JO JOURNAL OF OSSEOINTEGRATION periodontics and prosthodontics

The efficiency of using advanced PRF-xenograft mixture around immediate implants in the esthetic zone: a randomized controlled clinical trial

S. KALASH[1], N. ABOELSAAD[1-2], M. SHOKRY[3-4], J. CHOUKROUN[5]

[1] Oral Surgical Sciences Department, Division of Periodontology, Faculty of Dentistry, Beirut Arab University, Beirut, Lebanon
[2] Oral Medicine and Periodontology Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt
[3] Oral Surgical Sciences Department, Division of Oral Maxillofacial Surgery, Faculty of Dentistry, Beirut Arab University, Beirut, Lebanon
[4] Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt
[5] MD, Pain clinic, Nice, France

TO CITE THIS ARTICLE
Kalash S, Aboelsaad N, Shokry M, Choukroun J. The efficiency of using Advanced PRF-Xenograft mixture around immediate implants in the esthetic zone: a randomized controlled clinical trial. J Osseointegr 2017;9(4):317-22.

DOI 10.23805 /JO.2017.09.04.02

ABSTRACT

Aim Immediate implant placement in fresh extraction sockets is an accepted treatment modality and for better predictable outcomes the resultant peri-implant gap should be grafted. Many grafting materials are available; in this study, a xenograft was used with Advanced-Platelet-Rich Fibrin (A-PRF) as a supplement to tissue regeneration procedures. The aim of this study was to evaluate clinically and radiographically the efficiency of using A-PRF-xenograft mixture around immediate implants in the esthetic zone.

Materials and methods For this randomized controlled clinical trial, 18 patients requiring extraction of maxillary anterior teeth and immediate implant placement were selected. They were randomly divided into two groups: the study group, where the peri-implant gap was filled with A-PRF-xenograft mixture, and the control group, where the gap was filled with xenograft alone. The variables studied were probing depth, implant stability, marginal bone height and bone density; the follow-up period was 9 months. For statistical analysis, independent and paired t-tests were used.

Results Improvements were seen regarding all variables with no significant differences noticed during follow-up, except for implant stability which showed statistically significant differences.

Conclusion The results highlighted the promising effects of A-PRF-xenograft mixture on bone and soft tissue healing around immediate implants in the esthetic zone.

KEYWORDS A-PRF, immediate implant, esthetic zone, xenograft.

INTRODUCTION

Modern dental implantology aims to provide satisfying esthetics as well as a stable osseointegration (1). Placing an immediate implant usually results in a direct bone-to-implant contact in the apical part of the socket which provides osseous anchorage to ensure a high degree of initial mechanical stability. Yet, this causes a circumferential gap coronally (2). The size of this gap depends on implant diameter, socket morphology and tooth type (3). Little gaps are generally filled with new bone, with or without graft or membrane. On the contrary, large gaps encourage the development of connective tissue between the coronal portion of the implant and the peri-implant bone (4).

Recently, platelet concentrates have been frequently used in many medical fields (5) largely in oral and maxillofacial surgery (6), plastic surgery (7) and sports medicine (8). Platelet-Rich Fibrin (PRF) was developed by Choukroun et al. (2000) (9) It is a simple method to prepare fibrin gels without exogenously added supplements. PRF is strong, and releases significantly during more than seven days large quantities of key coagulation and healing molecules (Thrombospondin-1, Fibronectin, Vitronectin) and growth factors- particularly the Transforming Growth Factor-β1 (TGF-β1), Platelet-Derived Growth Factors (PDGF) and Vascular Endothelial Growth Factor (VEGF) (10, 11). The Advanced Platelet-Rich Fibrin (A-PRF) was described by Ghanaati et al. (12) and the new concept is referred to as A-PRF+; these low speed concepts especially A-PRF+ show increase in growth factor release (13). Therefore, this work was done in order to evaluate the efficiency of using PRF-xenograft mixture around immediately placed implants in the esthetic zone.

