

# Additional benefits of titanium platelet-rich fibrin (T-PRF) with a coronally advanced flap (CAF) for recession coverage: A case series

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## Abstract

**Background.** Platelet concentrates (PCs) are a boon in the field of dentistry. Various generations of PCs have been tried and utilized in different treatment methods, such as intrabony defect therapy, root coverage procedures, oral surgical procedures, and palatal wound healing. Titanium-prepared platelet-rich fibrin (T-PRF) is a third-generation PC that is prepared in medical-grade titanium tubes and achieves good healing in the field of periodontics.

**Objectives.** Not many studies have been performed utilizing T-PRF in the treatment of gingival recession (GR). The present case series study aimed to evaluate the efficacy of T-PRF in the treatment of Cairo's Type 1 GR defects.

**Material and methods.** A total of 20 patients with 34 Cairo's Type 1 GR defects were recruited. The surgical sites were treated using the trapezoidal coronally advanced flap (CAF) technique and T-PRF as a biomaterial underneath the flap. The plaque index (PI) and the gingival index (GI), recession depth (RD) and recession width (RW), as well as the width of keratinized tissue (WKT), were measured at baseline and 6 months postoperatively. The obtained values were subjected to statistical analysis. The values were presented as mean (*M*) and standard deviation (*SD*), the paired t test was performed to measure all the parameters, and a *p*-value <0.05 was considered to be statistically significant.

**Results.** The changes observed 6 months after the use of T-PRF were non-significant for PI (*p* = 0.053) and significant for GI (*p* = 0.016) as compared to the baseline. Significant reductions (*p* < 0.001) were noted for RD and RW, as well as a significant increase in WKT and a mean root coverage (MRC) of 91%.

**Conclusions.** Titanium-prepared platelet-rich fibrin can be used as a biomaterial for the treatment of GR defects, as it eliminates the possible silica contamination, as in the case of leukocyte-platelet-rich fibrin (L-PRF), and the need for a second surgical site, as with subepithelial connective tissue graft (SCTG). Moreover, the use of T-PRF results in a thicker membrane formation, and titanium tubes can be reused after proper sterilization.

**Keywords:** titanium, chronic periodontitis, gingival recession, platelet-rich fibrin

## Introduction

The recession of gingiva can be described as the migration of gingiva apically below the cemento-enamel junction (CEJ), causing the exposure of the root surface. It is always a tough task to treat and manage gingival recession (GR).<sup>1</sup> The main reason for the occurrence of GR may be faulty toothbrushing techniques causing trauma, poor oral hygiene causing plaque accumulation, gingival inflammation, and the anatomical variations of a buccally or labially placed tooth, where thinner buccal or labial bone causes GR.<sup>2</sup> Apart from these, the thickness of gingiva also plays a role; in thinner and scalloped tissue, higher chances of GR are reported.<sup>3</sup>

Various treatment modalities, such as free gingival graft (FGG),<sup>4</sup> coronally advanced flap (CAF), semilunar coronally positioned flap (SCPF),<sup>5</sup> subepithelial connective tissue graft (SCTG)<sup>6</sup> or a combination of CAF + SCTG, resorbable and non-resorbable membranes,<sup>7</sup> like amnion/chorion membranes and collagen membranes, and platelet concentrates (PCs),<sup>8</sup> like platelet-rich plasma (PRP), leukocyte-platelet-rich fibrin (L-PRF), advanced platelet-rich fibrin (A-PRF), and acellular dermal matrix (ADM) allograft<sup>9</sup> had been tried, and showed good long-term results regarding complete recession coverage and gain in the width of keratinized tissue (WKT). Yet later on, researchers used more conservative surgical techniques, like envelop flap, vestibular incision subperiosteal tunnel access (VISTA), modified VISTA, and combination approaches.<sup>10</sup> The modified coronally advanced tunnel (MCAT)<sup>11</sup> and laterally closed tunnel (LCT)<sup>12</sup> techniques are the recent advancements in soft tissue surgery for the treatment of multiple or single isolated deep GR sites, with good results being reported regarding recession coverage and improved clinical parameters.

