**ORIGINAL ARTICLE**

# A CROSS-SECTIONAL STUDY ON MODERN TECHNOLOGIES IN DENTAL PRACTITIONERS OF ENDODONTICS IN ROMANIA BASED ON A QUESTIONNAIRE

Anca Gabriela Gheorghe[1], Alexandra Carina Bănică[1], Lelia Mihaela Gheorghiță[1*], Oana Andreea Diaconu[1], Cezar Tiberiu Diaconu[1], Mihaela Jana Țuculină[1]

[1] Endodontics, Faculty of Dentistry, University of Medicine and Pharmacy of Craiova, Romania

All authors contributed equally to this work.

[*] Corresponding author:
**Lelia Mihaela Gheorghiță**
Endodontics, University of Medicine and Pharmacy of Craiova, Romania
Email:
*leliagheorghita@yahoo.com*

**Abstract**: (1) *Background*: The constant technological progress, occurring sometimes at a rapid pace, can be challenging for some dentists, demanding significant additional effort to acquire knowledge and adapt to new techniques. New methods and materials should be implemented throughout the medical field, regardless of the specialty, from establishing the diagnosis using three-dimensional imaging to the actual endodontic treatment. (2) *Methods*: This cross-sectional study was designed to assess Romanian dentists' use of modern endodontic techniques and materials through an online questionnaire targeting dentists who perform endodontic treatments as part of their clinical practice. The survey was conducted over seven months, from November 2022 to May 2023. (3) *Results*: 207 fully validated responses were obtained, resulting in a response rate of 69%. (4) *Conclusions*: Upon analysis of the questionnaire responses, a substantial proportion of medical professionals demonstrate openness to the utilization of contemporary technological advancements within the field of endodontics.

**Keywords**: endodontics, questionnaire, modern technologies

## 1. Introduction

The development of technologies, methods, and materials is prevalent nowadays, regardless of the field of practice. In the medical field, practitioners are in a continuous process of assimilating new concepts. Most technological advancements aim to facilitate the establishment of diagnoses, data interpretation, and the treatment process. However, choosing specific equipment or technology requires thorough information gathering beforehand and passing it through one's decision-making filter before being applied to in vivo treatments on patients [1].

The general dentist specialized in a certain branch of dentistry should always gain an in-depth understanding of a particular aspect of oral care, and continuous learning is their obligation through participation in specialized conferences and the study of international literature, which is constantly enriched with new insights [2].

From establishing the diagnosis using three-dimensional imaging to the actual endodontic treatment, new methods and materials should be implemented throughout the entire medical field, regardless of the specialty. CBCT is gradually replacing conventional retro-alveolar radiography; the endodontic access cavity is made using special burs or, even more recently, using a laser; the mechanical preparation of the root canals benefits from a multitude of file systems to choose from, which is beneficial in decreasing the working time and increasing the efficiency of the treatment; also, endodontic irrigation uses certain chemicals whose effect can be enhanced by different methods; canal obturation benefits from an explosion of materials and techniques; the definitive coronal restoration is, more recently, fully realized by using CAD/CAM systems and 3D printers [2,3].

This constant technological progress, occurring sometimes at a rapid pace, can be challenging for some dentists, demanding additional effort to acquire knowledge and adapt to new techniques. Moreover, using the dental microscope, scanning systems, and 3D printers may occasionally require physics or computer science knowledge that an early-generation medical practitioner might not possess [3-5].

Therefore, the advancements made in the technical and technological area require well-informed doctors who have an open mindset while also having a solid foundation of knowledge to discern between what is truly useful and beneficial and what is merely a marketing strategy [1,2].

The purpose of this study was to analyze the extent to which the current dental equipment is used, especially the one used in the field of endodontics, among dentists in Romania.

The objectives were set:

- Establishing the most frequently used imaging method for the diagnosis of endodontic pathologies.
- Determination of the percentage in which magnification is used in performing root canal treatments.
- Determination of the most frequent type of instrumentation used in endodontics.
- Determination of the most appreciated methods of potentiating the effect of the irrigants.

 DOI: 10.58179/RJDR1401

- Determination of the most often used obturation techniques.
- Determination of the percentage of doctors who use bioceramic materials in their daily practice and their specialty.
- Determination of the indications for the use of calcium hydroxide in endodontics.
- Determination of the most approved methods of definitive restoration of endodontically treated teeth.

## 2. Materials and method

### Study design

This cross-sectional study was designed to assess the use of modern endodontic techniques and materials by Romanian dentists through an online questionnaire targeting dentists who perform endodontic treatments as part of their clinical practice. The survey was conducted over a seven-month period from November 2022 to May 2023.

The target population consisted of Romanian dentists across various specializations, including general dentistry, endodontics, and other relevant fields, provided they perform endodontic treatments in their practice. The sample size was calculated using the IDSurvey Sample Size Calculator, with a 90% confidence level and a 5% margin of error.

Based on an estimated population of dentists practicing in Romania who perform endodontic treatments, the required sample size was determined to be 194. This ensured adequate statistical power to generalize the findings to the broader population of Romanian dentists.

Participants were recruited through professional dental networks, online forums, and social media platforms dedicated to dentistry. In total, 300 dental practitioners were invited to participate in this survey, and 210 answers were obtained.

The inclusion criteria were:

- Dentists practicing in Romania.
- Currently performing endodontic treatments.

Exclusion Criteria were as follows:

- Incomplete responses to all questions
- The responses were collected beyond the specified time frame.

As a result of our exclusion criteria, only 207 fully validated responses were included.

### Data Collection

Data were collected via a structured, self-administered online questionnaire hosted on Google Forms (Google LLC, Mountain View, CA, USA). The questionnaire was developed by two members of the Endodontic Department in the Faculty of Dental Medicine, Craiova, Romania.

The questionnaire consisted of 15 closed-ended questions designed to assess the following:

- Demographics and Professional Information: The first two questions collected data on dental specialization and years of experience (seniority) in the dental field.
- Endodontic Practices: The remaining 13 questions focused on the participants' use of modern instruments, techniques, and materials in endodontic treatments, including the adoption of rotary and Ni-Ti instruments, magnification tools (e.g., microscopes), and advanced disinfection methods.

 DOI: 10.58179/RJDR1401

**Data Management and Statistical Analysis**

Data were securely stored on Google Forms and were accessible only to the research team. After the data collection period concluded, the dataset was exported for statistical analysis.

