AJDS LAZHAR Al-Azhar Journal of Dental Science
Vol. 26- No. 3- 345:353- July 2023
Print ISSN 1110-6751 | online ISSN 2682 - 3314
https://ajdsm.journals.ekb.eg
Oral Biology, Medicine & Surgical Sciences Issue *(Oral Biology, Oral Pathology, Oral Periodontology, Medicine, Oral & Maxillofacial Surgery)*

EVALUATION OF CLINICAL EFFECT OF TITANIUM-PREPARED PLATELET-RICH FIBRIN AND PLATELET- RICH FIBRIN IN TREATMENT OF GINGIVAL RECESSION

Ibrahim Abdallah El-Sayed Hassouna [1*], Hazem Mohamed Mandor [2], Mahmoud Taha Eldestawy [3]

ABSTRACT

Objectives: The aim of the study is to evaluate the effectiveness of titanium prepared platelet rich fibrin (TPRF) for treatment of gingival recession and comparing it to platelet rich fibrin (PRF). **Subjects and methods**: This study was conducted on subjects having multiple gingival recession. Twenty-four patients of both sexes, aged between (23-41) and having miller class I, II were selected to participate in the present study. Subjects were randomly divided into two equal groups with coin toss method. The plaque index, gingival index, Periodontal pocket depth, Recession width, Recession depth, Clinical attachment level, Keratinized tissue width, keratinized gingival mucosa, Gingival thickness, T-TRF membrane thickness, and VAS were measured. **Results**: At 6 and 9 months: there was a statistically significant difference in mean RD in the two groups. T. PRF group showed a less mean RD, RW, and KTW than PRF group. At 9 months: T. PRF group showed a significant higher mean GT than PRF group. At day 3 and 7: T. PRF group showed a significant lower mean VAS than PRF group. **Conclusion:** In conclusion Within the limits of this study, the results demonstrated that T-PRF procedure is a safe, effective method in treating gingival recessions. In addition, this procedure can be recommended to treat localized or multiple-adjacent gingival recessions without additional surgery. However, future randomized clinical trials with a split-mouth design and larger sample size are essential for evaluating the TPRF efficiency in gingival recession treatment modalities.

KEY WORDS: Gingival recession, titanium-prepared platelet-rich fibrin, Recession width, Recession depth, Keratinized tissue width, Gingival thickness, T-TRF membrane thickness.

INTRODUCTION

Gingival recession (GR) is defined as gingival marginal tissue displacement apical to the cementoenamel junction (CEJ) [(1)]. Recession can be isolated or multiple. First line of treatment includes removal of the etiological factors followed by surgical intervention [(2)].

Several periodontal plastic surgical procedures have been proposed for the treatment[(3)]. The most reliable method is Coronally advanced flap (CAF) aiming for complete root coverage (CRC) of isolated GR defect. However, still this method does not show evidence for coverage of multiple recession defects (MRD) [(4)].

1. Masters Candidate, Dentist, Ministry of Health
2. Professor, Department of Oral Medicine, Periodontology, Oral Diagnosis and Radiology Faculty of Dental Medicine, Boys, Cairo Al-Azhar University.
3. Associate Professor, Department of Oral Medicine, Periodontology, Oral Diagnosis and Radiology Faculty of Dental Medicine, Boys, Cairo Al-Azhar University.

• ***Corresponding author*:** ebrahassouna@gmail.com

DOI: *10.21608/ajdsm.2021.95382.1241*

MRD can be treated by connective tissue graft (CTG)[5], guided tissue regeneration membrane[6]. Derived enamel matrix [7], dermal acellular matrix[8], platelet-rich plasma, and platelet-rich fibrous membrane (PRF). (4) Despite the many surgical methods used to treat GR, CTG is considered to be the gold standard compared to other grafts and methods available[9,10]. This type of graft is entirely autogenous, enhances soft tissue thickness and keratinized tissue width and covers gingival recession[11,12]. On the other hand, the use of CTG in the treatment of multiple large gingival recessions may face some problems such as the amount of CTG may be inadequate, be of insufficient thickness and followed by bleeding and so refused by the patients[13-15].

Other adjunctive method for treatment of GR Concentrated blood products, platelet-rich plasma and platelet-rich fibrin (PRF) was considered and preferred for stabilizing and revascularizing flaps and grafts because of the growth factor they contain. [16] In 2001, chukron developed the second generation of PRF and did so in full Autogenic and does not require the addition of anticoagulants or other foreign bodies substance [17].

