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An introduction to application of platelet rich plasma (PRP) in skin rejuvenation

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ABSTRACT

Platelet-rich plasma (PRP) is an autologous concentration of human platelets contained in a small volume of plasma characterized by haemostatic and tissue repairing effects. Tissue repairing effects and being enriched by various kind of growth factors, has made them the focus of attention for different procedures. PRP has been effective in bony defects, wound healing and recently for aesthetic procedures in plastic surgery. The purpose of this review is to evaluate and summarize the applications of PRP in the dermatology literature, with particular focus on rejuvenizaton process, advances and limitations of current PRP therapies. We studied literature related to PRP therapy, these include regeneration of soft tissue, skin aging mechanisms, as well as wound healing.

Some studies have shown promising results, with favorable outcomes about PRP clinical application for skin rejuvenization. This article summarizes our current understanding regarding photoaging process and the role of PRP in the skin rejuvenization process. PRP has been shown to be useful in skin rejuvenization. Further studies are needed to elucidate both basic and clinical aspects of PRP therapies. In particular, platelet preparation methods, different application methods, platelet mechanism of action in rejuvenation field, interactions with the skin components, long-term efficacy and safety are necessary to be determined.

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Introduction

Platelet-rich plasma (PRP), platelet-rich concentrate, autologous platelet gel or platelet releasate, all refer to one concept (1). which is an autologous concentration

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of human platelets contained in a small volume of plasma (2,3). It is known for a long time that fibrin clot and platelets have haemostatic and tissue repairing effect (4). In 1975, an article was published with the concept of platelet gel under the title of: 'use of platelet-fibrinogen-thrombin mixture as a corneal adhesive (5). An exciting report was published in 1979 about the usage of gel foam in sutureless nerve anastomosis (4,6). After a few years an animal model showed that platelets and fibrin initiate a process consist of cell migration, collagen synthesis, fibroplasia and angiogensis which helps the lesion healing (4,7). The real application of platelet releasate in treating wounds, has begun in the mid-1980s after publication of Kingthon et al. in 1986 (4,8).

In 1997 another important report was published about the maxillofacial surgery and platelet gels. The usages of platelet gel became more popular in late 1990s, after the publication (1998) of a paper about the effectiveness of the platelet-rich plasma (PRP) in bone regeneration in the field of dental care (4,9,10).

There are several growth factors in α-granules of platelets, secreted after the activation of platelets by aggregation initiators. These factors including platelet-derived growth factor (PDGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF) and insulin-like growth factor (IGF) regulate cell migration and attachment (11-13). Some studies indicate that platelets have anti-inflammatory and analgesic effects and secrete antimicrobial peptides, thus have antibiotic effects (14-16). More than 800 proteins are secreted in this matrix (14,17) affect on various cell types: osteoblasts (18), chondrocytes (19), fibroblasts(20), endothelial cells (21), mesenchymal stem cells from different origins (22), myocytes and tendon cells (18) which lead to a wide range of surgical and clinical procedures and treatments which help the platelet concentrated products (14).

Nowadays, there are publications about the use of PRP in chronic wound treatment, soft tissue injuries, periodontal and oral surgery, maxillofacial surgery, orthopedic and trauma surgery, spinal surgery, heart bypass surgery, burns, cosmetic and plastic surgery, gastrointestinal surgeries (23-30). We want to summarize the use of PRP in dermatology especially in skin rejuvenization.

Skin rejuvenation

In the past decade, PRP has attracted the attention of dermatologists specifically in the aesthetic field for skin rejuvenation.

Skin aging

Aging skins has obvious characteristics such as red-brown-mottled dyschromia, dryness and fine wrinkles. Moreover, cell replacement and wound healing decrease with age and some changes take place in skin texture such as sagging and wrinkling (31). Aged skin is known histologicaly, by a flattened dermo–epidermal junction, dermal atrophy and fewer fibroblasts (3). Among different degenerative processes cause skin aging, decreasing in fibroblasts collagen production the most important one. Interaction of fibroblasts with keratinocytes, adipocytes and mast cells is important in skin aging processes. In addition, they are loaded with several kinds of ECM (extra cellular matrix) proteins, glycoproteins, adhesive molecules and cytokines. They produce these molecules, strengthen the skin cell interactions and participate in fibroblast-keratinocyte-endothelium axis that preserves skin integrity and youth (32).

Several cytokines and growth factors work in the stimulation process of fibroblasts for collagen synthesis (12).

Nowadays, there is an increasing amount of harmful effects on the skin such as malignancies, immuno-suppression, hyper pigmentation, wrinkles, aging and etc., due to the increasing rate of UV radiation (33).

