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Single vs. Multiple Visit Root Canal Treatment: Outcomes and Patient Preferences in African Dental Practices

Prof (Dr) Daniel Mairafi Gimbason, Head of Department Health Sciences, Nasarawa State University Keffi, Nasarawa State, Nigeria

Abstract

Root canal treatment remains one of the most common endodontic procedures performed globally, with ongoing debate regarding the optimal number of visits required for successful outcomes. This research examines the comparative effectiveness of single-visit versus multiple-visit root canal treatments within the unique context of African dental practices, considering clinical outcomes, patient preferences, and socioeconomic factors that influence treatment decisions. Through systematic analysis of contemporary evidence and consideration of Africa-specific challenges including resource limitations, patient accessibility issues, and diverse clinical settings, this study provides comprehensive insights into treatment protocols that best serve African populations. The findings indicate that while single-visit treatments demonstrate comparable success rates to multiple-visit approaches in uncomplicated cases, patient preferences and clinical circumstances in African settings often favor flexible treatment protocols. This research contributes to the growing body of literature on context-appropriate endodontic care and offers evidence-based recommendations for dental practitioners, policymakers, and researchers working within African healthcare systems.

Keywords: Root canal treatment, single-visit endodontics, multiple-visit endodontics, African dental practices, patient preferences, treatment outcomes, endodontic success

1. Introduction

Endodontic treatment has evolved considerably over the past several decades, with technological advancements and refined clinical protocols transforming the landscape of root canal therapy. The fundamental question of whether root canal treatment should be completed in a single appointment or spread across multiple visits has generated substantial academic discourse and clinical investigation. This debate holds particular significance for African dental practices, where unique socioeconomic, geographical, and healthcare infrastructure considerations profoundly influence treatment planning and execution (Nair, 2019).

The traditional multiple-visit approach to root canal treatment, which typically involves initial cleaning and shaping followed by subsequent appointments for medication placement and final obturation, has been the standard protocol for many decades. This methodology was predicated on the belief that interappointment medication, particularly calcium hydroxide, would provide superior antimicrobial effects and allow for better healing of periapical tissues

(Siqueira & Rôças, 2008). However, advances in instrumentation techniques, irrigation protocols, and obturation materials have challenged these conventional assumptions, leading to increased acceptance of single-visit treatments in contemporary endodontic practice.

Within the African context, the choice between single-visit and multiple-visit root canal treatment extends beyond purely clinical considerations. Africa's vast geographical expanse, diverse population distribution patterns, and variable healthcare infrastructure create unique challenges for dental service delivery. Many patients face considerable difficulties in accessing dental care, with substantial portions of the population residing in rural or remote areas where specialized endodontic services may be scarce or nonexistent (Adeniyi et al., 2012). Transportation costs, time away from work or family responsibilities, and the limited number of trained endodontists across the continent all factor into treatment planning decisions.

The socioeconomic landscape of African nations further complicates treatment protocol selection. While urban centers in countries such as South Africa, Kenya, and Nigeria boast modern dental facilities with advanced equipment and trained specialists, many regions struggle with basic infrastructure and resource limitations (Oginni & Adekoya-Sofowora, 2007). The distribution of dental practitioners remains heavily skewed toward urban areas, creating significant disparities in access to quality endodontic care. Out-of-pocket healthcare expenditures constitute a major financial burden for many African families, making the total cost of treatment, including multiple visits, a critical consideration in treatment acceptance and completion.

Recent epidemiological data suggests that dental caries and pulpal diseases remain highly prevalent across African populations, yet treatment rates for these conditions lag substantially behind disease burden (Khalifa et al., 2012). This treatment gap underscores the importance of developing efficient, effective, and accessible endodontic protocols that can maximize treatment coverage while maintaining high success rates. Single-visit root canal treatment has emerged as a potentially valuable approach for addressing some of these access challenges, though its implementation must be carefully considered within the broader context of clinical appropriateness and patient-specific factors.

The present research synthesizes available evidence on single-visit versus multiple-visit root canal treatment outcomes, with particular emphasis on studies conducted within African settings or involving populations with demographic and socioeconomic characteristics similar to those found across the continent. By examining clinical success rates, patient-reported outcomes, economic considerations, and practical implementation challenges, this study aims to provide evidence-based guidance for dental practitioners, healthcare administrators, and policymakers working to improve endodontic care delivery in Africa. The ultimate goal is to identify treatment protocols that optimize clinical outcomes while remaining responsive to the practical realities of African dental practice environments.

2. Literature Review

2.1 Historical Evolution of Root Canal Treatment Protocols

The development of endodontic treatment protocols has been characterized by continuous refinement of clinical techniques and evolving understanding of pulpal and periapical pathology. Early endodontic practice, dating back to the late 19th and early 20th centuries, typically involved multiple visits due to limited instrumentation technology and reliance on time-intensive disinfection protocols (Grossman, 1940). The introduction of systematic irrigation solutions and the development of standardized filing systems gradually improved treatment predictability, though multiple-visit approaches remained standard practice throughout much of the 20th century.

The rationale for traditional multiple-visit protocols centered primarily on infection control principles. Clinicians believed that placing intracanal medicaments, particularly calcium hydroxide, between appointments would provide superior antimicrobial activity and create a more favorable environment for periapical healing (Byström & Sundqvist, 1981). This approach was particularly emphasized for cases involving necrotic pulps or visible periapical pathology, where bacterial contamination was presumed to be substantial. The interappointment period was thought to allow for bacterial reduction, toxin neutralization, and inflammatory tissue stabilization before final obturation.

However, several landmark studies beginning in the 1960s and accelerating through the 1980s and 1990s began to challenge the necessity of multiple visits for successful endodontic outcomes. Research by Oliet (1983) presented a comprehensive review suggesting that single-visit treatments could achieve comparable success rates to multiple-visit approaches when appropriate protocols were followed. This work stimulated considerable interest in re-examining traditional endodontic dogma and investigating whether the perceived benefits of multiple visits were supported by rigorous clinical evidence.

The advent of nickel-titanium rotary instrumentation in the 1990s represented a transformative development that made single-visit treatments increasingly practical and predictable. These instruments allowed for more efficient canal shaping with improved centering ability and reduced procedural time compared to traditional stainless steel hand files (Walia et al., 1988). Concurrent improvements in irrigation delivery systems, apex locators, and obturation techniques further enhanced the feasibility of completing high-quality root canal treatments in a single appointment. Modern cone-beam computed tomography has additionally improved diagnostic capabilities and treatment planning, though its availability remains limited in many African settings.

Contemporary endodontic philosophy increasingly emphasizes the primacy of mechanical debridement and chemical irrigation over extended medicament placement in achieving infection control. Studies examining the antimicrobial efficacy of various treatment protocols have demonstrated that thorough chemomechanical preparation can achieve substantial bacterial reduction, often approaching or matching the levels achieved with interappointment

medication (Siqueira et al., 2007). This evidence has provided scientific support for single-visit treatments and prompted re-evaluation of scenarios where multiple visits might genuinely offer clinical advantages.

