**Effectiveness of using platelet rich fibrin as a sole grafting material and membrane**

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**ABSTRACT**

**Background:** The lack of bone adjacent to an implant can be considered a true “bony defect” and bone regeneration that fills the defect can be improved with the use of platelet rich fibrin (PRF) that provides a scaffold for new bone regeneration. This study was conducted to assess the effectiveness of PRF as a graft material and membrane in these defects.

**Materials and Methods:** This prospective clinical study included 20 patients: 7 males and 13 females with mean age group 43.4 years (range: 25-64 years) who received 31 dental implants that demonstrated 31 defects. Defects were augmented using PRF as sole grafting material. Fifteen defects in 10 patients were treated with L-PRF and 16 defects, in the remaining 10 patients, were treated with A-PRF. Twenty four weeks postoperatively the defect resolution and the density of regenerated bone were assessed by CBCT and re-entry surgery. The assessment also included measurement of primary and secondary implant stability, success rate and complication rate of the installed implants.

**Results:** Re-entry after 6 months postoperatively revealed that the mean overall intraoperative defect size changed from (29.44±14.1) mm2  to (2.07±3.6) mm2 and the difference was statistically significant (p= < 0.0001). Defect resolution ranged from 80% to 100% with a mean of (95.7%±6.7%). The overall mean primary stability recorded was (2.9±1.6), and overall mean HU of the newly formed peri-implant bone was (385.7±77.4).

**Conclusion**: PRF as the sole graft material for peri-implant defects results in complete bone fill in defects that are not more than 21 mm2 in size, which equals roughly to a 5×5 mm defect. Larger defects may require the addition of bone substitute to achieve complete defect resolution.

**Keywords:** Peri-implant defect, Defect resolution, Implant stability, Bone density.

**INTRODUCTION**

The dental implants are a reliable and popular treatment of edentulous jaws because of high survival rate and predictability.(1,2) The implant surface should be covered with at least 1 mm of alveolar bone.(3) Placement of dental implants in areas of insufficient bone volume can lead to cortical bone defects such as dehiscence or fenestration that may compromise the survival of implant.(4) A dehiscence is a bone defect involving the cervical portion of the implant whereas fenestration is a bone defect not involving the cervical portion.(3) Guided bone regeneration (GBR) allows spaces maintained by barrier membrane to be filled by bone.(1,4) GBR procedures in dehiscence and fenestration defects can be obtained with resorbable or non-resorbable membranes, in association with a variety of graft materials.(4)

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Among these biomaterials, autogenous bone is often selected as the first choice for bone regeneration.(5)Platelet rich fibrin (PRF) is a second generation platelet derivative after platelet rich plasma (PRP). It contains platelets and growth factors in the form of fibrin membranes prepared from the patient’s own blood free of any anticoagulant.(5) It has been shown that PRF improves tissue healing in different applications; it acts as scaffold for cell proliferation, migration, and differentiation and for delivery of growth factors, leading to an enhancement of neoangiogenesis and acts as a scaffold for the restoration of bony defects.(6) In the field of dental implants, PRF has been utilized as a clot, mixed with a bone graft, or as a membrane in an effort to enhance and accelerate tissue healing; however, variable results have been obtained regarding its benefits.(7) There appears to be no clinical studies that use PRF alone in treatment of peri-implant defects; therefore, this study was conducted to assess the effectiveness of PRF as a sole grafting material and membrane for augmentation of dehiscence and fenestration defects encountered during dental implant procedure and the density of the regenerated bone, The other aim was to assess primary and secondary stability of dental implants installed in the augmented implant sites.

**MATERIALS AND METHODS**

This prospective clinical study included 20 consecutive patients who received (31) dental implants that demonstrated buccal/labial bony defects, in the form of dehiscence or fenestration, with exposed implant surface that were accidentally created during implant placement through either delayed or immediate implant placement protocol. The bony defects were treated using PRF as the sole graft material to augment the defect. The inclusion criteria for this study were: medically fit patients ≥ 18 years old who developed fenestration or dehiscence defects during immediate or delayed implant placement, with no evidence of local infection at or near the implant zone. Patients were excluded from this study if they had history of radiotherapy to the head and neck region, chemotherapy or drugs that compromise the healing of bone such as bisphosphonates. Also patients who demonstrated fenestration or dehiscence less than 3 mm in a greatest dimension were excluded from this study. For dehiscence defects the defect height was measured as the distance from the most apical aspect of the buccal crestal bone to the coronal aspect of the implant body and the defect width was measured as the widest mesio-distal dimension of the buccal bony defect (Figure 1). For the fenestration defect, the defect was measured at the greatest dimension for the length or width, the surface area calculated as circle (r2× π ) where the radius was considered as half of greatest dimension (length or width) as shown in figure 2.



