

Endodontic therapy in older adults patients: a narrative review

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The aging process induces morphophysiological changes that significantly impact oral health, necessitating specialized endodontic care in older adults. Systemic diseases common in this population, such as diabetes and cardiovascular conditions, further complicate treatment outcomes by influencing pulp and periradicular structures. Key age-related alterations include pulp chamber reduction, dentin sclerosis, and bone loss, which challenge conventional endodontic techniques. **Aim:** To address these issues, this review conducted a search in PubMed, Scopus, and Web of Science for articles published between 2010 and 2024, using keywords related to endodontics and aging, and selecting studies relevant to clinical practice. **Results:** This review highlights the interplay between systemic health and oral pathophysiology, emphasizing the need for tailored clinical strategies to enhance treatment predictability. Evidence indicates failure rates of approximately 26% in geriatric endodontics, frequently associated with suboptimal treatment quality, comorbidities, and microbial persistence. A comprehensive preoperative assessment, integrating medical, pharmacological, and dental histories, is critical to mitigate risks and optimize outcomes. Specific considerations include anesthesia modifications, calcified canal management (using microscopy or ultrasonics), and drug interactions (NSAIDs with antihypertensives). Successful treatment hinges on addressing both technical and systemic factors: precise canal preparation, antimicrobial protocols, and thermoplastic obturation improve longevity, while interdisciplinary collaboration ensures patient safety. Sedation may benefit anxious individuals, and postoperative monitoring is advised for high-risk cases. In conclusion, endodontic success in older adults relies on adapting techniques to age-related anatomical changes while managing systemic complexities. **Conclusion:** This review synthesizes evidence-based recommendations to guide clinicians in delivering effective, safe care for aging populations.

KEYWORDS: Root canal therapy. Endodontics. Aged.

Introduction

Aging is associated with a loss of homeostasis, which is essential for the proper functioning of the body¹. Consequently, the oral health of older adults can also be affected, particularly due to systemic diseases. This highlights the importance of understanding the health conditions prevalent in the older population.

We know that, in the oral cavity, the removal of infection foci and rehabilitative treatment are necessary in patients, which includes endodontic treatment if indicated. Thus, good planning and knowledge of the changes observed in the root canal system of older adults are fundamental². Furthermore, it is known that in aging, the pulp chamber and the volume of the root canals are decreased over the years³. In addition, we also observe the presence of progressive periodontal diseases, pulp calcifications, thickening of the periodontal ligament, and other conditions that can affect the course of endodontic treatment in these patients⁴.

Endodontics aims to treat pulp and surrounding tissue diseases, such as irreversible pulpitis and pulp necrosis. Thus, endodontic treatment is indicated when there is infection or inflammation of the dental pulp, usually resulting from deep caries, traumas, and other conditions. Moreover, its main objective is to eliminate the inflammatory condition and prevent microorganisms from accessing periapical tissues. Therefore, we can consider endodontic treatment as the intervention of choice to avoid extractions, minimize functional impacts such as chewing, eliminate odontogenic infection foci with systemic interference, preserving natural dentition and health⁵.

Moreover, dental trauma can present unique challenges due to various physiological changes and medical conditions associated with aging. Additionally, it can be classified according to the level of involvement of the dental element, and in more severe cases, it can even lead to tooth loss. Consequently, the rupture of the dental structure can facilitate the entry of microorganisms into the pulpal environment, leading to pulpal necrosis and local infection. In these clinical situations, endodontic treatment is necessary, and in cases where there is no pulpal infection, the tooth can repair itself by forming a barrier of reparative dentin that protects the dental pulp. This process can influence the selection of restorative treatment, which can be direct or indirect restorations⁶.

Finally, local and systemic associations may be related to the use of medications and changes in the immune system. Thus, this can contribute to the development of oral diseases and systemic changes that affect dental pulp and interfere with endodontic treatment. In summary, endodontists should be prepared to deal with age-related changes during the execution of the treatment plan. In this context, this review aims to clarify important points related to endodontic treatment in older adults and can contribute to its success, addressing age-related changes both locally and systemically.

