

CHALLENGES AND PERSPECTIVES IN ENDODONTIC TREATMENT OF OLDER ADULTS: A NARRATIVE LITERATURE REVIEW

DESAFIOS E PERSPECTIVAS NO TRATAMENTO ENDODÔNTICO EM IDOSOS: UMA REVISÃO NARRATIVA DA LITERATURA

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ABSTRACT

This study aimed to discuss the main challenges of endodontic treatment in older adults, as well as to analyze clinical and technological strategies that may contribute to safer and more predictable management. This is a narrative literature review, with searches conducted in the PubMed, SciELO, and Google Scholar databases using Portuguese and English terms related to aging, endodontic treatment, pulpal calcification and pulp canal obliteration, comorbidities, polypharmacy, dental operating microscopy, and cone-beam computed tomography (CBCT). Relevant publications addressing the biological, clinical, and technological aspects of endodontic treatment in older adults were selected. The literature indicates that age-related changes in the dentin-pulp complex, combined with a higher prevalence of systemic diseases and the concomitant use of multiple medications, influence treatment planning, procedural safety, and prognosis, requiring comprehensive clinical assessment and, when necessary, a multidisciplinary approach. From an operative perspective, canal calcification and narrowing increase the difficulty of canal location and instrumentation, raising the risk of deviations and perforations. Technologies such as CBCT, magnification, and ultrasonic tips enhance diagnosis and access, while digital approaches, including static guided endodontics and dynamic navigation, may improve efficiency and preservation of tooth structure. However, these techniques depend on adequate infrastructure, operator training, and control of potential sources of error. In conclusion, endodontic treatment in older adult patients is feasible and can be conservative when individualized, although further standardized clinical studies are needed to guide specific protocols for this population.

Keywords: Geriatric dentistry; Aged; Endodontics; Root canal therapy; Cone-beam computed tomography; Printing, Three-dimensional.

RESUMO

Este estudo teve como objetivo discutir os principais desafios do tratamento endodôntico em pacientes idosos, bem como analisar estratégias clínicas e tecnológicas que possam contribuir para um manejo mais seguro e previsível. Trata-se de uma revisão narrativa da literatura, com busca realizada nas bases de dados PubMed, SciELO e Google Acadêmico, utilizando termos em português e inglês relacionados a envelhecimento, tratamento endodôntico, obliteração e calcificação pulpar, comorbidades, polifarmácia, microscopia operatória e tomografia computadorizada de feixe cônico (TCFC). Foram selecionadas publicações consideradas relevantes para a compreensão dos aspectos biológicos, clínicos e tecnológicos envolvidos no tratamento endodôntico em idosos. A literatura evidencia que alterações do complexo dentino-pulpar associadas ao envelhecimento, somadas à maior prevalência de doenças sistêmicas e ao uso concomitante de múltiplos medicamentos, influenciam o planejamento terapêutico, a segurança do procedimento e o prognóstico, exigindo avaliação clínica ampliada e, quando necessário, abordagem multiprofissional. No âmbito operatório, a calcificação e o estreitamento dos canais aumentam a dificuldade de localização e instrumentação, elevando o risco de desvios e perfurações. Tecnologias como magnificação, pontas ultrassônicas e TCFC favorecem o diagnóstico e o acesso, enquanto abordagens digitais, como endodontia guiada estática e navegação dinâmica, tendem a aumentar a eficiência e a preservação da estrutura dentária, embora dependam de infraestrutura, treinamento e controle de fontes de erro. Conclui-se que o tratamento endodôntico em idosos é viável e pode ser conservador quando individualizado e que estudos clínicos mais padronizados são necessários para orientar protocolos específicos.

Palavras-chave: Odontologia geriátrica; Idoso; Endodontia; Tratamento do canal radicular; Tomografia computadorizada de feixe cônico; Impressão tridimensional.

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INTRODUCTION

Increased life expectancy is a global reality, according to the United Nations (UN) (1). The number of individuals aged 65 years and over is expected to more than double by 2050 compared to 2023. As a consequence, the demand for long-term care services is also expected to rise (2).

