

COMPARATIVE EVALUATION OF EFFECT OF CALCIUM HYDROXIDE AND TULSI (*OCIMUM TENUIFLOUROM*) MIXED WITH SALINE AND APPLE CIDER VINEGAR AS INTRACANAL MEDICAMENTS ON INCIDENCE OF INTER-APPOINTMENT FLARE UP IN DIABETIC PATIENTS: AN IN VIVO STUDY

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ABSTRACT

AIM: To evaluate and compare the effect of antibacterial intracanal medicaments on inter-appointment flare-up in diabetic patients.

MATERIALS AND METHOD: Sixty diabetic patients requiring root canal treatment were assigned into groups I, II, and III and IV. In group I and II, Ca(OH) mixed with saline and apple cider vinegar is used respectively. In groups III and IV, Tulsi (*Ocimum Tenuiflourom*) mixed with saline and apple cider vinegar were placed as intracanal medicaments, respectively. Patients were instructed to record their pain on days 1, 2, 3, 7, and 14. Inter-appointment flare-up was evaluated using verbal rating scale (VRS).

INTRODUCTION: An inter-appointment flare-up refers to the occurrence of intense pain, swelling, or both, following an endodontic treatment session.

Patients with diabetes mellitus are particularly susceptible to severe endodontic infections and show a higher frequency of flare-ups. (3)

To prevent bacterial growth between appointments, various intracanal medicaments are recommended. Innovations in dentistry as quoted in sustainable development goal 9(SDG9) can be related to using Tulsi and Apple Cider Vinegar as intracanal medicaments.

RESULTS: Overall incidence of inter-appointment flare-up was 20% among diabetic patients chosen in the study. 40% of the patients in group I, 15% in group II and 13.33% in group III, developed inter-appointment flare-up. While, no patient in group IV developed inter-appointment flare-up. There was a statistically significant difference between the groups ($P=0.04$). However in the intergroup analysis, there was a significant difference only between group I and 4 ($P=0.017$).

CONCLUSION: Calcium hydroxide and Tulsi (*Ocimum Tenuiflourom*) mixed in apple cider vinegar is more effective than calcium hydroxide and Tulsi in saline in preventing the occurrence of flare-up in diabetic patients.

KEYWORDS: Calcium Hydroxide, Tulsi (*Ocimum Tenuiflourom*), Apple Cider Vinegar (ACV), Intracanal medicament, diabetic patient, good health and well being (SDG-3 Sustainable development goal 3), innovations in dentistry (SDG-9 Sustainable development goal 9), Quality education (SDG-4 Sustainable development goal 4).

INTRODUCTION

An inter-appointment flare-up refers to the occurrence of intense pain, swelling, or both, following an endodontic treatment session (1,2). Patients with diabetes mellitus are particularly susceptible to severe endodontic infections and show a higher frequency of flare-ups (3). To prevent bacterial growth between appointments, various intracanal medicaments are recommended. Among them, calcium hydroxide (CH) is the most widely used, and its application has been shown to render root canals free of bacteria (4).

Tulsi (*Ocimum sanctum*), a sacred plant native to India, possesses notable antimicrobial activity and has long been employed in the treatment of diverse ailments. Research indicates that Tulsi is highly effective in removing the smear layer, performing significantly better than 2.5% sodium hypochlorite (NaOCl) (5,6). Similarly, apple cider vinegar (ACV) demonstrates antimicrobial properties, aids in smear layer removal, and reduces dentinal microhardness.

ACV primarily consists of malic acid and is rich in minerals such as potassium, phosphorus, magnesium, sulfur, calcium, fluoride, and silicon. It also contains compounds like pectin, β -carotene, enzymes, and amino acids, which neutralize free radicals, support immune function, and may contribute positively to periapical healing. Owing to these properties, ACV is being actively investigated in dentistry as a potential chelating agent (7,8).

