Platelet-Rich Fibrin in Bone Regenerative

Subjects: Materials Science, Biomaterials

Contributor: Inês Francisco

Background: Preservation of the alveolar bone is determinant in the outcome of orthodontic treatment. Alveolar bone defects or decrease of its height and width may occur due to common reasons such as inflammation, tooth extraction or cleft lip and palate. The aim of this systematic review was to investigate and appraise the quality of the most up to date available evidence regarding the applications and effects of platelet-rich fibrin (PRF) in orthodontics. Methods: This study was carried out according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines using the following databases: Medline via PubMed, Cochrane Library, Web of Science Core Collection and EMBASE. The qualitative assessment of the included studies was performed using Cochrane Risk of Bias tool and ROBINS-I guidelines. Results: From a total of 489 studies, 9 studies were selected. The majority of the included studies demonstrate that autogenous anterior iliac graft with PRF had higher amount of newly formed bone. Furthermore, this review also suggests that application of platelets derivatives in the extraction socket can accelerate orthodontic tooth movement. Conclusion: Despite the limitations in the included studies, this systematic review suggested that PRF can improve alveolar cleft reconstruction and orthodontic tooth movement.

Keywords: Orthodontics ; Bone Regeneration ; Platelet Rich Fibrin ; Platelet concentrate

1. Introduction

Regenerative therapy in oro-dental and maxillo-facial defects is challenging because the oral cavity has several tissues with distinct cell populations (ectodermal and mesodermal), making regenerative procedures more complex[1]. Bone and soft tissue regeneration may be indicated for managing defects subsequent from several conditions, such as congenital defects (cleft lip and palate), alveolar bone resorption, periodontal defects (recession coverage and furcation defects), cystic cavities, bone infection (osteomyelitis), and traumatic bone destruction [1][2][3][4].

Platelet derivatives are increasingly used in regenerative dentistry, particularly in implantology, oral surgery, and periodontology. Choukroun et al. reported that the platelet-rich fibrin (PRF) improves tissue repair and regeneration. PRF is prepared from centrifuged autologous blood with no addition of bovine thrombin or anticoagulants [5].

This fibrin matrix contains platelets, leukocytes, growth factors and cytokines, such as interleukin (IL)-1β, IL-4, and IL-6, transforming growth factor-beta1 (TGF-β1), platelet-derived growth factor (PDGF), and vascular endothelial growth factor (VEGF) [5][6]. These factors can promote the proliferation/differentiation pathways of osteoblasts, endothelial cells, chondrocytes, and various sources of fibroblasts, which can stimulate the regenerative capacity of periosteum and enhance bone and tissue repair and regeneration [7].

Tissue regeneration is a new emerging approach in orthodontics because a high percentage of patients need both regeneration and orthodontic treatment. Orthodontic treatment can be performed on children, young adults, and adults. All of these patients may need regenerative approaches due to different indications (e.g., children with cleft lip and palate who need closure of alveolar cleft; older patients who need an orthodontic treatment due to bone defect as a result of tooth loss). Moreover, the application of mechanical force on the teeth affects the periodontal ligament and the alveolar bone, which allows orthodontic tooth movement (OTM) [8]. Thus, a change in support structures may interfere with orthodontic success. Therefore, the use of PRF can improve orthodontic treatment results, since it promotes a biological response involving a minimally invasive procedure. During recent years, clinical applications and effects of PRF in regenerative dentistry have been reviewed, but studies on the application of PRF in orthodontics are sparse.

2. Objective

The purpose of this entry was to systematically investigate and appraise the quality of the most up to date available evidence from human studies regarding the applications and effects of PRF in orthodontics.

3. Main Results/Discussion

A total of 9 studies were included. Six studies investigated the efficacy of PRF in maxillary alveolar cleft reconstruction and three articles investigated tooth movement and post-orthodontic stability. Three studies were judged as having high risk of bias, two trials were judged as low risk of bias and the remaining studies were considered as unclear risk.

Orthodontic treatment combined with surgical approaches is a common procedure in cleft lip and palate patients. Alveolar cleft reconstruction with bone graft allows the adequate volume of alveolar bone, which is fundamental for the dental movement in the maxillary aesthetic zone throughout the orthodontic treatment. PRF membranes promote soft tissue healing functioning like a matrix to support neoangiogenesis, and migration of stem cells and osteoprogenitor cells into the graft [5].

