

Single visit nonsurgical endodontic therapy for periapical cysts: A clinical study

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Abstract

Aims: The aim of this study was to assess the outcome of single sitting root canal treatment (RCT) of asymptomatic teeth with periapical cysts. **Materials and Methods:** Ten maxillary anterior teeth showing periapical lesion on the radiograph was further screened by ultrasound with color power Doppler (CPD) for confirmation of a cyst. The average dimension of the lesions ranged from 1.3 to 1.9 cm. Single sitting RCT was performed on all the selected teeth. Postoperative healing was monitored at regular interval of 3 months, 6 months, and 1 year by using subjective feedback, radiograph, and ultrasound with CPD study. **Results:** Eight among the ten cases showed either signs of complete healing or healing in progress by the end of 6-12 months. **Conclusions:** It was observed that single sitting nonsurgical endodontic management of asymptomatic teeth with periapical cyst confirmed by ultrasound was successful in selected cases.

Keywords: Neovascularization, passive ultrasonic irrigation, periapical cyst, single visit endodontics, substantivity

Introduction

Periapical lesions are sequelae to endodontic infection caused due to dental caries or trauma and manifest itself as the host defense response to microbial challenge emanating from the root canal system. It is viewed as a dynamic encounter between microbial factors and host defenses at the interface between infected radicular pulp and periodontal ligament that results in local inflammation, resorption of hard tissues, and destruction of other periapical tissues.^[1]

Most periradicular lesions (90%) can be classified as dental granuloma, radicular cyst, or abscess.^[2] The reported incidence of cysts among apical periodontitis lesions varies from 6% to 55%. (Nair *et al*, 1998).^[3] Radicular cysts are the most common of all jaw cysts. It can be described as the inflammatory jaw cysts at the apices of teeth with infected and necrotic pulps. Anatomically, the apical cysts occur in

all tooth-bearing sites of the jaw, but are more frequent in maxillary than mandibular teeth. In the upper jaw, the anterior region appears to be more cyst-vulnerable, whereas in the lower jaw the radicular cysts occur more frequently in the premolar region (Borg *et al.*, 1974).^[3]


If the cystic lesion is separated from the apex and with an intact epithelial lining (apical true cyst), it may have developed into a self-perpetuating entity that may not heal when treated nonsurgically. On other occasions, a large periradicular lesion may have a direct communication with the root canal system (apical pocket cyst) and respond favorably to nonsurgical treatment. Nair examined various periapical lesions and reported that the incidence of true cysts were 9% and 6% were apical pocket cysts. When nonsurgical treatment modality is not successful in resolving the periradicular pathosis, additional treatment options should be considered.^[4]

Systematic reviews (Ng *et al.* 2007, 2008, 2010) on periapical status and survival of teeth following nonsurgical endodontic treatment revealed that conditions associated with better periapical healing is dependent on various preoperative, intraoperative and postoperative factors e.g., (1) The apical extent and quality of root filling, (2) an adequate coronal restoration, (3) absence of mid treatment complications, including iatrogenic occurrences such as perforations, untreated canals, fractured instruments, and massive sealer extrusion, (4) the presence of both mesial and distal proximal contacts, (5) absence of utilization of tooth as an abutment for removable or fixed prosthesis, and (6) tooth type (the finding of a better healed rate in single rooted teeth than multi-rooted teeth was shown [93% vs. 84%]).^[5,6]

The role of micro-organisms in the development and persistence of apical periodontitis is well-established.

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Studies have shown that instrumentation and irrigation of the root canal system substantially reduce the number of cultivable micro-organisms, but rarely leads to their total eradication. Therefore, antimicrobial dressings like calcium hydroxide have been recommended to eliminate the persisting microbiota. Although widely accepted and used, the inclusion of calcium hydroxide in a treatment strategy has many disadvantages. Calcium hydroxide does not kill all the canal flora, and requires at least two appointments to be optimally potent.^[7]

As clinical endodontics has undergone rapid changes over the past few years: Research in the field of diagnosis, intra-canal preparation, medicaments, root filling materials, and techniques have all contributed to considerable modification in the concept of root canal treatment (RCT), making single visit endodontics the norm in today's practice.^[8] Single visit endodontics is defined as the conservative nonsurgical treatment of an endodontically involved tooth, consisting of complete bio-mechanical preparation and obturation of the root canal system in one visit.^[1,2]