MATERIALS AND METHOD

Inclusion Criteria : Sixty male and female adult patients aged between 18-60 years and having Type 2 diabetes mellitus whose HbA1c levels <8 % and requiring root canal treatment were selected.

Exclusion Criteria : Fractured tooth, root resorption, retreatment cases calcified canals, perforated tooth.

Patients with systemic diseases such as type I DM, CHD, chronic liver disease, inherited coagulation disorders (hemophilia A or B or Von Willebrand disease), pregnancy, any immunocompromised state.

Patients with uncontrolled hyperglycemia.

METHODOLOGY

Study was carried out after obtaining the approval of the institutional ethics committee. Sixty selected patients, who signed the informed consent, were randomly assigned into following groups.

TABLE: 1

GROUP	NUMBER	MEDICAMENT
1	15	CALCIUM HYDROXIDE MIXED IN SALINE
2	15	CALCIUM HYDROXIDE MIXED IN APPLE CIDER VINEGAR
3	15	TULSI MIXED IN SALINE
4	15	TULSI MIXED IN APPLE CIDER VINEGAR

Root canal treatment was initiated under local anesthesia and rubber dam isolation. Working length was established 1 mm from the radiographic apex. The coronal one-third of the canal was enlarged using Gates Glidden drills. The apical portion of the canal was enlarged using K-files to size 3-4 files larger than the initial apical file, and the rest of the canal was prepared using step-back technique. The canals were irrigated copiously with 2.5% sodium hypochlorite, 17% EDTA , normal saline, and 0.2% chlorhexidine. The final irrigation was done with normal saline. Following instrumentation and irrigation, canals were dried and treated in the following manner.

GROUP-1

Calcium Hydroxide mixed in saline in a thick paste consistency.

GROUP-2

Calcium Hydroxide mixed in apple cider vinegar in thick paste consistency.

GROUP-3

Tulsi mixed in saline in thick paste consistency.

GROUP-4

Tulsi mixed in apple cider vinegar in the same consistency as rest.

The medicament paste was carried into the canal and gently compacted using a finger pluggers, and access opening was restored temporarily with Cavit and all the groups.

All the treated patients were prescribed paracetamol tablets. Inter-appointment flare-up was assessed on day 2,3,7,14 of the treatment using verbal rating scale (VRS) using the following criteria:

VRS-0 (the treated tooth felt normal)

VRS-1 (the treated tooth was slightly painful for a time, regardless of the duration, but there was no need to take analgesics)

VRS-2 (the treated tooth caused discomfort and/or pain, which was rendered comfortable by taking one tablet of paracetamol)

VRS-3 (the treated tooth caused discomfort and/or pain, which was rendered comfortable by taking two tablets of paracetamol at a 6-h interval)

VRS-4 (the treated tooth caused discomfort and/or pain, which was rendered tolerable by taking two tablets of paracetamol at every 6 h for 3 days)

VRS-5 (severe pain and/or swelling caused by the treated tooth that disturbed normal activity or sleep and paracetamol tablet had little or no effect.)

Cases with VRS 4 and 5 were regarded as inter-appointment flare-up. The results were analyzed using Chi-square test and statistical package Statistical Package for the Social Sciences (SPSS) 16.

Case 1(Treated with Calcium hydroxide mixed in Apple Cider Vinegar)

34year old, diabetic female, treated with Non surgical root canal treatment in 24 for acute irreversible pulpitis.

Calcium hydroxide mixed in Apple cider vinegar was used as intracanal medicament as in figure1.

Verbal rating scale readings was 0 at every appointment, patient showed healing without any flare up.



Figure 1

Case 2 (Treated with Calcium Hydroxide in saline)

41year old, male diabetic patient was treated with non-surgical root canal treatment in 34 for acute irreversible pulpitis.

Calcium hydroxide was used as intracanal medicament, showed healing without developing any flare up as in figure 2.

Verbal Rating Scale(VRS) reading was 0 in all the appointments.



