Original Research

Title: Does platelet-rich fibrin improve the clinical outcomes of intentional replantation in the treatment of periodontally hopeless teeth?

Running Title: Platelet-rich fibrin and replantation

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Abstract

Purpose: The purpose of this study was to evaluate the impact of using platelet-rich fibrin (PRF) on clinical parameters in intentional replantation (IR) treatment.

Materials and Methods: Data were obtained from 32 mandibular anterior teeth with a 15-month follow-up, treated with either IR (n=17) or IR+PRF (n=15). Periodontal parameters included probing depth (PD), clinical attachment level (CAL), plaque index (PI), gingival index (GI), and keratinized tissue height (KTH), all of which were assessed retrospectively.

Results: PD reduction at mesial and midlingual sites was greater in the IR+PRF group at the 15-month follow-up ($p=0.043$ and $p=0.017$, respectively), whereas CAL gain in the IR+PRF group was significantly higher at 3, 6, and 15 months ($p<0.05$). GI scores were similar in both groups, while PI scores were higher in the IR group at 6 and 15 months ($p<0.05$). Changes in KTH were similar in both groups at all follow-up periods.

Conclusion: IR can be considered for the treatment of periodontally hopeless mandibular anterior teeth, and combining IR with PRF may improve clinical outcomes. However, its clinical use should be recommended cautiously due to the lack of histological data regarding the effects of PRF on IR healing.

Keywords: *platelet-rich fibrin, tooth loss, tooth replantation, periodontal diseases, alveolar bone loss*

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Introduction

Intentional replantation (IR) is a surgical procedure involving the removal and reinsertion of a tooth, either before or after endodontic treatment (1, 2). Besides endodontic indications such as failed root canal treatment, accessibility problems, and anatomic limitations (2), IR is also recommended as a last-resort alternative for periodontally hopeless teeth (3–5). Hou *et al.* (5) reported that the survival rate of periodontally hopeless teeth after IR treatment was 88.2%.

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The application of additional biological or chemical agents, such as platelet concentrates or tetracycline hydrochloride (TS-HCl), has shown potential to improve IR success rates (3, 6). Among these, tetracycline (TS) has a direct inhibitory effect on osteoclasts and inhibits both bone resorption and collagenase activity in addition to its antimicrobial effects (7). Demineralization of the dentin surface with TS enhances the binding of matrix proteins to dentin and stimulates fibroblast attachment by increasing fibronectin binding to dentin surfaces (8). Moreover, root conditioning with TS can reduce inflammatory damage through its antimicrobial effects (5).

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate widely used in oral surgery (9). PRF contains a high concentration of platelets and growth factors (i.e., platelet-derived growth factor, vascular endothelial growth factor, and transforming growth factor-β) that induce wound healing and tissue regeneration (10). Preparation of PRF without anticoagulant factors that inhibit wound healing preserves the growth factors within a fibrin matrix for prolonged release over several postoperative days or weeks (11). PRF promotes osteogenesis by stimulating protein kinases that enhance the proliferation and differentiation of osteoblasts (12, 13). The positive effects of PRF have been demonstrated in various procedures, including peri-implantitis treatment, flap surgery, ridge or sinus augmentations, and aesthetic periodontal surgeries (11, 14). However, data on the effect of PRF in IR is limited, as it is based on only a few case reports (15, 16). Hypothetically, PRF can improve the clinical outcomes obtained after IR, and the aim of this study is to evaluate the impact of using PRF in addition to IR on clinical parameters.

Materials and Methods

Study design and subjects

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This retrospective study included the dental records of patients treated with IR or IR+PRF by a clinician at the Department of Periodontology. All enrolled patients provided informed written consent. Ethical approval was obtained from the Hacettepe University Ethics Committee (GO 18/544-29).