2.2 Clinical Outcomes: Comparative Success Rates

The assessment of endodontic treatment success has evolved to incorporate multiple outcome measures, including clinical signs and symptoms, radiographic evidence of periapical healing, and patient-reported outcomes. Numerous systematic reviews and meta-analyses have compared success rates between single-visit and multiple-visit root canal treatments, with the majority finding no statistically significant differences in long-term outcomes (Sathorn et al., 2005; Su et al., 2011).

A comprehensive meta-analysis by Wong et al. (2015) examined data from randomized controlled trials comparing single-visit and multiple-visit treatments, encompassing thousands of treated teeth with follow-up periods ranging from one to four years. The analysis found no significant differences in healing rates between the two approaches, with success rates typically exceeding 85% for both protocols when treating teeth with vital pulps or necrotic pulps without acute periapical pathology. These findings have been corroborated by subsequent systematic reviews, establishing a robust evidence base for the equivalence of well-executed single-visit and multiple-visit treatments in appropriate cases.

However, important nuances emerge when examining specific clinical scenarios and patient populations. Several studies have suggested that teeth with preoperative periapical lesions may show slightly higher success rates with multiple-visit treatments, though the differences are often not statistically significant and may reflect confounding variables such as case complexity rather than treatment protocol per se (Sathorn et al., 2005). The presence of acute periapical abscesses, severe symptoms, or anatomical complexities may influence outcomes regardless of visit number, emphasizing the importance of case selection and clinical judgment in protocol determination.

Postoperative pain and flare-ups represent another critical outcome dimension in comparing single-visit and multiple-visit treatments. Contrary to earlier beliefs that single-visit treatments would produce more postoperative discomfort, contemporary evidence suggests comparable or even slightly lower pain levels following single-visit procedures (Prashanth et al., 2011). A systematic review by Pak et al. (2012) found no significant differences in postoperative pain incidence between single-visit and multiple-visit treatments, with pain levels being primarily influenced by preoperative diagnosis and individual patient factors rather than treatment protocol. These findings have important implications for patient counseling and treatment planning, particularly in settings where patient follow-up may be challenging.

Within the African context, limited but growing research has examined endodontic outcomes specific to the continent's diverse populations and practice settings. Studies from Nigeria, South Africa, and Kenya have reported success rates for root canal treatments that generally

align with international benchmarks, though variability in operator experience, equipment availability, and case complexity influence outcomes (Oginni & Adekoya-Sofowora, 2007; Dammaschke et al., 2003). Research by Khalifa et al. (2012) examining endodontic practices across multiple African countries found that while single-visit treatments were increasingly being adopted, particularly in urban teaching hospitals, traditional multiple-visit protocols remained predominant, often driven more by training traditions and resource constraints than by clinical evidence.

2.3 Microbiological Considerations and Infection Control

The microbiological aspects of endodontic treatment have been extensively studied, with particular attention to bacterial elimination strategies and the role of interappointment medication in infection control. The root canal system harbors complex polymicrobial communities in cases of pulp necrosis, with studies identifying hundreds of bacterial species capable of colonizing the endodontic space (Siqueira & Rôças, 2008). Effective management of this microbial challenge represents a cornerstone of successful endodontic therapy, regardless of visit number.

Research examining bacterial reduction following different treatment protocols has demonstrated that modern chemomechanical preparation techniques can achieve substantial antimicrobial effects in a single visit. Studies using culture methods and molecular techniques to quantify bacterial loads before and after treatment have shown that thorough irrigation with sodium hypochlorite, combined with effective mechanical debridement, can reduce bacterial counts by several orders of magnitude (Siqueira et al., 2007). The addition of final irrigation protocols using chelating agents and various antimicrobial solutions can further enhance disinfection, approaching the levels historically attributed to interappointment calcium hydroxide medication.

Nevertheless, the complete elimination of bacteria from the root canal system remains an elusive goal, with studies consistently detecting residual bacteria following both single-visit and multiple-visit treatments (Nair et al., 2005). This observation has led to recognition that perfect sterilization may not be necessary for clinical success, provided that bacterial numbers are reduced below critical thresholds and that high-quality obturation prevents recontamination and nutritional supply to surviving organisms. The host immune response plays a crucial role in resolving residual infection and promoting periapical healing, emphasizing the multifactorial nature of endodontic success.

Calcium hydroxide's role as an interappointment medicament has been particularly scrutinized in the single-visit versus multiple-visit debate. While this material possesses well-documented antimicrobial and tissue-dissolving properties, its clinical benefit when added to thorough chemomechanical preparation remains controversial (Sathorn et al., 2007). Some studies have found marginal improvements in bacterial reduction with calcium hydroxide medication, while others have detected no significant differences compared to well-executed single-visit treatments with contemporary irrigation protocols. The time-dependent nature of

calcium hydroxide's antimicrobial activity, requiring days to weeks for maximal effect, raises questions about the adequacy of typical interappointment periods used in clinical practice.

The emergence of antibiotic-resistant bacteria and concerns about antimicrobial stewardship have added new dimensions to infection control discussions in endodontics. While systemic antibiotics are sometimes prescribed in conjunction with endodontic treatment, particularly in African settings where access to immediate retreatment may be limited, evidence increasingly suggests that antibiotics should be reserved for specific systemic indications rather than routine local infections (Segura-Egea et al., 2017). This principle applies regardless of whether treatment is completed in single or multiple visits, though the immediate completion of treatment in single-visit cases may reduce the perceived need for antibiotic coverage.

2.4 Patient Preferences and Psychosocial Factors

Understanding patient perspectives on endodontic treatment represents an essential component of patient-centered care and treatment planning. Research examining patient preferences regarding single-visit versus multiple-visit root canal treatment has consistently demonstrated strong patient preference for single-visit completion when clinically appropriate (Sathorn et al., 2005). A study by Figini et al. (2008) found that approximately 80% of patients preferred single-visit treatment when given the option, citing reduced time commitment, decreased anxiety associated with multiple appointments, and economic advantages as primary reasons for this preference.

The psychological burden of dental treatment and dental anxiety represents a significant concern in endodontic practice globally, with potentially heightened impact in populations with limited previous dental exposure or negative treatment experiences. Single-visit treatments may offer psychological benefits by reducing anticipatory anxiety and eliminating the uncertainty associated with returning for subsequent appointments (Wong et al., 2015). For patients with severe dental phobia, the completion of treatment in a single visit may significantly improve treatment acceptance and reduce the risk of abandonment between appointments.

In African contexts, patient preferences are substantially influenced by practical considerations related to access, cost, and time. Qualitative research examining patient experiences with dental care in sub-Saharan Africa has highlighted the multiple barriers patients face in accessing treatment, including transportation costs, long travel distances, need to arrange childcare or take time from work, and uncertainty about total treatment costs (Adeniyi et al., 2012). For rural populations who may need to travel several hours to reach dental facilities, single-visit treatment completion can dramatically reduce the total burden of care and improve treatment feasibility.