According to the World Health Organization (WHO), oral health is closely associated with quality of life and overall well-being, and is essential for the social participation and engagement in advanced activities of daily living among older adults (3). In this context, preserving natural teeth through dental and endodontic treatments whenever indicated is essential to maintaining dentition throughout later life (4). However, providing endodontic treatments for older adults can be challenging, due to additional technical difficulties.

Aging is associated with anatomical, physiological, and biological changes, as well as physical and functional limitations, all of which have oral and systemic implications. However, the clinical complexity of older adults frequently arises from the concomitant presence of multiple comorbidities (5-7).

These factors may influence the planning, execution, and prognosis of endodontic treatment. Therefore, dentists must assess patients' systemic conditions and the risk of drug interactions and, when necessary, collaborate with the patient's medical team to increase treatment safety, reduce risks, and promote oral and overall health (7,8).

Histopathological studies examining tooth structure have shown that, in older adults, there is a significant reduction in cells of the dentin-pulp complex, as well as decreased pulp vascularization and innervation, accompanied by increased dentin thickness and the frequent formation of pulp stones. These changes compromise pulp vitality and regenerative capacity, resulting in narrow or obliterated root canals that are more difficult to locate and instrument, thereby increasing the risk of procedural complications during endodontic treatment (4,9,10).

Conversely, technological advances have helped overcome these challenges and improve the prognosis of endodontic treatment in this population. For example, microscopes and high-resolution CBCT imaging, combined with guided endodontics, facilitate the conservative localization

of calcified canals, preserving tooth structure and reducing clinical time (11-13).

Thus, this narrative literature review aimed to examine the challenges of endodontic treatment in older adults, considering the anatomical and physiological changes associated with aging, as well as their clinical management and the role of new technologies in supporting favorable treatment outcomes and preserving natural teeth.

MATERIALS AND METHODS

This study is a narrative literature review focusing on the challenges of endodontic treatment in older adults and on therapeutic strategies supported by technologies that may contribute to more predictable outcomes. Specifically, it addresses the following question: How do age-related changes, particularly root canal narrowing and calcification, hinder endodontic treatment in older adults, and how can technologies support clinical management?

An electronic bibliographic search was conducted in the PubMed, SciELO, and Google Scholar databases using combinations of the following keywords: geriatric dentistry, older adults, endodontics, root canal treatment, cone-beam computed tomography, three-dimensional printing, and their Portuguese equivalents.

Whenever a relevant therapeutic approach was identified, a complementary search was performed by combining the name of the technique with the keyword "older adults" to expand the scope of the review. No publication date restrictions were applied, allowing the inclusion of studies published across different time periods in both English and Portuguese. Original articles, systematic and narrative reviews, case reports, clinical guidelines, cross-sectional studies, and clinical trials were included based on their relevance to the topic.

RESULTS AND DISCUSSION

The findings show that challenges associated with endodontic treatment in older adults arise predominantly from age-related biological and clinical factors, while technological innovations have emerged as complementary tools capable of improving the predictability and safety of these procedures. The studies most relevant to the topic are summarized in Chart 1 and will be discussed in depth throughout this section.

Chart 1 - Summary of the main findings of the studies included in the narrative literature review.