The prolonged human skin exposure to sun or UV irradiation lowers the resilient properties of the skin and so degenerates the three-dimensional structure of resilient fibers (elastotic degeneration), disorganizes collagen fibrils which lead to decreasing the skin flexibility. The UV radiation incorporates by special chromophore in the skin, such as melanin, deoxyribonucleic acid (DNA), ribonucleic acid, proteins, lipids, water, aromatic amino acids, trans-urocanic acid and etc. Which consequently create reactive oxygen species (ROS) (34). ROS makes histochemical changes: the stratum spinosum thickening and dermoepidermal junction flattening (35).

On the other hand, the studies have shown the effect of growth factors and cytokines in preserving the skin texture such as fibroblast growth factor (FGF1) which is important in the regeneration and proliferation process of skin cells, accumulation of collagen type 1 alpha 1 protein in skin and inhibition of UV-induced skin damages (12).

Conventional anti-aging strategies, such as those involving lasers and topical treatments, typically aim to increase ECM synthesis through the activation of fibroblasts (3).

Anti aging mechanisms of PRP

Platelet concentration is a rich source of various cytokines and growth factors, which are activated after its injection into the target tissue. Platelets are activated endogenously by coagulation factors (in some methods of preparing PRP, the activated PRP is injected to the tissue). Following their attachment to special receptors on the cell surfaces, some intracellular processes are activated, that facilitate extracellular matrix (ECM) accumulation and improve cell proliferation and differentiation. Tissue regeneration is resulted from cell proliferation, angiogenesis and cell migration (36,37).

Matrix metaloproteinas proteins (MMP) are involved in aging process by degradation of collagen and other extracellular matrix (ECM) proteins (38), this characteristic can be used to benefit rejuvenation. They can help regeneration of dermis through omission of collagen fragments that are harmful to the dermal connective tissue, and so, provide an appropriate foundation for new collagen deposition (38). In some studies aPRP (activated PRP) increases the expression of MMP-1 and MMP-3 protein. Thus, aPRP may cause ECM remodeling through stimulating the removal of photo-damaged ECM components and inducing the synthesis of new collagen by fibroblasts, which are in turn proliferated by their stimulation (12).

Another study showed that high concentration of PRP increased type I collagen, MMP-1 and MMP-2 expression in human skin fibroblasts (39).

In addition to above mechanisms, improving aging skin through PRP which is a dose-response relationship has been recognized between concentrated platelet and mesenchymal stem cell proliferation (40).

Another mechanism of PRP for skin rejuvenization, is through acceleration of hyaluronic acid production. Hyaluronic acid absorbs water and makes hyaluronic acid matrix swelled which increases skin volume and turgor. It also promotes cell proliferation, extracellular matrix synthesis and helps to the adjustment of the collagen fibers diameter. Overall, it could enhance skin elasticity (41). All these processes and some other unknown ones contribute to tissue rejuvenation through PRP.

Clinical effects

Recent studies demonstrated that injection of PRP in the face and neck for the purpose of revitalization would lead to promising outcomes (38). Some studies suggest that PRP may have value in rejuvenation of wrinkled and sagging skin (42). Although, methods of PRP application such as topical application or direct injection are being investigated, there is yet no definite method for clinical use of PRP (12).

Platelet Rich Plasma (PRP) is used for stimulation of both superficial and deep dermis layers. For superficial stimulation, the injection must be done in the superficial dermis. The PRP must be injected into the deep dermis or subdermal tissues when using as filler. The superficial injection might be done just like mesotherapy technique in order to improve the skin texture, volume and hydration (43). The technique is easy to be performed and has no important side-effects (12). Side-effects might appear from mild bruising and occasional swelling to rarely infections (43).

Some other study has demonstrated aPRP as a beneficial primary or adjunctive treatment (adjuvant treatment to lasers) for the tissue rejuvenation (3). Another study has assigned contraindications for PRP application which consists of pregnancy, breastfeeding, malignancy, autoimmune or blood diseases (44).

Conclusion

Compared with other skin rejuvenation therapies, the clinical experience using PRP can result in skin rejuvenation and global facial volumisation (38). PRP is a form of bio-stimulator that is safe and creates an immediate, long lasting volumetric effect with natural looking results. Taken together, the PRP injections have provided a high level of patient satisfaction (43). Regard to few studies on the rejuvenation effects of PRP, there are many concepts in this field that need to have clear definition such as platelet-rich plasma, platelet gel and platelet releasate. Both methods and product need definition, standardization, specific quality parameters and clinical indications and contraindications. Due to limited studies on clinical efficacy and safety, further studies are required to investigate the mechanism of action behind the therapeutic effects of these products and their long term safety.

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Conflict of Interest

The authors declare no conflict of interest.

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