Methods

Search Strategy

A comprehensive literature search was carried out on November 16, 2024, utilizing the PubMed, Scopus, and Web of Science platforms (<https://pubmed.ncbi.nlm.nih.gov/>, <https://www.scopus.com/>, <https://www.webofscience.com/>). The following combination of keywords and terms guided the search: (aging OR elderly OR "older adults" OR geriatric OR senescence) AND (endodontics OR "root canal treatment" OR "root canal therapy") AND ("dental pulp" OR "pulp tissue" OR "oral health" OR "oral cavity") AND ("systemic diseases" OR "systemic conditions" OR comorbidities) AND ("dental trauma" OR "tooth injury"). To enhance the retrieval of relevant studies, Medical Subject Headings (MeSH), their synonyms, and additional related terms cited in the literature were incorporated. No restrictions or filters were applied to ensure the inclusion of all potentially relevant publications.

Eligibility Criteria

This narrative review encompassed publications that explored, addressed, or referenced older individuals within the field of endodontics. Studies written in English and released from 2010 to 2024 were considered eligible for inclusion.

Selection Process

The selection of articles was conducted independently by three researchers (J.C.S., T.S.S.L., and R.F.R.), who screened the titles, abstracts, and, when required, the full texts to determine eligibility. Any discrepancies in the selection process were discussed and resolved collectively, with the involvement of a fourth researcher (T.M.B.R.) to reach a final consensus.

Literature Review

Dental elements and endodontic principles

Before exploring age-related changes of endodontic interest, physiological tooth elements will be briefly explained. Enamel is the outermost tooth surface, which has low permeability, and dentin is a highly permeable tissue with dentinal tubules⁷. Primary dentin is formed by odontoblasts⁸, while secondary dentin is formed by the remaining odontoblasts in a lifelong process. Tertiary dentin is formed by new odontoblasts next to injury areas. The last type is the reparative dentin that is deposited in response to pathogenic agents⁹. Internally to dentin, pulp is a very complex tissue that contains collagenous and nerve fibers, defense cells, odontoblasts, and fibroblasts. Normally, pulp tissue is able to respond with a painful sensation to chemical, mechanical and/or biological processes¹⁰. This tissue is covered by radicular cement tissue that connects tooth and alveolar bone, via periodontal fibers¹¹.

Chemical, physical, and biological stimuli promote a pulp tissue response, leading to chronic or acute processes (depending on the duration, intensity and nature of the aggression and host response)¹². Pulp inflammation starts with hyperemia and

edema, developing to reversible, irreversible pulpitis and pulp necrosis¹³. Pulp necrosis occurs gradually, and the infectious process may reach periradicular areas, leading to apical periodontitis. In this regard, endodontic diagnosis must be based on the history of signs and symptoms, clinical and complementary tests: radiographic images, cone beam computed tomography, and clinical tests¹⁴.

Consequences of aging in the oral cavity

Over the years, dental elements are subjected to various stimuli, and their conformation is constantly changing¹⁰. Nonetheless, local diseases can contribute to the deposition of cement, secondary, and tertiary dentin, consequently interfering with pulp diagnosis¹⁵. Dentin deposition leads to vascular reduction, and the pulp also becomes fibrous, making it difficult to recognize pulp diseases.

Furthermore, cement deposition tends to decrease sensitivity to diagnostic tests. Thus, in older adults, it is common to observe the evolution from pulp inflammation to necrosis, without symptoms¹⁵. Additionally, other observations are necessary for the correct diagnosis of these patients, such as the presence of periodontal support, reduced pulp chamber, and/or presence of calcifications, periapical changes, caries, and restorations. Finally, requesting radiographic and tomographic exams is essential to explore diagnostic possibilities.

It is known that the treatment of endodontic lesions is prioritized over tooth extraction, aiming to keep natural teeth in the mouth for as long as possible, contributing to both masticatory and aesthetic functions. With advancing age, there are changes in the proportions of the components of individuals' bone tissues, leading to a gradual reduction in bone mass and compromising their functions. Thus, fractures due to bone fragility and slow healing make treatments like implants and dental prostheses difficult, which depend on a firm and adequate bone structure. Additionally, the imbalance in bone homeostasis and the bone/fat ratio increases with age, making aging a risk factor for osteoporosis and oral bone loss. In this sense, it is essential to investigate and understand the molecular factors and regulatory mechanisms of oral bone loss to better manage these conditions and promote correct clinical and dental care strategies¹⁶.