Descriptive statistics were used to summarize participant demographics and endodontic practices, with results presented as frequencies and percentages. Chi-square tests and t-tests were used to compare responses based on specialization, years of experience, and other demographic factors, where applicable. Statistical significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics for Windows software, Version 29.0 (Armonk, NY, USA: IBM Corp.).

## 3. Results

In this cross-sectional study conducted among dentists practicing endodontics in Romania, a total of 207 fully validated responses were obtained, resulting in a response rate of 69%.

Regarding the specialization of the doctors participating in this study, the first place was occupied by the General Dentistry specialization, with a percentage of 50.24%, followed by Endodontics (25.12%), Prosthetics (8.70%), Oral-Maxillo-facial Surgery (6.76%), Pedodontics (5.80%) and Orthodontics (3.38%), as shown in Table 1.

**Table 1**. Respondent distribution based on postgraduate training.

| Specialty | Number of Responses | Percentage (%) |
|---|---|---|
| General Dentistry | 104 | 50.24 |
| Endodontics | 52 | 25.12 |
| Prosthetics | 18 | 8.70 |
| Oral Maxillofacial Surgery | 14 | 6.76 |
| Pedodontics | 12 | 5.80 |
| Orthodontics | 7 | 3.38 |
| Total | 207 | 100.00 |

The work experience was almost equally distributed: more than 10 years (29.9%); less than 2 years (25.5%); 6-10 years (22.9%), and 2-5 years (21.7%).

When choosing the radiological methods used in establishing the diagnosis of endodontic diseases, the participants could select one or more answers. Thus, the results were as observed in Table 2: 38.20% responses for retro-alveolar radiography, 34.21% for orthopantomography (OPG), and 27.57% for CBCT. When the statistical analysis was performed, we found that there is a statistically significant difference in the use of CBCT in establishing the diagnosis of endodontic diseases ($p<0.001$) between Endodontics specialists and doctors from other or no specialty.

 DOI: 10.58179/RJDR1401

**Table 2**. Radiological Methods.

| Radiological Methods | Respondents | Percentage (%) |
|---|---|---|
| Retro-alveolar radiography | 115 | 38.20 |
| Orthopantomography | 103 | 34.21 |
| CBCT | 83 | 27.57 |

Regarding magnification, 37.61% of doctors do not use any kind of magnification method, while 34.86% use the microscope and 27.52% use loupes. It should be mentioned that this question had multiple answer options, so there are some respondents who use both methods of magnification (Table 3).

**Table 3**. Magnification Methods.

| Magnification Methods | Respondents | Percentage (%) |
|---|---|---|
| Yes-Microscope | 76 | 34.81 |
| Yes-Loupes | 60 | 27.52 |
| No | 82 | 37.61 |

Further statistical analysis of the data revealed that a significantly higher proportion of practitioners with Endodontics specialty used the microscope for magnification, compared with the other specialties, the difference being statistically significant ($p<0.001$).

When making the access cavity, the majority of doctors answered that they use special burs: 64.68%. Ultrasonic instruments are used by 27.77% of dentists, while the laser is used by only 7.53% of doctors participating in the questionnaire, as seen in Table 4.

**Table 4**. Access Cavity.

| Access Cavity | Respondents | Percentage (%) |
|---|---|---|
| Special Burs | 148 | 64.68 |
| Ultrasound Tips | 55 | 27.77 |
| Laser | 4 | 7.53 |

Regarding the creation of the access cavity, the doctors answered as follows: 50.3% of the doctors perform the conventional access cavity, 48.4% perform the conservative access cavity, and 1.3% perform the ninja access cavity (Figure 1). None of the doctors participating in the questionnaire made the access cavity directed to the openings of the root canals (truss access). When we compared the groups, we found out that there is a significant statistical correlation between doctors using magnification in their endodontic treatments and those performing the conservative and ninja access cavities ($p<0.001$).

 DOI: 10.58179/RJDR1401

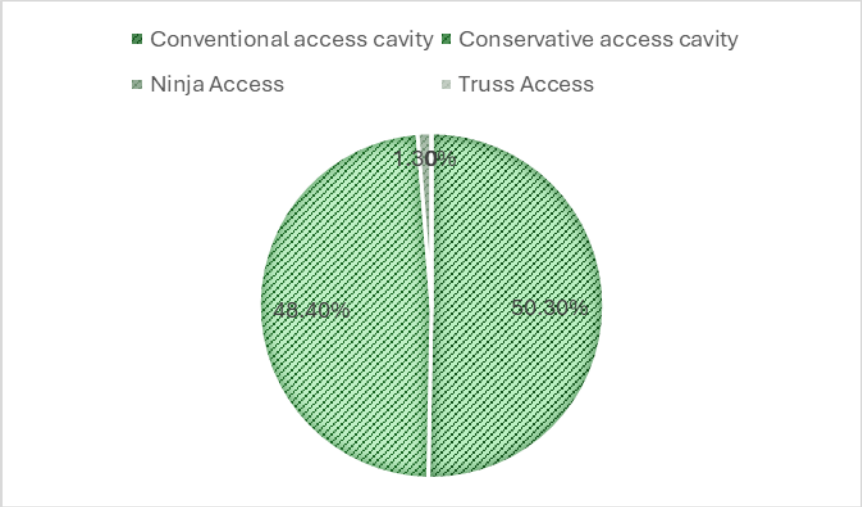


**Figure 1.** The preferred access cavity design.

The preferred instruments of the doctors participating in the questionnaire are Ni-Ti rotary instruments (40%), followed by manual instruments (35%) and memory-controlled rotary instruments (25%), as observed in Figure 2.