PRF, which occurs via natural coagulation and contains leukocytes, has been referred as leukocytes platelets-rich fibrin (L-PRF) owing to its leukocyte content [18]. L-PRF can be used as a membrane [19-28,29] and believed to be important to achieve the clinical success of the graft material because it leads to a more limited inflammatory response at the surgery site compared with a connective tissue graft.

In contrast, it has been mentioned that L-PRF may have some limitations when used for treatment of gingival recession. The short duration of intra-tissue resorption of PRF is approximately 7-11 days, and not offering additional advantage over coronal positional flap when used as a single layer membrane [20, 30]

Moreover, the blood sample drown from each patient and activated by silica for fibrin formation. Some researchers speculated that, silica particles serve as a catalyst only and may have an unfavorable effect on the patient even if they are not included in the material [31].

Therefore, Titanium-prepared platelet-rich fibrin (T-PRF) was developed to treat the limitations of L-PRF. T-PRF has a more compact and thicker fibrin network than LPRF. Such a compact fibrin structure can play an important role in prolonging intra-tissue fibrin resorption and in releasing growth factors in a drop-by-drop manner over a longer period aiming to improve the wound healing and enhancing tissue regeneration [32-34]. The aim of the study is to evaluate the effectiveness of titanium prepared platelet rich fibrin (T-PRF) for treatment of gingival recession and comparing it to platelet rich fibrin (PRF).

SUBJECTS AND METHODS

Study design: This study is set to be a randomized clinical trial study.

Subjects: This study was conducted on subjects having gingival recession. Twenty-four patients of both sexes, aged between (23-41) years old, and having miller class I, II recession defects were selected to participate in the present study. They were selected from those attending the outpatient clinic of Oral medicine, periodontology, Diagnosis and Oral Radiology Department, Faculty of Dental Medicine (Boys-Cairo) Al-Azhar University. The patients were selected on the basis of inclusion and exclusion criteria

Inclusion criteria:

1. Having multiple gingival recessions, including at least two adjacent Miller class I or II teeth among mandibular or maxillary incisors and premolars. Molars are excluded.
2. Periodontal condition profitable for the surgical treatment of defects of the receding gingiva in the form of a vestibule of sufficient depth and an area of the existing keratinized gingiva

3. Absence of systemic disease likely to interfere with periodontal surgery or impair wound healing.
4. Avoid receiving any medication that is likely to cause gingival enlargement.
5. Do not smoke or smoke less than five cigarettes a day.
6. The treated teeth are considered vital without restoration or caries in the tooth neck and with enamel cement boundaries that can be fully or partially fixed.
7. The associated teeth in the arch are free from rotation when immobile
8. The teeth have no occlusal trauma. Patients over 18 years of age.
9. The teeth had no occlusal trauma; and the patients are older than 18 years of age.

Exclusion criteria:

1. Heavy smokers
2. Parafunctional habits
3. Badly decayed teeth
4. Presence of oral periodontal infection Patient grouping:

Subjects were randomly divided into two equal groups with coin toss method. Group I: defects received treatment with tunnel technique with PRF membrane placement in the defects. Group II: defects received treatment with tunnel technique with T-PRF membrane placement in the defect (Figure (1).

Evaluation

Clinical evaluation:

The plaque index, gingival index, Periodontal pocket depth, Recession width, Recession depth, Clinical attachment level, Keratinized tissue width, Gingival thickness, T-TRF membrane thickness, and VAS were measured.

Statistical analysis of the data:

Data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level. The used tests were Student t-test, Mann Whitney test, ANOVA with repeated measures, Friedman test.