Whether adequate microbial control can be obtained in one appointment is a source of controversy. Furthermore, the effect of number of treatment visits on treatment outcome is not clear (Ng *et al.*, 2008). However, one issue which is frequently debated in recent years is whether conscientious cleaning by instrumentation and irrigation may reduce the need for a dressing and effect a satisfactory disinfection of the root canal system. Such single visit treatment would, if successful, be time-saving, and reduce the risk of inter-appointment infection.^[5,9]

A systematic review of literature shows that the biological benefit of multi-session treatment has not been supported by clinical evidence. Thus, single sitting RCT probably has the same prognosis in terms of healing and postoperative discomfort levels as that of multiple sitting RCT.

Thus, this study was designed specifically to evaluate the prognosis of single visit RCT of asymptomatic maxillary anterior teeth associated with periapical cyst.

Materials and Methods

Ten patients with a noncontributory medical history were selected. After thorough clinical examination and radiographic evaluation patients with nonvital, maxillary anterior teeth with periapical lesions of endodontic origin were included in this study [Figure 1]. The selected patients were clinically asymptomatic as there were no signs of pain, soft-tissue swelling, and tenderness to palpation of adjacent soft-tissues, tenderness to pressure and percussion of the tooth. Three of the patients with preoperative sinus tract labially at the apical region were also included. Bender and Seltzer have indicated that clinical symptoms such as pain,

swelling, and presence of a sinus tract can be associated with unfavorable treatment outcome. However, as mentioned earlier three patients included in the study had intra-oral sinus tract [Table 1].

As it is well-accepted that periradicular lesions cannot be differentially diagnosed as radicular cysts or apical granulomas based on radiographic evidence alone, all patients were subjected to preoperative ultrasonographic examination.

For the ultrasound technique, the machine used was the state-of-the-art GE Voluson PRO 730, GE Medical Systems, Kretz Ultrasound. This was a multi-transducer system with Doppler facilities. Preoperative ultrasound examination was carried out with an intracavitary multi-frequency ultrasound probe of 8-12 MHz. The probe was first covered with disposable latex for the control of infection and then covered with a layer of ultrasound gel. The probe was positioned intraorally on the buccal sulcus corresponding to the apical area of the tooth. Echo characteristics, dimensions, and volume of all the lesions were noted. Color power Doppler (CPD) was applied to each examination to detect the blood flow and the information was recorded. The periapical lesions were classified as granulomatous or cystic, based on the findings on ultrasonography (USG) combined with CPD.

Only the cystic lesions were included in this study.

Single visit RCT was performed for all the patients. Preprocedural mouth rinsing was carried out with 0.12% chlorhexidine, followed by isolation with rubber dam. The isolated area was disinfected again with 0.12% chlorhexidine for 1 min. Access to the pulp chamber was gained through a sterile bur (Endo-Access Bur, Dentsply) at slow speed, with sterile saline as coolant. On completion of the access cavity preparation, working length was determined radiographically and was confirmed with the help of apex locator (Root Zx). It was followed by the preparation of the canal by Gates Glidden drill in the crown down fashion until the middle third of the canal was reached. Apical third of the canal was prepared using hand K-File (Dentsply, Mallifer). Step back technique was used and the two preparations were merged at the middle third to complete cleaning and shaping according to the hybrid technique. Recapitulation was carried out after each instrumentation with 15 size K-File. H file was used for circumferential filing of the canal wall. Each file was followed by irrigation of the canal with 2 ml of 1% NaOCl in a syringe with 27 gauze needle.^[10] After the completion of shaping procedure, the canal was rinsed with 15% ethylenediaminetetraacetic acid (EDTA) solution, for 1 min, using 5-10 ml of the solution.^[10] Passive ultrasonic irrigation (PUI) was carried out with 1% NaOCl for at least 3 min, after finishing canal preparation.^[11] A final rinse of 2% chlorhexidine was used in the canal. The master cone was selected on the basis of master apical file size. It was followed

by drying of the root canal with paper points. The canal was then obturated with lateral condensation method. Finally, the access cavity was restored with glass ionomer cement.

Postoperative healing was monitored by clinical, radiological and ultrasonographical method. All the ten patients were scheduled for follow-up at the end of 3 months, 6 months, and 1 year.