MATERIALS AND METHODS

Study design and setting

This study was carried out as an experimental, randomized

controlled clinical trial. The estimated sample size was calculated according to http://epitools.ausvet.com.au/ by taking the means of probing depth from a previous similar study (14) where mean for test site = 3.46 ± 0.69 and mean for control site = 3.17 ± 0.63, and the variance was calculated to be 0.036, assuming a confidence level of 95% and a study power of 80%. The calculated sample size was 14 patients; 20% was added to the sample size from the start of the study to eliminate the probability of drop-out through the treatment protocol. Thus, a total of 18 patients were recruited. They were selected conveniently to fulfill inclusion (patients with age ranging from 25 to 45 years, needing immediate implant placement in the esthetic zone and teeth with intact buccal plate of bone) and exclusion criteria (patients with uncontrolled systemic conditions, heavy smokers and peri-implant gaps <1.5).

The selected sample was randomly and equally divided into two groups: study group in which the peri-implant gaps were filled with A-PRF-xenograft mixture; and control group in which the gaps were filled with xenograft alone. All work was conducted in accordance with the Declaration of Helsinki (1964). Thus all patients were informed about the whole procedure, and signed a detailed informed consent form. The study started after obtaining the approval of the Institutional Review Board (IRB) of Beirut Arab University (code: 2015H-0030-D-M-0100).

Pre-operative stage

Medical and dental histories were recorded; clinical and radiographic examinations were done through periapical X-ray (X-Mind AC/DC, France) and CBCT (CS 9000 Extraoral Imaging System, US).

Operative stage

All flapless surgeries were performed by the same surgeon under local anesthesia, Articaine hydrochloride 4% with Adrenaline 1/100.000 (Ubistesin forte, 3M ESPE, US). Atraumatic extractions were done using the straight periotome (Ergoplant Periotome, Aesculap AG, Germany) (Fig. 1a).

After curettage and saline irrigation, implant sites were drilled according to the manufacturer's instructions. The implants (Leone implant system, Italy) were placed 3-5 mm beyond the apex, approximately 2 mm subcrestal at a torque of 40-50 Ncm. The peri-implant gaps (Fig. 1b) were measured, only gaps larger than 1.5 mm were included.

A-PRF was prepared as follows: 20 ml of blood were drawn into two separate tubes (Tube A-PRF+, Process for PRF, France) and immediately centrifuged at 1300 rpm for 8 minutes. The tubes were placed symmetrically in the centrifuge (Centrifuge PRF DUO, Process for PRF, France). At the end of the centrifugation process, A-PRF was placed on the grid in the PRF Box (PRF box, Process for PRF, France) to produce A-PRF membranes. Serum exudate collected in the bottom of the box was used to hydrate the graft (15).

For the study group, the membranes were cut into small pieces and mixed with the graft (Botiss dental GmbH, Germany) and serum. The mixture was then packed in the peri-implant gap (Fig. 1c).

Healing abutments were placed on top of the implants to stabilize the graft material and preserve the ridge contour. Interrupted sutures approximating the tissues mesial and distal to the healing abutments were made using 4-0 black silk suture material. Essix retainers were delivered to the patients after being relieved from the soft tissue aspect.

Post-operative stage

Immediately after surgery, patients applied ice packs extra-orally for 10 minutes every half an hour; they used warm saline rinses the next day.

The following medications were prescribed: Antibiotic (Augmentin 1g, GlaxoSmithKline, UK) for 7 days, NSAID (Voltfast, Novartis International, Switzerland) 50 mg for 3 days and Chlorhexidine mouthwash 0.1% (Eludril, Pierre Fabre Medicament Production, France) for the next 7 days. Sutures were removed one week after surgery.

Three months later, zirconia crowns were fabricated and cemented (Fig. 1d).

Follow-up stage

Immediate follow-up

Clinical evaluation was done at the 2nd, 7th and 14th postoperative days to evaluate soft tissue healing.

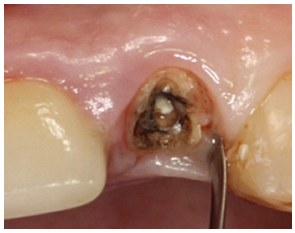
FIG. 1 A

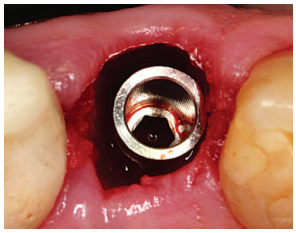
FIG. 1 B

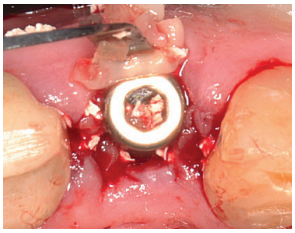
FIG. 1 C

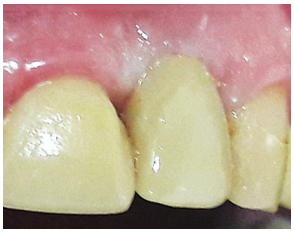
FIG. 1 D

FIG. 1 A Atraumatic extraction of tooth 22 using a periotome. B Peri-implant gap. C: PRF-xenograft mixture packed in the gap. D Final zirconium crown.

