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Research Araştırma

EVALUATION OF PLATELET RICH FIBRIN (PRF) USAGE ON OSSEOINTEGRATION IMMEDIATE IMPLANTATION BY RESONANCE FREQUANCY ANALYSIS (RFA)

PRF KULLANIMININ İMMEDİAT İMPLANTASYONDA OSSEOİNTEGRASYONA ETKİSİNİN RESONANS FREKANS ANALİZ (RFA) İLE DEĞERLENDİRİLMESİ

ABSTRACT

Objective: Modern implant therapy concept is aimed to accelerate and enhance the osseointegration. Considering this, some interventions at bone metabolism have been defined utilizing by modifying the implant surface, using pharmacologic agents, biomaterials and bio-active molecules. PRF (Platelet Rich Fibrin) among the platelet derived factors (living bio-active molecules) have been under research in recent studies and literature. The aim of this study is evaluation of the PRF usage on osseointegration for immediate implantation in maxillary and mandibular posterior zone by the RFA (Osstell) technique.

Materials and Method: A clinical study was conducted on sixteen (16) fresh extraction sockets on 8 males and 8 females patients at maxillary and mandibular posterior zone. Bone level implants were inserted immediately. The participants were assigned to 2 group randomly. Group I (Test Group; PRF+Allogreft). Group II (Control Group; Only Allogerft). For all implants a mixture of PRF and allograft placed around the marginal aspects in order to compensate a dehiscence of bone. PRF membranes were placed as dual layers bidirectionally and the healing abutments were placed simultaneously through the PRF membranes in the Test Group. In Control Group, healing abutments only placed without any layer. After implant placement, RFA values were measured as ISQ values immediately intra-operatively and post-operatively at 1st, 2nd and 3th months by utilizing Osstell.

Results: Only 11 participants (6 male,5 female) co-operated with follow phase of study. 5 participants did not show up for measurement on time. There was no implant failure. The mean average ISQs values of Test group (PRF+Allograft) were measured as 69.57 at opertion day, 72 at 1st month, 78.28 at 2nd mount, 79.71 at 3th month. Average values of Control group (Only allograft) were measured as 67.5 at operation day, 69.75 at 1st month, 75.5 at 2nd month, 76.5 at 3th month. There was no significant differences between the groups by the statistically, only slightly different.

Conclusion: It was observed that this study with limited number of participants have revealed a slightly but non-significant positive effect of PRF usage on implant stability in immediate implantation post-extraction in posterior zone by RFA technique. Considering, further clinical studies with larger study groups must be performed in order to evaluate the potential effect of PRF on implant stability.

Key Words: Dental Implants, PRF, Immediate implantation, RFA, Osseointegration.

ÖZ

Amaç: Bu çalışmanin amaıi PRF kullanımını posterior bölgede immediat implantasyonda Osteointegrasyon üstündeki etkisini/gelişimini RFA (Rezonans Frekans Analizi) tekniği ile değerlendirilmesidir.

Gereç ve Yöntemler: Maksiller ve mandibular posterior zonda 8 erkek ve 8 kadın hasta üzerinde on alt (16) taze çekim soketi üzerinde klinik bir çalişma yapıldı. Kemik seviyesi implantlar: cekimden hemen sonra yerleştirildi. Katılımcılar Grup I (Test Grubu; PRF+Allogreft) ve Grup II (Kontrol Grubu; Yalnızca Allogreft) olarak rastgele 2' ye ayrıldı. Tüm implantlarda kemik kaybını telafi etmek için marjinal bölgelere PRF ve allogreft kartsimi verlestirildi. Test grubunda PRF membranlar cift yönlü ve gift katmanı olarak yerleştirildi. İyileşme başlıkları PRF membranla birlikte eş zamanlı olarak yerlestirildi. Kontrol Grubunda, iyileştirme başlıklar implant üzerine direkt yerlestirildi. İmplantlar yerleştirildikten sonra RFA tekniği ile, ameliyat sırasında ve ameliyat sonrası 1., 2. ve 3. aylarda Osstell kullantlarak ISQ değerleri olarak ölçüldü.