Certainly, aging causes numerous dental changes, both at the tissue and cellular level. These changes include sclerotic or calcified dental pulps. Thus, the decrease in pulp space occurs due to the deposition of secondary dentin, being more common in pulp horns and pulp chamber floor of molars⁹. Another change is dental wear associated with bruxism and uncontrolled mandibular movements (mainly in elderly individuals with neurocognitive impairment) which can affect dental sensitivity, be mistaken for tooth pain, and complicate the diagnosis of pulp lesions in geriatric people¹⁰. Therefore, all these conditions can have a significant impact on oral health during aging and warrant special attention from dental professionals (Fig. 1). It is important to note that Figure 1 is a schematic illustration created using BioRender to conceptually summarize these conditions, and as such, it does not represent anatomical variations or quantitative data.

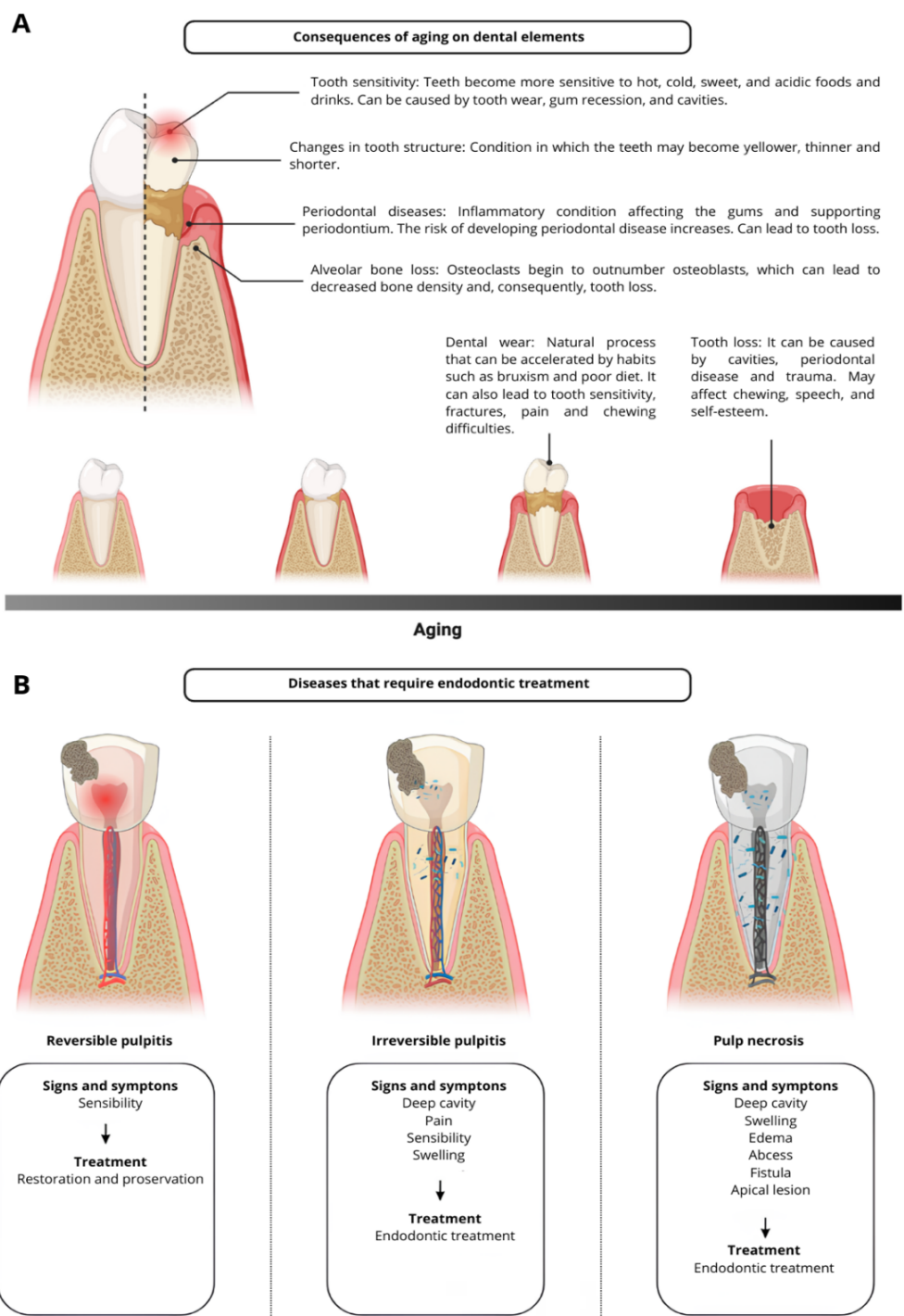


Figure 1. A: Consequences of aging for dental elements. Created using BioRender.com. B: Diseases that require endodontic treatment. Created using BioRender.com.

Systemic diseases, drugs, and precautions

As individuals age, changes occur in the biological, psychological, and social context, leading to morphological and physiological aging. There are several factors associated with this process, including molecular, cellular, systemic, cognitive, and behavioral factors. These interactions regulate numerous functions in aging and quality of life¹⁷. However, with the increase in educational and preventive activities, elderly people are seeking guidance and treatments for their systemic conditions, often resorting to the safe use of a variety of medications under medical supervision.

We know that some systemic diseases are common in older adults, such as hypertension, diabetes mellitus, cardiovascular diseases, among others. Thus, some medications to control these systemic diseases, combined with poor oral hygiene, a common condition in elderly individuals, can promote gingival hyperplasia, such as phenytoin, nifedipine, and cyclosporine-A-based medications, as they cause fibrotic changes in gingival tissues. Additionally, medications like tramadol, carbamazepine, zolpidem, and clonidine can cause salivary hypofunction, increasing the risk of cavities, opportunistic infections such as candidiasis, or other oral alterations like periodontal disease¹⁸. Moreover, poorly controlled diabetic patients may also present alveolar bone loss and xerostomia, and periodontal and pulp diseases are common⁷.