Inclusion and exclusion criteria

In total, the data of 32 patients treated with IR or IR+PRF and followed up for 15 months were included. The cases aimed to treat periodontally hopeless teeth with severe bone loss (≥60%) and third-degree mobility, with or without periodontal pockets ≥5 mm (1, 2). Only mandibular anterior teeth were considered for this study. The exclusion criteria were as follows: any systemic diseases such as hypertension, osteoporosis, diabetes mellitus, or allergies that could affect periodontal healing and conditions; contraindications for periodontal surgery; and smoking.

Data collection

Demographic information regarding age, gender, and health status was collected from the clinical records. Periodontal parameters, including probing depth (PD) (from the gingival margin to the base of the pocket), clinical attachment level (CAL) (from the cementoenamel junction to the base of the pocket), plaque index (PI) (19), gingival index (GI) (20), and keratinized tissue height (KTH) (from the gingival margin to the mucogingival junction) were also recorded. PD, CAL, PI, and GI were measured at four sites per tooth: mesial (M), midbuccal (MidB), distal (D), and midlingual (MidL).

Treatment procedures

Four weeks before the IR procedure (21), phase I periodontal therapy and root canal treatment were completed (Figure 1). After local anesthesia, the tooth was gently extracted, and the root surfaces were scaled and planed to remove calculus and necrotic cementum. The apical foramen was slightly resected and sealed using mineral trioxide aggregate (MTA). Then, TS-HCl (at a concentration of 100 mg/ml) was applied to the root surfaces for 5 minutes.

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Granulation tissues were also removed from the extraction socket using Gracey curettes. After these procedures, the root surfaces were rinsed with sterile saline for 1 minute, and the tooth was replaced into the socket. In the IR+PRF group, before replantation, intravenous blood was collected in sterile 10 ml tubes without anticoagulant and centrifuged at 3000 rpm for 10 minutes (22). After fibrin clot formation, it was placed on a grid inside the PRF box and compressed with a cover to create a PRF membrane. The PRF membrane was placed at the base of the socket before replantation (Figure 2). Occlusal reduction was performed to protect the tooth from traumatic occlusion. Splinting was performed by placing composite material on the interproximal and lingual surfaces after the tooth was repositioned in the socket.

Patients were prescribed doxycycline 100 mg once per day and a 0.12% chlorhexidine rinse three times per day for one week. The use of interdental brushes, in addition to routine oral hygiene procedures, was recommended. Patients were advised to avoid biting with their anterior teeth and to refrain from consuming hard foods. The splint was removed six months after surgery, and the patients were recalled at three-month intervals for professional plaque control. Clinical data were collected at 3 (T-3), 6 (T-6), and 15 (T-15) months of follow-up.

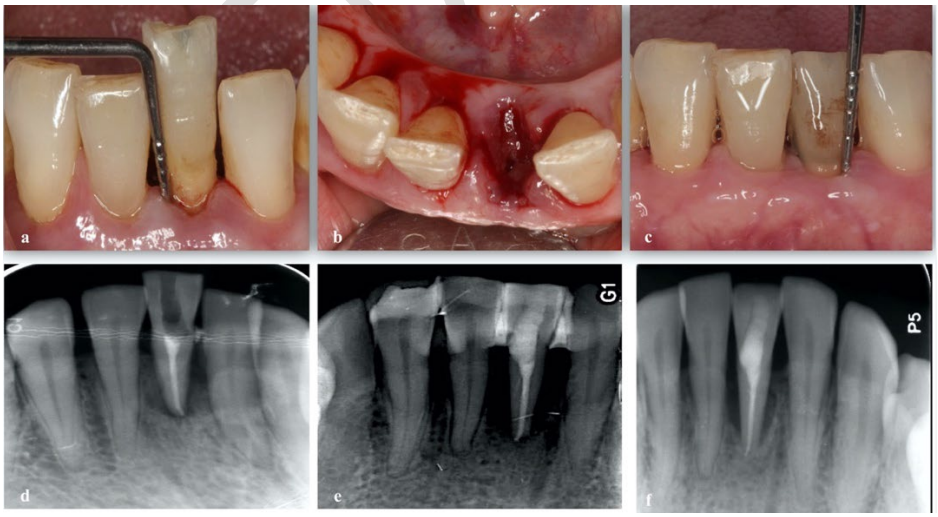


Figure 1. *Overview of treatment procedures and 15-month follow-up images. (a) Baseline clinical view, (b) socket view after tooth extraction in the IR procedure, (c) clinical view showing reduced CAL and PD with no sign of inflammation in the 15 months follow-up, (d) baseline radiographic view showing bone loss extending to the apex, (e) radiographic view immediately after the IR procedure showing the*