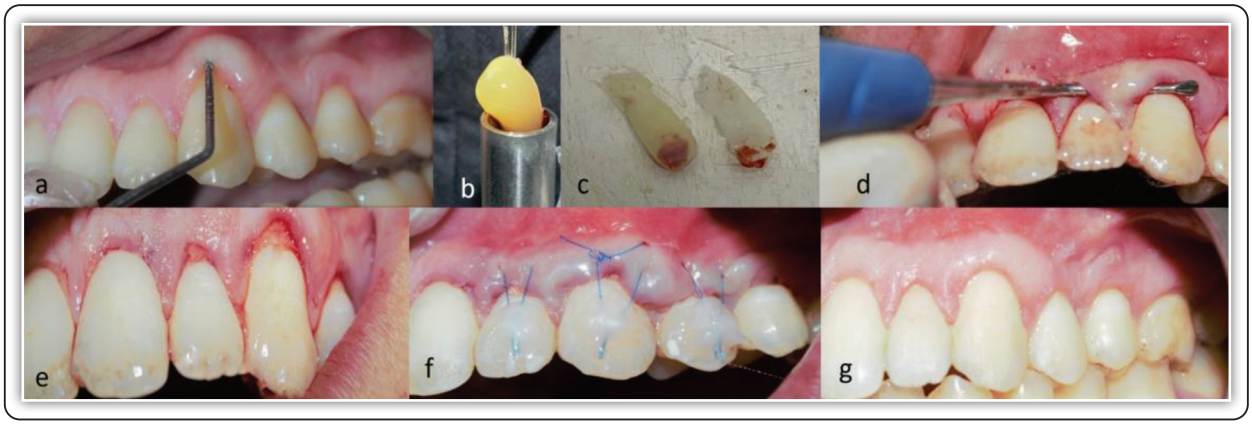

FIG (1) a, Initial situation recession present in lateral incisor and canine and first and second premolar tooth, b, T-PRF clot prepared, c, T-PRF membrane prepared with the help of PRF box, d, Tunnel prepared, e, T-PRF membrane seated in its bed, f, Modified anchorage suture with composite fixation, and g, 9 months follow up picture.

RESULTS

At Baseline, 6, and 9 months: there was a statistically non-significant difference in mean GI in the two groups. At 3 months: there was a statistically significant difference in mean GI in the two groups. T. PRF group showed a less mean GI than PRF group. At Baseline: there was a statistically nonsignificant difference in mean PD and CAL in the two groups. At 3, 6, and 9 months: there was a statistically significant difference in mean PD in the two groups. T. PRF group showed a less mean PD and CAL than PRF group.

TABLE (1) Comparison between the two studied groups according to GI, PD, and CAL.

	T. PRF (n = 20)	PRF (n = 20)	p
GI			
Baseline	1.0 ± 0.0	0.80 ± 0.41	0.289
3 months	1.0 ± 0.0	1.40 ± 0.50	0.030*
6 months	1.0 ± 0.0	1.20 ± 0.77	0.289
9 months	1.0 ± 0.0	1.0 ± 0.0	1.000
PD			
Baseline	1.90 ± 0.31	1.95 ± 0.51	0.688
3 months	1.90 ± 0.31	2.37 ± 0.49	0.001*
6 months	1.77 ± 0.34	2.27 ± 0.50	0.001*
9 months	1.73 ± 0.40	2.27 ± 0.50	0.001*
CAL			
Baseline	3.85 ± 0.89	4.30 ± 0.77	0.095
3 months	2.0 ± 0.0	2.30 ± 0.47	0.010*
6 months	1.73 ± 0.47	2.10 ± 0.55	0.029*
9 months	1.84 ± 0.53	2.58 ± 0.64	<0.001*

p: p value for comparing between the studied groups

**: Statistically significant at p ≤ 0.05*

At Baseline and 3 months: there was a statistically non-significant difference in mean RD in the two groups. At 6 and 9 months: there was a statistically significant difference in mean RD in the two groups. T. PRF group showed a less mean RD than PRF group.

At Baseline 3, 6, and 9 months: there was a statistically non-significant difference in mean RW in the two groups. T. PRF group showed a nonsignificant less mean RW than PRF group.

At Baseline 3, 6, and 9 months: there was a statistically non-significant difference in mean KTW in the two groups. T. PRF group showed a nonsignificant less mean KTW than PRF group.

At Baseline 3, and 6 months: there was a statistically non-significant difference in mean GT in the two groups. At 9 months: there was a statistically non-significant difference in mean GT in the two groups. T. PRF group showed a significant higher mean GT than PRF group.

At day 1: there was a statistically nonsignificant difference in mean VAS in the two groups. At day 3 and 7: there was a statistically significant difference in mean VAS in the two groups. T. PRF group showed a significant lower mean VAS than PRF group.

TABLE (2) Comparison between the two studied groups according to RD, RW, KTW, GT, and VAS.

