

Success and Failures of Single Visit over Multiple Visit Nonsurgical Endodontic Treatment in Permanent Teeth : A Review

ABSTRACT

Root canal treatment is a common procedure in endodontic dentistry treating the teeth with necrosis of the dental pulp caused by carious processes, coronal crack or fracture, or dental trauma. The success of root canal treatment depends on a number of variables related to the preoperative condition of the tooth, as well as the procedure options for endodontic treatment. **A successful root canal treatment is defined by the absence of symptoms and observable clinical signs.** Single visit root canal treatment used to give more success rate compared to multiple visit treatments. In this paper we aim to treatments based on time, restoration, esthetics, post operative pain, technique and fracture resistance of teeth.

KEY WORDS

Single Visit Root Canal Treatment, Multiple Visit Root Canal Treatment, Access Opening, Working Length, Biomechanical Preparation.

INTRODUCTION

“Root canal therapy is a conservative therapeutic option that entails the removal of diseased pulpal tissue and prevents or treat pulpal/periradicular pathosis and safeguards the treated tooth from recurrent microbial invasion”.¹ “An electronic database (Pubmed, Scopus, Research gate, Medline) were screened with key words endodontic treatment, root canal therapy, single visit and multiple visit endodontics and data were collected from the identified articles”[48-51].

“Single-visit **root canal treatment** refers to a conservative, non-surgical approach for treating a tooth with endodontic issues it involves thorough cleansing, shaping, and filling of the root canal system in just one appointment”.² “Single visit reduces

treatment time and material use compared with multiple-visit treatment”.³ “As Anjali Sharma et al (2011) said that success rate for treating periapical lesions non-surgically was 86.02%”.⁴ Amy Wai-Yee Wong et al (2015) said that “success rate of single visit root canal treatment is 88.9”.⁵ Proponents of multiple visit procedures contend that antimicrobial property of inter appointment calcium hydroxide placement is required to ensure successful periradicular healing, although predictable levels of bacterial reduction via refined cleaning and shaping techniques in one appointment may negate this need.

FACTORS THAT CONTRIBUTE TO THE SUCCESS OF ONE VISIT ROOT CANAL TREATMENT

Several factors play an important role in the decision-making process of single visit versus multiple visit root canal treatment. Factors contributing to the success of endodontic treatment include objective considerations such as the accuracy of the initial diagnosis, the effectiveness of infection control measures, the complexity of root canal anatomy, and the management of procedural complications. Additionally, subjective factors like the patient's reported signs and symptoms play a crucial role in determining treatment outcomes. Jorge Paredes-Vieyra et al (2012) Studies have shown that a carefully conducted single-visit root canal treatment can achieve similar success rates as multiple-visit treatments, with no significant difference in radiographic evidence of periapical healing observed between the two approaches.⁶

ISOLATION AND SEALING PROBLEMS

Main problem to perform multiple visits treatment was difficulty in effectively sealing off the root canal system from the oral cavity in between visits. In single-visit procedures, the risk of interappointment contamination and flare-ups can be completely eliminated.⁷

Teeth with subgingival lesions, missing coronal walls, and caries beneath the finished margins of full coverage restorations can be treated in a single appointment.⁷

ANTERIOR ESTHETIC PROBLEMS

Cases involving trauma to anterior teeth are commonly treated in a single visit, addressing aesthetic concerns as well as isolation and sealing issues in the treated tooth.

Badami V et al (2011) fractures of anterior teeth are relatively common and clinician can complete the treatment in a single visit by reattaching the fractured fragment.⁸ Melia Heptania et al (2022) in complicated crown anterior teeth fracture single visit endodontic treatment gives good outcome than multiple visit.⁹

RESTORATIVE CONSIDERATIONS

Treatments for restorative reasons as overdenture abutments, Full jacket crowns are used for severe coronal breakdown where the tooth cannot retain a restoration and teeth that require preparation for desired alignment should be treated intentionally by single visit.

VITAL PULP EXPOSURE AND SYMPTOMATIC PULPITIS

Teeth with pulp exposures due to trauma, caries, or iatrogenic reasons, and teeth showing clinical sensitivity to heat or cold but not percussion, can be treated effectively treated in single visit.

