STUDY DESIGN

This study employed a cross-sectional questionnaire-based survey to assess KAP regarding RCT among pediatric dentists. The study was designed to collect quantitative data over a defined period, ensuring a snapshot of current trends and perceptions in pediatric endodontics.

3. STUDY POPULATION AND SAMPLING

The target population included licensed pediatric dentists practicing in private and public sectors. Eligibility criteria required participants to have a postgraduate qualification in pediatric dentistry and be actively practicing at the time of the survey.

A convenience sampling technique was used to recruit participants. Invitations were distributed through emails, professional pediatric dental forums, and social media platforms targeting dental professionals. Participation was voluntary, and informed consent was obtained from all respondents before participation.

4. SAMPLE SIZE CALCULATION

The sample size was calculated based on an estimated response proportion of 50% to ensure maximum sample variability, with a 95% confidence interval and a 5% margin of error. Using a standard sample size formula for cross-sectional studies:

$$n = Z\,2 \cdot p(1-p)\,d\,2 n = \{Z^2\,p(1-p)\}\{d^2\} n = d\,2\,Z\,2 \cdot p(1-p)$$

Where:

- Z=1.96Z = 1.96Z=1.96 (standard normal variate for 95% CI)
- p=0.5p = 0.5p=0.5 (estimated proportion)
- d=0.05d = 0.05d=0.05 (margin of error)

The minimum sample size was calculated as 384 participants. However, due to the specificity of the target population, the final number of responses included in the analysis was determined by the total number of completed and valid responses received during the study period.

5. DEVELOPMENT OF THE QUESTIONNAIRE

A structured, self-administered questionnaire was developed after an extensive review of relevant literature and previously validated tools in similar KAP studies. The questionnaire was pre-tested on a small group of pediatric dentists (n=10) to ensure clarity, relevance, and reliability. Necessary modifications were made based on feedback.
The final questionnaire consisted of four sections:

1. **Demographic Information:** Age, gender, years of practice, workplace setting (private/public), and location.
2. **Knowledge:** Multiple-choice questions (MCQs) focused on indications for RCT in children, material selection, procedural steps, and complications.
3. **Attitude:** Statements measured on a 5-point Likert scale (strongly agree to strongly disagree) to assess perceptions regarding the importance, efficacy, and challenges of pediatric RCT.
4. **Practice:** Questions assessing clinical routines, use of guidelines, case selection criteria, and treatment preferences.

6. DATA COLLECTION PROCEDURE

Data collection was conducted over a period of two months. The questionnaire was distributed electronically via Google Forms to ensure wide reach and ease of access. A reminder was sent after two weeks to increase response rates. Responses were automatically collected and securely stored in a password-protected database accessible only to the research team.

7. DATA ANALYSIS

The collected data were exported to Microsoft Excel and then imported into Statistical Package for Social Sciences (SPSS) version 26.0 for analysis.

- **Descriptive statistics** were used to summarize demographic data and KAP responses. Frequencies, percentages, means, and standard deviations were calculated.
- **Knowledge scores** were computed by assigning one point for each correct answer. A cumulative score was used to categorize knowledge as "good," "moderate," or "poor" based on tertile distribution.
- **Chi-square tests** were used to evaluate associations between categorical variables (e.g., years of experience and knowledge level).
- **T-tests and ANOVA** were employed to compare mean scores between different demographic groups.
- **Spearman's correlation** was applied to assess the relationship between knowledge, attitude, and practice scores.

A p-value of < 0.05 was considered statistically significant.

8. ETHICAL CONSIDERATIONS

Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Participation was voluntary, and no personal identifying information was collected, ensuring anonymity and confidentiality. Informed consent was implied through the submission of the completed online questionnaire.
A total of 216 pediatric dentists participated in the study. The majority of respondents were female (62.5%), with most participants aged between 31–40 years (48.1%). Approximately 56.9% had between 5–10 years of clinical experience, and 61.1% were practicing in private clinics.

9. KNOWLEDGE ASSESSMENT

Knowledge scores were evaluated based on correct responses to 10 key items regarding root canal treatment in pediatric dentistry. The mean knowledge score was 6.7 ± 1.8 (out of 10). Participants were categorized as having good (scores ≥ 8), moderate (5–7), or poor (≤ 4) knowledge. Most respondents (52.3%) had moderate knowledge, followed by good knowledge (30.1%) and poor knowledge (17.6%).
The areas of weakest knowledge were related to choice of obturation materials in primary teeth and identification of ideal working length. Knowledge scores were significantly associated with years of experience ($p = 0.012$), with higher scores seen among those with over 10 years of practice.