Regarding orthodontic tooth movement, the two trials included in the present systematic review showed that the use of PRF or L-PRF in the extraction socket could accelerate OTM (p=0.006), specifically in the beginning of orthodontic treatment (alignment and leveling) [9][10]. Thus, the application of PRF may shorten the orthodontic treatment time reducing associated costs, which nowadays is a concern in orthodontic patients, specifically in adults and patients with longer treatments such as those needing tooth extractions.

References

1. Richard Miron; Giovanni Zucchelli; Michael A. Pikos; Maurice Salama; Samuel Lee; Vincent Guillemette; Masako Fujioka-Kobayashi; Mark Bishara; Yufeng Zhang; Hom-Lay Wang; et al. Use of platelet-rich fibrin in regenerative dentistry: a systematic review. *Clinical Oral Investigations* **2017**, *21*, 1913-1927, 10.1007/s00784-017-2133-z.
2. Nesrin Saruhan; Ümit Ertaş; Evaluating of Platelet-Rich Fibrin in the Treatment of Alveolar Cleft With Iliac Bone Graft By Means of Volumetric Analysis. *Journal of Craniofacial Surgery* **2018**, *29*, 322-326, 10.1097/scs.0000000000004125.
3. Vikas Meshram; Pravin Lambade; Aishwarya Kadu; Manish Tiwari; The autologous platelet rich fibrin: A novel approach in osseous regeneration after cystic enucleation: A pilot study. *Indian Journal of Dental Research* **2015**, *26*, 560, 10.4103/0970-9290.176915.
4. Alessandro Crisci; Giuseppe Marotta; Anna Licito; Edda Serra; Giulio Benincasa; Michela Crisci; Use of Leukocyte Platelet (L-PRF) Rich Fibrin in Diabetic Foot Ulcer with Osteomyelitis (Three Clinical Cases Report). *Diseases* **2018**, *6*, 30, 10.3390/diseases6020030.
5. Joseph Choukroun; Antoine Diss; Alain Simonpieri; Marie-Odile Girard; Christian Schoeffler; Steve L. Dohan; A. Dohan; Jaafar Mouhyi; David M. Dohan; Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part IV: Clinical effects on tissue healing. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **2006**, *101*, e56-e60, 10.1016/j.tripleo.2005.07.011.
6. David M. Dohan; Joseph Choukroun; Antoine Diss; Steve L. Dohan; A. Dohan; Jaafar Mouhyi; Bruno Gogly; Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part II: Platelet-related biologic features. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **2006**, *101*, e45-e50, 10.1016/j.tripleo.2005.07.009.
7. David M. Dohan Ehrenfest; Antoine Diss; Guillaume Odin; Pierre Doglioli; Marie-Pascale Hippolyte; Jean-Baptiste Charrier; In vitro effects of Choukroun's PRF (platelet-rich fibrin) on human gingival fibroblasts, dermal prekeratinocytes, preadipocytes, and maxillofacial osteoblasts in primary cultures. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **2009**, *108*, 341-352, 10.1016/j.tripleo.2009.04.020.
8. Hardy F. Limeback; Jaro Sodek; Procollagen Synthesis and Processing in Periodontal Ligament in vivo and in vitro. A Comparative Study Using Slab-Gel Fluorography. *JBIC Journal of Biological Inorganic Chemistry* **1979**, *100*, 541-550, 10.1111/j.1432-1033.1979.tb04200.x.
9. Azita Tehranchi; Hossein Behnia; Fereydoun Pourdanesh; Parsa Behnia; Nelson Pinto; Farnaz Younessian; The effect of autologous leukocyte platelet rich fibrin on the rate of orthodontic tooth movement: A prospective randomized clinical trial. *European Journal of Dentistry* **2018**, *12*, 350-357, 10.4103/ejd.ejd_424_17.
10. Ana Nemtoi; Ana Sirghe; Alexandru Nemtoi; Danisia Haba; The Effect of a Plasma With Platelet-rich Fibrin in Bone Regeneration and on Rate of Orthodontic Tooth Movement in Adolescents. *Revista de Chimie* **2019**, *69*, 3727-3730, 10.37358/rc.18.12.6829.