HEALTH CONSIDERATIONS THAT CHOOSE SINGLE OR MULTIPLE VISITS

In physically compromised patients, apprehensive but cooperative patient and in medically compromised conditions, single visit root canal treatment was considered over multiple visit treatment. Common psychiatric problems encountered in dental practice stated by ADA are anxiety disorders, mood disorders, psychotic disorders, and eating disorders.¹⁰ Poor oral health in these individuals affect their quality of life with an increased burden on their well-being.

Single visit root canal treatments exhibit more success in these conditions over the multiple visit treatments as systemic health conditions compromise the nonspecific immune system and the reparative response of the dental pulp and periapical healing process of teeth. The presence of a pro-inflammatory state and weakened immune response linked to systemic diseases can influence two key aspects of endodontics:

the occurrence of apical periodontitis (AP) and the frequency of root canal treatments (RCTs).¹¹

TIME

Another benefit of single-visit endodontic treatment is that it saves time for both operators and patients.¹² The primary reason for increased patient acceptance was the reduced number of visits to the dental clinic.

POST ENDODONTIC PAIN

“The evidence for recommending either single visit or multiple visits root canal treatment was not consistent. The primary cause of post-endodontic pain stems from the inadvertent displacement of canal contents, debris, and microorganisms from the root canal into the periapical region. This occurrence triggers a significant inflammatory reaction, resulting in discomfort after the completion of root canal treatment.¹³ Studies indicate that 25% to 40% of patients experience this discomfort, irrespective of their initial pulp and peri-radicular conditions. Even with careful and thorough endodontic therapy, the persistence of postoperative pain can be distressing for both patients and dentists”.¹⁴

“In 2019 study, Alomaym et al evaluated the frequency and intensity of post-obturation pain. Their research showed a statistically significant difference in pain occurrence between groups undergoing multiple visits and those undergoing a single visit. Specifically, they noted a lower incidence of pain in the multiple visit group compared to the single visit group”.¹⁵

Singh *et al* (2020) “It was concluded that while the mean pain score in the Single Visit group was lower than that of the Multiple Visit group, this difference was not statistically significant”.¹⁶ Úna M Bryce *et al* (2023) “It was concluded that there was no significant difference in postoperative pain between single-visit and multiple-visit treatments”.¹⁷

There was moderate certainty evidence of higher proportion of participants reporting pain within one week in single-visit groups compared to multiple-visit groups.

DISCUSSION

In feasible cases single-visit root canal treatment is preferred. This approach assumes the pulp infection is superficial and the root canal remains free of bacteria, provided sterile conditions are maintained during complete procedure. Thus, there is generally no reason to avoid treating cases in a single session. Conversely, when the pulp is necrotic or associated with periradicular disease, evidence suggests the root canal are infected. In those situations, it is advisable to clean, shape, and medicate the canals followed by filling the canal at a multiple visit.

Single-visit root canal treatment should be considered as an adjunct to comprehensive patient care in endodontics, rather than as a method intended to completely replace multi-visit procedures. Both single and multi-visit treatments should be regarded as components within the broader spectrum of endodontic care, with the decision between them guided by the specific circumstances of each case. It is essential for practitioners not to routinely apply a single technique universally, but instead to assess the unique aspects of each case and select the most appropriate technique accordingly.

STEPS TO CONSIDER IN SUCCESS OF SINGLE VISIT ROOT CANAL TREATMENT

1.ACCESS OPENING

A crucial step in successful endodontic treatment is the preparation of access to the pulp chamber and the root canal system.^{18,19} Two different access cavities as like: Traditional endodontic access cavities (TEC) involve removing the entire roof of the pulp chamber to create a straight-line access to the root canal system, while conservative endodontic access cavities (CEC) are formed by connecting the projections of each root canal orifice on the occlusal surface.^{20,21} The conservative endodontic access cavity (CEC) is less invasive compared to the traditional endodontic access cavity (TEC).

Utilizing ultraconservative (ninja) access cavity designs in endodontic procedures can potentially enhance the strength of treated teeth by minimizing invasiveness. The practice of cone-beam computed tomography (CBCT) imaging facilitates the accurate identification of all canals, thereby preserving dentin integrity during the single visit

endodontics thereby increasing the success rate.²² Truss access is designed for teeth with multiple canals, ensuring that a section of the chamber roof and an enamel-dentin bridge are retained to allow direct access to each canal.²³ However, concerns arise regarding the adequacy of space for subsequent treatment stages, although there is presently a lack of sufficient scientific evidence to validate these concerns.