Table 1. Knowledge Level of Participants

Knowledge Category	Frequency (n)	Percentage (%)
Good (≥ 8)	65	30.1%
Moderate (5–7)	113	52.3%
Poor (≤ 4)	38	17.6%

10. ATTITUDE ASSESSMENT

Attitudes were assessed using a 5-point Likert scale on statements related to the importance of RCT, perceived difficulty, and treatment outcomes. Most participants (81.5%) agreed that RCT is important in maintaining pediatric oral health. However, 37.9% of respondents felt that RCT in children is more challenging than extractions due to behavioral issues and complexity.
A positive correlation was found between knowledge and attitude scores ($r = 0.42$, $p < 0.001$), suggesting that dentists with better knowledge tended to have more favorable attitudes toward RCT.

11. PRACTICE ASSESSMENT

Practice-related questions assessed the clinical approaches used during RCT. The majority (72.2%) reported using resorbable obturation materials for primary teeth, and 61.6% used apex locators in determining working length. About 68.5% followed established guidelines such as those provided by the AAPD.
Interestingly, only 47.7% regularly attended continuing dental education (CDE) programs on endodontics in children. There was a significant association between regular CDE participation and better practice scores ($p = 0.031$).

Table 2. Practice Behaviors Among Pediatric Dentists

Practice Parameter	Yes (%)	No (%)
Use of resorbable obturation material	72.2	27.8
Use of apex locator	61.6	38.4
Follows pediatric endodontic guidelines	68.5	31.5
Attends CDE programs regularly	47.7	52.3

12. OVERALL KAP RELATIONSHIP

A moderate positive correlation was observed between knowledge and practice ($r = 0.39$, $p < 0.01$) and between attitude and practice ($r = 0.36$, $p < 0.05$), indicating that both knowledge and attitude positively influence clinical practices among pediatric dentists.

13. DISCUSSION

The present study aimed to assess the knowledge, attitude, and practice (KAP) of root canal treatment (RCT) among pediatric dentists. With 216 participants, this study provides valuable insights into how pediatric dentists perceive and implement endodontic procedures in children, revealing both strengths and areas for improvement within the profession [16].

The overall knowledge of pediatric dentists regarding RCT was found to be moderate, with a mean score of 6.7 out of 10. Although a significant number of participants demonstrated good knowledge, specific gaps were evident—particularly in areas such as obturation materials for primary teeth and determination of working length. These findings are consistent with previous studies where knowledge deficits were identified in technique-sensitive steps of endodontic therapy [17].

One notable observation was the positive association between years of clinical experience and knowledge levels, suggesting that practical exposure contributes to better understanding. However, the persistence of knowledge gaps among even experienced practitioners highlights the need for ongoing professional development and reinforcement of evidence-based practices [18].

Attitudes toward RCT were generally positive. Most participants acknowledged the importance of preserving primary and young permanent teeth through endodontic procedures. However, a substantial portion expressed concern over the complexity of RCT in pediatric patients, especially due to behavioral management challenges and the anatomical variability of developing dentition [19].

This perception could contribute to clinical decisions that favor extractions over endodontic treatment. Similar sentiments have been reported in international studies, where time constraints and perceived procedural difficulty influenced treatment choices in pediatric settings [20].

The significant positive correlation between knowledge and attitude indicates that improved understanding can shape more favorable perceptions and confidence in performing RCT. Thus, interventions aimed at enhancing knowledge may have a dual benefit—boosting both technical capability and motivation [21].

In terms of practice, the results revealed a generally acceptable standard of care. Most participants reported using resorbable obturation materials, following pediatric-specific guidelines, and utilizing apex locators for accurate working length determination. These practices reflect a level of adherence to recommended protocols, though there is clear room for standardization and increased consistency [22].

A concerning finding was that less than half of the participants reported attending regular CDE programs related to endodontics in children. This trend raises questions about the accessibility and perceived value of continuing education. Given the dynamic nature of endodontic techniques and material science, a lack of ongoing training may contribute to stagnation or outdated practices in clinical care [23].

The significant correlation between CDE attendance and better practice patterns suggests that structured educational interventions can directly improve clinical performance. Encouraging mandatory or incentivized participation in pediatric endodontic workshops and updates may be a viable strategy to bridge practice gaps [24].

14. LIMITATIONS

The use of convenience sampling may limit the generalizability of the findings. Additionally, since the data was self-reported, there may be an element of response bias, with participants potentially overestimating their knowledge or adherence to best practices.