Figure 2

Case 3(Treated with Tulsi mixed in saline)

45year old, male diabetic patient was treated with non-surgical root canal therapy in 44 for chronic irreversible pulpitis. Tulsi mixed in saline was used as intracanal medicament as in figure 3.

Verbal Rating Scale reading was 4 after the 1st appointment and later reduced to 0 in rest of the appointments.

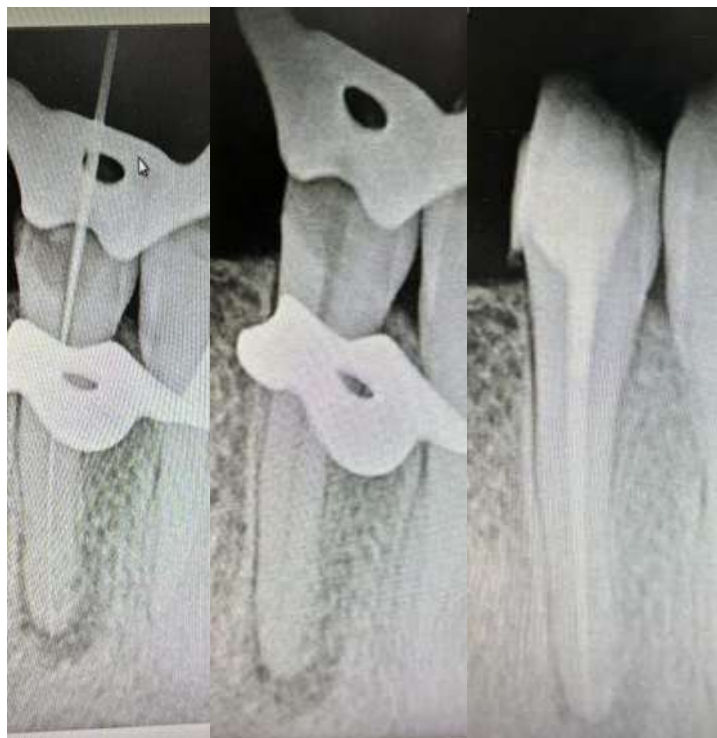


Figure 3

Case 4(Treated with Tulsi mixed in apple cider vinegar)

37year old, male diabetic patient, treated with non surgical root canal treatment in 15 for acute irreversible pulpitis.

Tulsi mixed in apple cider vinegar was used as intracanal medicament as in figure 4. Verbal Rating Scale(VRS) reading was 0 in all the appointments.