All the periapical radiographs were standardized by paralleling technique [Figure 2]. Radiographs were exposed maintaining identical exposure parameters, vertical, and horizontal angulations, film distance and using bite stent for individual patient, and analyzed with the help of the Adobe Photoshop CS image analysis software and changes in the periapical lesion dimensions (increase/decrease) were noted.

The ultrasonographical examination was carried out by a qualified, experienced radiologist. Ultrasonographically, the changes in echo characteristics, changes in the dimension, and volume of the lesion and presence of vascularity of the periapical lesions were observed and recorded.

Results

Clinical data recorded during follow-up examination showed that eight patients out of ten were clinically asymptomatic, and two patients showed clinical symptoms such as presence of intraoral sinus and tenderness on vertical percussion between 6 months and 1 year.

Radiographically at the end of 3 months not much significant changes were observed in all teeth [Figures 3 and 4]. Significant reduction in the size the lesion and changes in density was appreciated after 6 months [Figure 5] and complete evidence of healing was noticed at the end of 1 year [Figures 6, 7 and 8] for three cases. Five cases showed definite signs of healing at the end of 1 year [Figures 9 and 10]. In the remaining two cases, during the follow-up period of 1 year, there was a slight increase in lesion size.

Ultrasound coupled with CPD was also used to monitor healing in this study apart from its use as diagnostic tool. Healing was evident also by this method in eight cases by 3 months, as the preoperative hypoechoic regions became



Figure 1: Preoperative clinical photo of case 1



Figure 2: Radiograph taken by paralleling technique



Figure 3: Preoperative radiograph of case 1



Figure 4: Three months postoperative



Figure 5: Six months postoperative showing reduction in size of the lesion



Figure 6: One year postoperative: Complete healing is evident

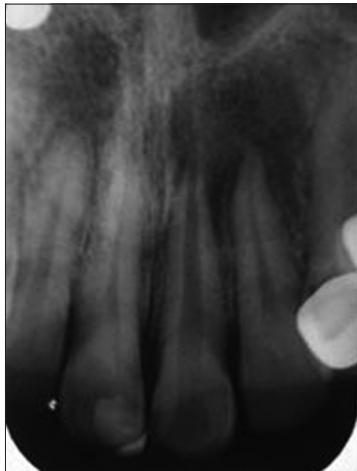


Figure 7: Preoperative radiograph of case 2



Figure 8: Complete healing noticed

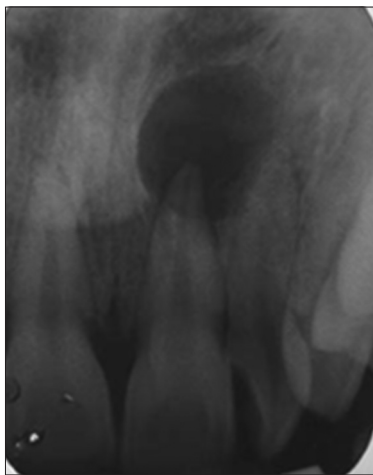


Figure 9: Preoperative radiograph of case 3

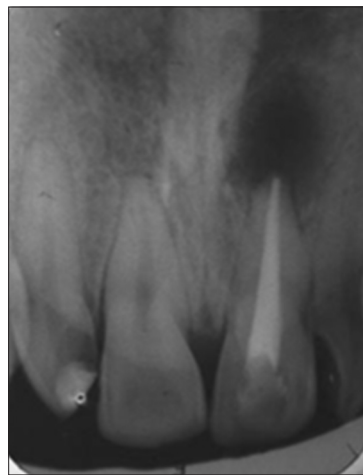


Figure 10: Healing in progress

hyperechoic postoperatively, with reduction in dimension and volume of the lesion, and most importantly proliferation of

new blood vessel in a healing lesion were observed by this method [Figures 11-14].