Medications such as analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), anticoagulants, antihypertensives, antiparkinsonian agents, diuretics, hypoglycemic agents, and psychoactive drugs can have adverse effects on the oral cavity. Additionally, analgesics and NSAIDs can induce gingival hyperplasia due to their expansive effects on the distribution of adipose tissue and plasma proteins, and they can increase the risk of peptic ulcers, bleeding, and, in the case of steroid containing NSAIDs, hemorrhage¹⁹. Moreover, medications such as atorvastatin, busulfan, methyldopa, simvastatin, and tetracycline can also be associated with gingival hyperplasia and contribute to bleeding, hemorrhage, and oral ulcers. Furthermore, antiparkinsonian agents, medications that interfere with the central nervous system, diuretics, psychoactive drugs, and hypoglycemic agents can cause hyposalivation and xerostomia (dry mouth sensation), which can increase the risk of dental caries, oral infections such as candidiasis, and discomfort in eating and speaking¹⁹.

Furthermore, inflammatory mediators from periodontitis can access the bloodstream and contribute to atherosclerosis²⁰. This is the major predisposing factor for heart diseases and is related to angina, myocardial infarction, hypertension, among others. Thus, angina occurs when the blood supply to the heart does not meet demand. In this context, symptoms of angina include pain in the central or left region of the chest, with the possibility of radiation to the back, jaw, or left arm²¹.

Moreover, pharmacological prescriptions should be based on drug interactions, resistance, effectiveness, and patient history. Considerations such as body condition, water retention, and reduction of liver metabolism should guide professionals. Additionally, the use of antibiotic prophylaxis is recommended for patients using immunosuppressive drugs, with prosthetic heart valves, congenital heart disease, rheumatic fever, or who have already been affected by bacterial endocarditis²².

Furthermore, it is recommended that all infection foci be treated before radiotherapy procedures, given that osteoradionecrosis has a high incidence in these cases²³. Additionally, patients with tremors or similar conditions may have difficulty with endodontic treatment⁹. For all these reasons, when attending to elderly people with systemic involvement, it is necessary to request their medical history, laboratory, and imaging tests, as well as the credibility of the responsible physician before endodontic treatment, based on interdisciplinary strategies. This is essential to ensure the safety and effectiveness of dental treatment in aging, considering any health conditions or medications that may influence the patient's treatment.