B

A

**Figure 1: Measurement of (A) Length of the defect and (B) Width of the defect, using reamer with stopper.**



**Figure 2: Measurement of fenestration defect at the greatest dimension**.

The PRF preparation was as follows: 10 mL of blood was collected from the patient for each implant defect and was immediately centrifuged at 3000 rpm for 10 minutes at the room temperature according to (Dohan et al., 2006).(8) For preparation of L-PRF and for the preparation of A-PRF the blood was centrifuged at 1300 rpm for 8 minutes (Ghanaati et al.,2014).(9) During PRF preparation, the primary implant stability was measured using Periotest®. The stability was determined asa Periotest value (PTV).

The statistical analysis was performed using GraphPad Prism version 6 for Windows (GraphPad Software, La Jolla, CA, USA). Descriptive analysis included percentages or mean ± standard deviation (SD). The investigated variables were analyzed statistically using the D'Agostino-Pearson omnibus normality test, *t*-test, Mann-Whitney test, Fishers’ exact test. The differences were considered significant at P<0.05.

**RESULTS**

A total of 20 patients participated in this study, they were 7 males (35%) and 13 females (65%), they ranged in age from 25 to 64 years with a mean age of 43.4 (± 13.4) years. Thirty one implants were inserted, of these 19 implants (61.3%) were installed conventionally and 12 implants (38.7%) were inserted immediately after tooth extraction. Twenty one implants (67.7%) were inserted in the maxilla and 10 (32.3%) were inserted in the mandible. Thirty one peri-implant defects were encountered during installation of the 31 dental implants, these were 25 dehiscence (80.6%) and 6 fenestrations (19.4%). In 10 patients who had 15 defects the augmentation was carried out using L-PRF while in the remaining 10 patients who had 16 defects the augmentation was with A-PRF, the differences in type of the defect, the treatment protocol and the jaws between the two groups were statistically non-significant (Table 1).

**Table 1: Differences between L-PRF and A-PRF group**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | L-PRF | A-PRF | P-value |
| **Type of defect** |
| Dehiscence | 13 | 12 | 0.65a[NS] |
| Fenestration | 2 | 4 |
| **Treatment protocol** |
| Conventional | 8 | 10 | 0.72a[NS] |
| Immediate  | 7 | 6 |
| **Jaw** |
| Maxilla | 8 | 13 | 0.13a[NS] |
| Mandible | 7 | 3 |

**[a ] Fishers’ Exact test**

 **[NS] Non-significant**

The mean overall intraoperative defect size was 29.44 (± 14.1) mm2 (range 11.8-61.2 mm2). Re-entry after 6

months postoperatively revealed that the mean defect size had become 2.07 (± 3.6) mm2 (range 0-11.8 mm2). The difference was statistically significant (p < 0.0001). Defect resolution ranged from 80% to 100% with a mean of 95.7% (± 6.7%) and median of 100%. Defects that showed complete resolution (100%) postoperatively had statistically significant smaller defect size intraoperatively than those that showed partial resolution; the other significant difference was in the bone density of regenerated bone which demonstrated statistically higher bone density in defects with complete resolution compared to defects with partial resolution (Table 2).

|  |  |  |
| --- | --- | --- |
| Variables | Defect resolution | p-value |
|  | **Complete**  | **Partial**  |  |
| **No. of defects (%)** | 20 (64.5%) | 11 (35.5%). |  |
| **Mean (± SD) defect size/mm2** | 21.2 (± 7) | 44.4 (±11) | p< 0.0001[S]a |
| **Type of PRF** **(No., %)** |
| L-PRF | 7 | 8 | 0.066 [NS]b |
| A- PRF | 13 | 3 |
| **Type of the defect** **(No., %)** |
| Dehiscence  | 16 | 9 | 1.00[NS]b |
| Fenestration | 4 | 2 |
| **Treatment** **protocol** |
| Conventional | 13 | 5 | 0.45[NS]b |
| Immediate | 7 | 6 |
| **Jaw** |
| Maxilla | 12 | 9 | 0.2617[NS]b |
| Mandible | 8 | 2 |
| **Bone density/mean (± SD) HU** | 395.5 (± 72.5) | 367.8 (± 83) | < 0.0001 [S]c |
| **Implant stability/****mean (±SD) PTV** |
| Primary | 2.85(±1.7) | 2.95(±1.6) | 0.1789[NS]c |
| Secondary | -0.5 (±1.6) | 0.1 (± 1) |