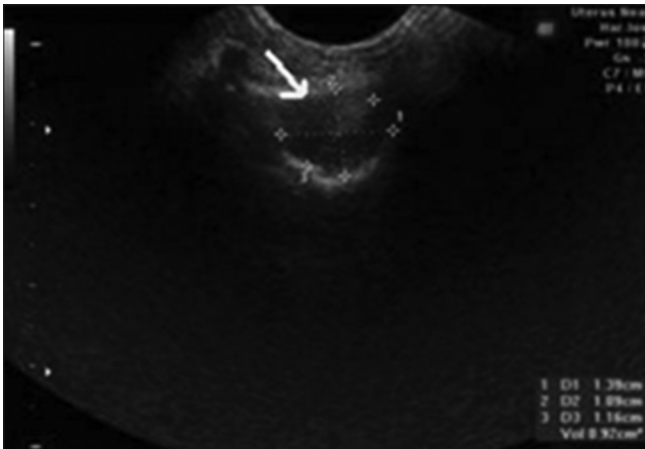


Figure 11: Preoperative Ultrasound showing dimension, volume and Hypoechoic area

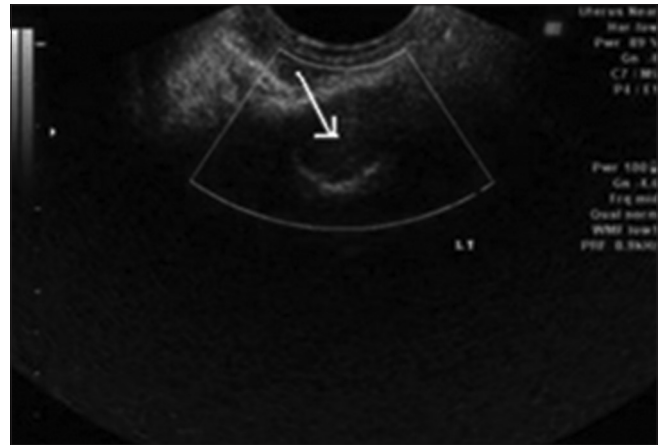


Figure 12: Preoperative ultrasound with color power Doppler – showing no vascularity. So, this case was diagnosed as cyst

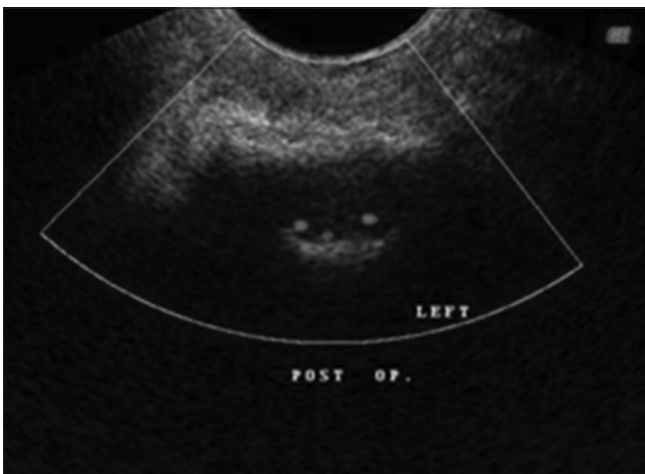


Figure 13: Postoperative: Neo - vascularization was noted after application of color power Doppler

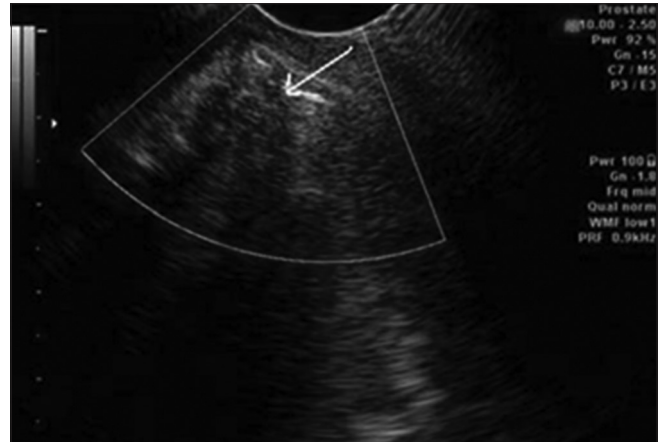


Figure 14: Complete healing of the lesion as echo characteristics has changed from preoperative hypoechoic to postoperative hyperechoic, which indicates bone formation

Discussion

Periapical pathology is a host defense mechanism to micro-organisms present in the root canal and endodontic treatment attempts to eradicate the micro-organisms from the root canal system and thus promoting periapical healing.^[12-14]

The various nonsurgical treatment options available to manage periapical cysts are conservative RCT with calcium hydroxide as intra-canal medicament, active nonsurgical decompression technique, aspiration and irrigation technique, lesion sterilization and repair therapy and apexum procedure. In some instances, nonsurgical treatment may be ineffective or difficult, and those cases may be treated by surgery.^[4]