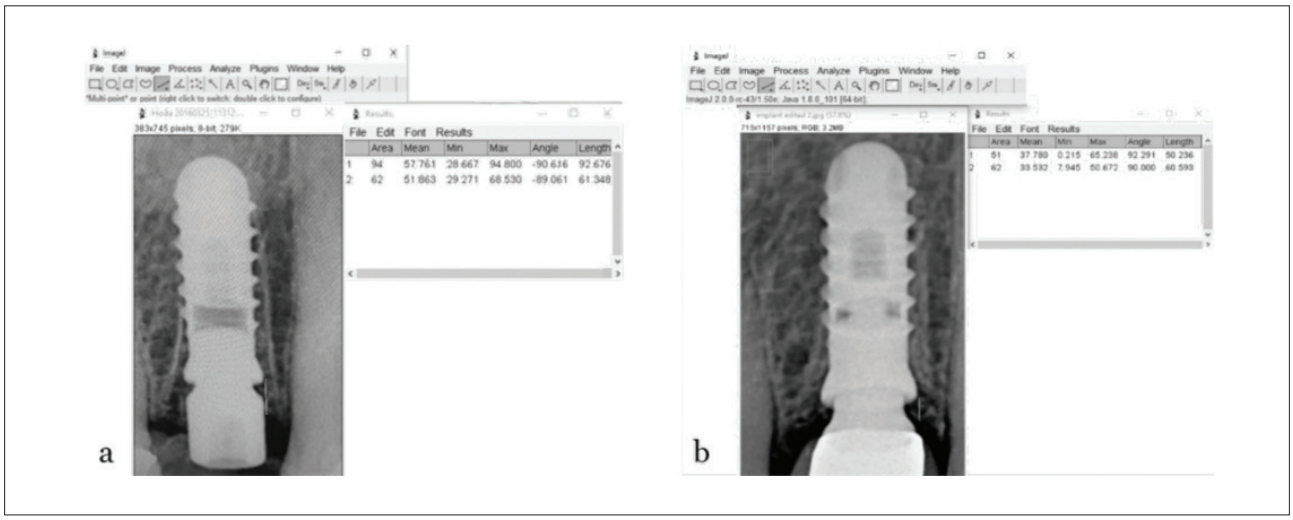

FIG. 2 A: Marginal bone height mesial and distal to the same implant immediately. B: After 9 months.

Radiographic evaluation (baseline): Standardized periapical radiographs using the XCP (Rinn®, Dentsply, US) sensor holder were done immediately post-operatively to measure the mean marginal bone height along the mesial and distal aspects of the implant (18) (Fig. 2a). Moreover, CT scans (Alexion/Advance edition, Japan) were done at the 2nd postoperative day to measure the bone density by Hounsfield units (HU). Sagittal cuts were taken and the implant length was measured, then two lines perpendicular to the implant were drawn, one at the ¼ of the whole length and one at the neck; the area opposite mid-distance between those lines was recorded for bone density.

Late follow-up

Clinical evaluation was performed at 3 and 6 months postoperatively to measure probing depth (17) and implant stability (18). Probing depth was measured with a periodontal controlled pressure probe (PDT Sensor Probe Type CP-12) (19) and implant stability was measured by Periotest (Periotest M, Medizintechnik Gulden, Germany) (20).

Radiographic evaluation was performed 9 months postoperatively, to measure marginal bone height (Fig. 2b) and bone density (Fig. 3); the measurements were compared to baseline.

Statistical analysis

The variables included in this study were tested for normality using Kolmogorov-Smirnov test. Since the data were normally distributed, study and control groups were compared regarding the study variables (probing depth, implant stability, marginal bone height and bone density) using the independent t-test. The baseline and follow-up values of the variables were compared in the same group, using the paired t-test. Descriptive statistics were calculated as means and standard deviations. Significance level was set at 5% level. Statistical analysis was performed using SPSS version 21.0.