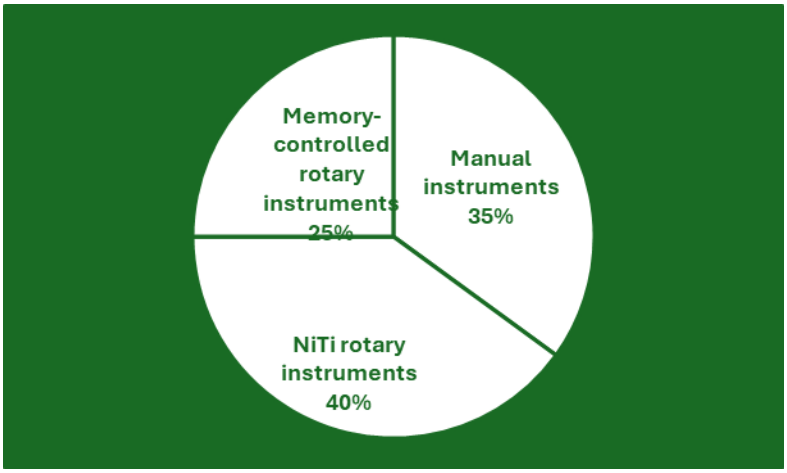


**Figure 2.** The preferred instruments.

In answering the following question, the participants expressed that they preferred the reciprocating movement (65.5%) despite continuous rotation (34.5%) (Figure 3). There was no statistically significant association between the specialty and the preference for a certain movement of the rotary endodontic instrument in root canal preparation ($p>0.001$).

 DOI: 10.58179/RJDR1401

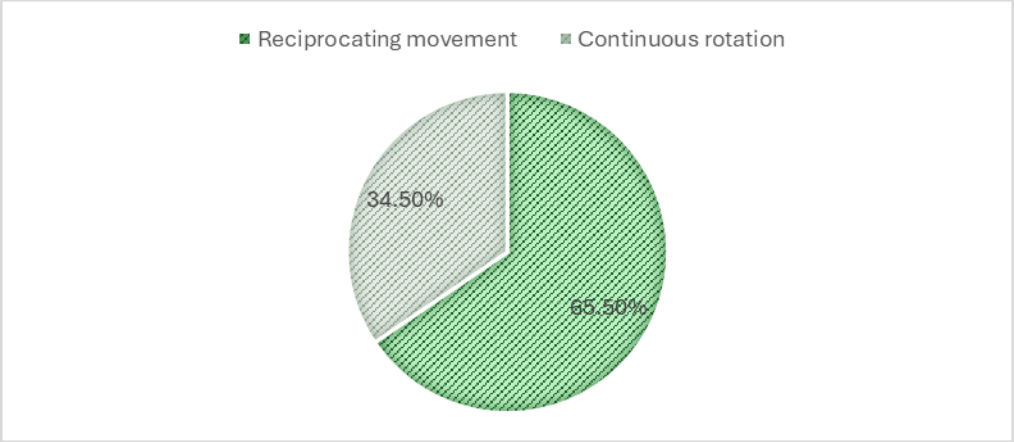


**Figure 3.** The preferred movement of the instruments.

Following the questionnaire, we found out that most of the doctors who completed it used additional means to enhance the effect of the irrigants, ultrasound being the favorite method (48.5%). At the opposite pole, 28.9% of the participants do not use additional means (Figure 4).

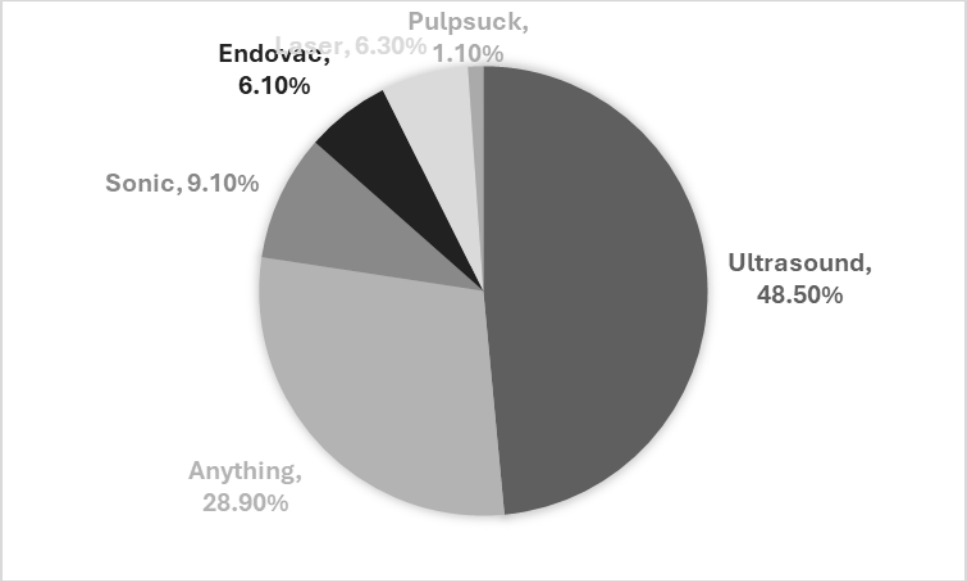


**Figure 4.** Additional means for irrigation.

In relation to the obturation technique, the doctors had six answer options, being able to choose one or more options. The preferred obturation technique was the single cone technique (29.58%), followed by warm vertical condensation (20.54%). The gutta-percha on rigid support had the lowest percentage (4.93%), as observed in Table 5.

 DOI: 10.58179/RJDR1401

**Table 5**. Obturation Technique.

| Method of obturation | Number of Responses | Percentage (%) |
|---|---|---|
| Single Cone | 108 | 29.58 |
| Warm vertical condensation | 75 | 20.54 |
| Injection | 64 | 17.53 |
| Cold lateral condensation | 62 | 16.98 |
| Continuous wave | 38 | 10.41 |
| Rigid obturation | 18 | 4.93 |
| Total | 365 | 100.00 |

Also, regarding root canal obturation, 55.2% of the respondents stated that they use bioceramic materials in its realization, while 44.8% deny their use. The statistical analysis showed a statistically significant difference between the Endodontics specialists and the other groups of respondents ($p<0.001$).

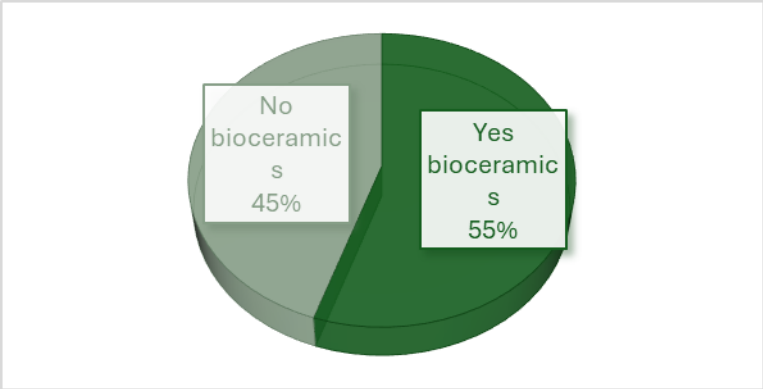


**Figure 5.** Use of bioceramics.

The following question aimed to identify the situations in which calcium hydroxide is used as a dressing between appointments. The question was multiple choice, and the doctors responded, as seen in Figure 6.