	T. PRF (n = 20)	PRF (n = 20)	p
RD			
Baseline	1.85 ± 0.89	1.90 ± 0.50	0.640
3 months	0.0 ± 0.0	0.0 ± 0.0	1.000
6 months	0.0 ± 0.0	0.25 ± 0.0	<0.001*
9 months	0.17 ± 0.19	0.38 ± 0.26	0.023*
RW			
Baseline	4.30 ± 0.80	4.20 ± 0.77	0.678
3 months	0.0 ± 0.0	0.0 ± 0.0	1.000

	T. PRF (n = 20)	PRF (n = 20)	p
6 months	0.25 ± 0.0	0.25 ± 0.0	1.000
9 months	1.60 ± 1.90	2.40 ± 1.79	0.201
KTW			
Baseline	4.40 ± 1.05	4.70 ± 0.66	0.286
3 months	4.90 ± 1.02	5.33 ± 0.88	0.161
6 months	5.24 ± 1.18	5.74 ± 0.87	0.135
9 months	5.23 ± 1.17	5.47 ± 0.82	0.448
GT			
Baseline	1.24 ± 0.15	1.28 ± 0.08	0.306
3 months	1.37 ± 0.12	1.36 ± 0.08	0.653
6 months	1.52 ± 0.13	1.45 ± 0.10	0.067
9 months	1.46 ± 0.14	1.37 ± 0.08	0.031*
VAS			
Day 1	6.0 ± 1.03	5.50 ± 0.51	0.059
Day 3	2.50 ± 0.51	3.50 ± 0.51	<0.001*
Day 7	0.50 ± 0.51	1.0 ± 0.0	<0.001*
Day 14	0.0 ± 0.0	0.0 ± 0.0	–

p: p value for comparing between the studied groups

**: Statistically significant at p ≤ 0.05*

DISCUSSION

Gingival recession is an apical migration of gingival margin, leading to exposure of root surface or unaesthetic elongation of the tooth, usually presents in a localized or generalized form. Despite many surgical approaches to treating receding gingiva, connective tissue grafting (CTG) is considered the gold standard [35]. This type of graft is completely autologous, improving the thickness of the soft tissue and the width of the keratinized tissue, and covering the gingival recession [36,37]. However, the amount of CTG may be inadequate, not thick enough in those with thin palates, or cause necrosis or disintegration of the donor area. In addition, profuse bleeding and pain may occur in the patient's roof after an operation [38]. Platelet-rich fibrin (PRF) is preferred for stabilizing and revascularizing flaps and grafts because of the growth factors it contains [39,40]. The current study was designed to evaluate the effectiveness of platelet-rich fibrin (T-PRF) made from titanium for treating gingival recession and compare it to platelet-rich fibrin (PRF).

In this study we used platelet rich fibrin (TPRF) made from titanium. The T-PRF process is based on the hypothesis that titanium may be more effective in activating blood platelets than the silicon dioxide doping used on glass tubes in the platelet-rich fibrin (PRF) process. The T-PRF samples appear to have a highly organized network with continuous integration compared to other PRFs. Platelet rich fibrin (T-PRF) made from titanium was developed to remove the limitations of PRF. The histological analysis showed that the T-PRF-fibrin network covers a larger area than the PRF-fibrin network; In addition, fibrin appeared to be thicker in T-PRF [41]. This compact fibrin structure plays an important role in the prolongation of fibrin resorption in the tissue and in the drop-wise release of growth factors over a longer period of time [42-44].

In the present study, Since PRF has previously shown promising results, the present study considered it as the standard (control) and compared it with T-PRF. Due to the limited number of studies reporting the use of T-PRF, it was used in the present study as a novel biomaterial in the treatment gingival recession.

In the present study, the gingival index (GI), was assessed. T. PRF group showed a less mean GI, than PRF group at 3month, and insignificant at 6, and 9-month. This is consistent with Chatterjee et al, [45] Chacko et al, [46] and Mitra, et al., [47] who showed a significant decrease in PI and GI values during a 9-month follow-up period for intra-group comparisons and a non-significant reduction in inter-group comparisons. This can be interpreted

as useful; repeated removal of plaque biofilm as well as oral hygiene maintenance by the patients contributed to a proper environment for healing and decreasing gingival inflammation. Thus, it is expected that wound healing occurs uneventfully only when patients maintain good oral hygiene [48].

