ORIGINAL ARTICLE

COMPARISON OF PERIAPICAL HEALING FOLLOWING NON-SURGICAL ROOT CANAL TREATMENT *VS* INJECTABLE PLATELET RICH FIBRIN IN REGENERATIVE ENDODONTIC TREATMENT OF NECROTIC IMMATURE PERMANENT ANTERIOR TEETH

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Background: Necrosis of dental pulp can act as bacterial ingression source causing periapical infection leading to tooth loss. Regenerative Endodontics is the desired technique for replacing damaged pulpal structures with normal physiology and function. Objective of this study was to compare the periapical healing following non-surgical root canal treatment using blood clot formation versus regenerative endodontic treatment utilizing injectable platelet-rich fibrin (i-PRF) in necrotic immature permanent anterior teeth. **Methods:** This comparative study was conducted at Department of Operative Dentistry, Bakhtawar Amin Dental Hospital, Multan, from May 2023 to April 2024. A total of 164 patients meeting the inclusion criteria were recruited and randomly assigned into two groups: Group-I (blood clot scaffold) and Group-II (i-PRF scaffold), with 82 patients each. Standardized clinical protocols were followed for canal disinfection and scaffold placement. **Results:** Both groups showed significant improvement over time; however, Group II (i-PRF) demonstrated a significantly greater reduction in periapical lesion size compared to Group-I at all follow-up intervals (p<0.05). At 12 months, the mean lesion perimeter was 5.6±4.7 mm² in Group-I and 2.8±3.5 mm² in Group-II (p<0.001). The i-PRF group exhibited faster clinical symptom resolution and a higher rate of complete radiographic healing (86.6% *vs* 73.2%). **Conclusion:** Injectable platelet-rich fibrin significantly improves clinical and radiographic healing outcomes compared to traditional blood clot induction in regenerative endodontic treatment of necrotic immature permanent anterior teeth, and provides a biologically active scaffold, enhancing the regenerative potential of endodontic therapies.

Keywords: Endodontic treatment, Healing, Injectable platelet-rich fibrin, Tooth

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INTRODUCTION

Children at the age of 7 to 9 years are considered most notorious for dental traumatic injuries.[1] Anterior teeth are more vulnerable to fracture during road accidents or sports activity.[2] At this age the anterior permanent teeth have immature apex and complicated crown fractures of these teeth make the treatment more complicating and challenging.[3] In immature complicated crown fracture old treatment modality is $Ca(OH)_2$ apexification in which $Ca(OH)_2$ make a barrier in the apex leaving the apex thin and week.[4–6] After that Mineral Triode Aggregate replaces the old $Ca(OH)_2$ apexfication but this later treatment does not solve the issue of weakness of thin roots.[7–9] Now-a-days regeneration or revascularization of pulp has gained the popularity regarding increasing the strength of roots.[8–12]

Necrosis of the dental pulp following trauma, caries, or previous dental procedures not only affects tooth survival and preservation, but can also act as a source of bacteria leading to the infection of periapical tissues.[13] Regenerative Endodontics is a technique aimed at replacing damaged dentino-pulpal structures, and restoring the vitality and continued normal physiologic development of root in case of necrotic immature (teeth with open root apices) permanent anterior teeth.[14] Blood clot revascularization is the most common and first revascularization method.[13] Studies conducted in the past showed that platelet concentrates like platelet rich plasma (PRP) and platelet rich fibrin (PRF) can be used as a scaffold for regeneration.[15] Different types of PRF with variable properties were introduced, however, the solid state of PRF limits its application. Following the low-speed centrifugation concept, injectable platelet rich fibrin (i-PRF) was developed as a novel liquid blood derivative, which is rich in platelets, leukocytes, and growth factors.[13]

In a recent study there have been implications of i-PRF in regenerative endodontics. Ibrahim *et al*[16] evaluated the comparative efficacy of non-surgical root canal treatment and i-PRF to treat teeth with necrotic pulp in 30 adult patients with an age range of 18–45 years. After 12 month follow-up period there were non-significant differences between control and intervention groups.[16]