Author	Study design	Objective	Main outcome
Florentina e Mihaela (22)	Literature review	Clinical considerations regarding endodontic treatment of older adults	The study demonstrates that endodontic treatment can be successful as long as specific equipment and technologies are used to overcome calcification challenges.
Chaniotis et al. (9)	Narrative review	To propose a new technique for instrumentation of calcified canals	The study illustrates the applicability of the Bending, Rotating, Advancing, Tactile-Controlled (BRAT) protocol, which involves bending, rotational, and advancing movements under tactile control.
Murray et al. (10)	Experimental laboratory (in vitro).	To evaluate age-related odontometric changes in healthy human teeth to understand how aging influences the dentin-pulp complex.	The study demonstrates that aging promotes dentin deposition and reduces pulp space, resulting in narrower and often calcified canals.
Santiago et al. (24)	Case report	To present a clinical case report of internal pulp calcification in an older patient, highlighting the particularities of endodontic diagnosis and treatment.	The article shows that, even in the face of specific and unconventional techniques to deal with calcification in older adults, successful endodontic treatment can be achieved, with a seven-year follow-up.
Kiefner et al. (13)	Clinical study	To evaluate success in the treatment of calcified root canals in older adults.	The study demonstrates that all canals could be located with the use of a microscope and the endodontic treatment was successful after three years of follow-up.
Zilinskaite-Petrauskiene and Haug (33)	Clinical study	To compare endodontic treatment in young and older individuals.	In a sample of 150 patients, the study showed greater difficulty in locating root canals in older adults, with no negative impact on the final quality of treatment.
Georges et al. (35)	Literature review	To evaluate the use of guided endodontics in calcified root canals.	Guided endodontics increases predictability, reduces tooth structure removal and complications.
Alberdi et al. (12)	Clinical case report	To report management of calcified canals using static guides.	The article reports 11 clinical cases successfully treated using static guided endodontics, showing the efficiency of this technique.
Nistor et al. (43)	Clinical experience report	To report the use of cone-beam computed tomography (CBCT), microscope, and ultrasound in a severely calcified root canal.	The study demonstrates that with CBCT, microscope, and ultrasound, successful outcomes can be achieved without guides.
Quaresma et al. (42)	Clinical study	To evaluate intraoperative CBCT in calcified teeth.	The study shows that the use of CBCT at different stages of the clinical appointment helps in the location, instrumentation, preservation of structure, and reduction of errors.
Ye et al. (44)	Observational clinical study	To evaluate the use of artificial intelligence (AI) in the diagnosis of pulp calcification.	AI shows good performance in sensitivity and accuracy, as well as potential for clinical use in endodontic planning.
Connert et al. (36)	Comparative laboratory experiment (in vitro)	To compare the amount of tooth structure loss between guided endodontics and the conventional access technique in artificial teeth with simulated pulp calcification.	Guided endodontics resulted in significantly less tooth structure removal, greater access accuracy, and reduced risk of perforation.
Li et al. (38)	Randomized clinical trial	To compare the conventional freehand technique with the static guided technique in patients with pulp obliteration.	Static endodontic guides provide a more accurate method for locating root canals, with a lower deviation rate.
Cui et al. (34)	Clinical trial	To compare the clinical and operative outcomes of endodontic treatment in older adults performed using CBCT combined with a dental operating microscope versus CBCT alone.	The use of CBCT in combination with dental operating microscope improves short- and long-term outcomes of endodontic treatment of older adults with pulpal disease.
Mahjourianqomi et al. (37)	Case report	To describe the successful management of teeth with severe calcification using three-dimensional static-guided endodontics to achieve more predictable root canal access.	Static-guided endodontics may be an effective and predictable approach for mandibular incisors, especially in difficult cases of obliterated root canals and in older adults.
Lara-Mendes et al. (39)	Technical article	To present the planning and clinical workflow for guided endodontics using a CAD/CAM-fabricated guide and CBCT as a more predictable and safer alternative for the management of calcified canals.	Guided endodontics is a simple, predictable, and clinically feasible technique that can be successfully performed even by less experienced professionals, making it an excellent option for managing severely calcified canals without the need for a dental operating microscope.

