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Pulp regeneration for permanent mature teeth by application of normal scaffolds

Submission date
03/07/2024

Recruitment status
No longer recruiting

Registration date
08/07/2024

Overall study status
Completed

Last Edited
11/08/2025

Condition category
Oral Health

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[X] Results
[ ] Individual participant data

Plain English summary of protocol

Background and study aims
Modern science has recently turned to innovating and developing biological dental pulp treatments based on tissue engineering techniques as an alternative to traditional endodontic treatments. Tissue engineering applications are an effective strategy, especially in the field of pulp regeneration. The efficient implementation of this strategy requires the provision of biological structures that mimic the extracellular matrix. Several recent studies indicate that chitosan-based scaffolds and modified chitosan-based scaffolds. This study aims to compare several scaffolds (blood clot, native chitosan in combination with blood clot, and enzymatically-modified chitosan in combination with blood clot) in terms of their efficacy in pulp regeneration for permanent mature teeth with periapical lesions by clinical and radiographic evaluation.

Who can participate?
Patients aged 15-45 years with necrotic single-rooted permanent straight teeth with mature roots

What does the study involve?
Participants will be randomly divided into three groups to be treated with blood clot scaffold or native chitosan in combination with blood clot scaffold or enzymatically modified chitosan in combination with blood clot scaffold. All the teeth will be evaluated clinically and radiographically for up to 1 year.

What are the possible benefits and risks of participating?
Biological endodontic treatments, which involve designing and manufacturing regenerative tissue similar to the original tissue to replace diseased and damaged tissue, are a promising alternative to traditional endodontic treatments. Traditional treatments typically involve removing the dental pulp, leading to a loss of the pulp's sensory and defensive functions. Without the dental pulp, the tooth is less resistant to infections because the odontoblasts die, and the dental pulp, which defends against certain pathological factors, is absent. In contrast, biological treatments aim to preserve or restore these vital functions, making the tooth more resilient to infections and other issues.

Where is the study run from?
Damascus University (Syria)

When is the study starting and how long is it expected to run for?
August 2018 to January 2024

Who is funding the study?
Damascus University (Syria)

Who is the main contact?
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Additional identifiers

Protocol serial number
UDDS-1189-25092018/SRC-74

Study information

Scientific Title
A comparative clinical study between the application of three types of normal scaffolds in pulp regeneration for permanent mature teeth with periapical lesions

Study objectives
1. This study is designed to assess the first hypothesis that enzymatically modified chitosan can be a good scaffold for pulp regeneration.
2. The second hypothesis, there are no differences between several scaffolds (enzymatically modified chitosan, native chitosan, blood clot) in terms of their efficacy in pulp regeneration by clinical and radiographic evaluation.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 18/06/2019, Scientific Research Ethics Committee of the Faculty of Dentistry (Damascus University, Almazzeh St, Damascus, -, Syria; +963(0)11 33923192; Osama.aljabban@gmail.com), ref: ref: 74

Primary study design
Interventional

Study design
Single-center interventional a double-blind randomized controlled trial with three-arm parallel groups

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Necrotic single-rooted permanent straight teeth with mature roots

Interventions
Thirty necrotic single-rooted permanent teeth with mature roots from healthy people aged between 15-45 years old will be randomly divided into three groups using https://www.random.org: Group A (control) patients will be treated with a blood clot scaffold, Group B (study) patients will be treated with native chitosan in combination with a blood clot scaffold. Group C (study) patients will be treated with enzymatically modified chitosan and a blood clot scaffold.

Endodontic Regeneration Procedures
In the first session, local anesthesia will be performed using 2% lidocaine with adrenaline and rubber dam isolation. The access cavity will be prepared, mechanical instrumentation of the canal will be performed using rotary files, and the apical foramen will be prepared to a size of #35, meaning that the measurement of the apical foramen after completion of the preparation will be 0.35 mm. Subsequently, chemical debridement will be performed using 2.5% sodium hypochlorite solution and physiological saline solution, then the canal will be dried. A low concentration (5 mg/ml) of modified triple antibiotic paste containing (metronidazole, ciprofloxacin, and cefaclor in a ratio of 1:1:1 by weight) will be prepared in a creamy consistency

using propylene glycol and macrogol ointment taken in a 1:1 ratio by weight and will be placed inside the canal to the level of the cementoenamel junction using a lentulo spiral, and the access cavity will be sealed with glass ionomer cement. Patients will be recalled after 3 weeks.

After three weeks, the safety of the temporary restoration will be confirmed and the initial treatment will be evaluated to ensure that there are no signs or symptoms. If symptoms are present, the triple antibiotic paste will be applied again, and if symptoms are not present, local anesthesia will be administered with 3% mepivacaine without a vasoconstrictor. The antibiotic paste will be removed by irrigation with physiological saline solution followed by 17% EDTA solution, and the final irrigation will be done using physiological saline solution. The root canal will be dried, and the regenerative procedure will be performed according to the group to which each patient belongs.

