

Platelet-Rich Plasma: Current Applications In Dermatology

Abhishek Kumar^{1*}, Vidhi Sangra², Tarun Gera³, Monu Barak⁴

¹MDS, Oral and Maxillofacial Surgery,

Consultant Oral Surgeon in Dentomax Dental and Surgical Centre, Jagadhri, Yamunanagar, Haryana, India.

²MDS, Oral and Maxillofacial Surgery,

Consultant Oral and Maxillofacial Surgeon at Root Canal Foundation Clinic, Jammu, Jammu & Kashmir, India.

³MDS, Oral and Maxillofacial Surgery,

Consultant Oral and Maxillofacial Surgeon in Dental Expert Multi Speciality Dental Clinic, Hisar, Haryana, India.

⁴BDS, FMC Fellowship in Medical Cosmetology, Consultant Dental Surgeon and Cosmetologist,

Dentomax Dental and Surgical Centre, Jagadhri, Yamunanagar, Haryana, India.

ABSTRACT

Platelet rich plasma (PRP) has played many pivotal roles in the field of aesthetics and dermatology. PRP has been known to contain various growth factors like TGF-b1, TGF-b2, interleukin-1 (IL-1), IL-6, granulocyte colony-stimulating factor (G-CSF), TNF-a, PDGF-AA, PDGF-BB, PDGF-AB, FGF, platelet-derived epidermal growth factor (PDEGF) etc. By utilising these growth factors, it has been applied in various surgeries like cardiac surgery, plastic surgery, ophthalmology, gynaecology and dentistry. In this review, there have been high chances of understanding the various clinical applications of platelet rich plasma (PRP).

Keywords: PRP, dermatology, Aesthetics.

*Correspondence to:

Dr. Abhishek Kumar,


MDS, Oral and Maxillofacial Surgery,

Consultant Oral Surgeon in Dentomax Dental and Surgical Centre, Jagadhri, Yamunanagar, Haryana.

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INTRODUCTION

Platelet rich plasma (PRP) or platelet concentrated plasma is processed by concentration of copious volume of platelets converting them into smaller volume of plasma.¹ its development has played a pivotal role in specialities such as aesthetics and dermatology. PRP composed of various growth factors such as TGF-b1, TGF-b2, interleukin-1 (IL-1), IL-6, granulocyte colony-stimulating factor (G-CSF), TNF-a, PDGF-AA, PDGF-BB, PDGF-AB, FGF, platelet-derived epidermal growth factor (PDEGF), platelet-derived angiogenesis factor (PDAF), platelet factor 4 (PF-4), EGF, keratinocyte growth factor (KGF), hepatocyte growth factor (HGF), and (IGF-1, IGF-2).^{2,3} This combination of growth factors helps in tissue repair, regeneration, development of bone structures and connective tissue.⁴ Hence it is widely used in other medical fields like cardiac surgery, plastic surgery, ophthalmology, gynaecology, dentistry.⁵ Over recent years properties of PRP in dermatology is vast which helps in regeneration of tissues, scar healing, rejuvenation of skin, healing of wounds and in prevention of hair loss (alopecia). It also stimulates proliferation of dermal fibroblast and synthesis of type I collagen which improves the scars caused by burns, acne scars and post-surgical scars which aids in improvement in the quality of skin and increased production of collagen and elastin fibers.^{6,7}

PREPARATION OF "ACTIVATED PRP"

PRP is processed either manually or with the use of automated devices, in a hospital setup just before the start of the procedure.^{1,2} PRP developing process is carried out in a strict aseptic sterile condition as and in an optimum temperature ranging from i.e., 20-22°C. ⁸In order to stop aggregation of platelets, PRP is prepared with an anticoagulant the most commonly used anticoagulant is citrate dextrose solution formula A (ACD-A) or sodium citrate. The platelets are isolated in higher concentrations and helps in attaining therapeutic benefit and are in a viable state at the same time, in order to secrete their growth factors. ⁹

Manual Double Spin Method

PRP "platelet-rich plasma is segregated from whole blood by 'light-spin' centrifugation method and the platelets are concentrated by 'heavy-spin' centrifugation method with transfer of the supernatant plasma." The basic conception separation of PRP separation procedure is as follows. The process of centrifugation separates the blood components based on their specific gravities, i.e., Red Blood Cells the heaviest component, followed by WBCs, whereas platelets are the lightest component. ¹⁰The first centrifugation process is to slow in order to avoid spinning down all the platelets and then to segregate plasma components from

the whole blood. The platelets are concentrated and settled on right on top of the Buffy coat layer. The subsequent centrifugation process is much faster, so that all the platelets present are spun down and get settled as a pellet at the bottom of the tube leaving the platelet-poor plasma (PPP) above. Approximately around 3/4 of the supernatant liquid is discarded and the platelet-rich pellet is then resuspended from the remaining amount of plasma. The resulting dissolution is the PRP.

The activator to trigger coagulation process is either with the help of Calcium chloride (CaCl₂) or thrombin and then degranulation of GFs aids to yield the "activated PRP". The platelet concentration yield depends mainly on parameters like size and shape of the container used, rate and time of spin and anticoagulant used. The centrifuge is refrigerated at 20°C to maintain the viability of the platelets and trypan blue staining helps in checking the viable state of the platelet concentrate obtained by the above method.¹¹

Automated Devices: For the preparation of PRPs numerous commercial devices of varying standards are available but their application is bit confused as each technique produces a different product with potentially dissimilar biology and with an unknown relative efficacy.¹² Although the automated devices are time saving, these are quite expensive when compared to the manual process. Easy reproducibility of the PRP product is also not consistent with these devices/ kits.

