



Assessment of the Clinical Outcomes of Single Visit Regenerative Endodontic Procedure In Treating Necrotic Mature Teeth with Apical Periodontitis Using Biological Irrigating Solution

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Abstract

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AIM: The aim of the study was to observe the effect of propolis and its nano counterpart when used as final irrigation materials and compare them to the conventionally used ethylenediaminetetraacetic acid (EDTA) and saline on the clinical outcomes of necrotic mature anterior teeth with apical periodontitis after treating them using regenerative endodontic procedure.

METHODOLOGY: Eighty-four patients who fulfilled the inclusion criteria were recruited for the study. Access cavity was prepared, rubber dam isolation was done. Mechanical preparation was performed up to #60 using K-files. Final irrigation procedure was done as follows:

- Group A (Control): Final irrigation was done using saline (3 ml/min) followed by 17% EDTA solution (20 mL/canal, 5 min)
- Group B (comparator 1): Final irrigation was done using propolis* irrigation (20 mL/canal, 5 min)
- Group C (comparator 2): Final irrigation was done using Nano-propolis[†] irrigation (20 mL/canal, 5 min).

Bleeding was then induced, platelet rich fibrin was placed in the canals, followed by Collacote[‡] and Bio-dentine[§] placement. Patients were recalled after 6 and 12 months. Teeth were checked for sensibility using electric pulp tester and thermal tests. All data were analyzed using Kruskal–Wallis test.

RESULTS: All of the 84 patients (100%) within the three groups showed both clinical success and survival. Using Kruskal–Wallis, there was no statistically significant difference among the three groups ($p = 1$). Two teeth in the nano propolis group responded positively to thermal test at 12-month follow-up. None of the teeth in the three tested groups (100%) responded to the electric pulp test at 12 months. There was no statistically significant difference between the three groups ($p = 1$).

CONCLUSION: Within the limitation of the study, single visit regenerative endodontics can be used to treat necrotic mature teeth with apical periodontitis and a periapical lesion.

Introduction

Regenerative endodontic procedures (REPs) are defined as a biologically based procedure to replace damaged tissues in the dentin-pulp complex with viable tissues. This treatment modality has been approved by the American dental association for the treatment of immature teeth. Its primary goal is the elimination of clinical signs and symptoms and the resolution of apical periodontitis [1].

There is a growing interest in using REPs to treat mature necrotic permanent teeth. Many successful case reports have been published; however,

the literature is lacking strong evidence based clinical trials.

REPs use the provoked apical bleeding as a source of growth factors. Autologous platelet concentrate is commonly used [2] as an aid due to the difficulty to induce bleeding in REPs for mature teeth within the canal space. Platelet concentrates contain large amounts of growth factors together with being considered as a biomimetic scaffold suitable for endodontic tissue regeneration. Clinical studies [3], [4] showed that platelet rich fibrin (PRF) significantly improved the clinical and radiographic success when used in treating immature permanent teeth.

Disinfection of the root canal is the key element for the success of the regenerative procedure. Sodium hypochlorite is considered the gold standard and the most potent irrigation material in the root canal therapy; however, it is a detrimental factor affecting the survival

* Propolis: Imtinan/Cairo, Egypt

† Nanopropolis: NanoTech/Cairo/Egypt

‡ Collacote: Collacote/Zimmer/Indiana /USA

§ Biodentine: Acrostone/Cairo/Egypt

and differentiation of stem cells. Natural irrigating materials can be used as a more biocompatible and safe alternative to NaOCl [5].

Propolis, a beehive product, has been known to have an anti-inflammatory, anti-oxidant, antibacterial, and antiviral effect. Its antimicrobial activity was attributed to its flavonoid content, proven to have a structural and functional damaging effect on bacteria, having the ability to interfere with the integrity of its cell wall and inhibiting the bacterial mobility together with having a high cell viability and biocompatibility. Using these materials in their nanoform can enhance their antimicrobial effect [6].

Thus, the aim of the present study was to compare the effect of propolis, nanopropolis, and the traditionally used ethylenediaminetetraacetic acid (EDTA) and saline on the outcomes of REPs on necrotic mature anterior teeth with apical periodontitis.