RESULTS

A total of 18 patients, 10 males and 8 females having maxillary single rooted teeth indicated for extraction and immediate implant placement were included in this study. Their ages ranged from 27 to 42 years with mean age of 31.64 years. All patients were followed up for nine months with two patients having dropped-out because of small peri-implant gap sizes. The results were registered as regards clinical and radiographic variables.

Clinical results

All patients showed no postoperative side effects and all implants showed signs of successful osseointegration and no signs of failure (dehiscence, infection or mobility).

Probing depth

At 3 months post-operatively, the mean probing depth value of the study group was 2.86 ± 0.64; that of the control group was 3.39 ± 0.4. At 6 months, the

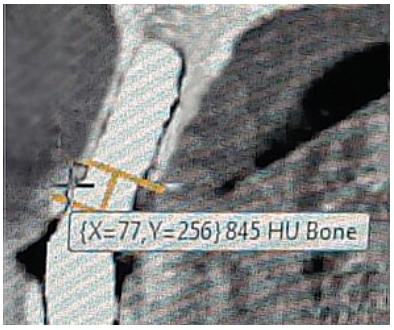

FIG. 3 Bone density measurement of the same implant.

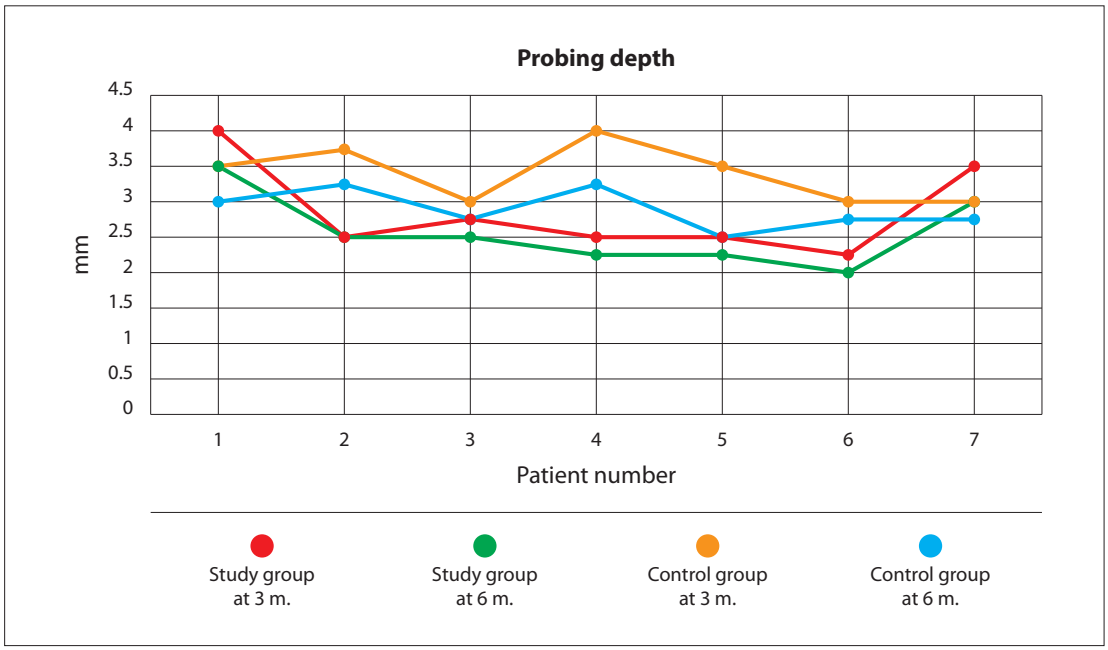

FIG. 4 The variation of the probing depth readings (in mm) related to the studied groups at 3 and 6 months.