Platelet rich plasma are a useful scaffold material for regenerative endodontics, it favourably leads to positive vitality test and apical closure.[17] In another study by Nara *et al*[18], 10 children of 8–13 years of age with no sex predilection were included for comparative evaluation of efficacy of i-PRF with blood clot in root completion of immature permanent teeth. The mean and standard deviation of pre-operative periapical radiolucency (mm) was 2.81±1.14 and 2.25±1.27 for group I and II respectively, while the mean and standard deviation of post-operative periapical radiolucency (mm) was 0±0 and 0.00±0.00 for group I and II respectively. The decrease in postoperative radiolucency was not statistically significant after 18 months of follow-up.[18] Compared to PRF, i-PRF results in better elimination of endodontic infection, hence vitality and continued normal physiologic development of root can be achieved. In young population this can be of great significance in terms of long-term tooth survival and preservation, thereby improving quality of life.[19,20]

The objective of this study was to compare the mean post-operative periapical radiolucency perimeter in non-surgical root canal treatment versus i-PRF.

METHODOLOGY

This comparative study was conducted at the Department of Operative Dentistry, Bakhtawar Amin Dental Hospital, Multan, from May 2023 to April 2024. A non-probability, consecutive sampling technique was used. The sample size was calculated as per parameters of study of Ibrahim *et al*[16]. The power of this study was kept at 80%, and the confidence interval was kept at 95%. This gave a sample size of 82 subjects in each of the two groups, thus making a total sample size of 164.

Inclusion Criteria

1. Age: 8 to 15 years, both male and female.
2. Teeth diagnosed with pulp necrosis based on thermal and electrical pulp testing.
3. Teeth having open root apices evident on radiograph.
4. Teeth presenting periapical radiolucency on radiographic examination.
5. Radiologic confirmation of a single-rooted tooth with a single root canal.

Teeth with root fracture, assessed radiographically were excluded.

Ethical approval was obtained from the Institutional Ethical Review Board of Bakhtawar Amin Medical and Dental College, Multan (Ref No. 414/22/COD). The study was carried out on patients visiting the Operative Department of Bakhtawar Amin Dental Hospital for root canal therapy. Fulfilling the inclusion criteria, 164 patients were included and divided into two groups with 82 patients in each group (Group I: blood clot, Group II: i-PRF). Baseline demographic data including age, gender, and tooth number were recorded on the Patient Record Sheet. Clinical and radiographic findings were recorded at baseline, and at 1, 3, 6, and 12 months after treatment. Periapical radiographs were taken using cone beam computed tomography (CBCT). Baseline findings such as periapical lesion dimensions were recorded. Access opening was performed on the involved tooth. The canal was instrumented with 20 mL of 1% sodium hypochlorite solution and dried with paper points. Triple antibiotic paste was placed within the canals below the cementoenamel junction (CEJ) to minimize crown staining. The access cavity was temporarily sealed with glass ionomer cement (GIC). Patients were scheduled for a second visit. After 3 weeks, if the tooth was found asymptomatic, the antibiotic paste was removed, and irrigation was done with 17% EDTA solution for 5 minutes. The canal space was dried with sterile paper points. After this procedure, patients were split into two groups.

For Group I, using a No. 20 K-file, apical bleeding was induced and allowed to form a blood clot up to the cementoenamel junction. Following this, white mineral trioxide aggregate (MTA) was placed to a thickness of 3 mm, followed by restoration with GIC and composite resin.

For Group II, i-PRF was prepared using Choukroun’s method. Freshly prepared i-PRF (0.5 mL) was placed in the coronal third of the canal. MTA was also placed in the coronal third of the root canal, and the tooth was restored with GIC and composite. All patients were recalled at 1, 3, 6, and 12 months for clinical evaluation of signs and symptoms, and radiographic assessment of the decrease in the size of the periapical lesion. All data were recorded on patient’s proforma.