In the present study, probing depth (PD) was assessed. T. PRF group and PRF group showed statistically significant decrease in mean PPD at 6,9 months. The comparing between both groups showed statistically non-significant reduction in PPD. This was consistent with Chatterjee et al, [45] and Patel et al,[49]. Thus, PRF (both T-PRF and L-PRF) serves as a reservoir for growth factors and cytokines, which decrease the levels of matrix metalloproteinase-8 and interleukin-1β and increase tissue inhibitors of matrix metalloproteinase-1 levels, resulting in periodontal soft tissue healing[50]. Moreover, PRF also helps prevent the migration of epithelial cells [51].

In the present study, clinical attachment level (CAL) was assessed. Both groups showed statistically significant reduction in CAL occurs during follow up periods than that present at base line. The comparison between both groups showed that this reduction was a non-statistically significant. PRF has been suggested to accelerate soft tissue healing due to their own growth factors in addition to the fibrin network structure. The current results were consistent with Chatterjee et al [45], and Mitra et al[47] who mentioned that this gain in CAL reflects the proper wound healing in the presence of T-PRF and PRF. Thus, CAL is considered as an endpoint of regenerative attempts around natural dentition in different regenerative studies [52,53].

Regarding this, a systematic review conducted by Trombelli et al[54] reached to conclude that specific biomaterials, such as bone grafts, GTR, growth factors, and platelet concentrates, able to improve the CAL levels in intra-bony defects. However, in the present study, PRF showed a moderate CAL gain, which was much higher than that reported by Patel et al., [49] who carried out a 12-month postoperative follow-up. This might be due to a higher clinical attachment loss recorded at baseline, resulting in a better gain in CAL values during the follow-up period in the present study.

The present study also showed that there was a statistically significant reduction in RD in the two groups at 6 and 9 months of follow up. On the other hand, the comparing at baseline 3,6, and 9 months between both groups manifested a statistically nonsignificant reduction observed between both groups in mean RW. T. PRF group showed a nonsignificant less mean RW than PRF group. In agreement with our results, Uzun et al., [55] 2018 found that Gingival recession depth and width decreased significantly at 6- and 12-months post-surgery in both groups.

Gingival thickness significantly increased at 9 months post-surgery versus the baseline values in both groups. Although at 9 months: this increase showed statistically non-significant difference in mean GT between both groups. T. PRF group showed a significant higher GT value than PRF group.

In agreement with the current results obtained, Tunalı et al., [56,57] Chatterjee et al., [58] they stated that, T-PRF samples seemed to have a highly organized network with continuous integrity compared to the other PRF, supporting by the Histomorphometry analysis done which showed that T-PRF fibrin network covers larger area than PRF fibrin network; also, fibrin seemed to be thicker in the T-PRF samples. They also concluded that T-PRF membrane has a better fibrin meshwork and cellular entrapment than PRF which is essential for the stimulation of periodontal cells leading to a proper wound healing. Moreover, titanium able to passivates itself into titanium dioxide and helps in the formation of a T-PRF clot.

Regarding to the KTW, the current study showed that there is statistically significant increase at 3,6 month and decrease at 9 months in both groups. But the comparison between both groups in term of KTW showed statistically a non-significant difference. In agreement with our results, Uzun et al., [55] compared the effects of autogenous T-PRF and connective tissue graft (CTG). the mean amounts of KTW increased by 1.97 and 0.75 mm in the T-PRF and CTG groups, respectively. Within the limits of this study, the results demonstrated that T-PRF is safe and effective for treatment of multiple Miller Class I/II gingival recession defects.

Pain assessment was performed with the Visual analogue scale (VAS) (0-10). In this method, patients were asked to question the pain as a score between 0 (no pain) and 10 (the most severe pain in my life). The VAS scores decreased gradually in all groups. At day 1: there was a statistically non-significant difference in mean VAS in the two groups. At day 3 and 7: there was a statistically significant difference in mean VAS in the two groups. T. PRF group showed a significant lower mean VAS than PRF group. T-PRF was superior to the control in terms VAS scores. In agreement, Previous studies demonstrated that inflammation occurs less frequently in the regions treated with T-PRF, and wound healing and patient comfort were better in the fibrin groups [44, 55].

CONCLUSION

Within the limits of this study, the results demonstrated that T-PRF procedure is a safe, effective method in treating gingival recessions. In addition, this procedure can be recommended to treat multiple adjacent gingival recessions without additional surgery. However, future randomized clinical trials with a split-mouth design and larger sample size are essential for evaluating the T-PRF efficiency in gingival recession treatment modalities.