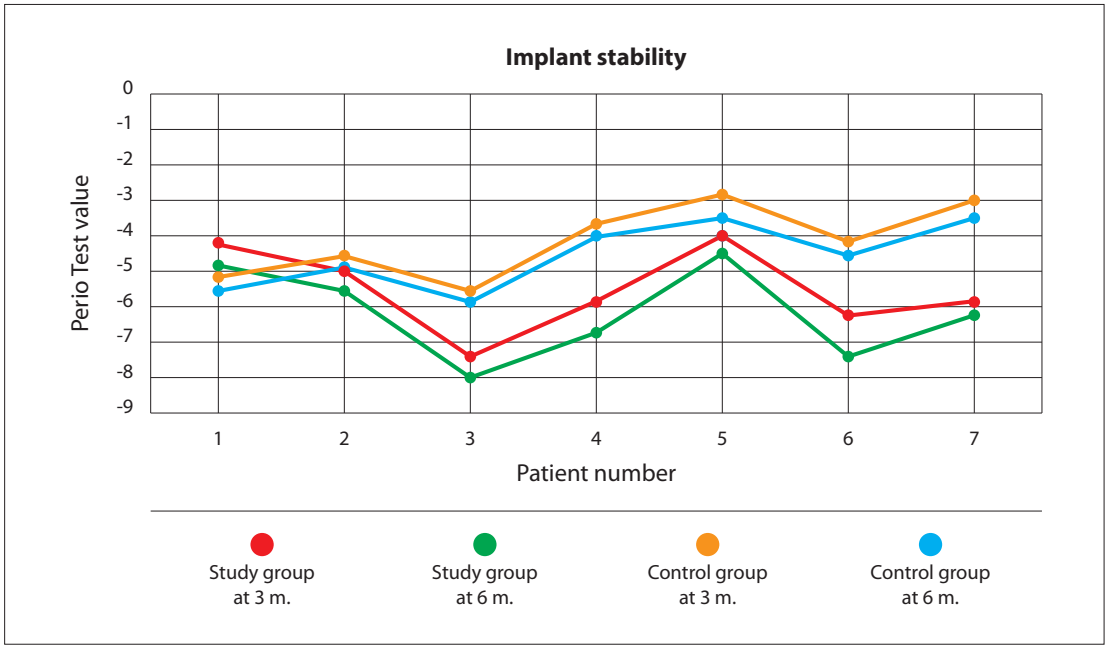

FIG. 5 The variation of implant stability (in Periotest values) related to the studied groups at 3 and 6 months.

mean probing depth value of the study group was decreased to 2.57 ± 0.51 and that of the control group decreased to 2.89 ± 0.28. When comparing both groups at 3 months and 6 months, there was no statistically significant difference (P=0.09) and (P= 0.173) respectively (Fig. 4).

Implant stability

At 3 months post-operatively, the mean implant stability value of the study group was -5.47 ± 1.16; that of the control group was -4.14 ± 1.06. At 6 months, the mean implant stability value of the study group decreased to -6.14 ± 1.27 and that of the control group decreased to -4.51 ± 0.94. When comparing both groups at 3 months and 6 months, there was a statistically significant difference (P=0.045) and (P= 0.018) respectively (Fig. 5).

Radiographic results

Marginal bone height (Fig. 6)

At the time of implant placement, the mean marginal bone height of the study group was 1.91 ± 0.22; that of the control group was 1.79 ± 0.29. At 9 months, the mean marginal bone height of study group decreased to 1.37 ± 0.2 and that of control group decreased to 1.3 ± 0.32. When comparing both groups at baseline and 9 months, there was no statistically significant difference (P=0.369) and (P= 0.63) respectively.

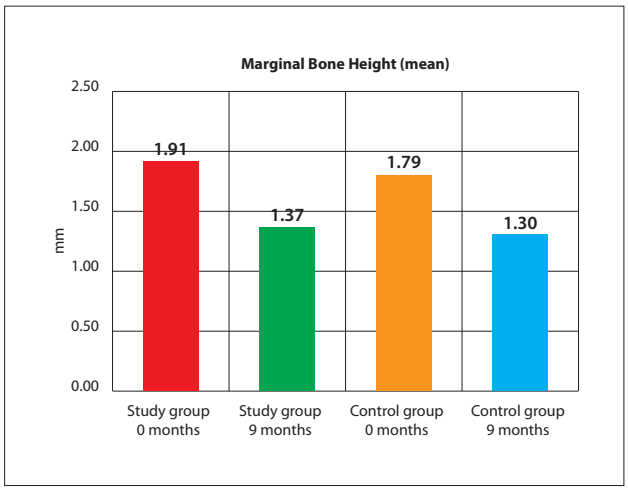

FIG. 6 The variation of the mean of marginal bone height (in mm) related to the studied groups at baseline and 9 months.