Author	Study design	Objective	Main outcome
Dianat et al. (41)	Case report	To demonstrate the applicability of dynamic navigation for locating a calcified root canal when conventional approaches, including the use of an operating microscope and CBCT-guided access, have failed, as well as to describe the advantages, disadvantages, and limitations of this technology.	Dynamic navigation may be a practical alternative for posterior teeth with calcified root canals, especially when conventional freehand canal location is unsuccessful; however, its use requires careful control of potential sources of error and consideration of the operator learning curve.
Torres et al. (40)	Prospective, non-randomized, controlled clinical trial	To compare the clinical outcomes of guided endodontics and conventional freehand treatment in teeth with pulp canal obliteration.	Guided endodontics achieved statistically superior outcomes compared with the conventional freehand approach, with fewer technical failures. However, the authors note that the procedure is technically demanding and should be performed by an experienced endodontist using a dental operating microscope.
Warwar et al. (26)	Comparative histological study	To compare the histological features of young and aged pulps and characterize age-related changes.	Aging is associated with reduced cellularity and vascularization, increased collagen fibers, and a greater presence of secondary dentin, consequently reducing the volume of the pulp chamber.

Individualized care in endodontic treatment for older adults

From a clinical perspective, aging is not limited to dental changes but encompasses a set of biological and functional changes that increase the complexity of care. In this context, the presence of comorbidities is a central factor in understanding treatment response in older adults (5-7).

Consequently, endodontic treatment planning should incorporate an evaluation of systemic conditions and medications in use, with collaboration with the medical team when appropriate, to enhance patient safety, minimize complications, and optimize outcomes (7,8).

Among the most common conditions, hypertension requires clinical monitoring, appropriate selection of the local anesthetic (including the agent and dosage), and attention to potential drug interactions (14). Type 2 diabetes mellitus, in turn, may compromise healing and increase the risk of complications. These conditions reinforce the need for strategies that increase predictability and reduce clinical time, especially in cases involving greater anatomical complexity (15).

Anliker et al. (16) reported that, among institutionalized older adults, polypharmacy (≥ 5 medications) and multimorbidity (≥ 2 chronic conditions) were associated with poorer oral health. Additionally, they identified a significant association between advancing age and tooth loss, suggesting increased oral vulnerability with aging. These findings reinforce that the assessment of older adults should integrate systemic, functional, and psychosocial factors, and not only local examination, to support safer therapeutic decision-making (16,17).

To support a structured and individualized approach to the care of older adults, the Comprehensive Geriatric Assessment (CGA) has been described as a multidimensional, interdisciplinary approach that evaluates medical, functional, cognitive, and psychosocial aspects of older patients (17).

By providing a comprehensive and early assessment of the patient, CGA helps dentists determine whether a more conservative approach or a more complex intervention is appropriate, directly informing clinical planning (17,18).

Its main components include the analysis of comorbidities and clinical stability, oral health, socioeconomic status, functional dependence, cognition and mental health, communication ability, and life expectancy, as well as screening for swallowing disorders, nutritional status, and fall risk (17).

According to Rubenstein et al. (19), CGA facilitates the coordinated implementation of interventions and monitoring of clinical outcomes. Its effectiveness depends not only on diagnostic evaluation, but also on the ability to translate its recommendations into a treatment plan.

In clinical practice, Veronese et al. (20) reported that CGA is conducted using validated instruments and interviews, enabling the identification of vulnerabilities and guiding the selection of the most appropriate level of dental care. Despite its strong conceptual framework, the absence of a structured questionnaire or recommendations regarding specific validated instruments may limit its practical implementation, especially in clinical settings that require objective and reproducible protocols (17).

In addition to systemic factors, personalized care is also essential in addressing local conditions, such as

reduced salivary flow, the increased prevalence of periodontal disease, and tooth wear, all of which require adapted clinical management (15,21-23). Florentina and Mihaela (22) emphasize that a personalized approach enables the identification of specific needs of older patients, adaptation of clinical protocols, selection of less invasive techniques, and incorporation of technologies that improve predictability and safety. This approach contributes to preserving natural teeth and masticatory function (5,24).

However, to understand why endodontic treatment tends to become more challenging in this population, it is necessary to consider the anatomical and physiological changes associated with dental aging, which modify the dentin-pulp complex and may reduce the patency of the canal system. In this context, geriatric endodontics has emerged as a promising and evolving field, responding to the needs of a population with increasing life expectancy (5,25).

