

## Review Article

# Platelet rich plasma in dermatology and cosmetology

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### ABSTRACT

Platelet rich plasma (PRP) therapies in medicine has become increasing popular during the last decade. The interest in in the application of PRP in dermatology and cosmetology has increased recently in different applications such as alopecia, skin rejuvenation, wound healing, scar revision, and tissue regeneration. PRP is an autologous blood product obtained from the blood of the patients. The detailed knowledge about PRP should help clinicians better understand this therapy. In this view, the current review was done for a better understanding of what pathologies can be corrected with PRP.

**Keywords:** PRP, Dermatology, Cosmetology, Alopecia, Skin pathologies

### INTRODUCTION

Platelet rich plasma (PRP) is also known as platelet concentrated plasma, autologous platelet gel or plasma-rich growth factors.<sup>1</sup> It is prepared by concentrating abundant platelets into a small volume of plasma. The successful utilization of PRP in dentistry is well documented by Marx et al.<sup>2</sup> This development has fueled research on its role in other specialties like aesthetics and dermatology.

PRP is a concentrate of multiple fundamental growth factors (GFs) by virtue of platelets alone and plasma proteins such as fibrin, fibronectin and vitronectin.<sup>3</sup> This combination is important for tissue repair, regeneration, structural development of the bone and connective tissue and helps in epithelial migration.<sup>4</sup>

Due to this mechanism, PRP has been used extensively in the musculoskeletal field in sports injuries.<sup>5</sup> Other medical fields that are using PRP are gynecology,

urology, cardiac surgery, plastic surgery and ophthalmology.<sup>6</sup> Recently PRP has gained interest in dermatology for its properties in conditions such as tissue regeneration, wound healing, scar revision, skin rejuvenating effects and alopecia.<sup>7-12</sup>

PRP plays an important role in stimulating human dermal fibroblast proliferation and increased type 1 collagen synthesis.<sup>13</sup> This made its utilization in cosmetic dermatology such as improvement of burn scars, postsurgical scars and acne scars. PRP alone or in combination with other techniques improve the quality of the skin by increasing the production of elastic and collagen fibres.<sup>14</sup>

Preparation of activated PRP is done either manually or by the use of automated devices under strict aseptic conditions and at optimum temperature regulations. Anticoagulant (citrate dextrose solution A or sodium citrate) is used to inhibit platelet aggregation.<sup>3</sup>

## PRP IN ALOPECIA

The angiogenic role of PRP gained attention of dermatologists and plastic surgeons to explore its use in hair growth modality. Activated PRP stimulates proliferation and differentiation of stem cells in the hair follicle bulge area via multiple molecular mechanisms such as upregulation of transcriptional activity of beta-catenin, increase bcl-2 levels by anti-apoptotic action, activation of Akt and ERK signaling pathways, expression of FGF-7 in dermal papilla cells and by proangiogenesis by increasing VEGF and PDGF.<sup>15</sup>

The efficacy of PRP in alopecia treatment is documented by few studies. According to the study performed by Akiyama et al, epidermal growth factor and transforming growth factor are involved in controlling 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.<sup>16,17</sup> Beside this mechanism, the anagen phase is also activated by Wnt/ $\beta$ -catenin/T-cell factor lymphoid enhancer.<sup>18</sup> In the dermal papilla cells, activation of Wnt will lead to accumulation of  $\beta$ -catenin, in combination with T-cell factor lymphoid enhancer which promotes survival, proliferation and angiogenesis. Then the dermal papilla cells in turn initiate the differentiation from the telogen to anagen phase.<sup>19</sup>

Another mechanism in the dermal papilla (DP) cell involved is the activation of extracellular signal-regulated kinase (ERK) and protein kinase B (Akt) signaling that promotes cell survival and prevents apoptosis.<sup>15</sup> Exact role of PRP in promoting hair growth is not fully understood. Li et al explained the mechanism by evaluating the effects of PRP on hair growth using *in vitro* and *in vivo* models. In the *in vitro* model, activated PRP was applied to isolated human DP cells. The results proved that PRP increased the proliferation of DP cells by activating ERK and Akt signaling, leading to antiapoptotic effects. It also increased the beta-catenin activity and FGF-7 expression in DP cells. In the *in vivo* model, mice injected with activated PRP exhibited a faster telogen-anagen transition in comparison to control group.<sup>15</sup>

