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Use of Platelet-Rich fibrin In Facial Plastic Surgery: A Review Of Literature

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Abstract- *Platelet aggregates has been used in surgery for many years. The primary goal of these 'Autologous Preparation' was to aggregate platelets and their growth factors and to convey it to a surgical site, to improve healing only. The latest research work shows that the PRF also can be used for Protection of Graft, neoangiogenesis, vascularization locally and release of various growth factors apart from healing.*

Platelet rich fibrin (PRF) is considered as the new generation of platelet concentrate. "Choukroun's PRF" or Leucocyte PRF (L-PRF) is the new development, which was first developed by Choukroun's et al. in 2001 as an 'Autologous biomaterial.' A systematic literature search was performed to identify relevant articles that describes the use of PRF, through PubMed and Scopus.

The focus of this article is to explore the role of PRF in esthetic facial surgery.

Key words- *Platelet rich fibrin, Platelet aggregates, facial plastic surgery*

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I. Introduction

Marx et al. in 1998 introduced Platelet-rich plasma and the platelet-rich fibrin (PRF), which was developed by Choukroun et al. in 2001 as an autologous biomaterial, also known as Leucocyte PRF (L- PRF). [1] PRF contains a fibrin matrix polymer, blood aggregates, leucocytes, cytokines and stem cells within it which acts as a biodegradable scaffold that favors the development of microvascularization and is able to guide epithelial cell migration to its surface. [2, 3] Also, PRF may serve as a medium in carrying cells involved in tissue regeneration and seems to have a sustained release of growth factors in a period between 1 to 4 weeks, stimulating the environment for wound healing in a significant amount of time. [4, 5] It has a complex structure of strong fibrin matrix with favorable mechanical properties, similar to blood clot. [5] Some studies have demonstrated that PRF is a healing biomaterial with a great potential for bone and soft tissue regeneration, without inflammatory reactions and may be used alone or in combination with bone grafts, promoting hemo-stasis, bone growth, and maturation. [6] PRF is obtained by centrifugation with autologous peripheral blood, without adding any biological agents. Platelets release a variety of cytokines and growth factors, including tumour growth factor β (TGF- β), platelet-derived growth factor (PDGF), insulin like growth factor-1 (IGF-1), basic fibroblast growth factor (bFGF), vascular endothelial growth factor (VEGF), connective tissue growth factor (CTGF) and so on. [3, 7, 8]

II. Preparation of L-PRF

Protocol of preparation of PRF was developed by Choukroun et al. The method of PRF preparation is simple; however it is to be prepared just before its use.

Requirements:

(i) Table centrifuge,
(ii) Dry glass test tube 10-mL (without anticoagulant),
(iii) Armamentarium for Blood collection

PRF protocol needs only centrifuged blood without any addition of anticoagulant and bovine thrombin. Then, a blood sample is taken without anticoagulant in 10-mL tubes in a glass or glass-coated plastic tube, then immediately centrifuged at 3,000 rpm for 10 minutes or 12 minutes at 2700 rpm or 14 minutes at 1500 rpm. [1, 2]

The absence of any anticoagulant permits the activation of platelets to set off a coagulation cascade. Due to the absence of the anticoagulant, the blood coagulates immediately upon contact with the glass tube.

Initially, fibrinogen occupies the upper part of the tube, only till the circulating thrombin transforms it into a fibrin network.

The layers that are formed are as follows:

(a) The bottom part contain the RBCs,

(b) The centre part contains the fibrin clot,

(c) The upper part contain acellular plasma.

The upper part of the test tube which contain the acellular plasma is discarded. Centre part which contains the fibrin clot is then removed and is scrapped far-away from the lower part containing the red blood cells. The natural and progressive polymerization results in a fibrin clot formation with substantial embedding of platelets, and leukocyte growth factors into the fibrin-matrix. An autologous fibrin membrane obtained after squeezing of clot between two gauze pieces. The serum exudate is rich in proteins like vitronectin and fibronectin. This exudate may be used to hydrate graft materials, rinse the surgical site, and store autologous graft. [1, 3]

PRF can be further modified to two types: An advanced type of PRF that is A-PRF, which contains significant white blood cells and other one is concentrated growth factors (CGF), prepared under a facilitated intrinsic coagulation cascade. Advanced-PRF (A-PRF) and injectable-PRF (i-PRF) are different from conventional PRF and is based on the concept that low speed of centrifugation, contains higher number of leukocytes, platelets, and growth factor concentration-enhancing the regeneration process. [2]

III. Application Of PRF In Facial Plastic Surgery

The facial plastic surgeries demands strong clotting and wound-healing responses. The resulting blood clots consist mainly of erythrocytes. Introducing PRF to the surgical site efficiently replaces the erythrocytes with fibrin, WBC's, stem cells, and platelet derived growth factors. This accelerates wound healing and attraction of MSCs to the site, making the foundation for tissue regeneration, collagen remodelling, and a noticeable cosmetic result.