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new position of tooth, and (f) radiographic view in the 15 months follow-up. Besides the low-density shadows around its lateral surface possibly due to incomplete hard tissue mineralization, significant hard tissue gain was observed in the apical 1/3 of the root.

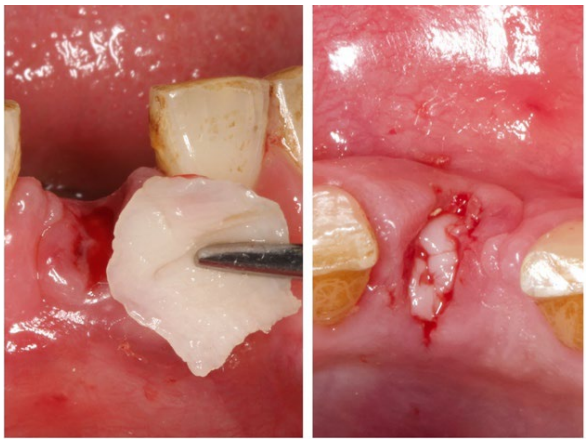


Figure 2. *Application of platelet rich fibrin.*

Sample size estimation

The sample size was calculated based on an alpha error of 0.05 and a power of 0.80. For variability, data from a previous study were used as a reference (23). Assuming the effect size (d) as 1 and the inter-group difference in the CAL gain as 1 mm, a minimum of 14 teeth per group was required.

Statistical analysis

Statistical analysis was carried out using IBM SPSS Statistics version 26.0. Numeric data were expressed as mean ± standard deviation and categorical data as number and percentage. The significance level was set at 5%. Group comparisons for categorical variables were made by chi-square test and extract p-values were calculated. Student t-test was used to compare two independent groups with normally distributed data and homogenous variances; if variances were heterogeneous, the Welch t-test was used. Mann–Whitney U test for quantitative variables and Chi-square test for categorical data were performed to compare inter-group differences. Intra-group comparisons were made using the Friedman test.

Results

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No adverse events were recorded during the follow-up period. No tooth mobility was detected after splint removal. Data from 32 patients (15 in the IR+PRF group and 17 in the IR group), each contributing one replanted tooth, were included in the analysis. Demographic data and the type of tooth for each group are presented in Table 1. The 32 replanted teeth consisted of 8 lower lateral incisors and 24 lower central incisors. The mean age was 44.07 ± 10.01 years in the IR+PRF group and 42.71 ± 8.21 years in the IR group. No significant differences were found between the groups in terms of age (p=0.676) or gender (p=0.712).

Table 1. *Demographic data of the study sample.*

Variables	**IR+PRF (n=15)**	**IR (n=17)**	**p**
Age, years	44.07±10.01	42.71±8.21	0.676[a]
Gender			
Female	11 (73.3)	11 (64.7)	0.712[b]
Male	4 (26.7)	6 (35.3)	
Type of tooth			
Lower lateral incisor	3 (20.0)	5 (29.41)	
Lower central incisor	12 (80.0)	12 (70.59)	

[a]: Student t-test; [b]: chi-square test. Age data reported as mean ± SD, others n (%).