Another mechanism was proposed for the action of PRP on human follicles by Gupta et al. They found elicitation of the Wnt/ $\beta$ -catenin, ERK, and Akt signaling pathways are responsible for promoting cell survival, proliferation, and differentiation.<sup>19</sup> After binding of growth factors with its respective GF receptor, the signalling for the responsible expression begins. The GF-GF receptor activates both Akt and ERK signalling. This activation of signals will inhibit 2 pathways through phosphorylation. Firstly, glycogen synthase kinase-3 $\beta$  that promotes degradation of  $\beta$ -catenin and secondly, Bcl-2-associated death promoter, which is responsible for inducing apoptosis. By these mechanisms PRP might increase

vascularization, prevent apoptosis and prolong the duration of anagen phase.<sup>17</sup>

## PRP IN SKIN REJUVENATION

It has been reported that use of PRP increases dermal elasticity by stimulating the elimination of photodamaged extracellular matrix components and by inducing the synthesis of new collagen by dermal fibroblasts via various molecular mechanisms that include increased proliferation of human dermal fibroblasts, increased expression of matrix metalloproteinase (MMP)-1 and MMP-3 (removal of photodamaged ECM), increased production of procollagen type 1 peptide and expression of collagen type-1, alpha-1 which synthesis new collagen, and increased expression of G1 cell cycle regulators which accelerates wound healing.<sup>20,21</sup>

The use of PRP in skin rejuvenation is evidenced by the reports of Shin et al.<sup>22</sup> He used a combination of topical PRP with fractional non-ablative (erbium glass) laser therapy, resulted in improvement in skin elasticity and increase in collagen density. Histological examination showed an increase in length of dermoepidermal junction, and number of fibroblasts and collagen in the treated skin.

In another study, treatment of deep wrinkles and severe photodamaging skin with PRP in combination with fractional ablative lasers (carbon dioxide) reduced transient adverse effects and decreased the downtime.<sup>23</sup>

## PRP IN SCARS AND CONTOUR DEFECTS

PRP has become a promising modality among soft tissue augmentation techniques. Activated PRP has been used as a filler to correct deep nasolabial folds without any adverse effects. It can be used as an adjuvant in autologous fat transfer procedures. In an *in vitro* pilot study, the findings revealed that fat grafts in combination with PRP increased vascularity, less fibrosis, fewer cysts and vacuoles and overall improved quality and life time of fat grafts compared to saline.<sup>24</sup> Other findings suggest that fat grafts can be admixed with PRP in treating traumatic scars followed by fractional laser resurfacing to give good results. PRP injections in combination with fractional carbon dioxide resurfacing have shown good results in acne scar resurfacing also, apart from skin rejuvenation.<sup>25</sup>

## PRP IN ACUTE AND CHRONIC ULCERS

PRP showed promising results in the treatment of diabetic neuropathy and other chronic wound ulcers as similar to recombinant PDGF- $\beta\beta$  (becaplermin) gel. Activated PRP is rich in growth factors, and has shown promising results when applied topically to the non-healing ulcers, to enhance re-epithelization.<sup>26</sup>

In a study by Kim et al, topical application of PRP significantly accelerated the re-epithelialisation process in the case of stasis ulcers, diabetic ulcers, livedoid vasculitis, claw foot and traumatic ulcers by upregulation of cell cycle regulatory proteins like cyclin A and CDK4.<sup>27</sup> Even dermatomyositis associated elbow ulcers have been successfully treated with PRP.<sup>28</sup>

### PRP IN LIPODERMATOSCLEROSIS

Subcutaneous PRP injections in five sessions fortnightly showed complete re-epithelization of venous ulcer and marked improvement in hyperpigmentation and induration at the treated site.<sup>29</sup>

### SAFETY OF PRP

PRP is an autologous preparation and is devoid of any serious adverse effects. Pain or secondary infection at the site of infection can be avoided with proper precautions. PRP is safe and has no issues regarding transmission of infections such as hepatitis-B, C or HIV. Still, some safety concerns with bovine thrombin have been raised about the potential transmission of Cruetzfeld-Jacob disease (mad-cow disease) but some authors refuted the statement affirming that prion vector has been found only in the neural tissues of cattle, whereas thrombin is exclusively isolated from the blood and is also further processed by heating.<sup>30</sup> Some reports stated that post-operative bleeding due to bovine thrombin-induced factor-V deficiency, have made it an unpopular choice but use of CaCl<sub>2</sub> as an activator, automatically eliminates the above risks.<sup>31,32</sup>

### CONCLUSION

PRP can be considered as new therapeutic option for different pathologies in dermatology and cosmetology. Understanding the biology and mechanism of action of PRP therapy will help clinicians in selecting specific system to meet the needs of a given indication. In addition, characterizing the type of PRP will helps in standardization of PRP, making it easier to sort and interpret the available data.

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