REFERENCES

1. Glossary of periodontal terms. American academy of periodontology. 4th edition. 2001. P. 44.
2. Chan H, Chun Y, MacEachern M, Oates T. Does gingival recession require surgical treatment? Dent Clin North Am. 2015; 59:981–96.
3. Chambrone L, Sukekava F, Araújo MG, Pustiglioni F, Lima L. Root-coverage procedures for the treatment of localized recession-type defects: A Cochrane systematic review. J Periodontol 2010; 81:452–78.
4. Aroca S, Keglevich T, Barbieri B, Gera I, Etienne D. Clinical evaluation of a modified coronally advanced flap alone or in combination with a platelet-rich fibrin membrane for the treatment of adjacent multiple gingival recessions: A 6-month study. J Periodontol.2009; 80:244–52.
5. Chambrone L. Subepithelial connective tissue grafts in the treatment of multiple recession-type defects. J Periodontol.2006; 77:909–16.
6. Zadeh H. Minimally invasive treatment of maxillary anterior gingival recession defects by vestibular incision subperiosteal tunnel access and platelet-derived growth factor BB. Int J Periodontics Restorative Dent. 2011; 31:653–60.
7. Aroca S, Keglevich T, Nikolidakis D, Gera I, Nagy K, Azzi R, et al. Treatment of class III multiple gingival recessions: A randomized-clinical trial. J Clin Periodontol.2010; 37:88–97.
8. Modaressi M, Wang H. Tunneling procedure for root coverage using acellular dermal matrix: A case series. Int J Periodontics Restorative Dent. (2009); 29:395–403.
9. Roccuzzo M, Bunino M, Needleman, sanz M. Periodontal plastic surgery for treatment of localized gingival recessions: a systematic review. J Clin Periodontol 29(Suppl 3)2002; 178–94.
10. Chambrone L, Chambrone D, Pustiglioni
11. F, Lima L. Can subepithelial connective tissue grafts be considered the gold standard procedure in the treatment of Miller Class I and II recession type defects? J Dent 2008; 36:659–71.
12. Rebele S, Zuhr O, Schneider D, Jung R, Hürzeler M. Tunnel technique with connective tissue graft versus coronally advanced flap with enamel matrix derivative for root coverage: a RCT using 3D digital measuring methods. Part II. Volumetric studies on healing dynamics and gingival dimensions. J ClinPeriodontol 2014; 41:593– 603.
13. Zucchelli G, Mounssif I, Mazzotti C. Coronally advanced flap with and without connective tissue graft for the

treatment of multiple gingival recessions: a comparative short- and long-term controlled randomized clinical trial. J Clin Periodontol 2014; 41:396– 403.