Periodontal variables

No significant intergroup differences were found in the baseline variables, except for GI (p=0.008), PD-M (p=0.011), CAL-M (p=0.026), CAL-MidL (p=0.033), and KTH (p=0.019). Mean GI scores were similar for both groups at all follow-up periods, while PI scores at T-6 and T-15 were significantly higher in the IR group (p=0.023 and p=0.037, respectively) (Table 2). The deepest baseline mean PD was recorded on the mesial surface (5.73 mm), with mean PD values ranging between 2.74 and 5.73 mm. After treatment, PD-M, PD-MidB, PD-D, and PD-MidL values in the IR+PRF group were significantly reduced up to T-15 (p<0.001 for all). Similarly, mean PD-M, PD-MidB, and PD-MidL values in the IR group were significantly lower at T-15 (p<0.001, p=0.002, and p=0.003, respectively). However, mean PD did not show any significant intergroup differences at any time point (p>0.05) (Table 2, Figure 3). While baseline mean CAL values ranged from 9.17 to 6.07 mm in the IR+PRF group, they were recorded as 7.24 to 5.53 mm in the IR group. In both groups, mean CAL at all four sites showed significant improvement at T-15 compared to baseline (p<0.05). CAL-MidB values were similar at baseline; however, mean CAL-MidB at T-3, T-6, and T-15 were significantly lower in the IR+PRF group (p=0.013, p=0.011, and p=0.004, respectively) (Table 2, Figure 4). Mean

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KTH values were 5.60 ± 1.40, 5.13 ± 1.46, 4.87 ± 1.51, and 4.80 ± 1.42 mm for the IR+PRF group and 4.12 ± 1.90, 3.35 ± 1.22, 3.35 ± 1.37, and 3.47 ± 1.28 mm for the IR group at baseline, T-3, T-6, and T-15, respectively. Mean KTH was significantly higher in the IR+PRF group at T-3, T-6, and T-15 (p=0.001, p=0.006, and p=0.009, respectively). In both groups, mean KTH did not show any significant differences at T-15 compared to baseline (p=0.104 for the IR+PRF group and p=0.13 for the IR group) (Table 2).

Table 2. *Assessment of the periodontal variables.*

Variables	Time of assessment	IR+PRF (n=15)	IR (n=17)	p (group)
GI	BL	1.93±0.20	1.59±0.44	**0.008**
	T-3	0.83±0.61	1.16±0.36	0.082
	T-6	0.87±0.53	1.15±0.48	0.13
	T-15	0.98±0.64	0.99±0.43	0.992
	p (time)	**<0.001**	**<0.001**	
PI	BL	1.28±0.57	1.31±0.51	0.894
	T-3	0.90±0.61	1.16±0.45	0.174
	T-6	0.65±0.40	1.19±0.82	**0.023**
	T-15	0.72±0.51	1.26±0.87	**0.037**
	p (time)	**<0.001**	0.509	
PD-M (mm)	BL	5.73±1.93	3.91±1.88	**0.011**
	T-3	2.50±0.68	2.38±0.99	0.703
	T-6	2.43±0.53	2.21±0.81	0.362
	T-15	2.60±0.60	2.15±0.91	0.106
	p (time)	**<0.001**	**<0.001**	
PD-MidB (mm)	BL	3.60±1.50	3.24±2.17	0.581
	T-3	1.53±0.64	1.65±0.86	0.678
	T-6	1.40±0.51	1.53±0.72	0.565
	T-15	1.40±0.63	1.71±0.69	0.202
	p (time)	**<0.001**	**0.002**	