Endodontic needs and treatment

Numerous studies demonstrate the need for endodontic care in older adults. Infield examined 143 volunteers with an average age of 66 years, assessing the presence of root canal treatment, periapical treatment, and endodontic treatment with periapical lesions in these patients. It was reported that 78% had at least one tooth with root canal treatment, 8.5% had periapical radiolucency, and of these, 73% had endodontic treatment associated with radiolucency²². Similarly, Chen et al.²⁴ (2007) studied 206 individuals aged at least 55 years with an average of 17.1 teeth. Of these, 5.1% had periapical radiolucency, and 4.8% had undergone endodontic treatment. Additionally, 37.5% of the teeth had root canal treatment, showing the presence of apical radiolucency, which indicates a failure in the endodontic treatment. Hebling et al.²⁵ (2014) evaluated 942 teeth in 98 patients with an average age of 74 years and demonstrated that 126 teeth had endodontic treatment, but only 36.5% had good-quality endodontic treatment. Moreover, in 42.9% of the older adults, 12.1% of teeth showed radiolucent lesions, and 70.2% showed radiolucent lesions associated with endodontic treatment.

As reported in the highlighted studies, it can be observed that there is a demand for endodontic treatment in older adults. However, the results demonstrated a failure rate due to poor-quality endodontic treatment. Additionally, the success of endodontic treatment depends on other factors, such as the presence of systemic diseases related to aging, which are closely related to the failure of these treatments demands specific care in relation to local anesthesia and coronary access. Diseases like diabetes mellitus, cardiovascular diseases, or compromised immunity can negatively influence the body's ability to respond to treatment or recover properly after the endodontic procedure. Furthermore, certain microorganisms present in the oral cavity, such as bacteria associated with tooth decay or periodontal disease, can cause secondary infections, or compromise the health of adjacent tissues, thus hindering the success of endodontic treatment. Therefore, to perform treatment in older adults, there are differences in diagnosis, local anesthesia, rubber dam clamp isolation, coronary access, chemical-mechanical preparation, obturation, rehabilitation, and drug prescription²⁶. Regarding anesthesia, there are discussions about the use of epinephrine, the most widely used vasoconstrictor in healthy patients worldwide. It is an endogenous catecholamine that can stimulate alpha and beta adrenergics, promoting increased systemic vascular resistance²³. It also increases systemic stress through the rapid accumulation of mature and functional natural killer cells in peripheral circulation²⁷.

Some studies have revealed the direct action of epinephrine on cell receptors, causing cardiovascular changes and coagulopathy when administered in combination with anesthetic salts²⁸. Heidenreich et al.²⁹ (2022) revealed that cardiac patients should avoid the use of epinephrine to decrease the risk of stroke and increased heart rate. In cases of controlled cardiac patients, low doses of epinephrine may be used. However, recent studies reveal that epinephrine 1:100,000 mg/mL poses no risks in controlled patients³⁰.

Like any other drug, epinephrine has limitations and contraindications. It is not recommended for patients with a history of acute myocardial infarction or those with hypertension (>160/100 mmHg), a history of stroke within six months, a history of coronary bypass surgery, unstable angina pectoris, cardiac arrhythmias, congestive heart failure, hyperthyroidism, a history of allergies to sulfites, or the use of amphetamines and illicit drugs³⁰. Therefore, treatment decisions should be based on medical feedback. Additionally, intraligamentary and intrapulpal anesthesia may be less effective due to reduced nerve fibers in these patients²⁶.

In the context of endodontic pain control, nonsteroidal analgesics may be considered. This class of analgesics is indicated for managing acute pain in the postoperative period²⁶. The interaction of nonsteroidal analgesics with antihypertensive drugs may cause a sharp rise in arterial blood pressure³¹. Patients with a history of myocardial infarction or angina should avoid cyclooxygenase (COX) inhibitors due to an increased risk of thrombosis³². Indeed, all nonsteroidal analgesics can cause side effects contributing to sodium and water retention, decreased glomerular filtration, and increased arterial blood pressure³³.

Paracetamol can be classified as a COX inhibitor, although practically without anti-inflammatory activity, and is often used as an analgesic for mild to moderate pain. COX-3 might be a target for paracetamol to control fever and prostaglandin-mediated pain, besides acting directly on the central nervous system through the activation of serotonergic pathways. However, chronic use may lead to liver toxicity³⁴.