Data were analysed on SPSS-25. Descriptive statistics were presented for both quantitative and qualitative variables. Mean±SD were calculated for age, duration of symptoms, and periapical lesion perimeter preoperatively and postoperatively at the 12-month follow-up period. Frequencies and percentages were calculated for gender and tooth number. Data were stratified concerning age, gender, duration of symptoms, and tooth number. Independent sample *t*-test was applied to compare the mean measurements of the periapical lesion perimeter of both groups, and $p \leq 0.05$ was considered statistically significant.

RESULTS

Data were collected from 164 patients. The mean age in Group I was 11.4±2.2 years and in Group II it was 11.6±2.0 years, with a male-to-female ratio of 47/35 in Group I and 45/37 in Group II. The most commonly treated teeth were tooth numbers 11 and 21 in both groups. At baseline, the mean periapical lesion perimeter was 17.1±7.9 mm² for Group I and 17.0±8.0 mm² for Group II. Group II showed a greater reduction in lesion size compared to Group I: at 1 month

(13.1±6.8 mm² *vs* 15.2±7.5 mm², *p*=0.03), 3 months (9.5±6.0 mm² *vs* 12.4±6.9 mm², *p*=0.01), 6 months (5.9±5.2 mm² *vs* 8.8±6.0 mm², *p*=0.001), and 12 months (2.8±3.5 mm² *vs* 5.6±4.7 mm², *p*<0.001. (Table-1).

In Group I, absence of pain was reported in 80 (97.6%) patients compared to 82 (100%) patients in Group II (*p*=0.24). Absence of swelling was seen in 77 (93.9%) patients in the blood clot group and in 81 (98.7%) patients in Group II (*p*=0.09). Regarding sinus tract healing, 75 (91.5%) patients in Group I and 80 (97.5%) patients in Group II showed complete resolution (*p*=0.08). The overall clinical success was slightly higher in Group II at 98.7% compared to 95.1% in Group I (*p*=0.19). The differences were not statistically significant. (Table-2).

Radiographic assessment at 12-month follow-up revealed that complete healing was achieved in 60 (73.2%) patients in Group I and in 71 (86.6%) patients in Group II, (*p*=0.03). Partial healing was observed in 15 (18.3%) patients in the blood clot group and 9 (11%) patients in Group II (*p*=0.18). No healing or failure was noted in 7 (8.5%) patients in Group I compared to 2 (2.4%) patients in Group II, (*p*=0.04). (Table-3).

The mean time for pain resolution was 3.1±1.2 weeks in Group I and 2.4±1.0 weeks in Group II (*p*=0.002). Swelling resolved in 3.6±1.5 weeks in the blood clot group and in 2.7±1.1 weeks in Group II (*p*=0.001). Sinus tracts closure occurred at an average of 4.2±1.7 weeks in Group I and 3.0±1.2 weeks in Group II, (*p*<0.001). (Figure-1).

Table-1: Baseline demographic data

Variable	Group I (Blood Clot)	Group II (i-PRF)	*p*
Mean Age (Years)	11.4±2.2	11.6±2.0	0.54
Gender (M/F)	47/35	45/37	0.71
Common Tooth	11 (41%) 21 (39%)	11 (43%) 21 (38%)	0.89
Periapical lesion			
Baseline	17.1±7.9	17.0±8.0	0.92
1 month	15.2±7.5	13.1±6.8	<0.05*
3 months	12.4±6.9	9.5±6.0	<0.01*
6 months	8.8±6.0	5.9±5.2	<0.001*
12 months	5.6±4.7	2.8±3.5	<0.001*

(*Statistically significant)

Table-2: Clinical success rates at 12 months [n (%)]

Clinical Finding	Group I (Blood Clot)	Group II (i-PRF)	*p*
Absence of pain	80 (97.6)	82 (100)	0.24
Absence of swelling	77 (93.9)	81 (98.7)	0.09
No sinus tract	75 (91.5)	80 (97.5)	0.08
Total clinical success	78 (95.1)	81 (98.7)	0.19