Anatomical and physiological changes associated with aging

Clinically, these changes tend to make root canal identification and access more difficult, increasing procedural complexity. Among such alterations, narrowing of the pulp chamber, occlusion of dentin tubules, cementum thickening, reduction in odontoblast size, and decreased nerve fiber density stand out, all of which constitute a characteristic structural pattern of dental senescence, especially within the pulp (25).

Furthermore, histological studies have demonstrated a significant reduction in pulpal cellularity with advancing age (26). These findings reveal a continuous process of pulp degeneration, as the reduced activity and differentiation potential of dental pulp stem cells compromise the regenerative capacity of the dental pulp. Nevertheless, these cells remain metabolically active and continue to produce molecules involved in inflammation and extracellular matrix degradation. The loss or decline of their reparative capacity results in a pulp tissue that is more fibrotic and less vascularized, leading to structural and functional changes that often culminate in partially or completely obliterated root canals (27).

Continuous dentin deposition, together with dystrophic calcification of the pulpal blood vessels, reduces pulpal blood flow and compromises the internal blood supply to the pulp, making it less well nourished and more susceptible to degeneration and necrosis (28).

Solomonov et al. (29) also reported age-related changes in root canal system morphology and dentin structure, resulting in narrower, more sclerotic root canals that require adaptations in both instrumentation strategy and endodontic treatment planning. Accordingly, the authors proposed an algorithm for individuals aged ≥ 41 years that recommends initial instrumentation with small hand files, followed by preflaring using nickel-titanium (NiTi) instruments and subsequent preparations with instruments that impose less stress on dentin (i.e., instruments with a smaller core, lower taper, and/or more flexible alloys). They further emphasize that no universal protocol exists and that the final decision should consider the anatomy and real conditions of each tooth (29). However, because the study included individuals as young as 41 years and was not specifically designed to evaluate older adults, its applicability to patients aged ≥ 60 years should be interpreted with caution (29).

In this context, it is essential that dentists possess the technical expertise and proficiency in adjunctive technologies, such as dental operating microscopy and three-dimensional imaging, to enhance the safety and predictability of endodontic treatment (4,9,10).

In addition to structural changes in the tooth, the systematic review by Preshaw et al. (30) indicates that aging is also associated with alterations in immune function, which may contribute to the increased prevalence of dental caries and periodontal disease. Human studies have shown that older adults tend to exhibit impaired neutrophil function and increased production of inflammatory mediators compared to younger individuals. However, the extent to which these age-related immunological changes directly contribute to the greater susceptibility to dental caries and periodontal disease in older populations remains unclear (30).

Given that dental caries and periodontal disease increase the cumulative burden of oral disease over time, they may also contribute to the greater need for endodontic treatment among older adults (30). In this regard, Hamedy et al. (31), in a systematic review and meta-analysis, concluded that older adults (≥ 65 years) have a higher prevalence of endodontically treated teeth as well as a higher prevalence of periapical radiolucency in untreated teeth compared with the general adult population.

One possible explanation for the higher prevalence of periapical lesions in untreated teeth is that pulpal

disease in older adults may progress to necrosis with less pronounced clinical symptoms, favoring delayed diagnosis. These structural and vascular changes in the pulp, such as reduced pulpal blood supply and greater susceptibility to degeneration, may help explain this finding (28).

Despite age-related changes in the dentin-pulp complex, endodontic treatment remains a conservative and effective approach with favorable predictability for the maintenance of dentition in older adults (21).

Xie et al. (32) noted that biomedical research on dental aging remains limited, reinforcing the need to expand scientific production specific to endodontic treatment in older populations. Similarly, Warwar et al. (26) highlighted the relevance of investigations aimed at developing strategies to mitigate these changes and preserve pulp health throughout the aging process.

These findings highlight the need for dedicated training in the dental care of older adults, as well as the careful integration of adjunctive technologies into clinical practice (4).

