Available online at www.sciencedirect.com
SciVerse ScienceDirect
journal homepage: http://www.elsevier.com/locate/aob

Effects of platelet rich fibrin alone used with rigid titanium barrier

Hakan Ozdemir [a], Seref Ezirganli [b], M. Isa Kara [c,*], Ahmet Mihmanli [b], Emre Baris [d]

[a] Department of Periodontology, Faculty of Dentistry, Cumhuriyet University, Sivas, Turkey
[b] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Bezmialem Vakif University, Istanbul, Turkey
[c] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Izmir Katip Celebi University, Izmir, Turkey
[d] Department of Oral Pathology, Faculty of Dentistry, Gazi University, Ankara, Turkey

ARTICLE INFO

Article history:
Accepted 28 September 2012

Keywords:
Guided bone regeneration
Platelet rich fibrin
Anorganic bovine bone
Biphasic calcium phosphate
Titanium barrier
Rabbit

ABSTRACT

Objective: Platelet-rich fibrin (PRF) is a platelet and leukocyte rich and platelet preparation that concentrates various growth factors and therefore has the potential to be used as regenerative treatment. The aim of study was to assess the effects of platelet rich fibrin (PRF) on bone augmentation when used in conjunction with titanium barrier a rabbit calvaria model.

Study design: Twenty-four adult male New Zealand rabbits were used in this study. Two titanium barriers were fixed on each rabbit's calvarium. The rabbits were divided into four groups (group one is control and the other three groups are experimental) and each group contains 6 animals. PRF, anorganic bovine bone (ABB), and biphasic calcium phosphate (BCP) were used with titanium barriers in the experimental groups. Any materials were not used in the control group. Half of the animals were sacrificed after 1 month, and the rest were sacrificed after 3 months. Histomorphometric evaluation was carried out in order to compare new bone formation among the groups.

Results: Significantly more new bone area was noted in the PRF alone group than in the control group, no statistically significant differences were found among PRF, BCP and ABB groups after 1 month. PRF and ABB also had superior effects in new bone formation area control to the BCP group after 3 months.

Conclusion: PRF may offer the ease of use, simple handling, and enhanced delivery of growth factors during the bone augmentation procedures. When used in conjunction with the titanium barriers, PRF use can increase the quality of the newly formed bone and enhance the rate of bone formation due to the concentration of growth factors.

1. Introduction

The etiologies of alveolar bone defects include advanced periodontal disease, respective surgery, especially resulting from trauma or tumor surgery, large-bone defects.[2] To overcome these problems, guided bone regeneration (GBR) is used with numerous grafting materials including autografts, allografts, xenografts and alloplastic grafts.

Among grafting materials, autogenous bone grafts possess superior osteogenic and osteoinductive properties, they are considered the gold standard for grafting materials.[3] However,

* *Corresponding author at*: Izmir Katip Celebi University, Faculty of Dentistry, 35180 Izmir, Turkey. Tel.: +90 232 3293535; fax: +90 232 3293999.
E-mail address: phismer@yahoo.com (M. Isa Kara).

Abbreviations: BCP, biphasic calcium phosphate; βTCP, beta-tricalcium phosphate; ABB, anorganic bovine bone; GBR, guided bone regeneration; HA, hydroxyapatite; PRF, platelet rich fibrin; PRP, platelet rich plasma.

0003–9969/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.archoralbio.2012.09.018

limited availability, postoperative morbidity, prolonged pain and neural damage in the donor site areas, deterioration of the facial aesthetic vs. discomfort for patients resulting from extra-oral grafts, surgeons prefer to use other graft materials in bone regeneration. Allografts is the most commonly used autograft alternative; however, its osteoinductive capability remains controversial and there are risks of infections, including hepatitis and HIV.[3,4] Anorganic bovine bone graft (ABB) and biphasic calcium phosphate (BCP) bioceramic graft materials are possible alternatives to autologous and allogenic grafts. Surgeons have frequently preferred ABB grafts for bone augmentation because their structural configuration is biocompatible and structurally similar to human bone, improving its osteoconductive capability compared to that of synthetically derived mineral. [4,12,29,36,37] There are two sources of ABB used for bone replacement: bovine bone and natural coral. Although the clinical performance of these inorganic xenografts bone substitutes has been confirmed and widely accepted by physicians the disadvantage of these products are their high price, the time-consuming manufacturing process, and controversial ethical issues pertaining to animal slaughter.[38] BCP grafts have received much attention, since their biocompatibility with host tissues, non-antigenic, non-inflammatory, and effective as a scaffold for the formation of new bone.[9,16,26,30] Calcium phosphate ceramics such as hydroxyapatite (HA), beta-tricalcium phosphate (βTCP), and BCP have been shown to induce bone formation in animal models with suggested superior stability and osteogenic properties compared to autologous bone grafts.[4–6] Depending on their composition and structure, bioceramics degrade and are gradually replaced by bone.[12,26]