14. Harris R, Miller R, Miller L. Complications with surgical procedures utilizing connective tissue grafts: a follow-up of 500 consecutively treated cases. Int J Periodontics Restorative Dent 2005; 25(5):449–59.
15. Zucchelli G, Mele M, Stefanini M. Patient morbidity and root coverage outcome after subepithelial connective tissue and deepithelialized grafts: a comparative randomized-controlled clinical trial. J Clin Periodontol 2010; 37:728–38.
16. Zucchelli G, Mounssif I, Mazzotti C. Does the dimension of the graft influence patient morbidity and root coverage outcomes? A randomized controlled clinical trial. J Clin Periodontol 2014; 41(7):708–16.
17. Petrungaro P Using platelet-rich plasma to accelerate soft tissue maturation in esthetic periodontal surgery. CompendContinEduc Dent2001; 22(9):729–32.
18. Choukroun J, Adda F, Schoeffler C, Vervelle A Uneopportunité en paroimplantologie: le PRF. Implantodontie2001; 42:55–62.
19. Dohan Ehrenfest D, Rasmusson L, Albrektsson T Classification of platelet concentrates: from pure platelet-rich plasma (P-PRP) to leucocyte- and platelet-rich fibrin (L-PRF). Trends Biotechnol 2009; 27:158– 67.
20. Aroca S, Keglevich T, Barbieri B. Clinical evaluation of a modified coronally advanced flap alone or in combination with a platelet rich fibrin membrane for the treatment of adjacent multiple gingival recessions: a 6month study. J Periodontol 2009; 80:244–52. 20. Del Corso M, Sammartino G, Dohan Ehrenfest D. Clinical evaluation of a modified coronally advanced flap alone or in combination with a platelet-rich fibrin membrane for the treatment of adjacent multiple gingival recessions: a 6-month study. J Periodontol 2009; 80(11):1694–97.
21. Jankovic S, Aleksic Z, Milinkovic I. The coronally advanced flap in combination with platelet-rich fibrin (PRF) and enamel matrix derivative in the treatment of gingival recession: a comparative study. Eur J Esthet Dent 2010; 5(3):260–73.
22. Jankovic S, Aleksic Z, Klokkevold P. Use of platelet-rich fibrin membrane following treatment of gingival recession: a randomized clinical trial. Int J Periodontics Restorative Dent 2012; 32(2):41–50.
23. Eren G, Atilla G Platelet-rich fibrin in the treatment of localized gingival recessions: a split-mouth randomized clinical trial. Clin Oral Investig 2014; 18(8):1941–48.
24. Gupta S, Banthia R, Singh P. Clinical evaluation and comparison of the efficacy of coronally advanced flap alone and in combination with platelet rich fibrin membrane in the treatment of Miller Class I and II gingival recessions. ContempClin Dent 2015; 6(2):153–60.
25. Keceli H, Kamak G, Erdemir E. The adjunctive effect of platelet-rich fibrin to connective tissue graft in the treatment of buccal recession defects: results of a randomized, parallel-group controlled trial. J Periodontol 2015; 86(11):1221–30.
26. Tunalı M, Özdemir H, Arabacı T. Clinical evaluation of autologous platelet-rich fibrin (L-PRF) in the treatment of multiple adjacent gingival recession defects: a 12-month study. Int J Periodontics Restorative Dent 2015; 35(1):105–14.
27. Uraz A, Sezgin Y, Yalim M. Comparative evaluation of platelet-rich fibrin membrane and connective tissue graft in the treatment of multiple adjacent recession defects: a clinical study. Journal of Dental Sciences 2015; 10(1):36–45.
28. Castro A, Meschi N, Temmerman A. Regenerative potential of leucocyte- and platelet-rich fibrin. Part A: intra-bony defects, furcation defects and periodontal plastic surgery. A systematic review and meta-analysis. J Clin Periodontal 2017; 44(1):67– 82.
29. Öncü E, Bayram B, Kantarci A. Positive effect of platelet rich fibrin on osseointegration. Med Oral Patol Oral Cir Bucal.2016; Sep 1 21(5): e601–e7.
30. Choukroun J, Diss A, Simonpieri A. Platelet rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. Oral Surg Oral RadiolEndod 2006; 101:56–60.
31. O'Connell SM Safety issues associated with platelet-rich fibrin method. Oral Surg Oral Med Oral Pathol Oral RadiolEndod2007; 103:587(author reply):587–93.
32. Tunali M, Ozdemir H, Kucukodacı Z. In vivo evaluation of titanium-prepared platelet rich fibrin (T-PRF): a new platelet concentrate. Br J Oral MaxillofacSurg2013; 51:438–43.
33. Tunali M, Ozdemir H, Kucukodacı Z. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. BioMed Research International Article ID 2014; 209-548.
34. Tunali M, Ozdemir H, Kucukodacı Z. A novel platelet concentrates for guided bone regeneration: Titanium Prepared Platelet-Rich Fibrin (T-PRF). Gulhane Med J 2015; 57:102–06.

35. Chambrone L, Chambrone D, Pustiglioni F et al Can subepithelial connective tissue grafts be considered the gold standard procedure in the treatment of Miller Class I and II recession type defects? J Dent (2008) 36:659–71

36. Rebele S, Zuhr O, Schneider D et al Tunnel technique with connective tissue graft versus coronally advanced flap with enamel matrix derivative for root coverage: a RCT using 3D digital measuring methods. Part II. Volumetric studies on healing dynamics and gingival dimensions. J Clin Periodontal (2014) 41:593–603

37. Zucchelli G, Mounssif I, Mazzotti C et al Coronally advanced flap with and without connective tissue graft for the treatment of multiple gingival recessions: a comparative short- and long-term controlled randomized clinical trial. J Clin Periodontol (2014) 41:396–403

38. Zucchelli G, Mounssif I, Mazzotti C et al Does the dimension of the graft influence patient morbidity and root coverage outcomes? A randomized controlled clinical trial. J Clin Periodontol(2014) 41(7):708–16

39. Tatakis DN, Chambrone L, Allen EP et al Periodontal soft tissue root coverage procedures: a consensus report from the AAP Regeneration Workshop. J Periodontal (2015) 86(2) Suppl):52–55

40. Petrungaro P Using platelet-rich plasma to accelerate soft tissue maturation in esthetic periodontal surgery. Compend Contin Educ Dent (2001) 22 (9):729–32

41. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Yaprak E, Toker H, Fıratlı E. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. Biomed Res Int. 2014; 2014:209548.