Clinical management of older adults: the role of technologies in endodontic treatment

In endodontics, no technologies have been developed specifically for the treatment of older adults. Rather, the literature describes diagnostic and operative technologies that are applicable across different age groups but become particularly relevant in cases of increased anatomical complexity, such as calcified root canals. This condition, which is frequently associated with aging, may hinder root canal access, location, and instrumentation (25,28,29).

Accordingly, the following sections discuss technologies that improve the predictability and safety of treatment in severely calcified root canals, considering their contributions to planning, clinical execution, and the reduction of iatrogenic complications.

Dental operating microscopy

Dental operating microscopy plays an important role in the endodontic treatment of teeth with pulp calcification, mainly by enhancing visualization of the pulp chamber floor and facilitating root canal location (33,34). In a study with 150 patients equally divided between younger (<65 years) and older (≥65 years), Zilinskaite-Petrauskiene and Haug (33) reported greater technical difficulty when treating older

adults, particularly during access cavity preparation and root canal location. However, no significant differences were observed in the technical quality of fillings between the groups, suggesting that these challenges can be overcome with the use of a dental operating microscope or dental loupes (33).

Corroborating these findings, Kiefner et al. (13) evaluated 114 calcified canals in different tooth types from 41 patients with a median age of 72 years and reported that the use of a dental operating microscope enabled the location of all calcified canals within 60 minutes, with approximately 80% clinical success after three years of follow-up.

Additionally, Cui, Peng, and Lin (34) demonstrated that, among older adults with pulp disease, the combination of CBCT and dental operating microscopy resulted in fewer treatment sessions, lower patient-reported pain, higher-quality canal fillings, and a higher clinical and radiographic success rate than the conventional approach, without increasing procedure time. However, despite these advantages, the benefits of dental operating microscopy depend not only on its availability, but also on the operator's expertise and its integration with other strategies for the complete performance of endodontic therapy.

BRAT protocol

The Bending, Rotating, Advancing, Tactile-Controlled (BRAT) protocol has been proposed as a structured approach for managing severely calcified canals by integrating well-established principles of endodontic instrumentation, including the flexibility of NiTi instruments, controlled rotational movements, gradual advancement, and tactile control (9). According to Chaniotis et al. (9), small-caliber instruments with non-cutting tips may be susceptible to torsional fracture when attempting to penetrate calcified canals. Therefore, the protocol recommends the use of NiTi instruments with cutting tips manufactured using electrical discharge machining (EDM) technology, which enhances cutting capacity while maintaining instrument flexibility (9). The technique involves continuous chemical conditioning using sodium hypochlorite associated with a weak chelator such as etidronic acid, followed by the creation of a small indentation using an access drill and a motor-driven NiTi instrument with an active cutting tip to achieve controlled progression through the calcified obstruction (9). Although clinical case reports have demonstrated the feasibility of the protocol, evidence from controlled clinical studies is still lacking.

Therefore, the BRAT protocol should be considered a promising approach, pending further robust clinical evidence to support its routine use in practice (9).

Static guided endodontics

Static guided endodontics uses a digital workflow based on CBCT, intraoral scanning, and CAD/CAM technology to fabricate a physical guide that directs the drill with previously planned precision. This approach has demonstrated greater predictability for accessing calcified root canals, reducing clinical time, unnecessary dentin removal, the risk of perforations, and other procedural complications, especially in cases of severe calcification (12,36,38,40). Experimental studies, clinical studies, and a randomized clinical trial have reported greater accuracy and higher canal location rates than the conventional freehand technique (12,36,38,40). Furthermore, combining guided endodontics with adjunctive technologies such as dental operating microscopy, ultrasonics, and CBCT may further improve treatment success in older adults, among whom pulp canal calcification is more prevalent (22,35). However, this technique has several limitations, including cost, need for specialized digital infrastructure, time required for treatment planning, and dependence on image quality and accuracy of the digital workflow. In certain clinical situations, conventional techniques may still be required to complement the procedure (12,37-39). Despite these limitations, the literature consistently identifies static guided endodontics as a promising and conservative approach for managing calcified root canals, particularly in complex cases (12,35-40).