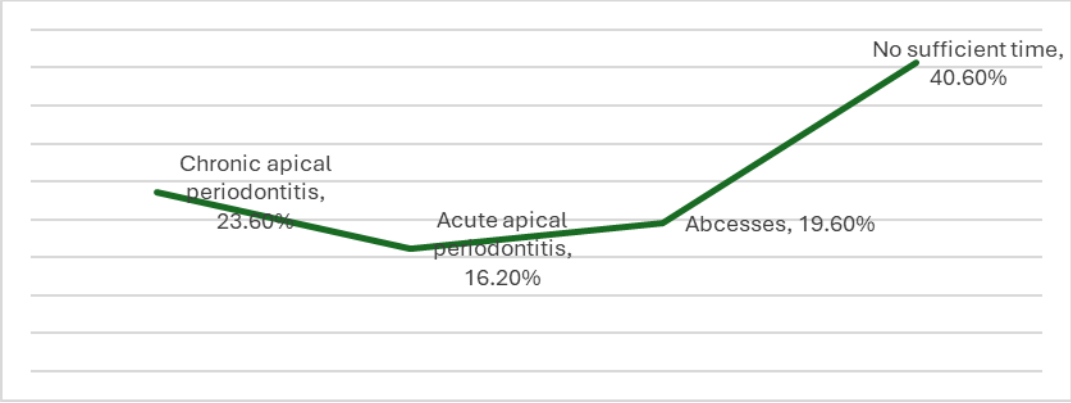


**Figure 6.** Use of Calcium Hydroxide.

 DOI: 10.58179/RJDR1401

Regarding the restoration of endodontically treated teeth, 63.40% of doctors prefer full-coverage crowns, while 36.6% perform Inlay or Overlay. Doctors could choose one, two, or all three answer options (Figure 7).

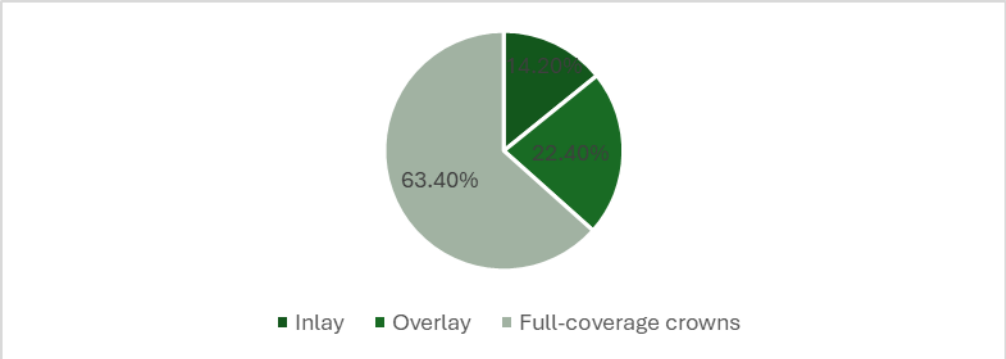


**Figure 7.** Final restoration of endodontic treated teeth.

## 4. Discussion

This study had as its starting point a questionnaire that included a total of 15 questions; the first two aimed at identifying specialization and work experience in dentistry, while the following 13 questions were designed to highlight the extent to which dentists use modern means and materials in the field of endodontics.

The work experience of the doctors varied. Most of the participants (29.9%) had over 10 years of experience. 25.5% of participants had less than 2 years, 22.9% had between 6 and 10 years, and only 21.7% had 2 and 5 years of experience.

Radiography is an essential method in endodontics for diagnosis, treatment planning, and execution, as well as for evaluating treatment success. In endodontics, image quality is extremely important for a correct interpretation of the endodontic system, visualizing possible canal curvatures, immediate postoperative assessment, and ongoing evaluation of treatment success [6]. OPG (Orthopantomography) is used for an overall assessment of the patient's dental status, providing a general view of the image and an easy visualization of the mandibular canal and the temporomandibular joint. Limitations of OPG include the anterior areas, nasal cavity floor, incisive foramen, and implant bony margins [7].

In our study, the majority of participants answered that they prefer radiography as an imaging method (38.20 % for retro-alveolar radiography and 34.21% for OPG), with CBCT being preferred by 27.57%. A similar study conducted by Mathew et al., in which the questionnaire was sent to doctors in Riyadh, Saudi Arabia, showed that the imaging method of choice was still radiography: 59.3% for conventional film radiography, 35.6% for digital radiography, and only 4% for CBCT [8].

In the same study, the majority of doctors (73.3%) responded that they have never used magnification tools such as loupes or microscopes, 16.3% use them occasionally, and only 3.7% use them every time [8]. The magnification-related results of this study are similar to the results of our study, with the

 DOI: 10.58179/RJDR1401

majority (37.61%) not using magnification tools, while 27.52% responded that they use loupes, and 34.86% use microscopes. These results are promising for Romania, where access to technology is becoming increasingly easier.

An ideal imaging technique must be accurate, simple to perform, non-destructive, and feasible in an in vivo scenario. It has been concluded that CBCT is the most accurate method for identifying the endodontic system [9]. CBCT has a lower cost and lower radiation exposure, with the radiation dose a patient is exposed to being three times greater compared to traditional OPG. Despite the increased radiation dose, studies have shown that CBCT identifies at least 20% more periapical lesions than periapical radiographs [7,9,10].

Dental microscopes provide greater magnification capacity than loupes. An in vitro study conducted by Park et al. in 2014 showed that the presence of the MB2 canal was identified in 15.8% using loupes and in 70.5% using a microscope [11]. Another study by Nath and Shetty in 2017, with the same purpose, had the following results: naked eye - 68%, loupes - 76%, microscope - 100% [12].

In order to analyze the effectiveness of loupes, Wong et al. [13] conducted a study with the purpose of comparing the time required for endodontic treatment with and without the use of loupes. The study results indicated that there is a time difference between endodontic treatments performed with and without loupes. The use of loupes helped reduce the time required for non-surgical endodontic treatments, and dentists' reluctance to use loupes due to the argument that treatment time would be increased was not supported. Dentists who performed treatments using loupes concluded that treatment efficiency and accuracy were enhanced.