The usage of biomaterials has improved the outcomes of recession coverage procedures. This statement is supported by a recent systematic review done by Chamberone et al.<sup>13</sup> The authors concluded that any biomaterial + CAF improved treatment outcomes in terms of complete root coverage, being comparable to CAF + SCTG, which is considered to be the gold standard in recession treatment.<sup>13</sup> Moreover, CAF alone would result in decreased postoperative root coverage percentage over time.<sup>14</sup> The abovementioned commercially available materials are very costly, and in this context, PCs are a boon to dentists, as they are readily available, easy to prepare, and they eliminate the second surgical site in SCTG procurement. Initially, PRP alone and in combination with SCTG or CAF were tried, but due to the drawbacks of PRP, such as the addition of an anticoagulant and hypersensitivity, L-PRF in combination with CAF were used, yielding increased WKT and full mean root coverage (MRC).<sup>15</sup> Later on, due to silica contamination through the glass test tubes and silica-coated Vacutainer<sup>®</sup> tubes used for the preparation of this PC, researchers again started search-

ing for a better biomaterial.<sup>16,17</sup> The search has resulted in the development of a third-generation PC called titanium-prepared platelet-rich fibrin (T-PRF).<sup>18</sup>

Titanium-prepared platelet-rich fibrin was introduced by Tunali et al. in 2013,<sup>18</sup> following a similar pattern of preparation of L-PRF given by Choukroun et al. in 2001.<sup>19</sup> Instead of glass tubes, medical-grade titanium tubes were used. Moreover, titanium has better hemocompatibility, activates platelets similarly to silica, and the tubes can be reused after proper sterilization and are unbreakable. Histological studies done by Chatterjee et al.<sup>20</sup> and Bhattacharya et al.<sup>21</sup> concluded that T-PRF showed a thicker membrane meshwork and better entrapment of cells, which might increase the regenerative capacity. Apart from this, T-PRF also has a greater percentage of platelets, monocytes and lymphocytes, and equal amounts of progenitor cells when compared with L-PRF.<sup>21</sup> Furthermore, the PC contains growth factors, like transforming growth factor beta (TGF- $\beta$ ), platelet-derived growth factor (PDGF), epidermal growth factor (EGF), and insulin-like growth factor (IGF), which accelerate the healing process and allow to achieve the required treatment outcomes.<sup>22</sup> A recent study done by Uzun et al. compared CAF + connective tissue graft (CTG) and CAF + T-PRF, and achieved good results in terms of recession coverage and gain in WKT in both cases.<sup>23</sup>

Since not many studies have been performed with the use of T-PRF, the present study aimed to evaluate the efficacy of T-PRF as a biomaterial along with conventional CAF in the treatment of Cairo's Type 1 GR defects.

## Material and methods

### Sample size calculation

The sample size was calculated using the G\*Power software, v. 3.1 (<https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower>). At a power of 80%, an effect size of 0.25 and an  $\alpha$ -value of 5%, a sample of 17 was sufficient to conduct the current research. For a better outcome, 34 recession sites were treated in the present study.

### Study design and patient enrollment

The present study is a prospective, single-centered, single-blinded case series. Patients were recruited from the outpatient clinic at the Department of Periodontology and Implantology of the Institute of Dental Sciences, Bareilly, India. Initially, 25 patients were examined for a study population, out of which 5 were eliminated, as 2 were not willing to participate and 3 did not meet the criteria for inclusion. Thus, a total of 20 systemically healthy patients (14 males and 6 females) with a mean age of  $30.3 \pm 10.11$  years and 34 Cairo's Type 1 GR sites<sup>24</sup> were recruited,

treated and followed up for 6 months in the present study. The research was approved by the Institutional Ethics Committee (IEC/IDS/152/2021), and informed consent was obtained from all patients prior to the commencement of the study. The study was performed from September 2020 to November 2020. Amidst the coronavirus disease 2019 (COVID-19) pandemic, all precautions were taken, with the proper sterilization of instruments and the operation theater area, and further self-protection of the operator and the patient. Pros and cons regarding the procedure were explained to the patients. The study was conducted in accordance with the 1975 Declaration of Helsinki, modified in 2008.