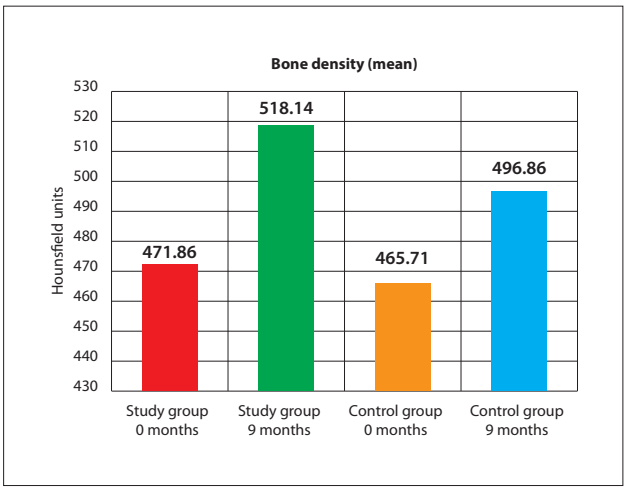

FIG. 7 The variation of the mean of bone density (in Hounsfield units) related to the studied groups at baseline and 9 months.

Bone density (Fig. 7)
At the time of implant placement, the mean bone density of the study group was 471.86 ± 51.64; that of the control group was 465.71 ± 48.57. At 9 months, the mean bone density of the study group increased to 518.14 ± 45.24 and that of the control group increased to 496.86 ± 43.98. When comparing both groups at baseline and 9 months, there was no statistically significant difference (P=0.823) and (P= 0.39) respectively.

DISCUSSION

A-PRF has been widely used as a viable autogenous material in periodontal, oral and implant surgery.
In this study, the dose received by each patient from the digital periapical x-rays, CBCT and CT scan was within the limit of patient maximum permissible dose according to the national council on radiation protection and measurements (NCRP) (21).
The teeth were removed atraumatically using a periotome in order to leave the buccal bone intact (22). Flapless approach was used in this case series so as to minimize the dimensional changes in the ridge; this is in accordance with Tarnow et al. (2014) (23) who indicated that only 1 mm or less of change was shown for all implant treatment groups that were performed as flapless placement.
The implants were positioned along the lingual wall (24), and they were placed approximately 2 mm subcrestally (25).
The primary stability was achieved by engaging 3 to 5 mm of bone beyond the root apex (26).
The peri-implants gaps were filled, this is in congruence with Tarnow et al. (2014) (23) who concluded that grafting the gap and using a contoured healing abutment or a provisional restoration resulted in the less ridge contour change. The gaps that were filled ranged from 1.5 to 3 mm; this is in parallel with Spinato et al. (2012) (27).
A-PRF clots were compressed into membranes to avoid the dehydration or death of the leukocytes living in the PRF clots and to prevent the shrinkage of the fibrin matrix architecture (28). It is also easier to cut the membranes than the clots and to mix them with the particles.
The probing depth results showed improvement in both groups, this may be accredited to the use of A-PRF in the gap as it helps maintain natural and healthy peri-implant gingiva. The results were not statistically significant; that was in agreement with Boora et al. (2015) (29) who placed PRF in immediate implants and found a mean decrease in probing depth around the implants in both PRF group and non-PRF group. Intergroup comparison for probing depth was not statistically significant.
The implant stability was measured by Periotest, and the scores decreased over time, with a statistically significant difference in support of the study group. This is in agreement with El Kenawy et al. (2014) (30), who placed immediate implants in the esthetic zone and evaluated the implant stability at the time of implant placement and at 3, 6, 9 and 12 months post-operatively; they found a decrease in Periotest scores throughout the follow-up periods with a significant difference at 3 months. The improvement in our work regarding implant stability may be attributed to the biological properties of A-PRF as it helps bone regeneration and promotes osseointegration.
Moreover, the marginal bone height was measured by standardized periapical radiographs. The results showed that in both groups there was some marginal bone loss, but it was more pronounced in the control group with no statistically significant difference. This in in parallel with Hehn et al. (2016) (31), who studied the effects of PRF inserted with a split-flap technique on marginal bone loss

around implants; they found no significant differences when comparing marginal bone loss between test and control groups.