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	BL	3.33±1.19	2.74±1.21	0.171
	T-3	2.37±0.74	2.27±0.90	0.732
PD-D (mm)	T-6	2.40±0.60	2.38±0.78	0.944
	T-15	2.37±0.61	2.38±1.11	0.962
	p (time)	**<0.001**	0.154	
	BL	4.20±2.21	2.94±1.82	0.087
	T-3	1.53±0.64	1.65±0.70	0.637
PD-MidL (mm)	T-6	1.40±0.51	1.65±0.79	0.295
	T-15	1.60±0.63	1.94±0.83	0.205
	p (time)	**<0.001**	**0.003**	
	BL	9.17±2.69	7.24±1.94	**0.026**
	T-3	4.40±2.06	5.59±1.44	0.074
CAL-M (mm)	T-6	4.57±1.83	5.56±1.64	0.116
	T-15	4.73±1.68	5.44±1.72	0.25
	p (time)	**<0.001**	**<0.001**	
	BL	6.07±2.28	6.76±2.80	0.449
	T-3	3.20±1.66	4.88±1.93	**0.013**
CAL-MidB (mm)	T-6	3.13±1.55	4.82±1.91	**0.011**
	T-15	3.20±1.47	5.12±1.90	**0.004**
	p (time)	**<0.001**	**0.002**	
	BL	7.17±1.97	7.06±1.95	0.878
	T-3	4.13±1.93	5.18±1.22	0.075
CAL-D (mm)	T-6	4.4±1.94	5.38±1.39	0.107
	T-15	4.63±1.93	5.44±1.57	0.202
	p (time)	**<0.001**	**<0.001**	
	BL	7.20±2.51	5.53±1.42	**0.033**
	T-3	3.80±1.78	3.94±1.09	0.786
CAL-MidL (mm)	T-6	3.80±1.78	4.24±1.48	0.456
	T-15	4.00±1.93	4.59±1.42	0.329
	p (time)	**<0.001**	**0.001**	
	BL	5.60±1.40	4.12±1.90	**0.019**
KTH (mm)	T-3	5.13±1.46	3.35±1.22	**0.001**
	T-6	4.87±1.51	3.35±1.37	**0.006**

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	T-15	4.80±1.42	3.47±1.28	**0.009**
	p (time)	0.104	0.13	

GI: gingival index; PI: plaque index; PD: probing depth; CAL: clinical attachment level; KTH: keratinized tissue height; M: mesial; D: distal; MidB: midbuccal; MidL: midlingual; BL: baseline; T-3: 3 months; T-6: 6 months; T-15: 15 months postoperative.

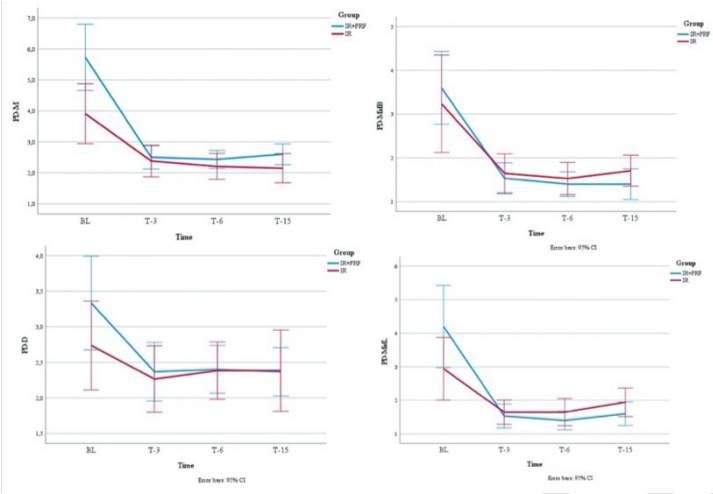


Figure 3. *Time-dependent change of probing depth.*

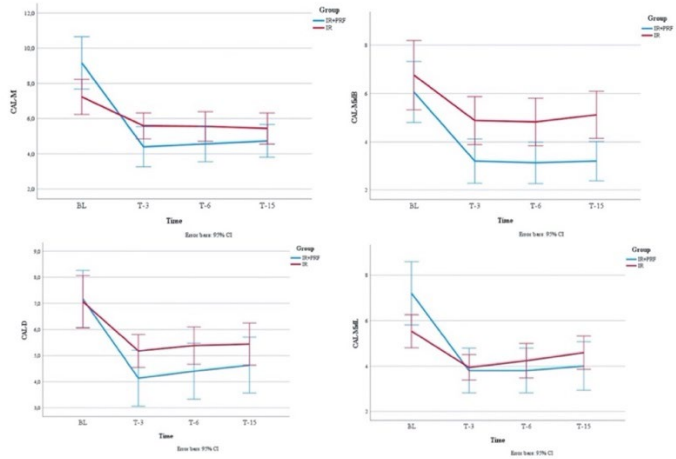


Figure 4. *Time-dependent change of clinical attachment level.*

Changes in periodontal variables

PD and CAL changes for both groups are shown in Table 3. In the IR+PRF group, mean PD-M at T-3, T-6, and T-15 (p=0.003, p=0.019, and p=0.043) and PD-MidL at T-6 and T-15 (p=0.043 and p=0.017) showed a significantly greater reduction.