### Inclusion and exclusion criteria

The inclusion criteria comprised patients with an age range of 18–45 years, having Cairo Type 1 GR defects<sup>24</sup> in maxillary teeth (anterior and premolars) without mobility, who were systemically healthy, did not undergo any periodontal treatment within the last 6 months, and were not using any medications that would hamper healing. Furthermore, the eligible patients were those who visited the periodontist mainly because they were seeking treatment for their GR. Patients having pockets deeper than 3 mm, any malposition of the teeth that needed to be treated, any systemic illness, smokers, alcoholics, pregnant and lactating females, patients with a platelet count (PLT) < 2,000,000/mm<sup>3</sup>, patients with GR Type 2 or 3 of Cairo's classification, patients with any mobility in the teeth of concern, and patients with the absence of the adjacent teeth, where CAF could rest, were excluded from the study.

### Clinical parameters

The plaque index (PI),<sup>25</sup> the gingival index (GI)<sup>26</sup>, recession depth (RD), recession width (RW), and WKT were assessed at baseline and 6 months postoperatively, using the CP15 University of North Carolina probe (UNC-15) (Equinox Instruments Ltd, Lincoln, UK). While measuring, CEJ is taken as the guide, and if CEJ is not visible, the CEJ of the adjacent tooth is taken into account. Prior to making the final measurements of the main study, the examiner evaluated the readings of 5 random patients who were not included in the study within a gap of 72 h. If the variation between the values was  $\pm 1$ , then the final outcome values had an accuracy of 90%, and only the examiner was allowed to take measurements in the main study.<sup>27</sup> The mean root coverage percentage (MRC%) was calculated at the 6-month follow-up based on root coverage, using the following formula (Equation 1):

$$\text{MRC\%} = \frac{\text{preoperative RD} - \text{postoperative RD}}{\text{preoperative RD}} \times 100\% \quad (1)$$

where:

MRC% – mean root coverage percentage; and  
RD – recession depth.

Pain perception was recorded using a visual analog scale (VAS; a scoring range of 1 to 10) 24 h after surgery and on the 7<sup>th</sup> postoperative day.<sup>28</sup> These measurements were taken via the telephone by calling the patient. Due to the COVID-19 pandemic, recall visits were limited, and patients could be recalled only in emergency cases.

### Pre-surgical procedure

Patients who were willing to undergo surgery were considered, and the initial phase I therapy, which included scaling and root planing, was performed. Then, oral hygiene instructions (OHI) were provided, soft brushes were advocated and the modified Stillman's brushing technique was demonstrated to the patients. Upon re-evaluation after 6–8 weeks,<sup>29</sup> if the patient maintained the lower PI and GI scores ( $\leq 1$ ), they were qualified for the surgical procedure. Before surgery, routine blood investigations and COVID-19 reverse-transcription polymerase chain reaction (RT-PCR) tests were performed to rule out abnormalities.

### Preparation of T-PRF clots

Just 20 min before surgery, 10 mL of blood was drawn from the antecubital vein and directly transferred into sterile medical-grade titanium tubes (Supra Alloys, Camarillo, USA). The blood was subjected to centrifugation in a centrifuge machine (Remi R-8C; India MART, New Delhi, India) at 3,500 rotations per minute for 15 min.<sup>18</sup> Three layers were formed within the test tubes, with the top layer being the supernatant serum, the lower layer being the red blood cell suspension and the T-PRF clots in the middle layer. The clots were carefully retrieved by using sterile tweezers and compressed into a thin membrane by placing them in between sterile gauze pieces so that the excessive serum could be eliminated. The obtained membranes were placed at the recession sites.