PRP IN ALOPECIA

The angiogenic role of PRP has gained attention among dermatologists and plastic surgeons are to explore its role in hair growth modality.¹³ The activated PRP concentration helps in stimulating the proliferation and division of stem cells in the hair follicle with the molecular mechanisms such as upregulation of transcriptional activity of beta catenin, increased bcl-2 levels by anti-apoptotic action, activation of Akt and ERK signalling pathways, expression of FGF-7 in dermal papilla cells and by proangiogenesis by increasing VEGF and PDGF. The efficiency of PRP in alopecia treatment according to Akiyama et al,¹⁴ epidermal growth factor and transforming growth factor which are involved in the growth and differentiation of bulge cells, and platelet-derived growth factor may have associated functions in the interactions between the bulge and the related tissues, starting with follicle morphogenesis. Beside this mechanism, the anagen phase is also activated by Wnt/β-catenin/T-cell factor lymphoid enhancer. In the dermal papilla cells, activation of Wnt will lead to accumulation of β-catenin, in combination with T-cell factor lymphoid enhancer which promotes survival, proliferation and angiogenesis.¹⁵ The dermal papilla cells help to initiate the division from the telogen to anagen phase. The other mechanism of dermal papilla (DP) cell is involved in the activation of extracellular signal-regulated kinase (ERK) and protein kinase B (Akt) signal which promotes cell survival and also aids in preventing apoptosis. But the appropriate role of PRP in promoting hair growth is not fully understood yet.¹⁶ The mechanism of evaluating the effects of PRP on hair growth using in vitro and in vivo models has been studied. In an in-vitro model, the activated PRP increased the proliferation of DP cells by activating ERK and Akt signals thus leading to anti-apoptotic effects. It also increased the beta catenin activity and FGF-7 expression in DP cells. In an in-vivo model, the mice were injected with activated PRP helps to exhibit faster telogen to anagen transition on comparison to control group.¹⁷

PRP IN SKIN REJUVENATION

PRP aids in increasing the dermal elasticity by aggravating the elimination of photo damaged extracellular matrix components and thereby inducing the production of new collagen by activation of dermal fibroblasts through various molecular mechanisms which include increased proliferation of human dermal fibroblasts,¹⁸ increased matrix metalloproteinase (MMP)-1 and MMP-3 expression, an increased synthesis of procollagen type 1 peptide and expression of collagen type-1, alpha-1 which production of new collagen, and an increased expression of Growth 1 cell cycle regulators which aggravates wound healing.^{19,20} The use of PRP in skin rejuvenation is studied by combining the topical PRP with non-ablative (erbium glass) laser, resulting in improvement of skin elasticity and with an increase in collagen production. On histological examination, an increase in length of dermoepidermal junction, and number of fibroblasts and collagen in the treated skin was observed. The treatment of deep wrinkles and severe photo damaging skin with PRP in combination with fractional ablative lasers (carbon dioxide) reduced transient adverse effects and decreased the downtime.²¹

PRP IN SCARS

PRP plays a promising treatment modality in soft tissue augmentation techniques. The activated PRP when used as filler in order to correct the deep nasolabial folds without any side effects. It can also be used as an alternative in autologous fat transfer procedures. The fat grafts when combined with PRP increases the vascularity, less fibrosis, fewer cysts and vacuoles and overall improved quality when compared to saline. Other findings suggests that fat grafts can be admixed with PRP in treating traumatic scars followed by fractional laser resurfacing to give good results.²² PRP injections in combination with fractional carbon dioxide resurfacing have shown good results in acne scar resurfacing also, apart from skin rejuvenation.

PRP IN ACUTE AND CHRONIC ULCERS

Based on the earlier studies, PRP revealed promising results in the treatment of diabetic neuropathy and other chronic wound ulcers as similar to recombinant PDGF-ββ (becaplermin) gel. Activated PRP is rich in growth factors and has displayed promising results when applied topically to the non-healing ulcers, to enhance re-epithelization.²³

In a study by Kim et al,²⁴ topical application of PRP significantly accentuated the re-epithelialisation process in the case of stasis ulcers, diabetic ulcers, livedoid vasculitis, claw foot and traumatic ulcers by up regulation of cell cycle regulatory proteins like cyclin A and CDK4. Even dermatomyositis related with elbow ulcers have been successfully treated with PRP.

PRP IN VITILIGO

PRP with its increased concentration in growth factors aids in proliferation of melanocytes and repigmentation which plays a vital role for managing vitiligo. Carbon dioxide laser promotes the growth factor secretion and thus helps to treat vitiligo lesion.²⁵

PRP IN MELASMA

PRP is found to be effective in the treatment of conditions like melasma due to the presence of TGF-β1 which helps to decrease melanogenesis. In addition to it, PDGF helps to increase skin

volume and which may increase the supplement of skin texture in melanotic conditions. Numerous case reports have been found to show improvement in melasma with the use of PRP injections.²⁶ A study which evaluated that use of PRP injection among 23 adult melasma patients have found to be reported with significant improvement in melasma area and the severity index have been improved with good MASI scores.²⁷ The same study also have compared PRP administration using micro needling method versus microinjection techniques in melasma and found that both were equally effective.

CONCLUSION

PRP is considered as a new therapeutic option for different treatment modalities in the field of dermatology and cosmetology. Hence, understanding the biology and mechanism of action of PRP therapy will help the clinicians in selecting specific system/devices and characterizing the type of PRP which helps in standardization of PRP, making it less easy to sort and interpret the available findings from various studies. Since there is no double blind, randomized, placebo-controlled trials conducted on a large sample size to constitute a good quality of evidence. Thus, a healthy amount of caution should be exercised by the treating physician with appropriate preparation and use during PRP procedures.

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