Obada A. Mandil et al (2022) said that Conservative access opening, Ninja access opening, and Truss access opening are contracted access cavities used as alternatives to the traditional access opening. Conservative access opening is a practical choice for root canal treatment because it preserves tooth structure while facilitating a safe and efficient procedure.²³

Wong A et al (2014) stated that According to the International Conference on Endodontics in 1958, it was recommended to enlarge the root canal regardless of its original size, to facilitate the removal of contaminated dentinal debris and ensure thorough filling of the root canal.²⁴

Conservative access opening exhibits more success in single visit root canal treatment than multiple visit. In multiple visit excess loss of coronal dentin was seen during removal of access seal in subsequent visits leading to decrease fracture resistance of teeth.

2.DETERMINATION OF WORKING LENGTH

Accurately determining the working length of the root canal during endodontic treatment is essential and crucial in root canal therapy. It serves as a reference point for working instruments and determines the endpoint of the endodontic preparation and obturation.²⁵

It facilitates easier removal of necrotic tissue and precise preparation of root canals during endodontic treatment.²⁶ Radiographs play a crucial role in endodontics for treatment, diagnosis and postoperative assessment. Yet, they offer a two-dimensional perspective of a three-dimensional object.²⁷

Non radiographic method using Electronic apex locators (EALs) are used clinically to accurately determine the file position within the canal for locating the apical constriction during endodontic procedures.²⁸ Combining electronic apex locators (EALs) with traditional radiography has notably enhanced the precision and accuracy of determining working length (WL) in endodontics. This integration has also reduced the need for multiple radiographs, thereby minimizing patient exposure to radiation.²⁹ According to Shearer AC et al. (1991), digital radiography proves advantageous in endodontic procedures. The diagnostic value hinges on factors such as beam angulation, superimposition of anatomical structures, and patient-related variables can affect radiographic interpretation in dental imaging.³⁰

Role of apex locators in single visit:

James L. Gutmann in Problem Solving in Endodontics (Fifth Edition), (2011) stated that the apex locator found to be significantly more reliable than the radiograph for determining working length. Thus suggest to the use of apex locators as the primary means of determining the working length during single visit endodontic procedures in patients with psychological and systemically compromised health conditions.

Ark, Jin-Sung et al (2007) said that In a case of single-visit root canal treatment using an electrical apex locator under general anesthesia for a patient with cerebral palsy, meticulous instrumentation was crucial due to muscle coordination issues that could lead to unexpected accidents. Dental treatments, particularly in endodontics, are challenging in such cases, as radiographic measurements for canal length can be hindered by the patient's walking and movement disorders.³¹

Dawood A, et al (2009) It has been noted that conventional two-dimensional radiographic methods are inadequate and do not provide sufficient information. The primary advantage of using CBCT for endodontic applications is its ability to offer three-dimensional (3D) views, which cannot be achieved with intraoral and panoramic radiography.^{32,33} While CBCT addresses several drawbacks of intraoral radiography, it's essential to note that patients are exposed to higher radiation doses compared to intraoral and panoramic radiography.

Dawood A, Patel S, Brown J and Patel S et al concluded that CBCT should be used only if conventional methods are not useful for diagnostic accuracy.^{32,33}

Single visit root canal treatment shows more success compared to multiple visit treatment by using the newer methods in working length determination as it decreases the operator failure to simulate the same in subsequent visits.

3. BIOMECHANICAL PREPARATION

A. Files used in single visit root canal treatment

Commonly files used in single visit root canal treatment are rotary NiTi files, reciprocating files, single file system, heat-treated NiTi files, ultrasonic files and hand files. Modern root canal preparation utilizes rotary nickel-titanium (NiTi) instruments, employing either rotational or reciprocating kinematics.³⁴

Pettiette MT et al (2001) It has been observed that nickel titanium (NiTi) files are five times more likely to achieve success compared to stainless steel files because they maintain the original shape of the canal during instrumentation.³⁵ NiTi rotary instruments reliably enlarge root canals while preserving the original pathway, achieving sizes typically unavailable with stainless steel files. Larger preparations effectively remove more bacterial cells, leading to an anticipated increase in treatment success rates.³⁶

Rotary single-file systems like Hyflex EDM (HEDM) are manufactured using a unique method known as electric discharge machining. This process involves spark erosion, which enhances both fracture resistance and cutting efficiency.³⁷

Wave One Gold (WOG) files are reciprocating files made with M-wire alloy technology, featuring an off-centered parallelogram cross-section. Through a thermal process, the molecular geometry is modified to enhance cyclic fatigue flexibility and resistance.