### Surgical procedure

The extraoral and intraoral antiseptic procedures were performed using 0.5 w/v% povidone-iodine and 0.2% chlorhexidine gluconate (CHX; Rexidine®; Indoco Remedies Ltd., Mumbai, India), respectively. Before performing the surgical procedure, the baseline measurements were made by a blinded experienced periodontal surgeon (SSG), and the surgical procedure was performed by a different periodontist (SV). After the achievement of profound anesthesia (local infiltrations were administered at the surgical site by using 2% lidocaine hydrochloride with adrenaline 1:80,000), RD was measured where measurements were necessary for the horizontal

incisions (the distal and mesial line angles of the recession of the treated tooth/teeth) and the interdental papilla was spared. These horizontal incisions were then connected with sulcular incisions. The vertical releasing incisions (VRIs) were performed on both sides of the treated site and connected with the horizontal incisions without involving normal tooth/teeth. The incisions were made using a No. 15 blade. Thus, a trapezoidal flap was reflected and VRIs were helpful in the advancement of the flap. A full-thickness mucoperiosteal flap was reflected by using a periosteal elevator up to the mucogingival junction (MGJ), and a partial-thickness flap was reflected beyond MGJ into the alveolar mucosa. The flap was carefully repositioned coronally and checked for muscle tension or strain. If the flap was advanced without any tension, the root surface was carefully planed to remove any debris and calculus remnants so that a smooth surface was obtained. Later on, the abovementioned freshly prepared T-PRF membranes were placed onto the denuded surface. The flap was repositioned coronally and stabilized with a sling suture, and VRIs were approximated with simple interrupted sutures. A periodontal pack (Coe-Pack™; GC Asia Dental, Hyderabad, India) was placed to protect the treated area from any abnormalities of the tongue or muscle tissue and food particles. The patients were recalled after 14 days for suture removal. The type of suture material used in the present study was non-resorbable 4-0 silk sutures. The type of surgical technique employed in the present study was described by Zuchelli et al.<sup>30</sup>

### Post-surgical procedure

After the surgery, the patient was re-educated on strict oral hygiene principles, and medications were prescribed – amoxicillin 500 mg thrice daily for 5 days to prevent postoperative bacteremia, and diclofenac + paracetamol twice daily on the 1<sup>st</sup> day and whenever necessary from the 2<sup>nd</sup> day onward to the 5<sup>th</sup> day. A CHX mouthwash (Rexidine) was prescribed at 24 h of surgery twice daily for a period of 14 days. The patient was called via the telephone after 1 day (24 h) to assess the VAS score for postoperative pain. The VAS pain assessment was repeated on the 7<sup>th</sup> day, and after 14 days, the patient was recalled for suture removal. After that, irrigation with betadine and saline was performed, and the patient was again educated on oral hygiene principles and told to refrain from brushing the surgical area for an additional 2 weeks. During this time, a wet cotton pad dipped in a CHX solution was used to clean the surgical site from soft tissue to the crown side so that debris did not accumulate. The patient was given instructions for normal regular brushing with the use of the modified Bass technique 1 month after surgery. The patient remained in follow-up and was recalled after 6 months to study the condition and gather the postoperative measurements. Midterm recall visits were reduced because of the COVID-19 pandemic.

The procedures described above, as well as the follow-up, are illustrated in Fig. 1.



Fig. 1. Baseline (preoperative) recession (A), the incision design (B), the images of titanium tubes (C,D), the titanium-prepared platelet-rich fibrin (T-PRF) membrane (E), the reflection of the flap and the placement of the T-PRF membrane (F), suturing at the surgical site (G); the placement of Coe-Pack (H), 15 days post-op (I), and 6 months post-op (J)

### Statistical analysis

All the gathered data was transferred to a Microsoft Excel spreadsheet, and statistical analysis was carried out with the use of IBM SPSS Statistics for Windows, v. 22.0 (IBM Corp., Armonk, USA). All parameter values were presented as mean (*M*) and standard deviation (*SD*). The paired *t* test was performed to find significant differences in the PI, GI, RD, RW, and WKT values 6 months postoperatively with regard to baseline. The mean root coverage was expressed as percentage (%).