Group A: Blood Clot Scaffold (BC): In this group, bleeding will be induced inside the root canal by gentle over-instrumentation using a #25 k-file. It will be gently twisted 2 to 3 revolutions clockwise and then counterclockwise. After obtaining clear bleeding in the canal that reaches the level of the cementoenamel junction, a small cotton pellet soaked with saline will be placed in the coronal third of the canal for 10 minutes to allow the blood clot to form.

Group B: Native Chitosan with Blood Clot Scaffold (NCS+BC): In this group, bleeding will be induced inside the root canal in the same way as Group A, then native chitosan with high molecular weight and a degree of deacetylation greater than 95% will be applied as a scaffold for pulp regeneration in gel form and mixed with the blood clot using a #25 k-file until they are homogenous.

Group C: Enzymatically Modified Chitosan with Blood Clot Scaffold (EMCS+BC): In this group, bleeding will be induced inside the root canal in the same way as in Group A. Then, the enzymatically modified chitosan, which will be modified in the Department of Biology, Faculty of Science, Damascus University, will be injected into the root canal and mixed with the blood clot using a #25 k-file until they are homogenous.

After applying the studied scaffolds to the experimental groups, white MTA material will be applied within the root canal orifices. A layer of glass ionomer cement will be applied to the MTA material, then the teeth will be restored with a composite resin material.

Clinical Evaluation: Patients of the three groups will be followed up at 1, 3, 6, and 12-month intervals to evaluate treated teeth clinically by examining for the presence of spontaneous or palpable pain, soft tissue swelling, or sinus tract, and radiographically to assess the condition of the periapical lesion. The vitality test will be conducted using ethyl chloride after isolating the tooth to be tested. A piece of cotton soaked in it will be placed on the buccal surface for 15 seconds, and before testing the sensation of the treated tooth, other adjacent vital teeth and non-vital teeth, if present, will be tested to establish a reference response and for comparison. The results of the cold test by ethyl chloride will be recorded as follows: *no response, *response.

2- Radiographical Assessment: Radiological follow-up results will be recorded during the follow-up periods, and evaluated by two specialists who will be blinded to the treatment group to which the patient is assigned. The certified degrees for healing of periapical lesions and the corresponding values given for each degree will be as follows:

0-Failure: It will be the case in which the size of the lesion has increased radiologically or the existing lesion has not changed in size with the presence of symptoms or signs.

1-Doubt: It will be the case in which the size of the lesion remains the same radiographically with no symptoms or signs.
2-Healing: This will be the case in which radiographic evidence indicates a decrease in the size of the lesion without complete disappearance, and the tooth will be clinically healthy without symptoms or signs.
3-Success: This will be the case in which radiographic evidence confirms that the lesion has completely disappeared and the tooth will be clinically healthy without any symptoms or signs.

Intervention Type
Procedure/Surgery

Primary outcome(s)
The condition of the periapical lesion will be measured clinically (spontaneous or palpable pain, soft tissue swelling, or sinus tract) using a vitality test and using radiographical scoring at 1, 3, 6, and 12-month intervals

Key secondary outcome(s)
1. Patient demographic information (age in years and sex) recorded during the patient examination at a baseline visit
2. Apex diameter (in mm) and working length (in mm) measured using a 35# k file during the preparation phase

Completion date
13/01/2024

Eligibility

Key inclusion criteria
1. Aged between 15-45 years old with necrotic single-rooted permanent straight teeth with mature root
2. Radiographical presence of periapical lesions less than 10 mm in diameter
3. Healthy and free of any systemic diseases
4. Patients with a negative response to the allergic patch test (triple antibiotic paste) were included in the study
5. Willingness to cooperate and commit to work sessions and follow-ups

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
15 Years

Upper age limit
45 Years

Sex
All

Total final enrolment
30

Key exclusion criteria
1. Teeth that are grossly decayed or fractured which cannot be isolated with the rubber dam and require post and core as final restorations
2. Teeth with previous root canal treatment
3. Teeth with root fracture or with external and internal resorption and teeth with developmental anomalies
4. Patients with generalized chronic periodontitis and the presence of draining sinus
5. Patients with calcified canals, canals with apparent curvature
6. Patients who were allergic to any drugs
7. Patients with systemic disease
8. Pregnancy
9. Patients with a history of major surgeries like cardiac, kidney transplantation, hemodialysis

Date of first enrolment
25/06/2020

Date of final enrolment
10/02/2023

Locations

Countries of recruitment
Syria

Study participating centre
Damascus University
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Sponsor information

Organisation
Damascus University

ROR

https://ror.org/03m098d13

Funder(s)

Funder type
University/education

Funder Name
Damascus University

Alternative Name(s)
University of Damascus, , DU

Funding Body Type
Government organisation

Funding Body Subtype
Universities (academic only)

Location
Syria

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated and/or analyzed during the current study during this study will be included in the subsequent results publication

IPD sharing plan summary
Published as a supplement to the results publication

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		17/12/2024	11/08/2025	Yes	No
Participant information sheet			08/07/2024	No	Yes