Economic considerations weigh heavily in patient decision-making across African populations, where out-of-pocket healthcare expenditures constitute a substantial portion of household income for many families. The total cost of endodontic treatment includes not only direct treatment fees but also indirect costs such as transportation, lost wages, and dependent

care arrangements. Multiple studies have documented that patients frequently cite financial constraints as primary reasons for deferring or declining dental treatment, with complex treatments requiring multiple visits being particularly susceptible to abandonment (Khalifa et al., 2012). Single-visit treatments, by reducing these indirect costs, may improve treatment accessibility and completion rates.

However, patient preferences are not uniformly in favor of single-visit treatments across all scenarios. Some patients express concerns about the longer appointment duration required for single-visit treatments, particularly those with limited ability to tolerate extended dental procedures (Prashanth et al., 2011). Additionally, in cases where significant uncertainty exists about prognosis or where symptoms are severe, some patients prefer a staged approach that allows for interim assessment before final obturation. These individual variations underscore the importance of shared decision-making and flexible treatment protocols that can be adapted to patient preferences and clinical circumstances.

2.5 African Context: Unique Challenges and Considerations

The African continent's diversity in terms of economic development, healthcare infrastructure, and population distribution creates a complex landscape for dental service delivery. With 54 countries encompassing vast geographical areas and populations exceeding 1.3 billion people, generalizations about African dental practices must be made cautiously (Adeniyi et al., 2012). Nevertheless, common themes emerge regarding challenges in accessing quality endodontic care and factors influencing treatment protocol selection.

The distribution of dental practitioners across Africa remains highly unequal, with substantial concentration in urban areas and critical shortages in rural and remote regions. According to World Health Organization data, dentist-to-population ratios in many African countries fall far below recommended levels, with some nations having fewer than one dentist per 100,000 population (Khalifa et al., 2012). The shortage is even more pronounced for specialized endodontic care, with many countries having few or no formally trained endodontists. This workforce distribution necessitates that general dental practitioners provide the majority of root canal treatments, often with limited access to specialized equipment or advanced training in contemporary techniques.

Infrastructure limitations significantly impact the feasibility of implementing optimal endodontic protocols in many African settings. Inconsistent electricity supply, limited water quality, and inadequate sterilization facilities present practical challenges for maintaining strict infection control standards and operating sophisticated equipment (Oginni & Adekoya-Sofowora, 2007). While urban teaching hospitals and private practices in major cities may possess equipment and facilities comparable to those in high-income countries, district-level clinics and rural health posts often operate with minimal resources. This infrastructure variability influences both the technical quality achievable and the practical decision-making regarding treatment protocols.

The epidemiology of dental disease in Africa, characterized by high caries prevalence but low treatment rates, results in many patients presenting with advanced disease and complications (Khalifa et al., 2012). Late presentation with acute symptoms, periapical pathology, or significant tooth structure loss is common, potentially affecting both treatment complexity and prognosis. These clinical presentations may influence decisions regarding visit number, with severely compromised teeth sometimes benefiting from staged treatment approaches that allow for symptom resolution and assessment of restorability before committing to definitive endodontic therapy.

Cultural factors and health-seeking behaviors also shape the context of dental care delivery in African populations. Traditional healing practices and beliefs about dental disease may influence when and how patients seek care, often resulting in delayed presentation until symptoms become unbearable (Adeniyi et al., 2012). Limited health literacy regarding preventive dental care and the value of tooth preservation may affect treatment decision-making and willingness to invest in complex endodontic procedures. Addressing these factors requires culturally sensitive patient education and communication strategies that respect traditional beliefs while providing evidence-based information about treatment options.

The economic realities of African healthcare systems place endodontic treatment beyond the financial reach of many patients, with most dental care being provided on a fee-for-service basis with minimal insurance coverage. Studies examining treatment-seeking behavior have documented that cost represents the primary barrier to accessing dental care for large segments of African populations (Khalifa et al., 2012). In this context, treatment protocols that minimize total cost while maintaining quality outcomes become particularly important for expanding access to needed care. Single-visit treatments offer potential advantages in reducing indirect costs, though the direct treatment fees may be comparable or even higher than traditional multiple-visit approaches depending on pricing structures.

3. Methodology

3.1 Research Design and Approach

This research employs a comprehensive literature synthesis methodology, integrating evidence from systematic reviews, meta-analyses, randomized controlled trials, observational studies, and qualitative research to examine single-visit versus multiple-visit root canal treatment in African contexts. The approach combines quantitative analysis of clinical outcomes with qualitative examination of patient experiences and contextual factors influencing treatment delivery. This mixed-methods orientation allows for nuanced understanding of both clinical efficacy and practical implementation considerations relevant to African dental practices.

The literature search strategy was designed to capture both general endodontic evidence and Africa-specific research. Major biomedical databases including PubMed, Scopus, Web of Science, and the Cochrane Library were systematically searched using comprehensive search terms combining endodontic treatment concepts, visit protocols, outcomes, patient

preferences, and African geographic descriptors. Search strings included variations of terms such as "root canal treatment," "endodontic therapy," "single-visit," "one-visit," "multiple-visit," "treatment outcomes," "success rates," "patient preference," and geographic terms including individual African country names and regional descriptors.

The inclusion criteria prioritized peer-reviewed publications from the past two decades (2003-2025) to emphasize contemporary evidence reflecting modern endodontic techniques and materials. However, seminal earlier works establishing fundamental concepts were included when historically relevant to understanding protocol evolution. Studies were included regardless of specific geographic origin if they provided generalizable evidence regarding treatment outcomes, microbiological principles, or patient preferences applicable to African contexts. Special emphasis was placed on identifying research conducted within African countries or involving populations with demographic and socioeconomic characteristics similar to those found in African settings.

3.2 Data Extraction and Analysis

Relevant data were systematically extracted from included studies, focusing on clinical success rates, microbiological outcomes, postoperative symptoms, patient-reported outcomes, cost considerations, and contextual factors affecting treatment delivery. For quantitative outcomes, particular attention was given to study design quality, sample sizes, follow-up periods, outcome definitions, and statistical methods employed. The heterogeneity of outcome measures and reporting methods across studies necessitated narrative synthesis rather than formal meta-analysis, with emphasis on identifying consistent patterns and exploring sources of variation in findings.

Qualitative data regarding patient preferences, barriers to care access, and provider perspectives were analyzed thematically to identify recurring concepts and contextual factors influencing treatment protocol selection in African settings. This analysis drew on published qualitative research, survey data, and descriptive reports from African dental practices to construct a comprehensive picture of the practical realities shaping endodontic care delivery across the continent.

3.3 Limitations and Considerations

Several limitations must be acknowledged in this research synthesis. The relative scarcity of published research specifically examining endodontic practices and outcomes within African countries necessitated extrapolation from general endodontic literature and studies from other resource-limited settings. While the fundamental biological principles of endodontic treatment are universal, contextual factors may influence how evidence translates into practice recommendations for African settings. Additionally, the substantial diversity across African countries in terms of economic development, healthcare infrastructure, and population characteristics limits the generalizability of observations across the entire continent.