**Table 2: Comparison between defects that demonstrated complete and partial defect resolution.**

**a t-test for 2 independent means**

**b Fishers’ exact test**

**c Mann-Whitney test**

**DISCUSSION**

One of the relatively recent advances in this field is the use of bioactive additives such as PRF to regulate inflammation and improve the healing process.(2-4,7) In the field of peri-implant defects, PRF can be used in management of peri-implantitis and in peri-implant defects encountered during conventional implant placement or in post-extraction implantation procedures.(8) In animal models, the use of PRF alone

**CONCLUSION**

The use of PRF as the sole graft material for peri-implant defects with simultaneous implant placement is effective for complete bone fill and defect resolution in case of defects not more than 21 mm2 in size, which equals roughly to a 5×5 mm defect. Larger defects may require the addition of bone substitute to achieve complete defect resolution. The augmentation with PRF alone is associated with high success rate without major complications.

**Conflict of interest:** None.

**REFERENCES**

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**الخلاصة**

الخلفية: العلاج بالزراعة هو أحد الأساليب الأكثر موثوقية لاستبدال الأسنان المفقودة ويجب تغطية سطح الزرعة بواسطة العظم السنخي كمبدأ عام أثناء تحضير موقع الزرعة ، قد يحدث التوهج أو الانكسار ويهدد بقاء الغرسة. يمكن اعتبار نقص العظم المجاور للزرعة "عيبًا حقيقيًا ، ويمكن تحسين عملية تجديد العظام التي تملأ العيب باستخدام الفايبرين الغني بالصفائح الدموية الذي يوفر سقالة لإعادة تجديد العظام الجديدة.

المواد والطرق العمل : شملت هذه الدراسة السريرية المحتملة 20 مريضا: 7 ذكور و 13 أنثى مع متوسط العمر 43.40 سنة (المدى: 25-64 سنة) الذين تلقوا 31 عملية زراعة أسنان أظهرت 31 عيبا. تم تعزيز هذه العيوب باستخدام الفايبرين الغني بالصفائح الدموية كمواد التطعيم الوحيدة. تم علاج خمسة عشر عيبا في 10 مرضى مع الفايبرين الغني بالصفائح الدموية القياسي و 16 عيبا ، في 10 مرضى الباقين ، تم علاجها مع الفايبرين الغني بالصفائح الدموية المتقدم. بعد 24 أسبوعًا ، تم تقييم حال العيب وكثافة العظم المجدد من قبل الاشعة الثلاثية الابعاد وجراحة إعادة الدخول. شمل التقييم أيضا قياس استقرار الزرعة الأولية والثانوية ، ومعدل النجاح ومعدل مضاعفات الغرسات المثبتة.

النتائج: أظهرت إعادة الدخول بعد 6 أشهر بعد العمل الجراحي أن متوسط حجم العيب الكلي أثناء العملية قد تغير من 29.44 (± 14.1) ملم 2 ليصبح 2.07 (± 3.6) مم 2 وكان الفرق ذو دلالة إحصائية (p <0.0001). من 80٪ إلى 100٪ بمتوسط 95.7٪ (± 6.7٪) كان المتوسط العام للثبات الأولي المسجل 2.9 (± 1.6) وكان متوسط الاستقرار الثانوي العام -0.22 ± 1.4 (P <0.0001) كان المتوسط العام لوحدة العظم المزروع حديثًا هو 385.7 ± 77.4.

الاستنتاجات: ينتج عامل التكاثف (الفايبرين الغني بالصفائح الدموية) باعتباره المادة المطعمة الوحيدة لعيوب المحيط الزائد في ملء العظم الكامل في العيوب التي لا يزيد حجمها عن 21 مم 2 والتي تساوي تقريباً 5 × 5 مم. قد تتطلب العيوب الأكبر إضافة بديل عظمي لتحقيق قرار عيب كامل.