Autologous platelet concentrates including platelet rich plasma (PRP) and platelet rich fibrin (PRF) have been widely used for this purpose. PRP[15,21,22] systems in that it does not use bovine thrombin or other exogenous activators in the preparation process. Platelet rich fibrin (PRF), an autologous fibrin matrix, is another such product developed in France by Choukroun et al. specifically for oral and maxillofacial surgery use.[31] PRF was first developed and defined as an autologous leukocyte and PRF biomaterial in France by Choukroun et al.[16] The PRF preparation process creates a gel-like matrix that contains high concentrations of non-activated, functional, intact platelets, contained within a fibrin matrix, that release, a relatively constant concentration of growth factors.[8] The chair side preparation of PRF is quite easy and fast and simplified processing minus artificial biochemical modification. Use of fibrin glue for bone regeneration improvement and enhancement is well documented,[33–35] as is that of PRF itself.[31,32]

Based on the literature, we have hypothesized that PRF can deliver growth factors and enhance the rate of new bone formation as well as the quality of new bone when used in conjunction with titanium barriers in the bone augmentation procedures. The aim of study was to assess the effects of PRF on bone augmentation when used in conjunction with titanium barrier a rabbit calvaria model. The aim of study was to assess the effects of platelet rich fibrin (PRF) on bone augmentation when used in conjunction with titanium barrier a rabbit calvaria model.

2. Materials and methods

The animal cohort was comprised of 24 male New Zealand white rabbits weighing 3 kg (±100 g), and aged 5 months. The animals were kept in temperature-controlled cages (approximately 25 °C), 55–70% humidity, 1 atm, and exposed to a 24-h light-to-dark cycle of equal time; the animals had free access to water and food ad libitum. The study protocol and experimental design were approved by the Institutional Review Board and Animal Use Committee of the Cumhuriyet University School of Medicine (B.30.2.CUM.0.01.00.00-50/54)

The experimental devices were custom-made, standardized stiff dome-shaped pure titanium barriers with a diameter of 8 mm, a height of 4 mm and a thickness of 0.3 mm Each barrier had a 3 mm-diameter hole at the top and a Teflon cover was used to close the hole. To prevent possible contamination and infection, all of the barriers were exposed to a series of alcohol solutions in an ultrasonic bath and sterilized by autoclave.

The animals were randomly divided into four groups: control, PRF, ABB[e] (0.25–1 mm particle size), and BCPβ (a fully synthetic bone substitute made of synthesized HA and -βTCP with a 60%/40% ratio. BCP is a graft material with an interconnected micro and 70% macroporosity). After 1 month, half of the rabbits from each group were sacrificed; the remaining rabbits were kept alive for 3 months.

3. Surgical procedure

All animals were operated under a general anaesthesia of intramuscular 10 mg/kg xylazine[f] and 50 mg/kg ketamine HCl.[g] Researchers also administered intramuscular ceftriaxon[h] 50 mg/kg every 24 h for 4 days starting one day before the operation, and intracutaneous carprofen[i] 4 mg/kg postoperatively for 3 days beginning immediately after the operation.

The skulls of the animals were shaved and disinfected with iodine. A skin incision, approximately 4 cm in length, was made over the linear media to raise the skin of the skull.

A cutaneous flap and the periosteum were reflected by using a sharp periosteal elevator, exposing the calvarial bone on both sides of the midline. To induce bleeding from the marrow space, nine small holes were drilled bilaterally around each centre hole using a round burr approximately 1.5 mm in the diameter with copious sterile physiological solution (0.9% NaCl) irrigation. Care was taken to irrigate the wounds thoroughly and to avoid involvement of the saggital and coronal sutures during drilling. Bilateral barriers were used for every animal. The borders of the barriers were glued to the bone with N-butyl-2-cyanoacrylate.[j]

In control group, only the decortications were done on the calvarial bone. The rabbits' blood, taken with a syringe from

[e] Bio-Oss®, Geistlich Biomaterials, Wolhusen, Switzerland.
[f] Rompun; Bayer, Germany.
[g] Ketalar; Eczacıbası, Istanbul, Turkey.
[h] Rocephin; Roche, Basel, Switzerland.
[i] Rimadyl; Pfizer, New York, USA.
[j] Histoacryl®, B. Braun, Melsungen, Germany.

Please cite this article in press as: Ozdemir H, et al. Effects of platelet rich fibrin alone used with rigid titanium barrier. *Archives of Oral Biology* (2012), http://dx.doi.org/10.1016/j.archoralbio.2012.09.018