Eventually, the bone density was measured by CT scan; the results showed increased HU units at follow-up because the baseline radiographs were done when the gaps were freshly grafted; 9 months post-operatively, the gaps were filled with denser bone. Although the inter-group difference was in support of the study group due to the various growth factors present in A-PRF, the results were not statistically significant; that could be attributed to the small sample size. The bone density results are in agreement with Zhang et al. (2012) (32), who performed sinus floor elevations, grafted PRF-Bio-Oss mixture in the test group and Bio-Oss in the control group. After 6 months, they found that the percentage of new bone formation in the PRF group was about 1.4 times higher than that controls with no statistically significant difference.

CONCLUSION

The limitations of this study were the small sample size and the short follow-up period. Within these limits, it can be concluded that A-PRF-xenograft mixture enhances soft tissue healing and bone regeneration around implants placed in fresh extraction sockets in the esthetic zone. It also enhances osseointegration by increasing implant stability.

REFERENCES

1. Paolantoni G, Cioffi A, Mignogna J, Riccitiello F, Sammartino G. "M" flap design for promoting implant esthetics: technique and cases series. Poseido 2013;1(1):29-35.
2. Farina R, Trombelli L. Wound healing of extraction sockets. Endod Topics 2012;25(1): 16–43.
3. Greenstein G, Cavallaro J. Managing the buccal gap and plate of bone: immediate dental implant placement. Dent Today 2013;32(3):70,72-7.
4. Colet D, Neiss FA, Conci RA, Griza GL. Using synthetic biomaterial to fill peri-implant defects (gap) in immediate implants. Dental Press Implantol 2013;7(4):98-105.
5. Bielecki T, Dohan Ehrenfest DM. Leukocyte- and platelet-rich Plasma (L-PRP)/fibrin (L-PRF) in medicine - past, present, future. Curr Pharm Biotechnol 2012;13(7):i-ii.
6. Del Corso M, Vervelle A, Simonpieri A, Jimbo R, Inchingolo F, Sammartino G et al. Current knowledge and perspectives for the use of platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) in oral and maxillofacial surgery part 1: Periodontal and dentoalveolar surgery. Curr Pharm Biotechnol 2012;13(7):1207-30.
7. Cieslik-Bielecka A, Choukroun J, Odin G, Dohan Ehrenfest DM. Curr Pharm Biotechnol 2012:13(7):1266-77.
8. Dohan Ehrenfest DM, Andia I, Zumstein MA, Zhang CQ, Pinto NR, Bielecki T. Classification of platelet concentrates (Platelet-Rich Plasma-PRP, Platelet-Rich Fibrin-PRF) for topical and infiltrative use in orthopedic and sports medicine: current consensus, clinical implications and perspectives. Muscles Ligaments Tendons J 2014;8;4(1):3-9.
9. Choukroun J, Adda F, Schoeffler C, Vervelle A. Une opportunité en paro-implantologie: le PRF. Implantodontie 2000;42:55-62.
10. Dohan Ehrenfest DM, de Peppo GM, Doglioli P, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): a gold standard to achieve for all surgical platelet concentrates technologies. Growth Factors 2009;27(1):63-9.
11. Dohan Ehrenfest DM, Bielecki T, Jimbo R, Barbé G, Del Corso M, Inchingolo F et al. Do the fibrin architecture and leukocyte content influence the growth factor release of platelet concentrates? An evidence-based answer comparing a pure platelet-rich plasma (P-PRP) gel and a leukocyte- and platelet-rich fibrin (L-PRF). Curr Pharm Biotechnol 2012;13(7):1145-52.
12. Ghanaati S, Booms P, Orlowska A, Kubesch A, Lorenz J, Rutkowski J et al. Advanced platelet-rich fibrin: a new concept for cell-based tissue engineering by means of inflammatory cells. J Oral Implantol 2014;40(6):679-89.
13. Fujioka-Kobayashi M, Miron RJ, Hernandez M, Kandalam U, Zhang Y, Choukroun J. Optimized Platelet Rich Fibrin with the low speed concept: growth factor release, biocompatibility and cellular response. J Periodontol 2017;88(1):112-21.