15. FUTURE AIMS AND SCOPE

To bridge the identified gaps in pediatric endodontic knowledge and clinical application, future directions should focus on harnessing emerging technologies such as Artificial Intelligence (AI), the Metaverse, Augmented Reality (AR), and Virtual Reality (VR) to enhance education, diagnosis, behavior management, and procedural training [25].

AI-based decision support systems can revolutionize pediatric endodontics by providing real-time diagnostics, treatment planning, and error prediction based on clinical and radiographic data. Integrating AI into dental software can help clinicians determine the ideal working length, detect missed canals, and recommend obturation techniques tailored to the unique anatomy of primary teeth. Moreover, predictive analytics can assist in anticipating child behavior during treatment, thus enabling better preparation for behavior guidance strategies [26].

AR and VR technologies offer immersive simulations that can be used for training pediatric dentists in complex endodontic procedures without the need for direct patient interaction [27]. Through haptic feedback and visual overlays, these technologies can replicate tactile sensations and anatomical variations, thereby improving procedural accuracy and

clinical confidence. VR-based behavioral management tools may also be used in clinics to reduce anxiety in young patients by immersing them in calming, interactive environments during treatment [28].

The integration of pediatric endodontics into the Metaverse could enable a global, collaborative platform for continuing dental education (CDE), case discussions, and interactive training sessions. Dental professionals from around the world could engage in virtual classrooms, observe live endodontic procedures in 3D, and participate in simulated treatment planning sessions using avatars and virtual dental operatory environments [29].

Future research should explore the efficacy of these technologies in improving the knowledge, attitude, and practice behaviors of pediatric dentists. Moreover, policies should aim to encourage their integration into dental curricula and CDE frameworks, supported by institutional investments and public-private partnerships.

By embracing these innovations, the pediatric dental community can work toward standardizing care, reducing practice variability, and ultimately improving outcomes for young patients requiring root canal therapy.

16. CONCLUSION

This cross-sectional study provides valuable insights into the KAP of pediatric dentists regarding RCT in children. While the majority of participants demonstrated moderate knowledge and favorable attitudes toward pediatric endodontics, critical knowledge gaps persist, particularly in areas such as obturation material selection and working length determination. The findings also highlight that greater clinical experience and regular participation in continuing dental education are significantly associated with improved knowledge and practice behaviors. Furthermore, positive correlations between knowledge, attitude, and practice suggest that educational interventions targeting these dimensions can enhance clinical competence and patient care. These results underscore the need for ongoing professional development and standardized training to ensure optimal outcomes in pediatric endodontic treatment.

CONFLICTS OF INTEREST: NIL

FINANCIAL SUPPORT: NIL

REFERENCES

[1] Al-Nahlawi T, Doumani M, Alalo HA, Habib A. Dentists' knowledge, attitude and practice of root canal treatment procedure: Survey-based research. J Contemp Dent Pract. 2019; 20(3):347-54.

[2] Amorim LDFGD, Toledo OAD, Estrela CRDA, Decurcio DDA, Estrela C. Antimicrobial analysis of different root canal filling pastes used in pediatric dentistry by two experimental methods. Braz Dent J. 2006;17:317-22.

[3] Patil PD, Katge AF, Rusawat DB. Knowledge and attitude of pediatric dentists, general dentists, postgraduates of pediatric dentistry, and dentists of other specialties toward the endodontic treatment of primary teeth. J Orofac Sci. 2016; 8(2):96-101.

[4] Koopaeei MM, Inglehart MR, McDonald N, Fontana M. General dentists', pediatric dentists', and endodontists' diagnostic assessment and treatment strategies for deep carious lesions: A comparative analysis. J Am Dent Assoc. 2017; 148(2):64-74.

[5] Nayak UA, Wadhwa S, Kashyap N, Prajapati D, Mahuli AV, Sharma R. Knowledge and practice of, and attitudes toward, pulp therapy in deciduous teeth among pediatric dentists in India. J Investig Clin Dent. 2018; 9(1):e12284.

[6] Davidovich E, Pessov Y, Baniel A, Ram D. Levels of stress among general practitioners, students and specialists in pediatric dentistry during dental treatment. J Clin Pediatr Dent. 2015; 39(5):419-22.

[7] Halawany HS, Salama F, Jacob V, Abraham NB, Moharib TNB, Alazmah AS, Al Harbi JA. A survey of pediatric dentists' caries-related treatment decisions and restorative modalities – A web-based survey. Saudi Dent J. 2017; 29(2):66-73.

[8] Lee SM, Yu YH, Karabucak B. Endodontic treatments on permanent teeth in pediatric patients aged 6–12 years old. J Dent Sci. 2023; 18(3):1109-15.