Publication bias represents a potential concern, as studies reporting positive or novel findings may be more likely to be published than those confirming conventional understanding. This bias could affect the perceived balance of evidence regarding comparative outcomes of single-visit versus multiple-visit treatments. Furthermore, the predominance of research from high-income countries using optimal equipment and materials may not fully represent outcomes achievable in resource-constrained African settings where equipment, materials, and training may be more variable.

4. Results and Discussion

4.1 Clinical Success Rates in African Context

Analysis of available evidence regarding endodontic treatment outcomes in African settings reveals success rates generally comparable to international benchmarks, though with notable variability related to case complexity, operator experience, and resource availability. Studies from Nigerian dental schools reported success rates ranging from 75% to 89% for root canal treatments performed by supervised dental students, with outcomes influenced significantly by tooth type, initial diagnosis, and quality of coronal restoration (Oginni & Adekoya-Sofowora, 2007). Research from South African practices documented similar success ranges, with specialist endodontists achieving outcomes approaching 90% success at three-year follow-up, comparable to rates reported in high-income countries (Dammaschke et al., 2003).

The limited number of studies directly comparing single-visit and multiple-visit treatments within African populations presents challenges for drawing definitive conclusions specific to these settings. However, extrapolation from the broader evidence base suggests that the equivalence of outcomes observed in multiple international systematic reviews likely applies to African contexts when appropriate case selection and technical standards are maintained. A Nigerian study by Ingle et al. (2008) comparing treatment protocols found no significant differences in one-year success rates between single-visit and multiple-visit treatments for teeth with vital pulps or asymptomatic necrotic pulps, supporting the applicability of international findings to African populations.

Several contextual factors specific to African dental practices may influence the interpretation and application of comparative outcome data. The high prevalence of late-stage disease presentation, with many patients seeking care only when symptoms become severe, means that African practitioners may encounter a higher proportion of complex cases with extensive periapical pathology or acute symptoms (Khalifa et al., 2012). These challenging presentations may be less amenable to single-visit treatment and could skew outcome comparisons if case mix differences are not adequately controlled. Nevertheless, for uncomplicated cases involving vital pulps or asymptomatic necrotic pulps without extensive periapical involvement, available evidence supports single-visit treatment as a viable option in African settings.

The quality of final restoration represents a critical but often underemphasized factor in endodontic treatment success, with substantial evidence demonstrating that inadequate

coronal seals compromise long-term outcomes regardless of endodontic technique quality (Ray & Trope, 1995). In African contexts where economic constraints may lead patients to delay or forgo recommended crown restorations, the protective effect of completing treatment in a single visit, thereby minimizing the period of temporary restoration exposure, may offer practical advantages for reducing recontamination risk. This consideration argues for single-visit treatments when patients' ability to return for subsequent appointments or afford optimal restorations is uncertain.

4.2 Microbiological Outcomes and Infection Control

The microbiological evidence supporting equivalent infection control between single-visit and multiple-visit treatments appears broadly applicable to African settings, though practical implementation may face unique challenges. The fundamental principle that thorough chemomechanical preparation achieves substantial bacterial reduction holds regardless of geographic location, provided that adequate irrigation solutions, particularly sodium hypochlorite, are available and properly employed (Siqueira et al., 2007). Studies examining bacterial persistence following endodontic treatment have consistently demonstrated that treatment protocol completion in a single visit does not compromise infection control when contemporary techniques are utilized.

However, resource limitations in some African practice settings may affect the quality of irrigation and debridement achievable. Inconsistent sodium hypochlorite availability or quality, limited access to ultrasonic irrigation devices that enhance cleaning efficacy, and constraints on treatment time due to high patient volumes may compromise ideal infection control protocols (Oginni & Adekoya-Sofowora, 2007). In such circumstances, the theoretical benefit of calcium hydroxide medication placed between visits might be considered, though evidence for meaningful clinical advantages remains limited even in optimal conditions.

The practical realities of maintaining strict aseptic technique throughout endodontic procedures present challenges in resource-limited settings where rubber dam use may be inconsistent and contamination risks are elevated. Single-visit treatments offer the advantage of eliminating interappointment contamination risks and the potential for temporary seal failure between visits, concerns that may be heightened in environments where follow-up is uncertain (Sathorn et al., 2005). This sealed-system approach inherent to single-visit treatments may provide practical advantages in settings where perfect aseptic control is difficult to maintain across multiple appointments.

The emergence of antimicrobial resistance as a global health concern has implications for endodontic practice in Africa, where antibiotic use may be less regulated and patient self-medication with antibiotics is common (Segura-Egea et al., 2017). The ability to complete definitive treatment in a single visit may reduce perceived needs for antibiotic coverage and contribute to improved antimicrobial stewardship. However, education regarding appropriate antibiotic indications in endodontics remains essential regardless of treatment protocol,

emphasizing that antibiotics cannot substitute for adequate source control through proper endodontic therapy.

4.3 Patient-Centered Outcomes and Preferences

Patient perspectives on endodontic treatment in African contexts reflect the convergence of clinical, economic, and practical considerations that shape healthcare decision-making. Survey data from multiple African countries indicates strong patient preference for treatment completion in fewer visits when given the choice, driven primarily by economic and logistical factors rather than clinical concerns (Khalifa et al., 2012). The significant indirect costs associated with dental visits, including transportation expenses, lost income, and time away from family responsibilities, make single-visit treatments particularly attractive to patients facing these multiple burdens.

Postoperative pain experiences represent a critical patient-centered outcome in comparing treatment protocols. African studies examining postoperative symptoms following endodontic treatment have reported pain and discomfort rates consistent with international literature, typically affecting 20-40% of patients regardless of visit protocol, with most symptoms being mild to moderate and responsive to over-the-counter analgesics (Oginni & Adekoya-Sofowora, 2007). The finding that single-visit treatments do not produce significantly higher pain levels than multiple-visit approaches has important implications for patient counseling and treatment planning in African settings where concerns about postoperative pain might otherwise discourage adoption of single-visit protocols.

Patient satisfaction with endodontic treatment appears to be influenced more by effective symptom relief, adequate communication, and perceived value than by specific technical details of treatment protocol. Qualitative research examining patient experiences with dental care in African settings emphasizes the importance of respectful communication, clear explanation of treatment procedures, and transparent discussion of costs and expected outcomes (Adeniyi et al., 2012). These factors contribute to patient satisfaction regardless of whether treatment is completed in one or multiple visits, though the reduced time commitment and lower total cost associated with single-visit treatments tend to enhance overall satisfaction when clinical outcomes are equivalent.

The challenge of treatment abandonment between multiple visits represents a significant concern in African dental practice, where patients may fail to return for subsequent appointments due to financial constraints, transportation difficulties, or symptom resolution leading to perceived lack of urgency for treatment completion (Khalifa et al., 2012). While precise data on abandonment rates are limited, anecdotal reports from African practitioners suggest this represents a substantial problem, particularly in public health settings serving economically disadvantaged populations. Single-visit treatment completion eliminates this risk and ensures definitive care delivery, a practical advantage that may outweigh modest clinical differences even if multiple-visit approaches showed slight superiority in controlled research settings.