Bulgular: Sadece 11 katılımcı (6 erkek, 5 kadın) çalışmanın her asamasında ve zamanında uyumlu olarak ölçümleri tamamladılar. 5 katılımcı ölçüme zamanında gelmedi. Herhangi bir implant kaybı olmadi. Test grubunun (PRF+Allogreft) ortalama ISQ degerleri ameliyat günƨ 69.57, 1. ayda 72, 2. ayda 78.28, 3. ayda 79.71 olarak ölçüldü. Kontrol grubunun (Sadece allogreft) ortalama değerleri ameliyat gun 67.5, 1. ayda 69.75, 2. ayda 75,5, 3. ayda 76,5 olarak ölçüldü. Erken dönem test grubundaki Is değerleri yüksek ölçülse de gruplar arasındaki fark istatistiksel olarak anlamlı görülmedi.

Sonuç: Sınırlı sayıda katılımcının yer aldığı bu çalışmada, RFA tekniği ile posterior bölge dis cekimi sonrası immediat implantasyonda PRF kullanımının implant stabilitesi üzerinde hafif fakat anlamlı olmayan bir pozitif etkisinin olduğu gözlenmistir. Yine de PRF°nin implant stabilitesi üzerindeki potansiyel etkisini değerlendirmek için daha büyük çalışma gruplarıyla daha ileri klinik çalışmaların yapılması gerektiği dikkate alınmalıdır.

Anahtar Kelimeler: Dental İmplant, PRF, İmmediat İmplantasyon, RFA(Rezonans Frekans Analizi), Osteointegrasyon.

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INTRODUCTION

Osseointegration of a dental implant is a complex flow of multifactorial mechanisms, as the biological basis of osseointegration depends on two major aspects of the implant-host interaction: tissue and biomaterial characteristics. Osseous tissue characteristics consist of the state of local bone and may be implied by the interventions aimed at bone metabolism to accelerate the osseointegration process (1).

On the other side, potential role of soft tissues such as level of keratinized tissue or gingival biotype in the osseointegration process have also been discussed, where clinical procedures to enhance the features of the soft tissue and promote osseointegration have been defined in recent literature. Beside the actual state of hard and soft host tissues are subject to clinical intervention, additive utilization of biomaterials for both type of tissues is also an availability under certain clinical conditions (2). Successful integration is driven by an inflammatory process and protein adsorption stands as the key for tissue integration with biomaterials, which is due to a cascade of immune-inflammatory reactions led by the host (3).

Modern concept of dental implant therapy, therefore, should consider the osseointegration as a dynamic process in relation to the in vivo lifetime and interaction of the implant and the host tissue. To enhance the osseointegration process in regard to more bone-implant contact (BIC) surface in less time various strategies have been proposed (4). Modifying the implant surface topography and roughness have been shown to increase BIC successfully. In similar context but different methodology, interventions through pharmacological agents have also been defined (5, 6).

In addition to referred methods above, another strategy as modulating the healing response of the host to reduce the osseointegration time period after the implant placement has been defined (7). Such intervention considers the osseointegration as an immunologically, inflammatory-driven, immune-modulated, multifactorial and complex healing process. From this point of view, utilization of biologically active molecules such as growth factors, bone-specific molecules and/or bone morphogenetic proteins (BMPs) is the strategy still under question (9).

Among the bioactive molecules utilized for enhanced osseointegration, platelet derived factors have been under demanding research in recent literature. In fact, bone healing in implant site begins with a fibrin scaffold formation as platelets adheres to this fibrin structure, get activated and release growth factors such as; (BMP s), (PDGF), (IGF), (VEGF), (TGF-B1,-B2) leading to accelerated healing process (10). These growth factors are plays a key role stimulating cell proliferation, matrix remodelling and angiogenesis in wound healing process.

On this biologic basis, platelet concentrate preparations have been used in tissue healing and guided tissue regeneration therapy, classified due to preparation technique from a patients' peripheral blood, adding chemicals, centrifugation speeds and times, and selection of supernatants and precipitates, with certain differences in fibrin network structures and content of platelets, leucocyte and growth factors (11). A recent classification consisted referring techniques in 4 groups depending on their leukocyte content and fibrin architecture:

a-Pure Platelet-Rich Plasma (P-PRP)

b-Leukocyte- and Platelet-Rich Plasma (L-PRP)

c- Pure Platelet-Rich Fibrin (P-PRF)

d-Leukocyte and Platelet-Rich Fibrin

[i.e. Choukrouns PRF; Advanced PRF, (A-PRF), and injectable i-PRF, (Duo Process, Nice, France); L-PRF (Intra-Spin, IntraLock, Boca-Raton, FL, USA)] and Concentrated Growth Factors (CGF) – Solid fibrin material with leukocytes (8).