Riluwan Siddique et al (2019) said that Single-file reciprocating systems was found almost similar microbial reduction when compared with rotary systems.³⁸

Using the newer files either rotary or reciprocating exhibits success in single visit root canal treatment compared to multiple visits as meticulous instrumentation of canals in

subsequent visits for removal of intracanal medicaments lead to excess loss of radicular dentin.

B. Irrigation technique for single visit treatment

Irrigation of prepared root canals is performed regularly to remove and dislodge debris and microorganisms, ensuring they are not pushed beyond the apex. This process aids in lubrication, flushing, and removal of the smear layer. One of the most commonly used root canal irrigants is 17% EDTA, 0.2% Chlorhexidine, 5.25% Sodium hypochlorite, and 10% Citric acid.³⁹

Lantigua Domínguez MC et al (2018) stated that The combined solution of 5% NaOCl and 18% etidronate reduces root fracture resistance. EDTA alters the microstructure of dentin and causes dentin erosion by demineralizing the inorganic components through chelation of calcium ions in the hydroxyapatite of root dentin. These effects of irrigant solutions depend on time and directly impact root fracture resistance.⁴⁰

Seniha Miçooğulları Kurt et al (2022) stated that in the single visit root canal treatment, irrigation with 5 mL 17% EDTA and 5 mL 2.5% NaOCl, with both solutions manually agitated by using a sterile gutta-percha cone for 1 minute was preferred. Followed by 5 mL 2% CHX used as a final irrigant that was enabled to contact the root canal walls for up to 5 minutes.⁴¹

Irrigation protocol along with manual passive agitation shows more success in single visit root canal treatment than in multiple visit treatments. Exposure of root dentin to chelating irrigants and agitation methods decrease fracture resistance of root dentin in multiple visits.

4. SEALER

Understanding the biological aspects involved in performing single-visit endodontic treatment for cases of pulpal pathosis is crucial. Calcium silicate based sealers (CSSs) and Epoxy resin based sealers (ERSs) are commonly used. Treating pulpal pathosis cases with Calcium silicate-based sealers are sensitive to low pH levels, which can compromise their setting and mechanical properties. Therefore, teeth with inflammatory conditions may not be suitable for their application. In those cases, epoxy

resin based sealers are used. In multiple-visit root canal treatment, the use of calcium hydroxide as an intra-canal medicament provides antibacterial effects and facilitates the dissolution of lipopolysaccharides while raising the pH level. This approach offers an optional scenario without known limitations for using either resin-based sealers (ERSs) or calcium silicate-based sealers (CSSs). However, the removal of calcium hydroxide may vary in effectiveness. Therefore, calcium silicate-based sealers demonstrate better adaptation to the canal wall, likely due to interactions between the sealer's setting process and any remaining calcium hydroxide on the dentinal walls.⁴²

5.OBTURATION

Obturation of the canals by cold lateral compaction technique in the manual group and single cone technique in the rotary.⁴³

The most frequently used technique in both single-visit and multi-visit root canal treatments is the lateral compaction technique. It has been proven successful due to its simplicity, cost-effectiveness (not requiring specific or expensive instruments), excellent length control, and acceptance with various fillers. However, this technique may not adequately fill canal irregularities.^{44,45} Thermoplasticized obturation technique which was frequently used offer several advantages, including improved adaptation to root canal complexities, reduced risk of void formation, and the creation of a dense filling, less time consumption. In single visit root canal treatments Thermoplasticized obturation shows more advantages compared to other obturation methods.

The warm vertical technique is generally the least utilized method in both single-visit and multi-visit root canal treatments, primarily because it is challenging to effectively obturate curved canals using this technique.⁴⁶ Additionally, it carries a risk of vertical root fracture and extrusion of material into the periradicular tissues.⁴⁷

CONCLUSION

According to the latest comprehensive evidence, single-visit root canal treatment demonstrates a marginally higher efficacy compared to multiple visits. Single-visit root canal treatments are typically based on the clinical judgment that additional treatments wouldn't enhance care quality.

Currently, there is no definitive evidence supporting the superiority of either single-visit or multiple-visit root canal treatment regimens in terms of effectiveness. Both approaches are unable to completely prevent postoperative pain and other complications within the first year.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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