42. Tunali M, Ozdemir H, Kucukodacı Z et al In vivo evaluation of titaniumprepared platelet rich fibrin (T-PRF): a new platelet concentrate. Br J Oral Maxillofac Surg (2013) 51:438–43

43. Tunali M, Ozdemir H, Kucukodacı Z, et al. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. BioMed Research International Article (2014) ID 209548

44. Tunali M, Ozdemir H, Kucukodacı Z et al A novel platelet concentrate for guided bone regeneration: Titanium Prepared Platelet-Rich Fibrin (T-PRF). Gulhane Med J (2015) 57:102–6

45. Chatterjee A, Pradeep A, Garg V, Yajamanya S, Ali M, Priya V. Treatment of periodontal intrabony defects using autologous platelet-rich fibrin and titanium platelet-rich fibrin: a randomized, clinical, comparative study. J Investig Clin Dent. 2017;8(3): e12231-e6.

46. Chacko NL, Abraham S, Rao HS, Sridhar N, Moon N, Barde DH. A clinical and radiographic evaluation of periodontal regenerative potential of PerioGlas®: a synthetic, resorbable material in treating periodontal infrabony defects. J Int Oral Health. 2014;6(3):20-6.

47. Mitra D, Potdar P, Prithyani S, Rodrigues S, Shetty G, Talati M. Comparative study using autologous plateletrich fibrin and titanium prepared platelet-rich fibrin in the treatment of infrabony defects: An in vitro and in vivo study. J Indian Soc Periodontol. 2019;23(6):554-61.

48. Rosling B, Nyman S, Lindhe J. The effect of systematic plaque control on bone regeneration in infrabony pockets. J Clin Periodontol. 1976;3(1):38-53.

49. Patel GK, Gaekwad SS, Gujjari SK. Platelet-rich fibrin in regeneration of intrabony defects: a randomized controlled trial. J Periodontol. 2017;88(11):1192-9.

50. Tsai C-H, Shen S-Y, Zhao J-H, Chang YC. Platelet-rich fibrin modulates cell proliferation of human periodontally related cells in vitro. J Dent Sci. 2009;4(3):130-5.

51. Marx R, Carlson E. Tissue banking safety: caveats and precautions for the oral and maxillofacial surgeon. J Oral Maxillofac Surg. 1993;51(12):1372-9.

52. Tonetti M, Pini-Prato G, Cortellini P. Periodontal regeneration of human intrabony defects. IV. Determinants of healing response. J Periodontol. 1993;64(10):934-40.

53. Snyder A, Levin M, Cutright D. Alloplastic implants of tricalcium phosphate ceramic in human periodontal osseous defects. J Periodontol. 1984;55(5):273-7.

54. Trombelli L, Heitz-Mayfield L, Needleman I, Moles D, Scabbia A. A systematic review of graft materials and biological agents for periodontal intraosseous defects. J Clin Periodontol. 2002;29 (s3):11735.

55. Uzun BC, Ercan E, Tunalı M. Effectiveness and predictability of titaniumprepared platelet-rich fibrin for the management of multiple gingival recessions. Clin Oral Investig. 2018 Apr;22(3):13451354.

56. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Yaprak E, Toker H, Fıratlı E. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. Biomed Res Int. 2014; 2014:209548.

57. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Fıratlı E. In vivo evaluation of titanium-prepared platelet-rich fibrin (TPRF): A new platelet concentrate. Br J Oral Maxillofac Surg. 2013; 51:438–43.

58. Chatterjee A, Debnath K, Ali M, Babu C, Gowda PL. Comparative histologic evaluation of titanium platelet-rich fibrin and platelet-rich fibrin in hypertensive and smoker participants: A cell cytology study. J Indian Soc Periodontol. 2017; 21:195–200.