Materials and Methods

Sample size was calculated based on a previous study by Bashetty and Hegde [7] the difference in pain score between the two groups was 1 ± 1 . Using power 80% and 5% significance level, 17 patients were assigned for each study group. This number was increased to a sample size of 20 to adjust for using a non-parametric test. The number was then increased again to a total sample size of 28 to compensate for losses during follow-up (over 25% more than the calculated). Sample size calculation was achieved using PS: Power and Sample Size Calculation Software Version 3.1.2 (Vanderbilt University, Nashville, Tennessee).

The protocol was approved by the Ethics Committee of Cairo University. The protocol had been registered in ClinicalTrials.gov (ID: NCT03591172). Eighty-four patients who fulfilled the inclusion criteria from the outpatient clinic of the endodontic department of Cairo university were recruited for the study.

Access cavity was prepared. Canal patency was performed using size #15 ISO k-file. The working length was determined using an electronic apex locator** and then confirmed with intraoral periapical radiography to be 0.5–1 mm shorter than the radiographic apex. Mechanical preparation of the root canals was performed using the modified step back technique, canals were prepared to a K-file size #60^{††} set as master apical file. The canals were thoroughly irrigated between each successive file with 3 ml of 1.5% NaOCl^{‡‡} using 30-gauge side vented needle (Navitip)^{§§}

applied 1 mm short of the working length to reach a total 21 mL [8]. Then, patients were classified according to the final irrigation protocol as follow:

- Group I (Control group): Canals were thoroughly irrigated using saline (3ml/min) followed by 17% EDTA solution (20 mL/canal, 5 min)
- Group II (Experimental group): Canals were thoroughly irrigated using propolis irrigation (20 mL/canal, 5 min)
- Group III (Experimental group): Canals were thoroughly irrigated using nano-propolis irrigation (20 mL/canal, 5 min).

All of the irrigation procedures were performed using a 30-gauge side vented needle positioned 1 mm short of the working length. Canals were then dried using #60 paper points equivalent to the size of the master cone. An apical bleeding was triggered in the apical region by intentional over instrumentation using pre-curved K-file size #25. The file was gently given 2–3 clockwise turns and then withdrawn using counter-clockwise rotation. Excess blood reaching the pulp chamber was dried using a small cotton pellet held with tweezers [8].

PRF preparation: A 10-mL sample of whole venous blood was drawn from the patient's forearm (right median cubital vein). PRF was prepared according to Choukroun's technique. PRF was prepared according to Choukroun's technique by drawing blood into a 10 ml test tube without the addition of an anticoagulant, and centrifuged immediately using a table top centrifuge at 3000 rpm for 10 min [4].

Then, the freshly prepared PRF membrane was fragmented, and the fragments were placed incrementally in the canal using different sized hand pluggers sizes up to the level of the CEJ. Collacote™ was then placed over the blood clot followed by Biodentine and adhesive resin*** for permanent restoration.

Follow-up

- Survival: The following parameters were recorded using the surgical microscope: Integrity of the remaining tooth structure and the restoration. Absence of cracks and fractures in tooth structure and restoration. Then clinical inspection was carried to inspect: Healing of a sinus tract if present. No tenderness to biting. Absence of a swelling. Absence of spontaneous pain
- Sensibility: Electric and thermal pulp testing was used to evaluate sensibility of the tooth, respectively, at 6 and 12 months using Denjoy electric pulp tester.

** Root ZX II: J.Morita/Kyoto/Japan

†† K-Files: Mani/Utsunomiya/Tochigi/Japan

‡‡ NaOCl: Clorox/10th Ramadan City/Cairo/Egypt

§§ Navitip: Ultradent/South Jordan/UT

*** Composite resin: Kerr/Texas/United states

Results

The recall was 100%. All of the 84 patients within the three groups showed survival. Using Kruskal–Wallis, there was no statistically significant difference among the three groups ($p = 1$). Two teeth in the nano propolis group responded positively to thermal test at 12-month follow-up. None of the teeth in the three tested groups (100%) responded to the electric pulp test at 12 months. There was no statistically significant difference between the three groups ($p=1$) (Figures 1 and 2).