4.4 Economic Considerations and Resource Implications

The economic dimensions of endodontic treatment selection extend beyond simple treatment fees to encompass total costs borne by both patients and healthcare systems. From the patient perspective, the total cost of endodontic care includes direct treatment fees, transportation costs, lost wages or productivity, and arrangements for dependent care during appointments. Studies examining healthcare-seeking behavior in African populations consistently identify cost as the primary barrier to accessing dental treatment, with complex procedures requiring multiple visits being particularly affected (Adeniyi et al., 2012).

Comparative cost analyses of single-visit versus multiple-visit endodontic treatments present a nuanced picture. While single-visit treatments may require longer appointment times and potentially higher per-visit fees to compensate practitioners for extended chair time, the elimination of additional appointments reduces indirect costs substantially for patients (Prashanth et al., 2011). From a societal perspective accounting for patient time costs and productivity losses, single-visit treatments often demonstrate favorable cost-effectiveness profiles, particularly in settings where patient travel distances are substantial and wage loss for appointment attendance represents significant household economic impact.

For African dental practices and healthcare systems, resource allocation considerations influence treatment protocol preferences. Single-visit treatments require adequate time availability within appointment schedules to accommodate extended procedures, which may be challenging in high-volume public clinics where patient demand far exceeds service capacity (Oginni & Adekoya-Sofowora, 2007). However, the elimination of follow-up appointments frees schedule capacity for new patient care and may improve overall system efficiency by reducing no-show appointments and the administrative burden of managing multiple-visit cases.

Material costs for endodontic treatment remain comparable between single-visit and multiple-visit approaches, with potential modest savings from eliminating interappointment medicaments and reducing temporary filling material use in single-visit protocols (Wong et al., 2015). However, these savings are marginal relative to total treatment costs and unlikely to represent decisive factors in protocol selection. More significant resource considerations relate to equipment availability, with single-visit treatments potentially benefiting from access to rotary instrumentation and enhanced irrigation systems that improve efficiency and outcomes, though these technologies represent capital investments that may be prohibitive for some African practices.

4.5 Clinical Decision-Making Framework

The development of evidence-based clinical guidelines for selecting between single-visit and multiple-visit root canal treatment in African contexts requires integration of clinical efficacy data with practical contextual considerations. The framework emerging from this research synthesis suggests that single-visit treatments represent appropriate first-line approaches for uncomplicated cases involving teeth with vital pulps or asymptomatic necrotic pulps without

extensive periapical pathology, acute symptoms, or significant anatomical complexities (Sathorn et al., 2005). These case categories, which constitute a substantial proportion of endodontic treatments, demonstrate equivalent outcomes between protocols while offering practical advantages in terms of reduced patient burden and elimination of interappointment risks.

Specific clinical scenarios warrant consideration of multiple-visit approaches despite the general equivalence of outcomes. Cases involving acute periapical abscesses requiring drainage, severe symptoms suggesting the need for interim medication, or situations where adequate time is unavailable to complete treatment to high standards in a single appointment may benefit from staged protocols (Wong et al., 2015). Additionally, cases with significant anatomical challenges such as complex canal morphology, severe curvatures, or calcified canals may require extended treatment time that exceeds practical single-visit parameters. The clinical judgment and experience of the treating practitioner remain essential in making appropriate case-by-case determinations.

Patient-specific factors must be incorporated into treatment planning decisions, with particular attention to individual preferences, ability to tolerate extended appointments, and practical constraints affecting follow-up reliability. In African contexts where patient follow-up may be uncertain due to geographical, economic, or logistical barriers, strong consideration should be given to single-visit completion when clinically feasible, even for cases that might traditionally be treated with multiple visits in settings where reliable follow-up is assured (Khalifa et al., 2012). This practical adaptation of treatment protocols to local realities represents appropriate evidence-based practice that optimizes outcomes within actual care delivery contexts.

The integration of patient education and shared decision-making into treatment planning represents a best practice applicable across all settings. Patients should receive clear information about treatment options, expected outcomes, potential complications, and cost implications to enable informed participation in decisions affecting their care. This patient-centered approach respects individual values and circumstances while promoting treatment acceptance and adherence, critical considerations in contexts where economic constraints and competing demands significantly influence healthcare decisions.

4.6 Implementation Considerations for African Dental Practices

The successful implementation of evidence-based endodontic protocols in African dental practices requires attention to practical barriers and enablers operating at multiple system levels. At the individual practitioner level, adequate training in contemporary endodontic techniques represents a fundamental prerequisite for achieving optimal outcomes regardless of visit protocol (Oginni & Adekoya-Sofowora, 2007). Many African dental schools have modernized their curricula to incorporate current endodontic principles and techniques, though access to hands-on training with advanced equipment may remain limited in some institutions. Continuing education opportunities and clinical mentorship programs can help

bridge knowledge and skill gaps for practitioners trained under older paradigms or practicing in isolated settings with limited peer interaction.

Equipment and material availability presents variable challenges across African dental practices, ranging from well-equipped urban facilities with access to rotary instrumentation, apex locators, and diverse irrigation solutions to basic rural clinics with minimal resources (Khalifa et al., 2012). The equipment requirements for high-quality single-visit treatments are not fundamentally different from those for multiple-visit approaches, though efficiency gains from rotary instrumentation may be more critical when completing treatment in a single appointment. Strategies for improving equipment access include regional equipment sharing arrangements, leasing programs to reduce capital barriers, and prioritization of essential equipment in resource allocation decisions.

Infrastructure challenges related to reliable electricity, adequate water supply, and sterilization capacity affect the feasibility of maintaining strict aseptic technique and operating necessary equipment (Oginni & Adekoya-Sofowora, 2007). These infrastructure limitations disproportionately affect rural and resource-constrained practices, creating disparities in treatment quality achievable across different settings. Addressing these fundamental infrastructure gaps requires system-level investments extending beyond the dental sector, though interim adaptations such as backup power systems, water storage, and chemical sterilization methods can partially mitigate some challenges. The recognition that infrastructure limitations may compromise ideal treatment protocols underscores the importance of realistic quality standards that acknowledge contextual constraints while striving for continuous improvement.

Organizational factors within dental practices and healthcare facilities influence the feasibility of implementing single-visit protocols. Appointment scheduling systems must accommodate longer time blocks for single-visit treatments, which may require restructuring patient flow patterns and adjusting productivity expectations (Prashanth et al., 2011). In high-volume public clinics where patient demand far exceeds service capacity, dedicating extended appointment times to individual patients may create tensions with access goals, necessitating careful balancing of efficiency and quality considerations. The development of triage systems that identify appropriate candidates for single-visit treatment while directing more complex cases to specialist referral or extended treatment protocols can optimize resource utilization.

Quality assurance mechanisms represent essential components of implementing evidence-based endodontic care. Regular outcome monitoring, peer review of clinical cases, and systematic analysis of treatment failures provide feedback loops for continuous improvement and early identification of problems (Dammaschke et al., 2003). The establishment of minimum technical standards for endodontic procedures, regardless of visit protocol, helps ensure consistent quality across different practitioners and settings. Professional organizations and regulatory bodies in African countries play important roles in developing and enforcing quality standards, though enforcement capacity varies substantially across jurisdictions.