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CAL gain values at the mesial site (around 4 mm) and midlingual site (around 3 mm) in the IR+PRF group were significantly greater at T-3, T-6, and T-15 ($p<0.05$). Both groups showed similar KTH changes (around 0.4–0.8 mm) at all follow-up periods ($p>0.05$) (Table 3).

Table 3. *Periodontal variables changes.*

Variables	Time of assessment	IR+PRF (n=15)	IR (n=17)	p
PD change-M	T-3	3.23±1.59	1.53±1.40	**0.003**
	T-6	3.30±2.02	1.71±1.60	**0.019**
	T-15	3.13±2.05	1.77±1.60	**0.043**
PD change-MidB	T-3	2.07±1.62	1.59±1.84	0.444
	T-6	2.20±1.42	1.71±1.90	0.416
	T-15	2.20±1.47	1.53±1.88	0.274
PD change-D	T-3	0.97±1.14	0.47±0.65	0.152
	T-6	0.93±1.37	0.35±1.01	0.180
	T-15	0.97±1.42	0.35±1.09	0.177
PD change-MidL	T-3	2.67±2.32	1.29±1.65	0.061
	T-6	2.80±2.40	1.29±1.61	**0.043**
	T-15	2.60±2.13	1.00±1.41	**0.017**
CAL gain-M	T-3	4.77±2.46	1.65±1.48	**0.000**
	T-6	4.60±2.93	1.68±1.81	**0.002**
	T-15	4.43±2.98	1.79±1.8	**0.004**
CAL gain-MidB	T-3	2.87±1.73	1.88±2.09	0.160
	T-6	2.93±1.58	1.94±2.33	0.175
	T-15	2.87±1.69	1.65±2.12	0.084
CAL gain-D	T-3	3.03±1.88	1.88±1.90	0.096
	T-6	2.77±2.24	1.68±1.92	0.148
	T-15	2.53±2.18	1.62±1.89	0.212
CAL gain-MidL	T-3	3.40±2.77	1.59±1.54	**0.036**
	T-6	3.40±2.85	1.29±1.83	**0.017**

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	T-15	3.20±3.08	0.94±1.52	**0.018**
KTH change	T-3	0.47±1.41	0.76±2.02	0.636
	T-6	0.73±1.71	0.76±1.82	0.960
	T-15	0.80±1.61	0.65±1.69	0.796

PD: probing depth; CAL: clinical attachment level; KTH: keratinized tissue height; M: mesial; D: distal; MidB: midbuccal; MidL: midlingual; BL: baseline; T-3: 3 months; T-6: 6 months; T-15: 15 months postoperative.

Discussion

Although complications are common and the predictability of IR has been found to be lower than that of implant treatment (24), periodontally hopeless teeth can be managed with IR, achieving significant apical bone gain and pocket depth reduction without ankylosis or root resorption (3). In addition, the survival rate of periodontally hopeless teeth treated with IR has been reported to be around 88% (5). In the present study, 32 lower anterior periodontally hopeless teeth were successfully treated and followed for 15 months without ankylosis or root resorption. Thus, IR can be considered a viable alternative to implants for periodontally hopeless teeth due to advantages such as lower cost, less surgical trauma without additional bone augmentation, ease of cleaning, a natural emergence profile, and less technical sensitivity.