In recent years, single-appointment endodontics has gained increased acceptance. The scientific basis for the single visit endodontics is that the residual micro-organisms are rendered harmless by entombing them by complete

obturation immediately after cleaning and shaping the root canal space in the same visit.^[13,14]

Guttman *et al.* (2004), in a clinical study, found that single visit RCT was as successful as multiple visit RCT in teeth with vital as well as in teeth with nonvital pulp associated with or without periapical radiolucencies.^[11] Various other clinical studies were also conducted to compare single visit and two visit endodontic procedures of teeth with and without periapical lesion. Based on the current best available evidence single visit RCT appeared to be slightly more effective than multiple visits, i.e., 6.3% higher healing rate. The outcome measured was healing of radiographically detectable lesions. Based on clinical outcomes, no additional benefit was provided by the use of an inter-appointment antibacterial dressing such as calcium hydroxide. Probably elimination of bacteria is not strictly necessary and maximum reduction of bacteria and effective canal filling may be sufficient in terms of healing, rather than complete eradication. The advantages of single visit endodontic include reduction in time and cost of treatment and prevention of inter-appointment flare ups

and as well as low incidence of postoperative pain when compared to multiple visit treatment.^[15,16]

In the present study, case selection and treatment protocol were carefully framed for a single visit nonsurgical endodontic therapy of maxillary anterior teeth associated with periapical cysts. Although many clinical studies have been conducted with periapical lesion, but specifically cases with periapical cysts have not been reported until now. Thus, the purpose of this study was to evaluate the prognosis of single visit RCT of teeth associated with periapical cyst.

Radiographs of the selected teeth revealed that the involved teeth had large periradicular lesion (average dimensions of the lesions ranged from 1.3 to 1.9 cm) and the presence of periapical cysts were confirmed by USG coupled with CPD.

Cotti *et al.*, have reported positive findings using the ultrasound in the differential diagnosis of periapical lesions and found it to be a very useful imaging technique, which could give significant diagnostic information in relation to periapical lesions in the anterior region, where the buccal bone is thin.^[17]

Root canal procedure was Carried out strictly under rubber dam isolation. Access cavity preparation and working length determination was followed by Hybrid technique of bio-mechanical preparation. It is a combination of step back and step down technique. The advantage of hybrid technique is that it maintains the integrity of dentin by preventing excessive removal of the radicular dentin and also reduces extrusion of debris into the periapical area. Disinfection of the root canal system by using antimicrobial and tissue-dissolving irrigants is considered as an essential part of chemo-mechanical debridement. Sodium hypochlorite solution (1%) was used as the main irrigant because of its broad antimicrobial spectrum as well as its unique capacity to dissolve necrotic tissue remnant (Sundqvist, 2006).^[10] The additional use of other irrigants was found to have a significant impact on periapical healing. EDTA solution (15%) was used as an adjunct irrigant to remove the smear layer (Bystorm *et al.*, 2006)^[10] and it also may help in detaching or breaking up adherent biofilms (Gulabivala *et al.*, 2005). It was followed by PUI with 1% sodium hypochlorite. PUI, where the ultrasonically activated instrument is not intended to touch the canal walls, has been shown to be an important and superior supplement for cleaning the root canal system as compared with the syringe irrigation, sonically activated Vibringe system and RinsEndo method of irrigation. It removes more organic tissue, planktonic bacteria, and dentine debris from the root canal and it has been attributed to acoustic streaming and cavitations produced by the ultrasonically activated file. PUI is also more efficient in cleaning canals than simultaneous ultrasonic instrumentation with ultrasonic irrigation (van der Sluis *et al.*)^[11,18] Various studies have also shown that PUI is as effective as Endovac method of irrigation.^[18,19] The other advantage of PUI is that the amount of NaOCl extruded

in the periapical tissue was lesser as compared to syringe and slotted-needle irrigation and was almost equivalent to Endovac method. Clinical studies have also proved that root fillings sealed the root canal better when PUI had been used. This can be explained by the fact that more dentine debris can be removed from the oval extensions or irregularities (Lee *et al.*, 2004) and/or more smear layer can be removed from the canal wall using PUI (Cameron 1983, 1987, Alacam 1987, Cheung and Stock 1993, Huque *et al.*, 1998).^[20-22]

2% chlorhexidine was used as the final irrigant, as it has a strong affinity to bind to dental hard tissues, and once bound to a surface, has prolonged antimicrobial activity, a phenomenon called substantivity.^[23,24] The tooth was then obturated with Gutta-percha as core material using zinc oxide-eugenol-based sealer by lateral condensation method followed by warm vertical compaction.