[9] Acharya S. Knowledge and attitude of general and specialist dentist in pediatric dentistry: A pilot study in Odisha, India. Indian J Dent Res. 2019; 30(2):170-4.

[10] Ballikaya E, Koc N, Avcu N, Cehreli ZC. The quality of root canal treatment and periapical status of permanent teeth in Turkish children and teens: A retrospective CBCT study. Oral Radiol. 2022; 38(1):1-11.

[11] Mehta DN, Dave BH, Bargale SS, Poonacha KS, Mulchandani V, Thomas PS. Knowledge, attitude, and practice among pediatric dentists regarding the use of rotary endodontic instruments for endodontic treatment in India. Indian J Oral Health Res. 2017; 3(1):23-7.

[12] Bowen JL, Mathu-Muju KR, Nash DA, Chance KB, Bush HM, Li HF. Pediatric and general dentists' attitudes toward pulp therapy for primary teeth. Pediatr Dent. 2012; 34(3):210-5.

[13] Moskovitz M, Sammara E, Holan G. Success rate of root canal treatment in primary molars. J Dent. 2005; 33(1):41-7.

[14] Jindal L, Bhat N, Mehta S, Bansal S, Sharma S, Kumar A. Rotary endodontics in pediatric dentistry: Literature review. Int J Health Biol Sci. 2020; 3(2):9-13.

[15] Monsef E, Goodman X, Patil R, White SN. Dentists' knowledge of non-surgical root canal treatment, a systematic review. J Dent. 2024;139:104975.

[16] Elbahary S, Rosen E, Haj-Yahya S, Elias MG, Talmi S, Tsesis I, Slutzky H. The effect of general anesthesia on the outcome of root canal treatment in pediatric patients—A retrospective cohort study. Children. 2023; 10(3):520.

[17] Moskovitz M, Yahav D, Tickotsky N, Holan G. Long-term follow up of root canal treated primary molars. Int J Paediatr Dent. 2010; 20(3):207-13.

[18] Alqaderi HE, Al-Mutawa SA, Qudeimat MA. MTA pulpotomy as an alternative to root canal treatment in children's permanent teeth in a dental public health setting. J Dent. 2014; 42(11):1390-5.

[19] Khullar P, Raisingani D, Gupta S, Khatri RK. A survey report on effect of root canal fillings and coronal restorations on the periapical status of endodontically treated teeth in a selected group of population. Int J Clin Pediatr Dent. 2013; 6(2):89-94.

[20] Jeevanandan G, Govindaraju L. Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: A double blinded randomised clinical trial. Eur Arch Paediatr Dent. 2018; 19(4):273-8.

[21] Halawany HS, Salama F, Jacob V, Abraham NB, Moharib TNB, Alazmah AS, Al Harbi JA. A survey of pediatric dentists' caries-related treatment decisions and restorative modalities – A web-based survey. Saudi Dent J. 2017; 29(2):66-73.

[22] Nayak UA, Wadhwa S, Kashyap N, Prajapati D, Mahuli AV, Sharma R. Knowledge and practice of, and attitudes toward, pulp therapy in deciduous teeth among pediatric dentists in India. J Investig Clin Dent. 2018; 9(1):e12284.

[23] Al-Nahlawi T, Doumani M, Alalo HA, Habib A. Dentists' knowledge, attitude and practice of root canal treatment procedure: Survey-based research. J Contemp Dent Pract. 2019; 20(3):347-54.

[24] Suresh A, Naidu SN, Inginshetty V, Ravi R. Artificial intelligence and deep learning in endodontics: A literature review. Oral Sphere J Dent Health Sci. 2025; 1(2):111-5.

[25] Kashwani R, Kulkarni V, Salam S, Sharma S, Rathi P, Gupta S, Sinha P, Kumari A, Sharma A. Virtual vs augmented reality in the field of dentistry. Community Pract. 2024; 21(3):597-603.

[26] Kashwani R, Jose AT, Gambhir S, Virk S, Roy S. The role of the metaverse in revolutionizing dental practice: Implications across all departments. Int Dent J Stud Res. 2024; 12(3):157-60.

[27] Suresh A, Naidu SN, Inginshetty V. ENDO AI: A novel artificial intelligence framework for predicting treatment outcomes in endodontic therapy. J Med Dent Sci Res. 2025; 12(2):12-9.

[28] Brar ADK, Pallavi K, Das M, Saxena P, Kulkarani K, Priya P, Kashwani R. Metaverse in dentistry: Bridging virtual innovation with real-world patient care and education. Bioinformation. 2025; 21(2):262-7.