PRF enhances the healing of periodontal tissues by releasing growth factors, stimulating the proliferation of gingival fibroblasts, osteoblasts, cementoblasts, and PDL cells necessary for regeneration, and creating a 3D fibrin network that supports healing (25–27). PRF also contributes to extracellular matrix synthesis (27) and new cementum formation (28). The results of this study showed that using PRF had positive effects on periodontal parameters, especially in terms of PD reduction and CAL gain, supporting its role in enhancing the healing process. However, the number of studies noting its variable contributions to regenerative therapy is not small (29). Due to the lack of in vitro or in vivo studies examining the effect of PRF specifically on IR healing, the possible mechanisms should be interpreted using insights from intra-bony defect models. Although PRF has potential to promote new ligament, cementum, and bone formation through mechanisms such as cell proliferation, differentiation, increased matrix synthesis, and vascularization, it does not function as a true regenerative barrier membrane due to its relatively short resorption period (10 to 21 days) (30), which limits its regenerative potential. Although greater CAL gain was achieved in the PRF-applied group, it remains controversial whether this gain represents true new attachment — a key indicator of periodontal

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regeneration — and it should be validated by further animal studies to distinguish ankylosis, root resorption, or long junctional epithelium from new bone, cementum, and PDL formation.

Although postoperative ankylosis and replacement resorption are common, especially within the first year following IR (31), no ankylosis or surface resorption was observed during the 15-month follow-up in the present study. The use of MTA for retrograde sealing and TS-HCl for root conditioning may have contributed to this outcome. Studies have reported that MTA improves the repair of replanted teeth by reducing surface resorption and promoting mineralized tissue formation in the periapical region (32, 33). TS helps inhibit collagenase activity in the early stages of healing (5) and its antimicrobial effects reduce the frequency of ankylosis in replanted teeth by removing microorganisms from the root surface (34). PRF use in regenerative endodontic procedures has been shown to result in root development, apical foramen size reduction, and periapical lesion repair (35). In a case report, IR yielded successful and stable outcomes two years after treatment of an upper second premolar using MTA and PRF (16). Although no clear clinical superiority was recorded for the IR+PRF group in this study, PRF may have contributed to the prevention of root resorption or ankylosis, which should be confirmed by histological evaluation. Based on the relevant literature (3, 36), a TS concentration of 100 mg/ml was selected in this study, with successful outcomes and no side effects. However, the biological interaction between TS and PRF in IR treatment is not yet fully understood and should be further investigated. In this context, the present study could have benefited from including an additional group treated with IR without TS to better clarify their potential interaction.

Splinting, which plays a vital role in IR treatment by preventing avulsion, malalignment, or tissue inflammation, may also inhibit PDL regeneration and increase the risk of permanent ankylosis (37). In addition to patient discomfort and daily cleaning challenges, splint removal after a sufficient healing period is recommended. However, the ideal timing for removal remains controversial. Considering the minimum time required for bone formation and mineralization, as well as the risk of tooth avulsion or fracture due to early removal, splints in this study were removed at six months to ensure patient comfort, ease of cleaning, and tooth survival without adjacent support.

The choice of biomaterial used around the replantation site is another factor that remains to be clarified. Bone grafts may improve outcomes due to their osteoconductive and/or

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osteoinductive properties (38), while membranes help maintain space and allow slow-migrating osteogenic cells to reach the defect (39). Ryana *et al.* (15) replanted a periodontally hopeless upper incisor with simultaneous application of PRF, xenograft, and type 1 collagen membrane to the bone defect and reported successful clinical and radiographic results without ankylosis at one-year follow-up. However, in this study, grafts were not used due to their long resorption time, which might impede PDL formation. Additionally, the risk of particle mobilization, especially in the apical region without supporting bone, could lead to undesirable fibrous encapsulation. Instead, alternative bioactive materials such as enamel matrix derivatives, which demonstrate regenerative potential by stimulating the secretion or activation of growth factors and bone morphogenetic proteins (40), may be recommended. Baltacioglu *et al.* (17) replanted 12 periodontally hopeless teeth in combination with enamel matrix derivatives and reported successful results after 12 months of follow-up. In the present study, PRF was used as an adjunct to IR and yielded comparable outcomes to the studies mentioned above. Considering its lower cost and regenerative potential, PRF may be preferred as an effective bioactive material in IR treatment.