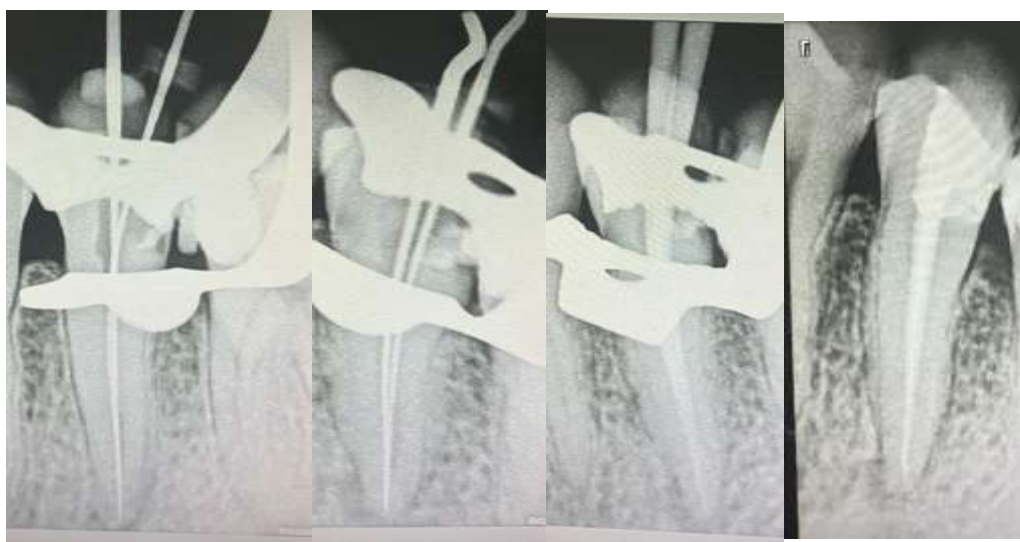


Figure 4

RESULTS

Among 60 patients evaluated in our study, 16.6% patients showed inter appointment flare up. The following table shows number of inter-appointment flare ups in each group.

Table 2

GROUPS	Day 2	Day 3	Day 7	Day 14	TOTAL	INTER APPOINTMENT FLARE-UP %
CALCIUM HYDROXIDE IN SALINE	3	2	1	0	6	40%
CALCIUM HYDROXIDE IN APPLE CIDER VINEGAR	1	1	0	0	2	13.33%
TULSI IN SALINE	0	2	0	0	2	13.33%
TULSI IN APPLE CIDER VINEGAR	0	0	0	0	0	0%

Among 15 patients of Group 1, there were 6 patients who showed up flare up as in table 2. Among Group 2 and 3, there were 2 patients in each group who showed flare up. However Group 4 patients showed no flare ups.

The chi-squared test revealed that the differences in flare-up rates between the groups are statistically significant (p -value = 0.0277), indicating that the flare-up occurrence varies meaningfully between these groups. The intergroup comparison further demonstrated that the difference between Group 1 and Group 4 is statistically significant (p = 0.01686), suggesting a substantial variation in flare-up rates between these groups. Other comparisons did not yield statistically significant results.

A flare-up is defined as the occurrence of severe pain or swelling within 48 hours following the initiation of endodontic therapy, and it is not influenced by the number of treatment visits. In the present study, the overall incidence of inter-appointment flare-ups among diabetic patients was observed to be 16.6%. Since pain is a subjective experience, its evaluation largely depends on patients' self-reports. Various scales and techniques have been employed to assess pain following endodontic procedures. Among these, the Verbal Rating Scale (VRS) is regarded as a reliable and valid tool for pain measurement, and was therefore chosen in this study to assess flare-ups.