### Results

The mean age, gender distribution, the type of recession, and the number of teeth treated are depicted as demographic data (Table 1). Regarding PI, there was no significant difference between the baseline values and those recorded 6 months postoperatively ( $p = 0.053$ ),

Table 1. Demographic data of the study group

Demographic characteristics		Data
Age [years] <i>M</i> ± <i>SD</i>		30.3 ± 10.11
Gender <i>n</i> (%)	M	14 (70.0)
	F	6 (30.0)
Cairo's Type 1 GR		34
Number of maxillary anterior/premolar teeth		19/15

*M* – mean; *SD* – standard deviation; *n* – number; GR – gingival recession; M – male; F – female.

though a reduction was noticed. However, there was a statistically significant reduction in the GI values from baseline to 6 months postoperatively ( $p = 0.016$ ). There were highly significant reductions in RD and RW, whereas significant gain was reported in WKT when the values were compared at baseline and 6 months postoperatively ( $p < 0.001$ ). There was also a significant reduction in the VAS scores when the values were compared at 24 h of surgery on the 7<sup>th</sup> postoperative day ( $p < 0.001$ ). The MRC% value was 91% (Table 2).

**Table 2.** Comparison of various parameters at baseline and 6 months post-op in the study group

Variable	Baseline <i>M ±SD</i>	6 months post-op <i>M ±SD</i>	MD	p-value
PI	0.75 ±0.28	0.64 ±0.16	0.11	0.053
GI	0.69 ±0.21	0.59 ±0.14	0.10	0.016*
RD [mm]	3.05 ±1.10	0.25 ±0.55	2.80	<0.001*
RW [mm]	3.55 ±0.60	0.55 ±1.19	3.00	<0.001*
WKT [mm]	3.00 ±1.21	4.25 ±0.72	1.25	<0.001*
VAS score	5.20 ±0.77	1.85 ±0.67	3.35	<0.001*
MRC%	91%			

PI – plaque index; GI – gingival index; RD – recession depth; RW – recession width; WKT – width of keratinized tissue; MRC% – mean root coverage percentage; MD – mean difference; \* statistically significant.

## Discussion

The present study describes the use of T-PRF as a biomaterial in the treatment of GR. There was uneventful healing in the treated sites, without any complications, and no patient was lost to the follow-up. The biomaterial used formed a thicker membrane, which helped in better entrapment of cells and growth factors, and resulted in better healing.<sup>31</sup> Titanium-prepared platelet-rich fibrin was previously used in the treatment of intrabony defects by Chatterjee et al.<sup>32</sup>, Arabaci et al.<sup>31</sup>, Mitra et al.<sup>33</sup>, and Gummaluri et al.<sup>34</sup> All researchers achieved a reduction in pocket depth (PD), gain in the clinical attachment level (CAL), and improved defect fill and resolution.<sup>31–34</sup> The current study data was compared with the available literature on the usage of T-PRF as a biomaterial in the treatment of GR, which is scarce.

In the present study, there were lower PI scores (non-significantly) and GI scores (significantly) at a 6-month follow-up as compared to baseline. The finding regarding PI is in contrast to the results obtained by Koyuncuoğlu et al.<sup>11</sup> and Uzun et al.,<sup>23</sup> whereas for GI, they reported comparable observations. In our study, the lower values of PI could not reach statistical significance. Sutures were used to maintain good tensile strength without tension, and the application of postoperative CHX mouthwash and good OHI to maintain proper oral hygiene caused lower plaque

accumulation, which in turn reduced gingival inflammation. Good compliance and attitude toward treatment helped achieve successful results.<sup>35</sup>