Regarding the instruments used for access cavity preparation, the majority (64.68%) reported using special burs, while 27.77% used ultrasonic instruments and only 7.53% used lasers. An important requirement for burs used in access cavity preparation is that they create a clean, smooth, and minimally vibrating cut. In cases of acute apical periodontitis, burs should be chosen to minimize vibration [14]. Erbium-based lasers are currently used for hard dental tissue removal, including for creating endodontic access cavities [15,16].

Because it's known that endodontically treated teeth are more susceptible to fracture [17], the study by Aydin et al. aimed to compare the fracture resistance of endodontically treated teeth when access cavities were prepared using conventional burs and Erbium lasers. The conclusion was that no significant differences were found between the group of teeth treated with burs and the group treated with lasers. Thus, in correlation with previous studies, it was suggested that fracture resistance is correlated with significant loss of hard tissue or micro-cracks produced during access cavity preparation [18].

The preferred access cavity among Romanian dentists is the conventional access cavity (50.3%), closely followed by the conservative access cavity (48.4%). A small percentage (1.3%) use the Ninja access cavity. An ideal access cavity should allow for the complete removal of pulp tissue,

 DOI: 10.58179/RJDR1401

debris, and necrotic materials. However, it's important to note that the smaller the cavity, the higher the risk of bacterial contamination due to incomplete tissue removal and the higher the risk of missing some root canals [19]. Several authors maintain that the conservative access cavity does not provide endodontically treated teeth with more excellent fracture resistance than the traditional access cavity [20,21]. In a study by Tsotsis et al. [21], 56.6% of participants preferred to perform CEC (Conservative Endodontic Cavity), 42.7% preferred TEC (Traditional Endodontic Cavity), and only 0.7% preferred ultraconservative access cavities [21].

In our study, the majority of dentists (40%) reported using NiTi rotary instruments, while manual instrumentation was used by 35% of the dentists. About 25% used controlled memory instruments. Similarly, in Turkey, out of 204 dentists, 76% (n=155) reported using NiTi rotary instruments [22]. In Chennai, India, in 2018, 31% of dentists used only rotary instruments, 13% used only manual instruments, and 56% used both types [23]. In 2021, 42% used only manual instruments, 16% used only rotary instruments, and 42% used both types [24]. In Brazil, in 2018, 82.20% of endodontists and 74.30% of general dentists used continuous rotary motion with manual instruments, and 76.80% and 73.80%, respectively, used reciprocating systems in combination with manual instruments. Their reasons for choosing single-file reciprocating systems were faster preparation and obturation and improved endodontic technique [25].

The two movement options available to Romanian dentists for rotary instruments were reciprocal motion (65.5%) and continuous rotation (34.5%). It's important to note that this question allowed for multiple answers, meaning dentists could choose both options. During root canal preparation, when the instrument comes into contact with the canal walls, there are moment forces on the dentin that can result in dentin defects and later, vertical root fractures. It has been reported that reciprocal motion reduces torsional stress by periodically reversing the direction of rotation of the instrument. This can help reduce the magnitude of forces generated on dentin walls and prevent cracks and root fractures [26].

In 2024, C. Diaconu et al. found that continuous rotation movement was preferred by 47% of the respondents, while reciprocating movement was preferred by 20.4% of the study participants. These results are quite opposite to ours, even though the respondents were from Romania in both studies [27].

Based on the questionnaire, it was concluded that the majority of dentists in Romania use methods to enhance irrigation solutions, including ultrasonic devices, ultrasonic machines, Pulpsuck, Endovac, and lasers. 28.9% reported not using any irrigation enhancement methods. Conventional irrigation penetrates dentinal tubules to a depth of up to 130 microns, while bacterial colonies have been found even at a depth of 1.15 mm within the dentinal tubules beyond the main root canal [28]. Activation of the irrigant using laser-activated irrigation (LAI) technology allows Er,Cr:YSGG and Er:YAG lasers. The wavelengths of these

 DOI: 10.58179/RJDR1401

lasers range from 2,780 to 2,940 nm, making them absorbed by water and sodium hypochlorite [29]. Studies have reported that irradiating the root canal simultaneously or after the irrigation protocol (distilled water, EDTA, chlorhexidine, sodium hypochlorite) results in a similar or even improved morphological dentin surface pattern compared to after simple irrigation [28]. When laser irradiation occurs after EDTA irrigation, cleaner surfaces are achieved, with less debris, open dentinal tubules, and minimal thermal alteration compared to irradiation in a dry environment [30].

Root canal obturation is an important step in endodontic treatment, aiming to achieve a three-dimensional tight seal of the root canals. According to our study, the single-cone obturation technique was the winner, chosen by 29.58%. This technique is easy to perform, takes less time, and has a low cost [31]. Despite its advantages, the single-cone technique requires a significant amount of sealer, and therefore, the fluidity and physicochemical properties of the sealer play an essential role in the success of endodontic treatment [32].

In Nepal, according to Manandhar et al. 2020, the following results were obtained: single-cone technique 13.41%, lateral cold condensation 95.12%, vertical warm condensation 1.21%, and thermoplastic techniques 2.43% [33]. According to Geetha et al., lateral condensation in combination with sealer is the most accepted obturation technique among practitioners [34].

In 2020, Gheorghe A. et al. conducted a study in which they analyzed teeth with three types of root canal fillings - single cone, cold lateral condensation, and warm vertical condensation. Seventeen teeth were obturated using the single cone technique, and after extractions, they were examined using a stereo-microscope. The following observations were made based on the analysis: in all teeth, the cone was shorter than the working length and did not match the prepared shape of the root canal; macroscopic voids and infiltrations were identified in the sealer, which had uneven coloration; morphological variations such as canals dividing into the apical third or oval canals could not be obturated [35].

Bioceramic materials are biocompatible with human tissues and exhibit excellent sealing capacity. They also possess antibacterial and antifungal properties [36]. In our conducted study, the majority of healthcare professionals (55.2%) reported using bio-ceramic materials in performing root canal obturations. However, the percentage of professionals not using such materials (44.8%) is quite close to those who do. The most popular bioceramic materials used by medical practitioners in Romania include BioMTA (Cerkamed), Biodentine (Septodont), ProRoot MTA (Dentsply), and BioRoot RCS (Septodont). MTA (Dentsply-Tulsa Dental, Johnson City, TN, USA) is an osteoconductive, osteoinductive, and biocompatible material that reaches a pH of 12.5 three hours after preparation [36].