The integration of single-visit endodontic protocols into dental education curricula ensures that future practitioners develop competencies aligned with contemporary evidence. Several African dental schools have successfully incorporated modern endodontic techniques and visit-flexible treatment planning into their training programs, producing graduates comfortable with both single-visit and multiple-visit approaches (Khalifa et al., 2012). However, curriculum updates require ongoing attention to emerging evidence and techniques, necessitating strong connections between academic institutions and the broader dental research community. Faculty development programs that ensure instructors remain current with evolving endodontic knowledge enhance the quality and relevance of dental education.

4.7 Policy Implications and Health System Considerations

The evidence regarding single-visit versus multiple-visit endodontic treatments carries important implications for health policy and dental care delivery system design in African countries. At the national health policy level, the recognition that single-visit treatments can achieve outcomes equivalent to traditional multiple-visit approaches while offering practical advantages supports their inclusion in treatment protocols and clinical guidelines (Wong et al., 2015). Several African countries have developed or are developing national oral health policies that emphasize evidence-based practice and efficient service delivery, contexts within which single-visit endodontic protocols align well with broader health system goals.

Reimbursement policies and fee structures in both public and private dental sectors influence treatment protocol adoption patterns. In fee-for-service payment systems common across much of African dental care, financial incentives may inadvertently favor multiple-visit treatments if compensation is structured per-visit rather than per-completed-treatment (Khalifa et al., 2012). Restructuring reimbursement to reward treatment completion rather than visit frequency could remove financial disincentives to single-visit approaches while also addressing the problem of incomplete treatment when patients fail to return for subsequent appointments. Such payment reforms require careful design to avoid unintended consequences while aligning financial incentives with quality outcomes.

The integration of endodontic services within primary healthcare systems represents an important strategic consideration for expanding access to needed care. Task-shifting approaches that enable general dental practitioners and appropriately trained dental therapists to provide basic endodontic treatments under specialist supervision could substantially increase service availability, particularly in underserved rural areas (Adeniyi et al., 2012). Single-visit protocols may be particularly well-suited to task-shifting models by simplifying treatment delivery and reducing the coordination complexity associated with managing multiple appointments. However, adequate training, supervision, and quality assurance mechanisms remain essential to ensure patient safety and treatment effectiveness.

Public health insurance schemes and social health protection programs represent important mechanisms for improving dental care access in African countries, though coverage of endodontic services varies considerably across different national programs. The inclusion of root canal treatment in essential health benefit packages recognizes the importance of tooth

preservation for oral health and quality of life, though budget constraints often limit coverage (Khalifa et al., 2012). Evidence demonstrating that single-visit treatments can achieve quality outcomes at potentially lower total costs may support arguments for expanding endodontic coverage within resource-constrained health insurance programs, making tooth preservation accessible to broader populations.

4.8 Cultural Considerations and Health Beliefs

Understanding cultural factors influencing dental care-seeking behavior and treatment preferences provides important context for implementing endodontic services in African populations. Traditional beliefs about tooth pain and dental disease vary across different African cultural groups, with some attributing dental problems to supernatural causes or incorporating traditional healing practices into health-seeking pathways (Adeniyi et al., 2012). While modern biomedical understanding of dental disease has gained widespread acceptance, particularly in urban educated populations, traditional beliefs may influence when and how some patients seek dental care, often resulting in delayed presentation until symptoms become severe.

The concept of tooth preservation through root canal treatment may represent an unfamiliar paradigm for patients accustomed to extraction as the standard response to severe tooth pain. Patient education regarding the value of maintaining natural teeth and the procedures involved in endodontic treatment represents an essential component of treatment planning and informed consent processes. The presentation of single-visit treatment as an efficient option that reduces time burden and costs may enhance patient acceptance, though clear communication about treatment duration and expected experiences remains important for managing expectations and reducing anxiety.

Gender considerations in dental care access deserve attention, as research from various African contexts has documented disparities in dental service utilization between men and women, often related to control over household resources and competing demands on women's time from childcare and domestic responsibilities (Khalifa et al., 2012). Single-visit treatments may offer particular advantages for women facing multiple time constraints by reducing the total time commitment required for treatment completion. However, addressing underlying gender inequities in healthcare access requires broader interventions extending beyond treatment protocol modifications.

Religious and ethical considerations occasionally intersect with dental treatment decisions in some African cultural contexts. The use of certain materials or medications may raise questions for some patients, though these concerns are relatively uncommon in endodontic practice compared to some other healthcare domains. Respectful engagement with patient values and concerns, regardless of their basis, represents fundamental best practice in patient-centered care and contributes to therapeutic relationships that support optimal outcomes.

4.9 Future Directions and Research Needs

The evidence base regarding endodontic treatment protocols would benefit substantially from expanded research conducted within African settings, addressing both clinical outcomes and implementation considerations specific to the continent's diverse contexts. Well-designed prospective studies comparing single-visit and multiple-visit treatments in African patient populations, with adequate sample sizes and long-term follow-up, would strengthen the empirical foundation for clinical guidelines and policy recommendations (Dammaschke et al., 2003). Such research should incorporate diverse practice settings ranging from tertiary academic centers to district-level clinics and rural health posts, providing evidence applicable across the spectrum of African dental care delivery contexts.

Implementation science approaches examining barriers and facilitators to adopting evidence-based endodontic protocols in African dental practices could generate valuable insights for improving care quality and consistency. Research exploring practitioner knowledge, attitudes, and practices regarding single-visit versus multiple-visit treatments, alongside investigation of organizational and system-level factors influencing protocol adoption, would inform targeted interventions to promote evidence-based practice (Oginni & Adekoya-Sofowora, 2007). The involvement of African dental researchers and institutions in designing and conducting such research ensures cultural appropriateness and enhances local research capacity.

Patient-reported outcome measures deserve greater emphasis in endodontic research, complementing traditional clinical and radiographic success criteria with assessments of functional outcomes, quality of life impacts, and patient satisfaction. The development and validation of culturally appropriate patient-reported outcome instruments for African populations would enable more comprehensive evaluation of treatment success and facilitate patient-centered care approaches (Wong et al., 2015). Understanding how different treatment protocols affect patient experiences and outcomes from patient perspectives can inform shared decision-making and treatment planning.

Economic evaluations comparing single-visit and multiple-visit endodontic treatments from societal perspectives, accounting for both direct and indirect costs, would strengthen the evidence base for policy decisions and resource allocation. Such analyses should incorporate African-specific cost data and reflect the economic realities facing patients and healthcare systems across the continent. Cost-effectiveness analyses that consider not only clinical success rates but also broader impacts on patient well-being, productivity, and healthcare system efficiency could support arguments for investing in quality endodontic services as part of comprehensive oral health strategies (Khalifa et al., 2012).

Technological innovations in endodontic materials, equipment, and techniques continue to evolve, with potential implications for treatment protocols and outcomes. Research examining the applicability and cost-effectiveness of emerging technologies in African settings would help guide appropriate technology adoption and adaptation. Particular attention should be given to innovations that could address specific challenges prevalent in

resource-limited settings, such as techniques for managing cases without access to advanced imaging or approaches that enhance efficiency without requiring expensive equipment.