Although positive changes can be tracked using mean values of periodontal parameters, they do not fully represent the resolution or persistence of the problem at every surface of the treated teeth. For example, significant improvements in buccal and lingual regions can mask negative changes in the proximal region, or vice versa. Given the differences in baseline PD and CAL values between proximal and buccal/lingual sites, it was preferred to examine the patterns of change in these regions separately.

Clinical parameters were measured by a clinician who underwent an intra-examiner calibration process before recording measurements. However, no additional calibration or training was applied to maintain consistency across time points, which might have introduced a risk of measurement error. Although this may not have affected the intergroup comparisons, it could limit the comparability of the results with the existing literature. The retrospective design is another limitation, and the lack of randomization or blinding may also have introduced bias into the findings.

Conclusion

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IR combined with PRF can be considered for the treatment of periodontally hopeless mandibular anterior teeth, as it may provide improved clinical outcomes. However, there is a strong need for additional clinical and histological studies to clarify the underlying mechanisms. Therefore, IR with PRF should not be widely promoted in dental treatment until its healing dynamics are better understood.

Türkçe öz: *Trombositten zengin fibrin periodontal olarak umutsuz dişlerin tedavisinde replantasyonun klinik sonuçlarını iyileştirir mi? Amaç: Bu çalışmanın amacı, replantasyon (R) tedavisinde trombositten zengin fibrin (TZF) kullanımının klinik parametreler üzerine etkisini değerlendirmektir. Gereç ve yöntem: Çalışmaya dahil edilen veriler, R (n=17) veya R+TZF (n=15) uygulanan ve 15 aylık takip tedavisini içeren 32 alt ön dişten elde edildi. Sondlama derinliği (SD), klinik ataçman seviyesi (KAS), plak indeksi (PI), gingival indeks (GI) ve keratinize doku yüksekliğini (KTH) içeren periodontal parametreler retrospektif olarak değerlendirildi. Bulgular: 15 aylık takipte mezial ve midlingual bölgelerdeki SD azalması R+TZF grubunda daha fazlaydı (sırasıyla p=0,043 ve p=0,017) ve R+TZF grubunda KAS kazanımı 3., 6. ve 15. aylarda anlamlı derecede daha yüksekti (p<0,05). GI skorları her iki grupta da benzerdi, PI skorları ise R grubunda 6. ve 15. aylarda daha yüksekti (p<0,05). KTH değişimi her iki grupta da tüm takip dönemlerinde benzerdi. Sonuç: Periodontal olarak umutsuz alt ön dişlerin tedavisinde replantasyon tercih edilebilir ve TZF ile kombinasyonu klinik sonuçları iyileştirebilir. Ancak TZF'in replantasyon iyileşmesi üzerindeki etkilerine ilişkin histolojik veri eksikliği nedeniyle klinik kullanımı dikkatle önerilmelidir. Anahtar kelimeler: Trombositten zengin fibrin, diş kaybı, replantasyon, periodontal hastalıklar, alveol kemik kaybı*

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Ethics Committee Approval: Ethical approval was obtained from the Hacettepe University Ethics Committee (GO 18/544-29).

Informed Consent: Participants provided informed consent.

Peer-review: Externally peer-reviewed.

Author contributions: OU, OD, HGK participated in designing the study. HMP participated in generating the data for the study. OD participated in gathering the data for the study. AP participated in the analysis of the data. HMP wrote the majority of the original draft of the paper. HGK participated in writing the paper. HMP, HGK has had access to all of the raw data of the study. HMP has reviewed the pertinent raw data on which the results and conclusions of this study are based. HMP, AP, OU, OD, HGK have approved the final version of this paper. HGK guarantees that all individuals who meet the Journal's authorship criteria are included as authors of this paper.

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