14. Cosyn J, Eghbali A, De Bruyn H, Collys K, Cleymaet R, De Rouck T. Immediate single-tooth implants in the anterior maxilla: 3-year results of a case series on hard and soft tissue response and aesthetics. J Clin Periodontol 2011;38(8) :746-53.
15. Toffler M, Toscano N, Holtzclaw D, Del Corso M, Dohan Ehrenfest DM. Introducing Choukroun's Platelet Rich Fibrin (PRF) to the reconstructive surgery milieu. J Implant Adv Clin Dent 2009;1(6):21-31.
16. Mangano FG, Colombo M, Mangano C. Clinical evaluation of 762 single-tooth, locking-taper implants: a prospective study with 1- to 12-years of follow-up. Journal of Dentistry and Oral Care Medicine 2016;2(2):1-11.
17. Buser D, Weber HP, Lang NP. Tissue integration of non-submerged implants: 1-year results of a prospective study with 100 ITI hollow-cylinder and hollow-screw implants. Clin Oral Impl Res 1990;1(1):33-40.
18. Schulte W. The new Periotest method. Compend Suppl 1988;(12):S410-5,S417.
19. Chung DM, Oh TJ, Lee J, Misch CE, Wang HL. Factors affecting late implant bone loss: a retrospective analysis. Int J Oral Maxillofac Implant 2007;22(1):117-26.
20. Zix J, Hug S, Kessler-Liechti G, Mericske-Stern R. Measurement of dental implant stability by resonance frequency analysis and damping capacity assessment: comparison of both techniques in a clinical trial. Int J Oral Maxillofac Implants 2008;23(3):525-30.
21. Li G. Patient radiation dose and protection from cone-beam computed tomography. Imaging Sci Dent 2013;43(2):63-9.
22. Mazzocco F, Jimenez D, Barallat L, Paniz G, Del Fabbro M, Nart J. Bone volume changes after immediate implant placement with or without flap elevation. Clin Oral Implants Res 2016;00,1-7 doi: 10.1111/clr.12826.
23. Tarnow DP, Chu SJ, Salama A, Stappert CF, Salama H, Garber DA et al. Flapless postextraction socket implant placement in the esthetic zone: part 1. The effect of bone grafting and/or provisional restoration on facial-palatal ridge dimensional change-a retrospective cohort study. Int J Periodontics Restorative Dent 2014;34(3):323-31.
24. Covani U, Cornelini R, Calvo JL, Tonelli P, Barone A. Bone remodeling around implants placed in fresh extraction sockets. Int J Periodontics Restorative Dent 2010;30(6):601-7.
25. Chen ST, Darby IB, Reynolds EC. A prospective clinical study of non-submerged immediate implants: clinical outcomes and esthetic results. Clin Oral Implants Res 2007;18(5):552-62.
26. Schwartz-Arad D, Grossman Y, Chaushu G. The clinical effectiveness of implants placed immediately into fresh extraction sites of molar teeth. J Periodontol 2000;71(5):839-44.
27. Spinato S, Agnini A, Chiesi M, Agnini AM, Wang HL. Comparison between graft and no-graft in an immediate placed and immediate nonfunctional loaded implant. Implant Dent 2012;21(2):97-103.
28. Dohan Ehrenfest DM. How to optimize the preparation of leukocyte- and platelet-rich fibrin (L-PRF, Choukroun's technique) clots and membranes: introducing the PRF Box. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110(3):275-8.
29. Boora P, Rathee M, Bhoria M. Effect of Platelet Rich Fibrin (PRF) on peri-implant soft tissue and crestal bone in one-stage implant placement: a randomized controlled trial. J Clin Diagn Res 2015;9 (4):ZC18-21.
30. El Kenawy MH, El Shinnawi UM, Salem AM, Fakhrdin HA. Efficacy of Platelet Rich Fibrin (PRF) membrane in immediate dental implant. Mansoura Journal of Dentistry 2014;1(3):78-84.
31. Hehn J, Schwenk T, Striegel M, Schlee M. The effect of PRF (platelet-rich fibrin) inserted with a split-flap technique on soft tissue thickening and initial marginal bone loss around implants: results of a randomized, controlled clinical trial. Int J Implant Dent 2016;2(1):13.
32. Zhang Y, Tangl S, Huber CD, Lin Y, Qiu L, Rausch-Fan X. Effects of Choukroun's platelet-rich fibrin on bone regeneration in combination with deproteinized bovine bone mineral in maxillary sinus augmentation: a histological and histomorphometric study. J Craniomaxillofac Surg 2012;40(4):321-8.