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Systematic Review and Meta-Analysis
Dental Implants

Effectiveness of platelet-rich plasma as an adjunctive material to bone graft: a systematic review and meta-analysis of randomized controlled clinical trials

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Abstract. The use of platelet-rich plasma (PRP) has become a strategic therapy in tissue regeneration medicine. PRP represents a good source of growth factors. Due to this property, it has been considered a reliable adjunctive material in bone augmentation procedures, such as the sinus lift technique. The aim of this review was to assess the scientific evidence on the effectiveness of PRP as an adjunctive material in the sinus floor elevation technique. The following databases were searched for relevant published studies: Medline, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, CINAHL, Science Direct, ISI Web of Knowledge, and SCOPUS. Only randomized controlled clinical trials comparing a group receiving PRP as an adjunctive material to a control group without PRP, involving adult human subjects (age >18 years) with no systemic disease, were included. Of the studies identified, only one reported a significant difference in bone augmentation in favour of the adjunctive use of PRP, while four studies did not find any significant difference. None of the studies included reported a significant difference in the implant survival rate. Further randomized clinical trials are needed to clarify the effectiveness of adjunctive PRP.

Key words: sinus augmentation; platelet-rich plasma; oral surgery.

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Platelet-rich plasma (PRP) is an autologous concentration of platelets in a small volume of plasma.[1] PRP represents a good source of growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor beta (TGF-β), vascular endothelial growth factor (VEGF), epithelial growth factor (EGF), insulin growth factor 1 (IGF-1), and basic fibroblast growth factor (bFGF).[2,3] PRP gel is formed by mixing PRP, derived from centrifugation of autologous whole blood, with thrombin and calcium chloride.[4,2,5,6] Since its introduction, PRP has been used widely in dentistry, including in procedures such as sinus floor elevation, alveolar ridge augmentation, mandibular reconstruction, maxillary cleft repair, treatment of periodontal defects, and treatment of extraction sockets.[7]

Augmentation of the sinus floor is a surgical technique intended to allow the placement of dental implants in an otherwise atrophic maxilla.[8] Several materials such as autologous bone, allografts, alloplasts, and xenografts have been proposed as bone substitutes with osteoconductive properties; the use of these materials has produced largely successful outcomes.[9–11] However, in addition to these materials, the use of biological mediators with osteoinductive properties has been proposed with the aim of reducing the consolidation of the osteoconductive materials and accelerating the formation of newly formed bone.[12,13]

With this aim, PRP has been proposed as an adjunct to osteoconductive materials. However, no general consensus has been reached regarding its effectiveness. Some studies have reported positive effects,[14,15] while other studies have shown limited effects in relation to the efficacy of PRP in bone formation.[16,17] A previous meta-analysis on this topic has been reported; however, the systematic review included few studies and these were non-randomized, therefore potentially biased conclusions were reached.[18] There is, therefore, a need to systemically assess the literature on this topic.

The aim of the present systematic review was to assess the scientific evidence on the effectiveness of PRP as an adjunctive material in the sinus floor elevation technique.

Materials and methods

The present meta-analysis was conducted in accordance with the Cochrane Collaboration and the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines.[19,20]

Search strategy

A literature search of the following databases, up to and including 3 November 2014, was performed: Medline, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, CINAHL, Science Direct, ISI Web of Knowledge, and SCOPUS. The following search algorithm was used to explore the databases, using Boolean operators and the asterisk symbol (*) as truncation: (sinus lift OR sinus elevation OR ((''paranasal sinuses''[MeSH Terms] OR sinus) AND (''lifting''[MeSH Terms] OR lift))) AND (platelet rich plasma OR platelet gel OR platelet rich-plasma OR ''Platelet-Rich Plasma''[MeSH]). The MeSH terms were not used in the Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, CINAHL, SCOPUS, ISI Web of Knowledge, or Science Direct databases. Additionally, a hand-search was performed of issues of the following journals published in the last 15 years: *Clinical Oral Implants Research*, *Clinical Implant Dentistry and Related Research*, *European Journal of Oral Implantology*, *International Journal of Oral and Maxillofacial Implants*, *Journal of Oral Implantology*, *Implant Dentistry*, *International Journal of Oral and Maxillofacial Surgery*, *Journal of Oral and Maxillofacial Surgery*, *Journal of Dental Research*, and *Clinical Oral Investigations*. To be as inclusive as possible, no restrictions were applied with regard to the year of publication of the studies. In addition, the references of all selected full-text articles and related reviews were cross-checked.

Study selection

Two independent reviewers (LS, AP) screened the titles and the abstracts of the articles identified during the literature search in duplicate. Inter-reviewer reliability in the study selection process was determined by Cohen kappa test, assuming an acceptable threshold value of 0.61.[21,22] Disagreements in the inclusion or the exclusion of studies were resolved by discussion.

Eligibility criteria

The study selection process was performed by two blinded reviewers (LS, AP). Only randomized controlled clinical trials comparing a group receiving PRP as an adjunctive material to a control group without PRP, involving adult human subjects (age >18 years) with no systemic disease, were included.

Outcome variables

The radiographic outcome assessed was bone to implant contact. The histomorphometric outcome assessed was bone formation at least 3 months after the bone graft. The clinical outcome assessed was implant survival at least 12 months after

Table 1. Categories used to assess the quality of the studies included.

Category	Description	Grading
A	Sample size calculation, estimating the minimum number of participants required to detect a significant difference among compared groups	0 = did not exist/not mentioned/not clear 1 = was reported, but not confirmed 2 = reported and confirmed
B	Randomization and allocation concealment methods	0 = clearly inadequate 1 = possibly adequate 2 = clearly adequate
C	Clear definition of inclusion and/or exclusion criteria	0 = no 1 = yes
D	Completeness of follow-up (specified reasons for withdrawals and dropouts in each study group)	0 = no/not mentioned/not clear 1 = yes/no withdrawals or dropouts occurred
E	Experimental and control groups comparable at study baseline for important prognostic factors	0 = no 1 = unclear/possibly not comparable for one or more important prognostic factors 2 = clearly adequate
F	Presence of masking	0 = no 1 = unclear/not complete 2 = yes
G	Appropriate statistical analysis	0 = no 1 = unclear/possibly not the best method applied 2 = yes