Follow-up protocol included periodic clinical examination for presence of pain, swelling, tenderness to apical and gingival palpation, tenderness to percussion and presence or absence of sinus tract. Presence of preoperative sinus tract was found to be a significant prognostic indicator for treatment outcome by many clinical studies. In our study, presence of preoperative sinus tract was noted for three cases, but all healed within a follow-up period of 6 months to 1 year.

Radiographic follow-up revealed that at the end of 1 year three lesions had healed completely (complete clinical and radiographic normalcy [no signs, symptoms, residual radiolucency]), five were healing lesions (decrease in size of a radiolucency and clinical normalcy), and two cases showed increase in size of the lesion radiographically. The two cases were also clinically symptomatic as there was pain and tenderness on percussion and was categorized as nonhealing lesion.

Further follow-up protocol during the recall period included ultrasonographic examination where changes in size and volume of the lesion, increase in echogenicity, and the presence of vascularity was observed and recorded for eight healing cases. The changes detected by ultrasound and CPD in the eight healing cases also included proliferation of the new blood vessels (NEOVASCULARIZATION), which is a very important sign in the healing phase of a lesion.^[25]

Various terms have been used to categorize the outcome of RCT. Although “success” and “failure” popular terms, it has been suggested that the terms “healing” and “healed” be used (Friedman and Mor 2004). “Success” means “the accomplishment of an aim or purpose” (Oxford dictionary). According to most endodontic textbooks, “success” has been defined as the prevention and elimination of a periapical radiolucency and symptoms, with “failure” being the development or persistence of apical periodontitis and/or symptoms (European Society of Endodontology 2006). For strict criteria of success minimum follow-up period required

Table 1: Tabular column showing the cases with age, sex, and presenting signs and symptoms

Case no.	Age/sex	Presenting signs and symptoms
1.	44/female	Discolored anterior teeth
2.	30/male	Recurrent sinus tract in the labial mucosa
3.	47/male	Recurrent sinus tract in the labial mucosa
4.	32/female	Discolored fractured anterior teeth
5.	55/male	Grossly carious maxillary anterior teeth
6.	22/female	Discolored anterior teeth
7.	31/male	Recurrent pain in the maxillary anterior region, but on the day of presentation patient was asymptomatic
8.	35/male	Recurrent sinus tract in the labial mucosa
9.	23/male	Discolored anterior teeth
10.	34/female	Fractured anterior teeth

is 3 years. According to Wesselink *et al.*, in comparison with “success” and “failure,” “effective” and “ineffective” are reasonable terms that should be considered. “Effective” treatment is defined as the absence of symptoms and complete or partial resolution of the preoperatively existing periapical radiolucency 1 year following treatment. “Ineffective” treatment is defined as the development or enlargement of a radiolucency and/or the persistence/emergence of symptoms and signs 1 year following treatment.^[26-29]

In the present study, single visit root canal therapy of asymptomatic maxillary anterior teeth with periapical cyst proved to be effective in eight out of ten cases, as observed clinically and monitored radio-graphically and ultrasonographically.

This treatment modality was ineffective for two of the cases. The possible reason for nonhealing may be the presence of apical true cyst. Other reasons can be attributed to the diversity of micro-organisms associated with large periapical lesions, and infection is more likely to persist following treatment (Bystrom and Sundqvist, 1981). This may be because long standing infections have penetrated dentinal tubules to a greater depth and peripheral aspects of the complex canal system, where mechanical and chemical decontamination procedures fail to readily reach. There can also be presence of extra-radicular infection.^[30,31] Finally, larger lesions may represent a most exaggerated host response that responds less readily to ecological shifts effected in the canal infection by the treatment protocols (Nair *et al.*).^[30]

Conclusion

Single visit nonsurgical endodontics was effective in eight out of ten cases of maxillary anterior teeth with periapical cysts. However, further long-term studies are required to confirm the effectiveness of single visit RCT for cyst cases.

Careful case selection and meticulous treatment planning with proper technique of cleaning and shaping, right choice of the irrigants and fluid tight seal are important factors for healing of periapical lesion.

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