Studies have demonstrated that the use of PRF membranes to stimulate hard and soft tissue healing around the implant is particularly significant, as therapeutic applications of these autologous products lead to accelerated bone regeneration and osseointegration, improved stability and maintenance of dental implants by increasing BIC.

Additively, growth factors control the synthesis and degradation of extracellular matrix proteins, enhance osteogenesis and potentially accelerate peri-implant wound healing and osseointegration (13).

Considering osseointegration in mechanic terms as a direct bone anchorage to an implant body providing the support the prosthesis, implant stability as a mechanical fixation in early term and a biologic fixation in late term stands as a requisite characteristic of osseointegration and long-term clinical success.

From this point of view, measuring and monitoring the stability might provide a clinically useful tool for maintaining and sustaining osseointegration (14, 15).

Resonance frequency analysis (RFA) is a non-invasive diagnostic method to monitor and measure the level of stability. RFA is offering repeatable measurements of lateral micro-mobility and bone density at various stages of the osseointegration, in regard to vibration and a structural analysis principle

(16, 17). RFA technique may have clinical advantage for evaluating and monitoring implant stability due to ease of application and repeatability, beside the fact some aspects are still under questions (15-19).
The aim of this clinical study is to evaluate the affect of platelet rich fibrin (PRF) usage on osseointegration of immediately placed implants in maxillary and mandibular posterior sites in early term, as monitored by RFA (Resonance Frequency Analysis) technique**.**

MATERIAL AND METHODS

This is a randomized, case-control clinical study. The study was conducted at Private Dental Clinic, Antalya, Turkey, on 16 (8 male, 8 female) non-smoker subjects. The inclusion criteria were subjects with i) overall stable health condition, ii) maintainable oral hygiene parameters and measures, iii) partially edentulous state with no signs of periodontal or endodontic disease in the remaining dentition, iv) adequate bone quantity at the implant site.
Exclusion Criteria were subjects with i) immunocompromised state and current record of bleeding disorder or anticoagulant therapy, ii) lack of oral hygiene measures and compatibility, iii) totally edentulous state, iv) having acute infection symptoms around implant site on in remaining dentition.
All selected subjects had standard treatment approach with a single bone level implant system (Bego Semados RSX, Germany) . Subjects were randomly assigned to either Group I (Test Group, PRF+allograft) or to Group II (Control Group, only allograft).

PRF Protocol: PRF membranes, prepared in accordance to the well-defined protocol by Choukroun et al. The PRF membranes were prepared immediately before surgery. For PRF preparation, a total of 70 ml of blood were drawn from the antecubital vein and instantly transferred to the non-additive test tubes (Vacutainer CAT) (7*10 ml). The blood samples were immediately centrifuged at 3000 rpm for 10 minutes, with the support of a balance tube. Centrifuged tube has the 3 distinct layers: A red blood cell (RBC) base at the bottom, a PRF clot in the middle, and an acellular plasma ([PPP] platelet-poor plasma) layer at the top. Following centrifugation, PRF samples were transferred to PRF Box to obtain standard PRF membranes, and stored until utilization (Figure 1).

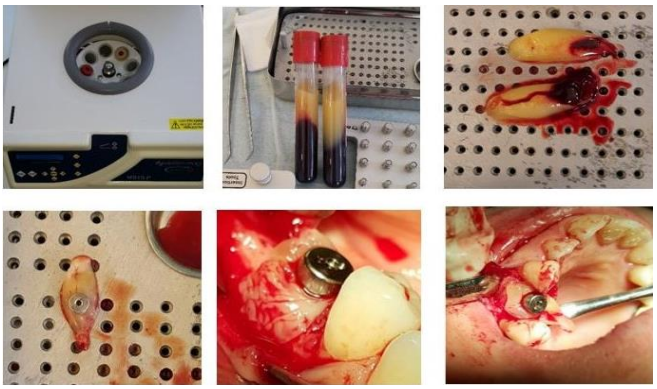

Figure 1. PRF membranes.