As a result, due to its strong alkaline pH, MTA has an effect on Enterococcus faecalis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Porphyromonas gingivalis, and Candida albicans [37,38]. Biodentine (Septodont, Saint Maur des Fosses, France) is a non-toxic bioceramic material that induces angiogenesis, cellular

 DOI: 10.58179/RJDR1401

differentiation, and mineralization. It presents several advantages over MTA, including easier handling, better mechanical properties, the ability to perform restorations in a single step, faster setting reaction, and a lower risk of bacterial contamination [36, 39].

Biocompatibility, excellent sealing ability, tissue conduction and induction, and a high success rate have made bioactive types of cement the materials of choice for performing root end fillings (apical obturations). Despite several cements being evaluated as materials for apical third obturation, MTA remains the gold standard and the reference point when testing new materials [40]. Several studies have assessed the influence of the material used in this type of obturation on treatment outcomes [41,42].

Bioactive endodontic types of cement can be used as root-filling materials on their own or in combination with gutta-percha. Several studies have shown successful treatments when using materials such as MTA Angelus, ProRoot MTA, Biodentine, BioAggregate, and CEM for obturating both temporary and permanent teeth with necrotic pulpal tissue, with complete or incomplete apex formation [43-50].

Numerous studies have highlighted the use of bioactive types of cement in treating cervical resorptions and internal and external root resorptions [51-54]. Due to its low compressive strength, MTA is not recommended for creating temporary or permanent coronal restorations. However, the manufacturer of the material Biodentine recommends its use for temporary coronal restorations. After 6 months, material abrasion was the reason patients returned to the clinic for definitive restoration [55]. The contact of Biodentine with dentin led to the forming of a thicker reparative dentin layer than Dycal in class V cavities [40].

In our study, most of the clinicians responded that they use calcium hydroxide as interim medication in cases where they cannot complete the root canal treatment in a single session (40.60%). In 2012, clinicians in Turkey used calcium hydroxide at a rate of 53.2% [22], and by 2015, the proportion had increased to 82.4% [22]. In Nepal, the percentage was 98.78% [33]. In Saudi Arabia, in 2014, only 4% used calcium hydroxide as intra-canal medication [56], and by 2015, the percentage had reached 36.3%, with 45.2% stating that they did not use any medicines between sessions [3]. The results obtained by Mathew et al. are lower compared to those obtained in Flanders, Belgium (69%), and in northern Jordan (63%) [3].

The protocol for multiple visits requires the placement of a medicament in the form of a paste into the root canal, with the purpose of disinfection [57]. Placing an antimicrobial agent in the root canal (for a week or more) allows the active ingredients to diffuse from the paste through the root canal into the root dentin, reaching microorganisms deep within dentinal tubules. The need for an intra-canal medicament is better in cases where present bacteria or fungi are resistant to conventional endodontic treatment. Such bacteria serve as sources of root canal reinfection. The active ingredients released from endodontic medicaments can penetrate dentinal tubules and neutralize bacteria at that level [58].

The most common intra-radicular medicament is calcium hydroxide. It can also

 DOI: 10.58179/RJDR1401

be used for apexification and direct capping procedures [59,60]. The released calcium ions play an important role in cellular stimulation, migration, and proliferation, and in the mineralization and repair of hard tissues [58].

Although this survey includes a limited number of respondents, the data obtained offer valuable insights and can serve to outline and compare the current standards of endodontic practice in Romania. Further research will undoubtedly make a significant contribution to the scientific literature. In this study, there is a lack of information regarding the objective evaluation of the respondents' practices. Additionally, it relies solely on the practitioners' self-assessments of the quality of their work, with no methods in place to objectively verify the correct application of medical techniques or proper use of materials and instruments. Conducting a cross-sectional radiological study with follow-up evaluations at specific intervals could offer more detailed insights into the quality of endodontic therapy performed by Romanian practitioners and yield more reliable data.

## 5. Conclusions

The aim of the questionnaire was to assess the protocols followed by dental practitioners in Romania and the degree of adoption of modern endodontic technology in root canal treatments.

Upon analysis of the questionnaire responses, a substantial proportion of medical professionals demonstrate openness to utilizing contemporary technological advancements in endodontics.

Nonetheless, it is noteworthy that certain phases of the endodontic treatment process continue to align with conventional methodologies among dentists in Romania, methods that have demonstrated their efficacy over time.

## References


1. Versiani M. Technology in Endodontics: A Double-Edged Sword? AAE. 2021.
2. Iandoloa A, Iandolob G, Malvanoc M, Pantaleoa G, Simeone M. Modern technologies in Endodontics. Giornale Italiano di Endodonzia. 2016;30: 2–9.
3. Ferreira I da C, Ferreira G da C, Tavares W.L.F., Côrtes MI de S, Braga T, Amaral RR. Use of technology in endodontics by undergraduate dental students in a south-eastern state of Brazil. European Journal of Dental Education. 2021;25(2): 225–231.
4. Kimura Y, Wilder-Smith P, Matsumoto K. Lasers in endodontics: a review. Int Endod J. 2000;33(3):173–85.
5. Kapetanaki I, Dimopoulos F, Gogos C. Traditional and minimally invasive access cavities in endodontics: a literature review. Restor Dent Endod. 2021;46(3):e46.
6. Lo Giudice R, Nicita F, Puleio F, Alibrandi A, Cervino G, Lizio AS, et al. Accuracy of periapical radiography and CBCT in endodontic evaluation. Int J Dent. 2018;2018:2514243. doi: 10.1155/2018/2514243.
7. Bonfanti E, Maddalone M, Pellegatta A, Citterio CL, Baldoni M. Digital orthopantomography vs cone beam computed tomography-part 2: a CBCT analysis of factors influencing the prevalence of periapical lesions. J Contemp Dent Pract. 2019;20(6):664–9. PMID: 31358706.
8. Mathew S, Nafea M. Evaluation of the current endodontic trends among general