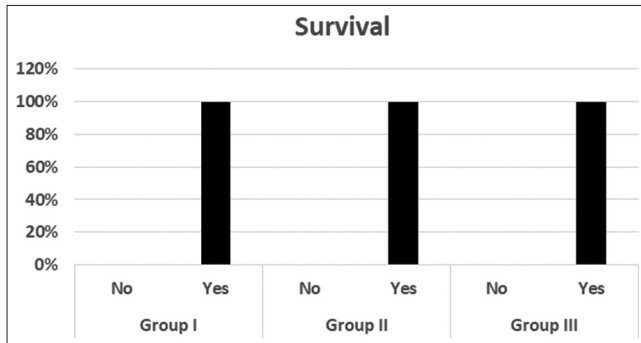


Figure 1: Bar chart representing frequencies of survival in the three groups

Discussion

Disinfection of root canal system aims to create a bacterial free environment of the root canal space, eliminating irritants and creating an environment favorable for tissue regeneration to occur. Irrigants should not only have a bactericidal properties but also should promote the survival and proliferation of the stem cells.

The present study aimed to evaluate the effect of natural irrigants (propolis and nano propolis) and compare these materials to saline and EDTA on the success of root canal regeneration when these materials were used as final irrigants.

Propolis has been selected for its known antimicrobial action due to its flavonoid content. Nano propolis was believed to have amplified action due to the unique size of the particles. Elgendy *et al.* studied the biocompatibility of nano propolis and compared it to that of propolis and found that both materials showed high cell viability and suggested that they can be used in REPs[5].

Maxillary anterior teeth were selected to allow for better standardization. Most of the successful published REPs cases used single rooted teeth in their studies [9], [10].

In the present study, no teeth responded to

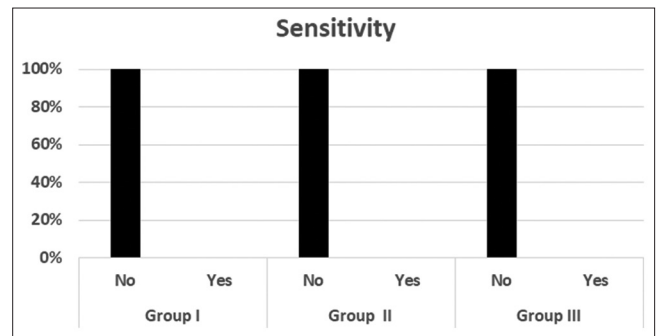


Figure 2: Bar chart representing frequencies of survival in the three groups

electric pulp test at 12-month follow-up. Only two teeth in the nano propolis group responded positively to thermal test at 12 months. These results are in agreement with Topçuoğlu and Topçuoğlu, [11] who reported that none of the four immature necrotic teeth treated with PRF revascularization responded to electric pulp test at 12 months. These results are also in agreement with the results of Saoud *et al.*, [12] who reported that none of the mature necrotic teeth treated with REP responded to electric pulp test at 26-month follow-up. They stated that the absence of a pulp response does not necessarily indicate the absence of vitality. The level of regenerated tissue and the thickness of the filling materials placed could affect the response to cold and electric pulp tests.

These results are in disagreement with the results of Shivashankar *et al.* [4] and Nageh *et al.* [13] who reported that in the two case reports where PRF was used in the REP of immature teeth with necrotic all teeth responded positively to sensibility testing at 12-month follow-up. This may be due to the difference in the experimental design.

In this study, survival has been defined as presence of tooth without any signs and symptoms. The tooth should also be functioning normally. All teeth included in our study (100%) survived. Our results support the successful outcome of revascularization of mature teeth in the studies of Abou Samra *et al.*, [14], Arslan *et al.*, [15], and Kateb and Fata, [16] who reported a favorable outcome of the revascularization procedure in mature teeth both clinically and radiographically, with a success rate ranging between 92.3 and 100%. They concluded that REP has the potential to be used as a treatment option for mature teeth.

Conclusions

Within the limitation of the present study, the following can be concluded:

Single visit regenerative endodontics achieved successful clinical outcomes when used to treat mature

single-rooted teeth with necrotic pulps and periapical lesions.

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