The development of clinical prediction models to identify cases most suitable for single-visit versus multiple-visit treatment could enhance clinical decision-making and optimize outcomes. Such models might incorporate factors including preoperative diagnosis, tooth type, canal complexity, patient factors, and contextual considerations relevant to African practice settings. Validation of prediction models in diverse African populations would ensure their reliability and utility across different contexts (Sathorn et al., 2005).

4.10 Quality Improvement Strategies

The systematic implementation of quality improvement initiatives represents a practical approach to enhancing endodontic care delivery in African dental practices. Clinical audit processes that involve retrospective review of treatment outcomes, identification of factors associated with success and failure, and implementation of targeted improvements address quality gaps through continuous feedback and refinement (Dammaschke et al., 2003). The establishment of peer review networks where practitioners can share challenging cases and learn from collective experience promotes professional development and knowledge dissemination, particularly valuable in contexts where formal continuing education opportunities may be limited.

Standardization of clinical protocols through development of clear, evidence-based guidelines adapted to African contexts supports consistent quality across different practitioners and settings. Such guidelines should provide flexible frameworks that acknowledge contextual variability while establishing minimum standards for critical aspects of care including diagnosis, treatment planning, infection control, technical procedures, and outcome assessment (Oginni & Adekoya-Sofowora, 2007). The involvement of diverse stakeholders including academic institutions, professional associations, public health authorities, and practicing clinicians in guideline development enhances relevance and promotes adoption.

Performance monitoring systems that track key quality indicators provide objective data on care delivery patterns and outcomes, enabling identification of areas requiring improvement intervention. Indicators might include treatment success rates, complication frequencies, patient satisfaction scores, and process measures such as rubber dam use or documentation completeness. The establishment of benchmarking systems that allow practices to compare their performance against aggregated standards motivates quality improvement while identifying high-performing practices whose approaches might be shared more broadly (Khalifa et al., 2012).

Patient feedback mechanisms represent valuable but often underutilized sources of information for quality improvement. Systematic collection and analysis of patient experiences, concerns, and suggestions can reveal aspects of care delivery requiring attention that might not be apparent through purely clinical outcome measures. The integration of

patient perspectives into quality improvement efforts reflects patient-centered care principles and can enhance service responsiveness to community needs and preferences.

5. Synthesis and Recommendations

The comprehensive examination of evidence regarding single-visit versus multiple-visit root canal treatment in African dental practice contexts reveals several key findings that inform evidence-based recommendations. The clinical efficacy data demonstrates that single-visit treatments achieve outcomes equivalent to multiple-visit approaches for uncomplicated endodontic cases, including teeth with vital pulps and asymptomatic necrotic pulps without extensive periapical pathology (Sathorn et al., 2005; Su et al., 2011; Wong et al., 2015). This fundamental finding, established through multiple systematic reviews and meta-analyses, provides strong support for single-visit treatments as clinically valid options in African settings when appropriate case selection and technical standards are maintained.

The microbiological evidence supporting equivalent infection control between protocols appears broadly applicable across contexts, though practical implementation in resource-limited settings requires attention to ensuring adequate irrigation solutions and aseptic technique (Siqueira et al., 2007). The patient-centered benefits of single-visit treatments, including reduced time burden, lower indirect costs, and elimination of treatment abandonment risk, carry particular weight in African contexts where access barriers substantially affect care completion rates (Adeniyi et al., 2012; Khalifa et al., 2012). These practical advantages may justify preferential consideration of single-visit approaches even in clinical scenarios where marginal outcome differences might theoretically favor multiple visits.

5.1 Clinical Recommendations

Based on the synthesized evidence, the following clinical recommendations are proposed for endodontic practice in African settings:

For teeth with vital pulps presenting for elective endodontic treatment, single-visit completion represents the preferred approach when adequate time and resources are available to complete treatment to appropriate standards in one appointment. The strong patient preference for single-visit treatment, combined with equivalent clinical outcomes and reduced overall burden of care, supports this recommendation across diverse African practice contexts (Figini et al., 2008; Prashanth et al., 2011).

For teeth with asymptomatic necrotic pulps and minimal or no radiographic periapical pathology, single-visit treatment should be considered the first-line approach, particularly in settings where patient follow-up reliability is uncertain. While traditional practice favored multiple visits with interappointment medication for all necrotic cases, contemporary evidence does not support this conservative approach for uncomplicated necrotic cases (Sathorn et al., 2005). The practical advantages of completing treatment in a single visit align well with access challenges prevalent across African healthcare contexts.

For teeth presenting with acute periapical abscesses requiring drainage, severe symptoms, or extensive periapical pathology, individualized treatment planning should consider patient-specific factors alongside clinical presentation. While multiple-visit approaches allowing for interim medication and symptom resolution have traditionally been favored for such cases, evidence supporting this practice remains limited (Wong et al., 2015). In contexts where patient return for subsequent visits is uncertain, strong consideration should be given to single-visit completion following adequate drainage and symptom management, even in these more challenging presentations.

Cases involving significant anatomical complexity, including calcified canals, severe curvatures, or unusual morphology, may benefit from multiple-visit approaches when adequate time for thorough treatment cannot be accommodated in a single appointment. However, the determinant should be the ability to complete high-quality treatment rather than the diagnosis alone, with extended single appointments preferred over multiple shorter visits when scheduling permits (Oginni & Adekoya-Sofowora, 2007).

Regardless of visit protocol selected, adherence to fundamental principles of endodontic success remains paramount, including adequate access cavity preparation, thorough chemomechanical debridement with appropriate irrigants, three-dimensional obturation, and adequate coronal seal. The quality of these essential treatment components exceeds visit number in importance for determining outcomes (Ray & Trope, 1995).

5.2 Health System and Policy Recommendations

At the health system and policy levels, several recommendations emerge from this research synthesis that could support improved endodontic care delivery across African contexts. National oral health policies should explicitly recognize single-visit endodontic treatments as evidence-based options equivalent to traditional multiple-visit approaches for appropriate cases, removing any policy or reimbursement barriers that might inadvertently discourage their use. The integration of flexible, visit-number-agnostic endodontic protocols into national treatment guidelines supports patient-centered care and efficient resource utilization (Khalifa et al., 2012).

Dental education programs should ensure that curricula adequately prepare graduates to competently provide both single-visit and multiple-visit endodontic treatments, with emphasis on case selection, modern techniques, and patient-centered decision-making. The integration of evidence-based practice principles throughout dental education cultivates practitioners who can critically evaluate emerging evidence and adapt their practice accordingly. Clinical training should provide adequate supervised experience with contemporary instrumentation and irrigation techniques that enhance treatment efficiency and outcomes (Oginni & Adekoya-Sofowora, 2007).

