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Effect of various methods of platelet-rich plasma gel preparation on transforming growth factor-β1 release

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Platelet-rich plasma (PRP) gel is used to deliver growth factors in high concentrations. There are differences in the last step of PRP preparation, which includes the addition of an agent to activate the release of growth factors from the platelet. The aim of this study was to determine the effect of PRP gel preparation by sodium alginate and by various concentrations of calcium–thrombin on the quantity of transforming growth factor-β1 (TGF-β1) released from PRP. This study was conducted in 20 adult male rats. PRP prepared from each rat was divided into four equal aliquots. Two different concentrations of calcium–thrombin were used in the activation of two of these aliquots, whereas sodium alginate was used in the activation of the third aliquot. Nothing was added to the fourth aliquot. The levels of TGF-βl in PRP gel preparations were assayed at 0, 1, 4, and 7 days by an enzyme-linked immunosorbent assay. Most TGF-β1 was released in the 4–7-day interval. The mean level of TGF-β1 was significantly elevated when thrombin and calcium were used in either concentration in comparison with other modes of PRP preparation. In conclusion, the highest amount of TGF-β1 released from PRP was obtained at 4-day and 7-day intervals by using thrombin and calcium chloride. ***Egypt J Oral Maxillofac Surg*** **2:17–21 © 2011 The Egyptian Association of Oral and Maxillofacial Surgeons**

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Introduction

The aim of periodontal therapy is to return the periodontal tissues to a healthy state, to regenerate lost attachment apparatus, and to achieve a gain in clinical attachment level [1].

Periodontal treatment, oral implant surgery, and maxillofacial reconstruction are highly dependent on successful bone regeneration. Bone regenerative techniques, including graft materials, some proteins (as growth factors), and barrier membranes, are often used to improve bone quality or bone quantity before or during these treatments [2,3].

The mechanisms and pathways that govern wound healing and tissue regeneration have been studied. The cellular and molecular events resulting after a traumatic injury are mostly shared by the different tissues of the body and include early and late inflammation phases, proliferation and migration of cells, angiogenesis, granulation tissue formation, and finally matrix formation and remodeling [4,5].

It is assumed that all the phases of tissue repair process are mediated and controlled by a wide range of growth factors (GFs) and cytokines that modulate cell function through direct physical interactions with the extracellular domain of transmembrane receptors. The latter transduce secondary signals, thereby controlling diverse aspects of subcellular biology. Although the role of all the GFs involved in tissue regeneration is only partially explained, the potential benefits of many of them have been shown. For example, platelet-derived growth factor is a powerful mitogen for connective tissue cells [6], transforming growth factor-β (TGF-β) not only stimulates osteoprogenitor cells to proliferate but also blocks in later stages of cell differentiation and mineralization [7], insulin-like growth factor-1 might promote the late-stage differentiation and the activity of osteoblasts, and vascular endothelial growth factor induces endothelial cell proliferation and migration, thus initiating the angiogenic response [8].

Some of these GFs are released by platelets that undergo active degranulation [9,10]. Factors released from the platelets include platelet-derived growth factor, TGF-β, platelet-derived epidermal growth factor, platelet-derived angiogenesis factor, insulin-like growth factor, and platelet factor 4 [11].

Platelet-rich plasma (PRP) gel obtained from autologous blood is used to deliver growth factors in high concentrations to the site of the bone defect or a region requiring augmentation [11]. There are differences in the last step of PRP preparation, which includes the addition of an agent to start gelation and the activation of platelets resulting in the release of a cascade of growth factors from the platelet α granules. Some investigators suggested different agents, such as bovine thrombin or fibrin adhesive or sodium alginate [12–17].

Although promising results have been obtained with the use of PRP in clinical applications, the optimal calcium and thrombin concentrations for PRP use are still unknown. A study conducted by Lacoste *et al.* [18] shows that calcium and thrombin induce immediate GF release from PRP in a dose-dependent manner and suggests that PRP could stimulate blood vessel formation.

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