dental practitioners and specialists in Riyadh, KSA. Int J Innov Educ Res. 2015;3:8–19. doi: 10.31686/ijier.vol3.iss9.428.
9. Patel S, Brown J, Semper M, Abella F, Mannocci F. European Society of Endodontology position statement: Use of cone beam computed tomography in endodontics. Int Endod J. 2019. doi:10.1111/iej.13187.
10. Maddalone M, Bonfanti E, Pellegatta A, Citterio CL, Baldoni M. Digital orthopantomography vs cone beam computed tomography-part 1: Detection of periapical lesions. J Contemp Dent Pract. 2019;20(5):593–7. PMID: 31316024.
11. Park E, Chehroudi B, Coil JM. Identification of possible factors impacting dental students' ability to locate MB2 canals in maxillary molars. J Dent Educ. 2014;78:789–95.
12. Nath KS, Shetty K. Comparative evaluation of second mesiobuccal canal detection in maxillary first molars using magnification and illumination. Saudi Endod J. 2017;7:166.
13. Wong AW, Zhu X, Zhang S, Li SK, Zhang C, Chu CH. Treatment time for non-surgical endodontic therapy with or without a magnifying loupe. BMC Oral Health. 2015;15:40. doi:10.1186/s12903-015-0025-7.
14. Adams N, Tomson PL. Access cavity preparation. Br Dent J. 2014;216(6):333–9. doi:10.1038/sj.bdj.2014.206.
15. Bahrololoomi Z, Heydari E. Assessment of tooth preparation via Er:YAG laser and bur on microleakage of dentin adhesives. J Dent (Tehran). 2014;11:172–8.
16. Stănuși A, Popa D, Ionescu M, Cumpătă C, Petrescu G, Țuculină MJ, Dăguci C, Diaconu O, Gheorghiță L. Analysis of temperatures generated during conventional laser irradiation of root canals—a finite element study. Diagnostics (Basel). 2023;13(10).
17. Pilo R, Metzger Z, Brosh T. Effect of root morphology on the susceptibility of endodontically treated teeth to vertical root fracture: An ex-vivo model. J Mech Behav Biomed Mater. 2017;69:267–74.
18. Aydın U, Aksoy F, Tosun S. Fracture resistance of root-filled teeth after cavity preparation with conventional burs, Er and Er,Cr lasers. Eur Oral Res. 2018;52(2):59–63.
19. Moore B, Verdelis K, Kishen A. Impacts of contracted endodontic cavities on instrumentation efficacy and biomechanical responses in maxillary molars. J Endod. 2016;42:1779–83.
20. Silva EJNL, Rover G, Belladonna FG, De-Deus G, da Silveira Teixeira C, da Silva Fidalgo TK. Impact of contracted endodontic cavities on fracture resistance of endodontically treated teeth: a systematic review of in vitro studies. Clin Oral Investig. 2018;22:109–18.
21. Tsotsis P, Dunlap C, Scott R, Arias A, Peters OA. A survey of current trends in root canal treatment: access cavity design and cleaning and shaping practices. Aust Endod J. 2021;47(1):27–33. doi:10.1111/aej.12449.
22. Küçükkaya Eren S, Gorduysus M, Gorduysus O, Anil D. A questionnaire survey on current endodontic practice of dental practitioners in Turkey. Clin Dent Res. 2015;101–9.
23. Patturaja K, Leelavathi L, Jayalakshmi S. Choice of rotary instrument usage among endodontists—a questionnaire study. Biomed Pharmacol J. 2018;11(2).
24. Saravanan K, Hameed S. Knowledge and practice of endodontic treatment carried out by general practitioners in Chennai: a questionnaire survey. Int J Soc Rehabil. 2021;6:36–9.

25. Georjutti R, Miura F, Faria R, De Martin A, Bueno C. Identification of the profile and perceptions of Brazilian dentists regarding the use of rotary and/or reciprocating instruments in endodontic treatment. Revistas. 2017;74:191.
26. Jamleh A, Komabayashi T, Ebihara A, et al. Root surface strain during canal shaping and its influence on apical microcrack development: a preliminary investigation. Int Endod J. 2015;48:1103–11.
27. Diaconu C, Gheorghita L, Diaconu A, Tuculina MJ, Gliga A, Gaeta C, et al. Current endodontic practices among Romanian dental practitioners: a cross-sectional study. Dent J. 2024;12:283.
28. Adrian ŞS, Lelia MG, Andreea S, Oana AD, Anca G, Ruxandra VG, et al. Endodontic bacterial reduction using diode laser radiation—short literature review. Rom J Oral Rehabil. 2020;12(3):8–19.
29. Meire MA, Poelman D, De Moor RJ. Optical properties of root canal irrigants in the 300–3,000 nm wavelength region. Lasers Med Sci. 2014;29(5):1557–62.
30. Olivi G, De Moor R, Divito E. Lasers in Endodontics—Scientific Background and Clinical Applications. 2016.
31. Girelli CF, Lacerda MF, Lemos CA, Amaral MR, Lima CO, Silveira FF, Nunes E. The thermoplastic techniques or single-cone technique on the quality of root canal filling with tricalcium silicate-based sealer: an integrative review. J Clin Exp Dent. 2022;14(7):e566–e572. doi: 10.4317/jced.59387.
32. Santos-Junior AO, Tanomaru-Filho M, Pinto JC, Tavares KIMC, Torres FFE, Guerreiro-Tanomaru JM. Effect of obturation technique using a new bioceramic sealer on the presence of voids in flattened root canals. Braz Oral Res. 2021;35:e028.
33. Manandhar A, Kunwar D, Shrestha S. Assessment of practice of endodontic treatment protocols among general dental practitioners in Pokhara, Nepal. Med J Pokhara Acad Health Sci. 2020;3(2):298–304.
34. Geetha RV, Veeraraghavan VP. Evaluation of antibacterial activity of five root canal sealants against Enterococcus faecalis: an in vitro study. Int J Pharm Pharm Sci Rev Res. 2016;40:221–3.
35. Gheorghe AG, Mercut V, Popescu SM, Tuculina MJ, Diaconu OA, Gheorghita LM, Gingu O. Microscopic study of the endodontic obturation sealing ability. Rom J Oral Rehabil. 2020;12(1):8–19.
36. Raghavendra SS, Jadhav GR, Gathani KM, Kotadia P. Bioceramics in endodontics: a review. J Istanbul Univ Fac Dent. 2017;51(3 Suppl 1):S128–S137. doi: 10.17096/jiufd.63659.
37. Pelepenko LE, Saavedra F, Antunes TBM, Bombarda GF, Gomes BPFA, Zaia AA, et al. Physicochemical, antimicrobial, and biological properties of White-MTAFlow. Clin Oral Investig. 2021;25:663–72.
38. Huang Y, Li X, Mandal P, Wu Y, Liu L, Gui H, Liu J. The in vitro antimicrobial activities of four endodontic sealers. BMC Oral Health. 2019;19:118.
39. Singh H, Kaur M, Markan S, Kapoor P. Biodentine: a promising dentin substitute. J Interdiscip Med Dent Sci. 2014;2:140.
40. Torabinejad M, Parirokh M, Dummer PMH. Mineral trioxide aggregate and other bioactive endodontic cements: an updated overview - part II: other clinical applications and complications. Int Endod J. 2018;51(3):284–317. doi: 10.1111/iej.12843.
41. Tortorici S, Difalco P, Caradonna L, Tete S. Traditional endodontic surgery versus modern technique: a 5-year controlled clinical trial. J Craniofac Surg. 2014;25:804–7.