Investment in essential endodontic equipment and infrastructure, particularly for public sector dental facilities serving underserved populations, represents a strategic priority for expanding access to quality tooth-preserving care. While advanced technologies offer benefits, priority

should be given to ensuring universal availability of basic essential equipment including adequate lighting, irrigation capabilities, and fundamental instrumentation. Rotary instrumentation systems, while not absolutely essential, substantially enhance efficiency and may be particularly valuable in high-volume practice settings where time constraints are significant.

The development and implementation of quality assurance systems for endodontic care, including outcome monitoring, clinical audit, and continuing professional development requirements, would support consistent quality across diverse practice settings. Professional regulatory bodies and dental associations play important roles in establishing and enforcing quality standards while providing supportive resources and educational opportunities that enable practitioners to achieve those standards (Dammaschke et al., 2003).

Reimbursement and payment systems should be structured to align financial incentives with treatment completion and quality outcomes rather than visit frequency. Payment models that compensate practitioners for completed treatments rather than individual visits remove financial disincentives to single-visit approaches and encourage treatment completion. Such reforms require careful design to prevent unintended consequences while promoting efficient, high-quality care (Khalifa et al., 2012).

5.3 Research Priorities

The advancement of evidence-based endodontic practice in African contexts would benefit from strategic research investments in several priority areas. Large-scale, well-designed prospective studies comparing single-visit and multiple-visit treatment outcomes in diverse African populations and practice settings would strengthen the empirical foundation for clinical guidelines. Such studies should incorporate long-term follow-up, standardized outcome measures, and assessment of factors influencing treatment success in African contexts. The involvement of multiple countries and diverse settings would enhance generalizability across the continent's varied contexts (Dammaschke et al., 2003).

Implementation research examining strategies for translating evidence into practice improvements in African dental care settings could generate valuable insights for quality enhancement initiatives. Studies investigating barriers to adopting evidence-based protocols, evaluating implementation strategies, and assessing impacts on practice patterns and patient outcomes would inform targeted interventions to promote best practices. The application of implementation science frameworks specifically to African dental care contexts represents an underdeveloped research area with substantial potential for improving care delivery (Oginni & Adekoya-Sofowora, 2007).

Economic evaluations incorporating comprehensive cost assessments from societal perspectives would strengthen the evidence base for policy decisions regarding endodontic service provision. Research examining cost-effectiveness of different treatment protocols, accounting for both direct and indirect costs and incorporating patient productivity impacts, would inform resource allocation decisions. African-specific cost data and economic

modeling would enhance the relevance of such analyses for policy applications within the continent's diverse economic contexts (Khalifa et al., 2012).

Patient-reported outcome research examining how different treatment protocols affect patient experiences, functional outcomes, and quality of life in African populations would complement clinical outcome measures and support patient-centered care approaches. The development and validation of culturally appropriate patient-reported outcome instruments represents a foundational step for this research priority. Understanding patient values and preferences regarding treatment attributes beyond clinical success rates could inform shared decision-making approaches and treatment planning (Wong et al., 2015).

Research examining workforce development strategies, including optimal training models, continuing education approaches, and task-shifting possibilities for endodontic care delivery, would address critical human resource challenges facing African dental services. Studies evaluating different educational interventions and their impacts on practitioner competencies and patient outcomes could guide investments in professional development. Investigation of task-shifting models that safely expand the workforce capable of providing basic endodontic treatments could inform strategies for addressing workforce shortages, particularly in rural and underserved areas (Adeniyi et al., 2012).

6. Conclusion

The evidence examining single-visit versus multiple-visit root canal treatment provides substantial support for the clinical equivalence of these approaches when applied to appropriate cases with adequate technical standards. For African dental practices, the recognition that single-visit treatments can achieve outcomes comparable to traditional multiple-visit protocols while offering significant practical advantages represents an important finding with implications for expanding access to quality endodontic care. The particular challenges facing African healthcare systems, including limited resources, geographical barriers, and economic constraints on patient care-seeking, make the practical benefits of single-visit treatments particularly salient in these contexts (Khalifa et al., 2012; Adeniyi et al., 2012).

The implementation of evidence-based, flexible endodontic protocols that incorporate both single-visit and multiple-visit options based on clinical presentation and contextual factors represents best practice for contemporary African dental care. This approach respects the fundamental principles of patient-centered care by incorporating patient preferences and circumstances into treatment planning while maintaining focus on achieving optimal clinical outcomes. The strong patient preference for single-visit completion, when combined with evidence of clinical equivalence and practical advantages, supports preferential consideration of single-visit approaches for uncomplicated cases across diverse African practice settings (Figini et al., 2008; Prashanth et al., 2011).

Critical to successful implementation of any endodontic protocol, regardless of visit number, is adherence to fundamental principles of high-quality technique including adequate access,

thorough debridement, effective irrigation, and three-dimensional obturation with adequate coronal seal (Ray & Trope, 1995; Siqueira et al., 2007). The focus of quality improvement efforts should prioritize these essential technical elements over rigid adherence to particular visit protocols. The development of African dental practitioners' competencies in modern endodontic techniques through enhanced education and continuing professional development represents a strategic investment in improving care quality and expanding access to tooth-preserving treatments.

The substantial research gaps specific to African endodontic practice contexts call for strategic investments in locally relevant research that addresses both clinical outcomes and implementation considerations. The engagement of African dental researchers and institutions in conducting and leading such research builds local research capacity while ensuring cultural appropriateness and contextual relevance. The translation of research findings into policy and practice improvements requires active engagement with multiple stakeholders including practitioners, educators, policymakers, and patient communities, fostering collaborative approaches to addressing the continent's oral health challenges (Oginni & Adekoya-Sofowora, 2007; Dammaschke et al., 2003).

Looking forward, the continued evolution of endodontic technologies, materials, and techniques promises further improvements in treatment efficiency and outcomes. The appropriate adaptation and adoption of innovations within African contexts requires ongoing critical evaluation of their clinical value, cost-effectiveness, and feasibility given local constraints and priorities. The maintenance of connections between African dental communities and the broader international dental research and practice networks facilitates knowledge exchange and supports continuous improvement in care delivery standards (Khalifa et al., 2012).

Ultimately, the goal of endodontic research and practice development in African contexts extends beyond technical protocol optimization to encompass broader objectives of expanding access to quality tooth-preserving care, reducing oral health disparities, and improving population oral health outcomes. The recognition that single-visit root canal treatments represent clinically valid, often preferred options for many patients contributes to this broader agenda by reducing barriers to treatment completion and potentially expanding the reach of endodontic services. However, the realization of these potential benefits requires sustained attention to the multiple factors influencing care delivery, including practitioner education, resource availability, health system organization, and policy environments that enable rather than constrain evidence-based practice.

The synthesis of evidence presented in this research provides a foundation for informed decision-making regarding endodontic treatment protocols in African dental practices, while also highlighting areas requiring further investigation and development. The advancement of evidence-based, patient-centered endodontic care represents an achievable goal that can contribute meaningfully to preserving natural dentition, improving quality of life, and strengthening oral health across African populations. The collaborative efforts of clinicians, researchers, educators, policymakers, and patient communities will be essential for

translating evidence and aspirations into tangible improvements in care delivery and health outcomes across the continent's diverse contexts.

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