Regarding the use of rubber dam clamps, these must be present from the beginning of the procedure, even with patients who have difficulty swallowing saliva³⁵. Patients should be asked about latex allergies and then observed³⁶. A narrow pulp chamber with or without abrasion or erosion needs special attention during access. As the root canal in elder patients is narrow, the use of an endodontic microscope or loupes is encouraged⁹. Techniques such as transillumination, the use of ultrasound tips, and endodontic guides are also employed to access calcified canals³⁶. Pre-treatment restorations can also be considered.

During root canal preparation, nickel-titanium rotary or reciprocating instruments can provide greater comfort for the dental professional and good conformation for calcified canals, reducing the required working time⁹. During obturation processes, thermoplasticized techniques allow good obturation quality in the root canal system in a shorter time³⁷. For patients with a latex allergy, special attention should be taken to avoid contact with gutta-percha in periradicular tissues to prevent allergic reactions³⁶.

It should be noted that although some variations may complicate endodontic treatment, treatment success does not vary based solely on the patient's age. Both young and elder patients react similarly to treatment. Successful endodontic treatment is determined by the correct preparation and sealing of the root canal system⁷. Thus, it is important to remember that apical periodontitis can also interfere with successful endodontic treatment²⁴. Teeth with pulp necrosis and apical periodontitis have a relatively lower success rate compared to teeth with vital pulp due to the persistence of microorganisms after conventional endodontic disinfection³⁸.

According to the literature, the approach to endodontic treatment in older adults should be individualized based on their systemic conditions and diagnosis to determine the most appropriate course of action. In this context, Figure 2 presents a detailed flow-chart outlining the steps involved in endodontic treatment in older adults, from anamnesis and diagnosis to post-treatment follow-up (Fig. 2). It should be noted that this flowchart serves as an illustrative guide and was created using BioRender; therefore, it is intended for conceptual visualization and does not encompass all clinical variations or decision-making nuances encountered in practice.

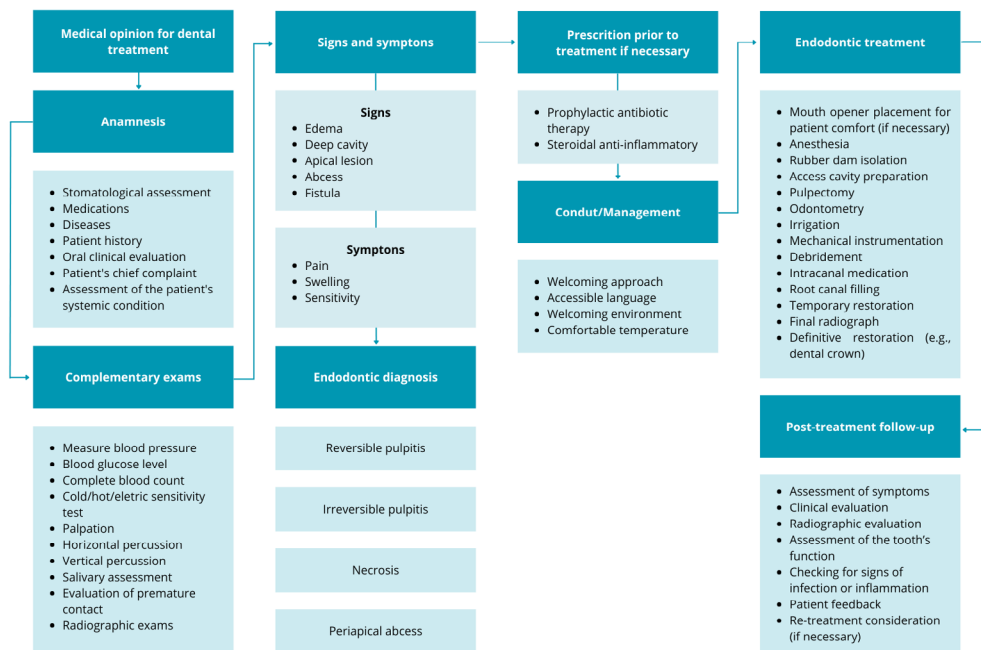


Figure 2. Endodontic care plan for elderly patients: (1) Medical opinion for dental treatment, (2) Anamnesis, (3) Complementary tests, (4) Signs and symptoms, (5) Diagnosis, (6) Prescription prior to treatment, if necessary, (7) Conduct/Management, (8) Endodontic treatment, and (9) Post-treatment follow-ups.