Table-3: Radiographic healing outcomes at 12 months [n (%)]

Radiographic Status	Group I (Blood Clot)	Group II (i-PRF)	*p*
Complete Healing	60 (73.2)	71 (86.6)	0.03*
Partial Healing	15 (18.3)	9 (11)	0.18
No Healing/Failure	7 (8.5)	2 (2.4)	0.04*

(*Statistically significant)

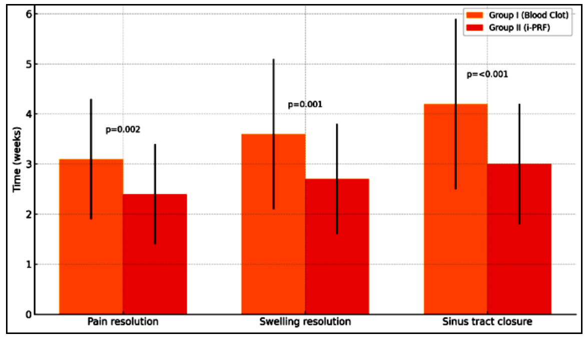

Figure-1: Mean time to clinical resolution of symptoms

DISCUSSION

This study compared the periapical healing following non-surgical root canal treatment with blood clot induction and regenerative endodontic treatment using i-PRF in necrotic immature permanent anterior teeth. The i-PRF significantly enhanced clinical and radiographic outcomes compared to the conventional blood clot technique. From baseline to the 12-month follow-up, patients treated with i-PRF exhibited greater reductions in periapical lesion size, faster clinical symptom resolution, and a higher percentage of complete radiographic healing. The i-PRF offers a biologically superior alternative to blood clot formation in regenerative endodontic therapy.[18] At the start of the study, no significant differences were observed between the two groups in terms of demographic characteristics or baseline lesion dimensions. Over time, however, distinct differences emerged. By the first month, the i-PRF group had already shown significantly greater reductions in lesion size compared to the blood clot group, and this trend[19] continued through the 3rd, 6th, and 12th months. The i-PRF group demonstrated quicker resolution of pain, swelling, and sinus tract closure, underlining the regenerative and anti-inflammatory potential of this biomaterial.[21,22]

The biological superiority of i-PRF may be explained by its rich composition of growth factors like PDGF, VEGF, and TGF-β, which are crucial for angiogenesis, stem cell proliferation, and tissue regeneration.[23] Unlike the traditional blood clot scaffold, which relies heavily on natural clot formation and host response, i-PRF provides a dense, fibrin-rich environment that facilitates cellular migration and tissue formation. This aligns with prior findings, who observed enhanced outcomes with platelet concentrates in regenerative endodontics.[24,25]

The main strengths of this study was its design, which minimized selection bias and improved the reliability of the findings. An adequate sample size was calculated and achieved. Standardized clinical protocols were followed for both groups. Despite these strengths, the study had certain limitations. It was a single-centre study, limiting generalizability of results. Histological analysis was not performed. The 12-month follow-up period may not fully capture the long-term success and durability of regenerated tissues. There could be a potential variability in preparation of i-PRF, which may influence concentration of growth factors and regenerative efficacy. Future implications of this study include true pulp regeneration, superior vital pulp therapy, and increased tooth survival, which will increase confidence of the dentists on this procedure.

CONCLUSION

Regenerative endodontic treatment using i-PRF results in significantly better clinical and radiographic outcomes compared to traditional blood clot-based techniques in management of necrotic immature permanent anterior teeth. Patients treated with i-PRF demonstrated faster resolution of clinical symptoms, greater reduction in periapical lesion size, and higher rates of complete radiographic healing over a 12-month follow-up period.

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HA: Concept, Data collection	**MS:** Supervision, Mentorship	**AG:** Literature review	**MA:** Study design
AS: Critical revision	**AN:** Discussion, Revision	**AM:** Final Revision	**MMJA:** Data Analysis

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