Dynamic guided endodontics

Dynamic guided endodontics uses real-time navigation systems based on CBCT to guide the drill trajectory during endodontic access, enabling continuous tracking of instrument position and providing greater flexibility than static guides (41). This technology may improve the predictability and safety of managing calcified canals, particularly in complex cases and in posterior teeth with limited interocclusal space (41). Clinical case reports have demonstrated successful localization of root canals that could not be identified using conventional techniques, even with the aid of dental operating microscopy and CBCT (41). However, its clinical application depends on specialized equipment, proper system calibration, and operator training, and remains

susceptible to errors related to system performance, image quality, and clinical execution (41). Thus, although dynamic navigation represents a promising alternative for the management of calcified canals, it still requires specialized infrastructure and does not completely eliminate the need for conventional methods to confirm the drill trajectory and root canal location (37,40,41).

Cone-Beam Computed Tomography (CBCT)

CBCT is an important adjunctive tool in the management of calcified root canals, both during preoperative planning and intraoperatively, by providing superior three-dimensional visualization of root canal anatomy and enabling the identification of deviations that might not be detected on two-dimensional imaging (40,42). When used intraoperatively, particularly in combination with radiopaque markers, CBCT can facilitate the location and instrumentation of severely calcified canals (42). Moreover, studies have shown that satisfactory outcomes can be achieved even without the use of static or dynamic guidance, provided that treatment is carefully planned and supported by operator experience and adjunctive technologies such as CBCT, dental operating microscopy, and ultrasonics (43). Therefore, CBCT represents a valuable tool for improving the predictability and safety of endodontic treatment in teeth with pulp canal calcification, regardless of the access technique employed (40,42,43).

Artificial intelligence

Artificial intelligence (AI) has primarily been used as a diagnostic imaging support tool, with potential to assist in the identification of pulp calcifications and in the preoperative estimation of case complexity (44). However, although AI may improve diagnostic accuracy, it does not replace operative procedures or eliminate the mechanical challenges posed by calcification, which still depend on access techniques, magnification, ultrasonics, CBCT, and guided approaches when indicated (44).

Technological limitations and clinical judgment

Although technological advances have expanded the possibilities for treating calcified root canals, clinical judgment and individualized treatment planning remain essential. In this context, Santiago et al. (21) reported the endodontic treatment of a 70-year-old patient with pulp canal calcification and a sinus tract, in which, due to clinical limitations

encountered during treatment, conventional protocols had to be adapted, with instrumentation restricted to the canal associated with the lesion and the use of smaller instruments and materials. After seven years of follow-up, tooth function was maintained and the sinus tract had resolved, demonstrating that individualized approaches can lead to favorable clinical outcomes even in complex situations (21). Thus, adjunctive technologies should be understood as tools to support clinical decision-making rather than substitutes for clinical experience and individualized case assessment (21).

STUDY LIMITATIONS

This study is a narrative literature review and does not employ robust systematic methods for search, selection, or statistical analysis, which limits the possibility of quantitative data synthesis. The limited number of available studies, together with their methodological heterogeneity, restricts the comparability of findings and the strength of the resulting inferences. These limitations highlight the need for further investigations with standardized study designs to support more effective preventive and clinical strategies in the context of oral health care for older adults.

CONCLUSIONS

Endodontic treatment in older adults presents challenges related to aging, particularly the calcification and narrowing of the root canal system. However, the literature shows that these limitations can be overcome by means of individualized treatment planning, technical expertise, and the judicious use of adjunctive tools such as dental operating microscopy, ultrasonics, CBCT, guided endodontics, and artificial intelligence for diagnostic support. The indication of these technologies should consider case complexity, available infrastructure, and the clinician's judgment. Thus, endodontic treatment in older adults remains a conservative, predictable, and effective option for preserving the natural dentition, although further clinical studies are needed to consolidate specific protocols for this population.

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