In the present study, significant reductions were reported regarding RD and RW, which is in harmony with recent studies conducted by Koyuncuoğlu et al.<sup>11</sup> and Uzun et al.<sup>23</sup> There was an increase in WKT of 1.25 mm in the present study, which is almost equal to the results obtained in the abovementioned studies, where the increases amounted to 1.97 mm<sup>11</sup> and 2 mm<sup>23</sup> at 6 months, and 2.2 mm at 3 years.<sup>11,23</sup> These variations might be due to smaller sample sizes and the type of surgical technique employed in their studies. The present study utilized the trapezoidal technique, whereas the researchers mentioned above used the tunneling procedure. The increased WKT and decreased RD and RW might be due to the thicker membrane that was formed during centrifugation, leading to a thicker fibrin mesh with a higher and constant release of growth factors, as greater cellularity leads to improved parameters.<sup>21</sup> Moreover, the conventional CAF utilized in the present study yielded similar outcomes as the tunneling techniques (the modified CAF and MCAT techniques<sup>11</sup>) which have been used in the recent era.

There was a 91% MRC recorded in the present study, which is in accordance with recent studies. Koyuncuoğlu et al.<sup>11</sup> and Uzun et al.<sup>23</sup> reported scores of 93.10% and 93.29%, respectively, and concluded that T-PRF produced similar results to SCTG. The present study MRC% is in harmony with their SCTG group, which is considered to be the gold standard. In their recent systematic reviews, Miron et al.<sup>36</sup> and Moraschini and Dos Santos Porto Barboza<sup>37</sup> considered L-PRF for the treatment of GR and concluded that although it was helpful in achieving a considerable percentage of relative root coverage (RRC), it provided no additional benefit in terms of increasing the width of keratinized mucosa (WKM); it was recommended that SCTG be used if the baseline WKM value was reduced. The present study used T-PRF in CAF and showed similar results to SCTG. Thus, T-PRF could be a better alternative to L-PRF in the treatment of GR defects. Apart from this, T-PRF also eliminated the second surgical site and postoperative pain. Though the present study had a shorter 6-month follow-up, it was sufficient to assess the outcome of the treatment, as stated by Jepsen et al.<sup>38</sup>. This might be due to the relocation of MGJ to its original position being completed in 6 months. Also, T-PRF was evaluated in palatal wound healing by Ustaoglu et al., who achieved good results.<sup>39</sup> Therefore, T-PRF can be an alternative histoconduction material to SCTG in the treatment of GR.

In regard to esthetics, patient satisfaction and fewer postoperative complications, like the absence of dentinal hypersensitivity and swelling, as well as achieving good root coverage, are very important. The present study met most of these criteria, and patients were totally satisfied regarding the outcomes of the treatment.<sup>28</sup>

## Limitations

Despite the good outcomes reported, there were some inevitable limitations to the study. Only maxillary-arch teeth were considered, the healing index was not considered, histological sectioning was not performed, a small sample size was used, the gingival thickness measurements were not taken, and the conventional technique of CAF was used, where VRIs might hamper the blood supply and cause scarring. The higher cost of titanium tubes also reduces their usage in clinical practice. Long-term split-mouth randomized controlled trials (RCTs) with SCTG as a control group compared with the conservative tunneling surgical techniques might help identify the efficacy of T-PRF in the treatment of GR.

## Conclusions

Within the limitations of the present study, T-PRF can be used as a biomaterial in the treatment of GR, as it eliminates silica contamination (L-PRF with silica-coated or glass test tubes) and the need for a second surgical site (SCTG procurement), reducing postoperative pain. Titanium tubes can be reused after proper sterilization. Moreover, the thicker fibrin structure resulted in better root coverage and a good WKT. So, in the near future, T-PRF may be regarded as a better choice among PC preparations in periodontal treatment.

## Ethics approval and consent to participate

The research was approved by the Institutional Ethics Committee (IEC/IDS/152/2021), and informed consent was obtained from all patients prior to the commencement of the study. The study was conducted in accordance with the 1975 Declaration of Helsinki, modified in 2008.

## Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Consent for publication

Not applicable.

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