Surgical Phase: The extractions have been made gently to protect the marginal bone and for suitable fresh sockets. The surgical phase involved full thickness mucoperiosteal flap reflection with osteotomy site preparation through sequential drilling in accordance with the instructions of the manufacturer and basic principles of surgery. Healing abutments were driven under 35Ncm of insertion torque and placed simultaneously, in accordance with the "one-stage non-functional immediate prosthetic protocol" (20).
For all implants, a mixture of PRF and allograft was prepared and placed around the marginal aspects in order to compensate a dehiscence of bone during remodeling. The PRF membranes were placed over the surgical site as dual layers bidirectionally to create homogenous layers of membrane and the flap was sutured over (Figure 2).

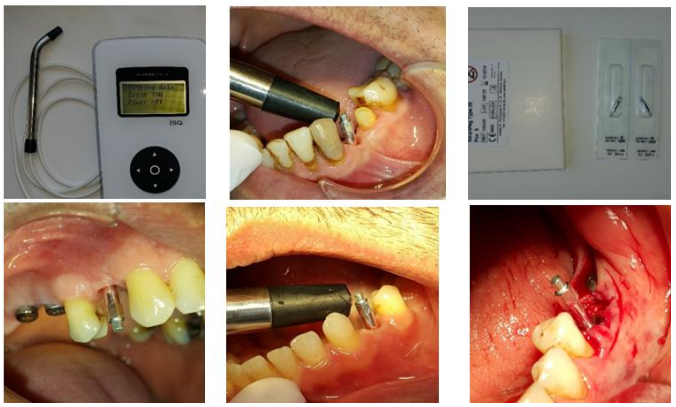

Figure 2. Homogenous layers of membrane and the flap.

Resonance Frequency Analysis: RFA values were measured as implant stability quotient (ISQ) values immediately after implant installation (intra-operatively) and post-operatively at 1st, 2nd and 3rd months, utilizing Ostell device with using suitable SmartPegs. Two measurements were made as mesiodistally and buccolingually, and mean ISQs were recorded. All measurements were well-documented in tables to make statistical analysis.

RESULTS

Only 11 participants (6 male, 5 female) co-operated with the follow-up phase where 5 participants did not show up for measurements on time. Considering this; ISQ measurements of the control group are given in Table 1.

Gender	Age	Position	Baseline	1st Month	2nd Month	3rd Month
M	45	14	67	65	77	78
F	47	34	65	68	77	78
M	23	46	68	77	77	79
M	46	26	70	69	71	71

Table 1. Control Group (Only Allograft) (n=4).

ISQ measurements of the test group are given in Table 2.

Gender	Age	Position	Baseline	1st Month	2nd Month	3rd Month
M	54	34	65	79	82	84
F	35	35	68	70	79	79
F	46	36	72	69	77	85
M	41	15	68	70	75	75
M	46	34	68	72	85	85
F	22	24	63	65	71	71
F	44	26	83	79	79	79

Table 2. Test Group (PRF + Allograft) (n=7).

Average ISQ values of test and control groups are given in Table 3.

	Baseline	1st Month	2nd Month	3rd Month
Only Allograft	67,5	69,75	75,5	76,5
PRF+ Allograft	69,57	72	78,28	79,71

Table 3. Average ISQ measurements.

DISCUSSION

Modern implant dentistry offers a wide range of variable adjunctive methods materials or techniques usage. Recent literature have focused on the clinical solutions and interventions in response to rising demand of accelerated osseointegration and prosthetic loading (9, 21).

Osseointegration is a complex process of cellular interaction between the host and the implant as the foreign material and a crucial biologic phenomenon.

At cellular level, thrombin and fibrinogen adhere to the implant surface as a response to surface topography and hydrophilicity of the implant surface, followed by the chemotaxis of neutrophils to the implant recipient site, before the infiltration of monocytes and macrophages.These events lead to an early homeostasis through the release of a group of cytokines and growth factors stimulating collagen matrix deposition around the titanium oxide layer and leading to newly-formed woven bone. Following mechanical fixation and referred cellular activity, lamellar bone initiates the biological stability, may also be called as osseointegration (1). Osseointegration is a dynamic process at immune-inflammatory and cellular level and should be considered as the interaction between the implant, the local bone and surrounding soft tissues are balanced between regulatory affect of host immune system and exogenous factors such as microbial structure and parameters of occlusion (4). Consideration of osseointegration as a dynamic process initialized by biologic (secondary) stability have been a significant point of research (4, 15). As the biologic phases, the process of implant stability have been the goal in order to prefer the most appropriate loading protocol and/or to enhance the clinical efficiency of the post-prosthodontic follow-up. Basically, to confirm the osseointegration by histomorphometry is theoretically the gold standard but practically contraindicated. The