Additional resources and recommendations

In cases of very anxious patients, the use of sedation is an option. Sedation can be performed with a benzodiazepine of short duration (a safe and effective drug),

preferably opioids. However, it is advisable to choose a benzodiazepine that is effective in small doses, which presents an ideal rapid onset and contributes to its rapid excretion³⁹.

It is also important that all staff that work in a dental office should be trained and know all the necessary first aid procedures, such as cardiopulmonary resuscitation. In cases of patients who have recently had a stroke or have a history of ischemic attacks, the dentist must postpone extensive invasive procedures. People over 65 years of age have a higher prevalence rate of cardiovascular disease compared to younger people⁴⁰. As aging is considered a risk factor for cardiovascular disease, other care for these patients includes the use of a sitting position during patient care, holding short sessions in the morning and monitoring blood pressure and coagulation³⁹.

Discussion

Aging is a multifactorial process affecting the morphology, physiology, and immune response of dental tissues. While age-related changes are well-documented, the association between chronological age and endodontic failure is increasingly debated. Studies such as AlRahabi⁴² (2019) show that older patients can achieve similar outcomes to younger patients when treated with high-quality protocols. Thus, age should not be considered a primary predictor of failure.

Anatomical changes like canal calcification complicate treatment but can be managed with advanced imaging (CBCT) and magnification. Systemic diseases and polypharmacy add complexity, impacting both healing and procedural safety.

Caution is needed with vasoconstrictors in anesthesia, especially in cardiac patients. Pain management with NSAIDs should consider comorbidities, and paracetamol requires careful monitoring due to hepatotoxicity risk.

Ultimately, age alone does not determine treatment success. Evidence-based techniques and multidisciplinary care are more critical. Overemphasis on age can lead to unnecessary extractions.

Modern guidelines, including AHA (2022) and ESE (2006), recommend individualized risk assessment over age-based exclusions. However, they often lack critical integration of conflicting evidence. Future guidelines must reflect this nuance.

In conclusion, endodontic treatment in older adults demands comprehensive scientific knowledge of age-related dental anatomical changes and proficient execution of all procedural steps, including diagnosis, local anesthesia, coronary access, chemical and mechanical preparation of the root canal system, obturation, and drug prescription management. Beyond technical skills, it is essential to consider the patient's systemic health, potential medication interactions, and prevalent comorbidities, which may significantly influence treatment outcomes. While age itself is not the primary determinant of success, a multidisciplinary approach that integrates systemic health assessment with tailored endodontic protocols enhances prognosis in this population. Future research should focus on longitudinal clinical studies evaluating geriatric patients to better understand the long-term

outcomes of endodontic treatments and how systemic conditions uniquely affect healing and success rates in older adults.

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Conflict of interest

The authors have no conflicts of interest to declare.

Data availability

Datasets related to this article will be available to the corresponding author upon request.

Author Contribution

Johnny Carvalho da Silva: Material preparation, data collection and analysis were carried out by, manuscript draft, created and designed Figure 1. **Thaís Sousa Silva Lima:** Material preparation, data collection and analysis were carried out by, manuscript draft. **Raquel Figuerêdo Ramos:** Material preparation, data collection and analysis were carried out by, manuscript draft. **Danilo César Mota Martins:** Material preparation, data collection and analysis were carried out by, manuscript draft. **Stella Maris de Freitas Lima:** Material preparation, data collection and analysis were carried out by, data analysis. **Alexandre Franco Miranda:** Material preparation, data collection and analysis were carried out by, data analysis. **Taia Maria Berto Rezende:** Material preparation, data collection and analysis were carried out by, bibliographic analysis, critical review and final corrections. All authors contributed to the conception and design of the study, commented on previous versions of the manuscript, read and approved the final manuscript.

Abbreviations

Nonsteroidal anti-inflammatory drugs (NSAIDs); Cyclooxygenase (COX).

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