42. Shinbori N, Grama AM, Patel Y, Woodmansey K, He J. Clinical outcome of endodontic microsurgery that uses EndoSequence BC root repair material as the root-end filling material. J Endod. 2015;41:607–12.
43. Costa GM, Soares SM, Marques LS, Gloria JC, Soares JA. Strategy for apexification of wide-open apex associated with extensive periapical lesion in a weakened root. Gen Dent. 2013;61:e2–4.
44. Shekhar V, Arora R, Roy M. Role of cone beam computed tomography and white mineral trioxide aggregate in the successful management of a permanent anterior tooth with open apex. J Int Oral Health. 2014;6:68–72.
45. Teixido M, Abella F, Duran-Sindreu F, Moscoso S, Roig M. The use of cone-beam computed tomography in the preservation of pulp vitality in a maxillary canine with type 3 dens invaginatus and an associated periradicular lesion. J Endod. 2014;40:1501–4.
46. Ashkenazi M, Kaufman A, Einy S. The diagnostic and treatment challenges associated with traumatized intruded permanent incisors: a case report. Quintessence Int. 2015;46:309–15.
47. Olczak K, Pawlicka H. Mineral trioxide aggregate in treatment of permanent teeth with open apex and endo-perio lesions: a case report. Eur J Paediatr Dent. 2015;16:287–9.
48. Heydari A, Rahmani M, Heydari M. Removal of a broken instrument from a tooth with apical periodontitis using a novel approach. Iran Endod J. 2016;11:237–40.
49. Martens L, Rajasekharan S, Cauwels R. Endodontic treatment of trauma-induced necrotic immature teeth using a tricalcium silicate-based bioactive cement.A report of 3 cases with 24-month follow-up', European Journal of Paediatric Dentistry, 17, pp. 24–28.
50. Parirokh M, Farzaneh S, Hallajmofrad AR. Conservative management of unset mineral trioxide aggregate root-end filling: a case report. Iran Endod J. 2016;11:241–5.
51. Arora S, Gill GS, Saluja P, Setia V. Management of a rare case of communicating internal-external inflammatory resorption. J Clin Diagn Res. 2015;9:ZD39–40.
52. Bendyk-Szeffer M, Łagocka R, Trusewicz M, Lipski M, Buczkowska-Radlińska J. Perforating internal root resorption repaired with mineral trioxide aggregate caused complete resolution of odontogenic sinus mucositis: a case report. J Endod. 2015;41:274–8.
53. Karypidou A, Chatzinikolaou ID, Kouros P, Koulaouzidou E, Economides N. Management of bilateral invasive cervical resorption lesions in maxillary incisors using a novel calcium silicate-based cement: a case report. Quintessence Int. 2016;47:637–42.
54. Sharifi R, Parirokh M, Satvati SAR, Torabinejad M. Treatment of inflammatory root resorption using mineral trioxide aggregate: a case report. Dent Hypotheses. 2014;5:172–6.
55. Koubi G, Colon P, Franquin JC, et al. Clinical evaluation of the performance and safety of a new dentine substitute, Biodentine, in the restoration of posterior teeth: a prospective study. Clin Oral Investig. 2013;17:243–9.
56. Iqbal A, Akbar I, Qureshi B, Sghaireen MG, Al-Omiri MK. A survey of standard protocols for endodontic treatment in North of KSA. ISRN Dent. 2014;2014:865780.
57. Kiran S, Prakash S, Siddharth PR, Saha S, Geojan NE, Ramachandran M. Comparative evaluation of smear layer and debris on the canal walls prepared with a combination of

hand and rotary ProTaper technique using scanning electron microscope. J Contemp Dent Pract. 2016;17:574–81.
58. Athanassiadis B, Walsh LJ. Aspects of solvent chemistry for calcium hydroxide medicaments. Materials (Basel). 2017;10(10):e1219. doi: 10.3390/ma10101219.
59. Ha WN, Duckmanton P, Kahler B, Walsh LJ. A survey of various endodontic procedures related to mineral trioxide aggregate usage by members of the Australian Society of Endodontology. Aust Endod J. 2016;42:132–8.
60. Madarati AA, Zafar MS, Sammani AMN, Mandorah AO, Bani-Younes HA. Preference and usage of intracanal medications during endodontic treatment. Saudi Med J. 2017;38:755–63.

**Author contributions**

*All authors read and approved of the final manuscript. All authors have equally contributed to this work.*

**Acknowledgements**

*Not applicable.*

**Funding information**

*Not applicable.*

**Conflict of interest statement**

*There are no potential conflicts of interest concerning this study.*

**Data availability statement**

*Data availability at request.*

**ORCID**

Gheorghe Anca Gabriela: https://orcid.org/0009-0007-6096-3510
Bănică Alexandra Carina: https://orcid.org/0009-0000-5283-9949
Gheorghiță Lelia Mihaela: https://orcid.org/0009-0008-9486-0744
Diaconu Oana Andreea: https://orcid.org/0009-0009-1547-2864
Diaconu Cezar Tiberiu: https://orcid.org/0009-0004-0308-8703
Țuculină Mihaela: https://orcid.org/0000-0002-6535-3152

***How to cite:***
Gheorghe AG, Bănică CA, Gheorghiță LM, Diaconu OA, Diacou CT, Țuculină MJ. *A cross-sectional study on modern technologies in dental practitioners of endodontics in Romania based on a questionnaire*. Rom J Dent Res. 2024;Vol.1(4):6-23.