Osstell technique is an analysis of resonance frequency, utilizing the Osstell device. This technique, also termed as resonance frequency analysis (RFA) reveals scores of implant stability quotient (ISQ) in a scale of 1-100. In this study, the Ostell technique have been used in order to monitor the process of osseointegration in an objective and quantitative approach. Basing on the analytical knowledge, clinical evaluation and actual expectations of patients and dental professionals is accelerated prosthetic loading and reduced total treatment time. The literature have focused on the issues of promoting osseointegration by the help of various adjunctive techniques, methods and materials. Among these basic methods, modulating the host response to reduce the healing time period and accelerate the biologic stability and process of osseointegration have been a topic of resent research.

As the healing process, the use biologically active molecules to induce osteoconductivity, enhance osteoblastic differentiation and healing of peri-implant bone (25). It should also be noted that, utilization of such agents may not only intervene with the osteologic process of peri-implant healing, but also with the structure of soft tissue healing and build-up. Other side the soft tissue aspect is still under question.

In fact, clinical availability of biomaterials and bioactive factors claimed to improve success and predictability of patient outcomes (8, 27). PRF an autogenous living biomaterial, have been a demanding point of research. As understanding and clinical reports, the platelet concentrates on wound healing is successful therapeutic applications

An early experimental study by Fontana et al. have referred PRP use as an enhancing factor on the amount of newly-formed bone around the implants (28).

On the contrary, an early clinical study by Monov et al. have noted no significant effect of the adjunctive use of PRP (as a first generation platelet concentrate) on a one-stage protocol implantation in anterior mandibular region, utilizing RFA in a limited number of cases (29). In regard to another primary platelet concentrate, Anitua have experimentally (histomorphometrically) demonstrated that osseointegration was enhanced when the surface of the implant was covered with PRGF (shown to be adsorbed) in comparison to the conventionally placed implants. (30). Anitua et al. have, in another experimental study, suggested that use of PRGF may improve the osseointegration process .Marrelli and Tatullo have performed a retrospective, observational study to evaluate the predictability of PRF-supported protocol increase the peri-implant tissues maintenance around post-extractive dental implants in maxillary anterior region (7). Boora et al., in their clinical research to evaluate the effect of PRF on peri-implant tissue response following one-stage implant placement with non-functional immediate provisionals in maxillary anterior region, have noted PRF as a healing biomaterial with potential beneficial effect on peri-implant tissue (32). Öncü et al. have demonstrated the enhancing effect of PRF usage on the stability of implants, significantly in the first week follow-up measurements by RFA (33). Kotsakis et al. have, on the other hand, introduced a protocol for "accelerated-early" implant placement using PRF to modulate the immun-inflammatory response of host tissue for accelerated, early wound healing and implant placement (34). The researchers have performed histological analysis at 6 weeks. They have suggested the use PRF the protocol to achieve increased primary stability. Öncü et al., in another clinical study, evaluated the effect of L-PRF on levels of crestal bone and gingival margin around implants and on immediate implant stability in earlier segments of healing period by RFA (35). The authors suggested the use of L-PRF to provide accelerated bone healing and prosthetic loading. Tassum et.al (A latest meta-analysis) suggest that PRF is effective in improving secondary implant stability with certain limitations and displays possible implication for clinical practice (38).

In this study, PRF material have been demonstrated to have an enhancing effect on wound healing and bone regeneration. In regard to RFA, the ISQ values between the groups were similar at all time-points of measurements, with slightly higher values recorded in the test group. RFA method, used in study, have been approved for monitoring the implant stability by numerous experimental and clinical studies (15, 19).

Considering the ISQ values noted, number and distribution of subjects are limited to perform a statistical analysis but it may be concluded that the use of PRF as an adjunct to the allograft and as a barrier membrane over the post-extractive implantation socket does not influence the stability course of the implant negatively, but slightly in positive manner. It may not be reported that utilization of PRF have significantly improved the osseointegration process.

CONCLUSION

This study with limited number of participants have revealed a slightly but non-significant positive effect of PRF use on implant stability in immediate implantation post-extractively in mandibular and maxillary posterior zone, measured by RFA. It seems slightly beneficial effect on osseointegration. Further clinical studies with larger study groups including only-PRF applications must be performed in order to evaluate the potential effect of PRF on implant stability.

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