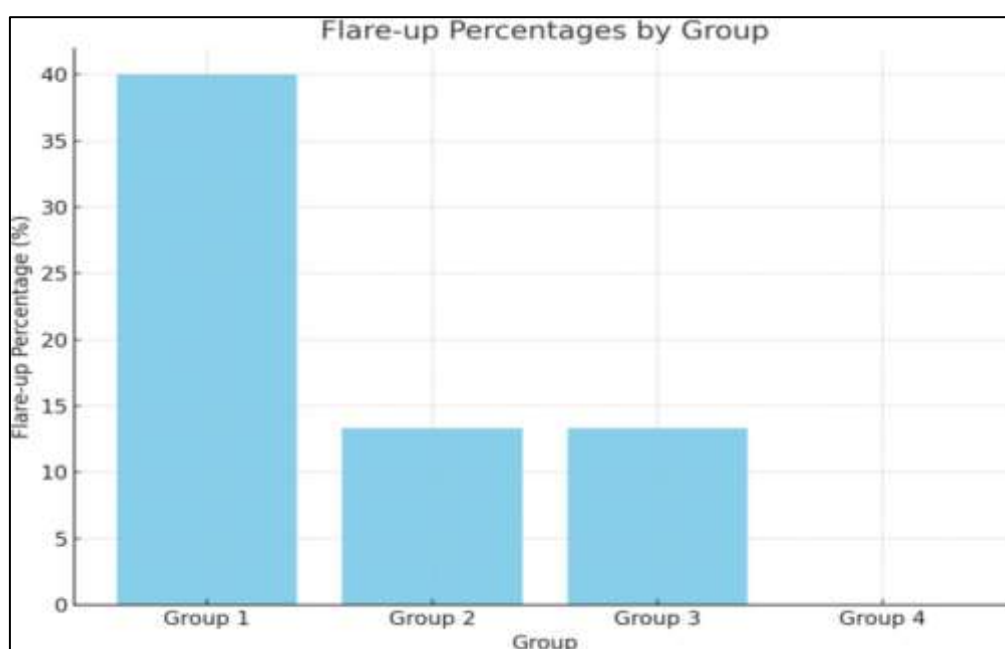


Figure 5

DISCUSSION

A retrospective analysis investigating the impact of diabetes mellitus on endodontic outcomes, based on electronic patient records, reported flare-up incidences of 4.8% in diabetic patients and 2.3% in non-diabetic patients as in figure 5.

Although the difference was not statistically significant, the findings suggested that diabetic individuals experienced approximately twice the number of flare-ups compared to non-diabetic counterparts. The higher incidence of flare-ups in diabetic patients may be attributed to impaired immune responses, including reduced leukocyte adhesion, chemotaxis, and phagocytosis, as well as the presence of more virulent microorganisms within necrotic pulp canals, as demonstrated in previous studies (9). Pain is inherently subjective and its

measurements primarily rely on the verbal report of the patients. Several scales and methods have been used for the assessment of pain after endodontic therapy. Among them, the VRS is considered to be a valid and reliable scale for the measurement of pain. Therefore, VRS was used in this study to evaluate inter-appointment flare-up (10).

Findings from this study indicate that a combination of Tulsi and calcium hydroxide prepared in apple cider vinegar is more effective in preventing inter-appointment flare-ups compared to the same mixture prepared in normal saline. Moreover, Tulsi mixed with apple cider vinegar proved superior to all other intracanal medicaments tested in diabetic patients (11). The antimicrobial efficacy of calcium hydroxide (CH) is primarily due to the release and diffusion of hydroxyl ions, which create a strongly alkaline environment unfavourable for microbial survival in the root canal. However, its effectiveness may be compromised by several factors, including enhanced bacterial adhesion to dentin, the buffering action of dentin, the persistence of biofilm, and the presence of necrotic tissue (11,12). Certain microorganisms, such as *Enterococcus faecalis* and opportunistic pathogens like *Candida*, which are frequently encountered in diabetic patients, exhibit strong resistance to calcium hydroxide (CH) (12).

Previous research has demonstrated that apple cider vinegar (ACV) is effective in eliminating the smear layer and reducing dentin microhardness. When calcium hydroxide is combined with ACV, the mixture has shown superior efficacy in preventing inter-appointment flare-ups compared to CH prepared in normal saline.

ACV is primarily composed of malic acid, which possesses both anti-inflammatory and antibacterial properties. It is also rich in minerals including potassium, phosphorus, magnesium, sulfur, calcium, fluoride, and silicon. In addition, ACV contains compounds such as pectin, β -carotene, enzymes, and amino acids that neutralize free radicals, enhance immune defense, and may contribute positively to periapical healing (7,8).

Tulsi (*Ocimum sanctum*) has been extensively studied for its antimicrobial activity and has demonstrated effectiveness against a wide spectrum of microorganisms, including *Escherichia coli*, *Klebsiella*, *Candida albicans*, *Staphylococcus aureus*, *Enterococcus faecalis*, and *Proteus* (5).

This study promotes SDG9 i.e innovations in dentistry, good health and well being as stated in SDG3, quality education as in SDG4.

CONCLUSION

Calcium hydroxide and Tulsi (*Ocimum Tenuiflorum*) mixed in Apple cider vinegar is more effective than calcium hydroxide and Tulsi in saline in preventing the occurrence of inter appointment flare-ups in diabetic patients.

However, more controlled studies are required for further clinical validation of the findings pertaining to the present study.

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