In rhinoplasties, cartilage grafts are required to get optimal results. Cartilage grafts are formed from diced autologous or cadaver cartilage. Diced cartilage when used alone may scatter after placement, resulting in structural irregularities which are palpable or visible. [9, 10] PRF aids in forming and depositing cartilage grafts by acting as a physiologic glue that enhances the consistency and pliability of the grafts and reduces the probability of graft rejection owing to its autologous nature. Studied in a rabbit model, PRF effectively improved cartilage graft viability. [9]

The typical amount of PRF used in a facelift surgery is about 2 mL per side. After the superficial muscular aponeurotic system (SMAS) modification, PRF is uniformly administered from a 3-mL syringe via a plastic angiocatheter placed under the skin flap as distally as possible. Excess fluid is then rolled out and skin is closed in the usual fashion. No drain is used, and a compressive facelift dressing is placed. During rhinoplasty PRF may be injected along the osteotomy lines, immediately after withdrawing the osteotome using a 21-gauge needle, 2 mL/side. [11] Use of platelet concentrates plays significant role in scar revision procedures.

Various applications of PRF are as follows-

1. Natural Filler:

Collagen, elasticity, and volume are lost naturally while ageing of skin. The thinning of dermis takes place and the fibroblast declines, reducing the production of hyaluronic acid & collagen. As collagen decreases, skin laxity and wrinkling become apparent. [12, 13] Our skin also loses moisture because the hydrophilic hyaluronic acid concentration decreases. [14] As a result, the dermis loses its turgidity, results in volume loss and unaesthetic changes. [15] Stimulating production of collagen and hyaluronic acid within ageing skin may reverse these changes. Here, PRF play its role.

With high concentrations and slow release of fibroblastic growth factors, PRF, when injected beneath the skin, should stimulate formation of fibroblast and increase collagen and hyaluronic acid contents. PRF also entangle hyaluronic acid, supporting it where injected. [3] PRF forms a gel & produces volumization effect; although this volumization lasts only a few weeks, repeated treatments show long-term effects from prolonged collagen production and localized regenerative activity.

2. Fat Grafting:

Autologous fat transfer, is comparatively more invasive than the hyaluronic acid fillers, effectively restores volume loss. Fat grafts provide potentially permanent volume restoration unlike conventional dermal fillers. [16] PRF plays role in improving fat retention. Adipose tissue is considered as source of stem cell. [17] Furthermore, subcutaneous fat is a source of progenitor cells because of its accessibility, abundance, and the existence of a supportive stromal vascular fraction (SVF). The SVF of the abdominal subcutaneous tissues is

regarded as an exceptional fat harvesting location considering its abundant supply of adipose-derived stem cells. [18]

However, stem cell viability can be difficult to sufficiently sustain while in transit during fat transfer. Liu and colleagues highlighted the enhancement of fat transfer with PRF supplementation, detailing that implementing PRF reduced resorption and improved retention of fat grafts. PRF's effect on fat survival likely results from its prolonged growth factor release and the ability of the autologous fibrin matrix to sufficiently support stem cell transfer.

After judging the amount of transfer required based on the patient's requirements, autologous fat is harvested and purified using the technique described by Coleman. [14] The centrifuged fat is then mixed with PRF in a 2:1 ratio. Two milliliters of fat are transferred to a 5-mL syringe, to which 1 mL of PRF is added. Contents of the syringe are then mixed by gently passing them back and forth between two 5-mL syringes several times. The mixture is then transferred to separate 1-mL syringes for use.

The fat/PRF mixture can then be placed in desired areas using stab incisions placed at distances from the deposit site. Incisions are then closed using appropriate sutures. [11]

3. Correction of Nasolabial folds:

A 27-gauge or 30-gauge needle is used to inject PRF into the desired areas at the dermal-sub dermal layer in a fanlike pattern. In the case of marionette folds, injection should ideally be limited to a triangular area with its base along the white roll of the lower lip. Injection lateral to the depressed area should be avoided. Overcorrection by 20% to 25% is desired. Typical volumes of PRFM used are 1.50 to 2.00 mL for nasolabial folds and 0.75 to 1.25 mL for marionette folds, per side. Similar techniques may be used to treat perioral rhytids, prejowl folds, or other desired areas. [11]

4. Wound healing

Many literature reported the effect of PRF in wound healing. Lundquist et al. suggested that the L-PRF could be beneficial for the healing of recalcitrant wounds by investigating the characteristics of L-PRF. Jorgensen et al. also suggested the consistent results. Chignon-Sicard et al. investigated the efficacy of L-PRF in a randomized controlled clinical trial (RCT) of wound healing and demonstrated that a single L-PRF application on fresh postoperative hand wounds shows a median improvement of 5 days in comparison to the standard treatment.

During PRF processing by centrifugation, platelets are activated and their massive degranulation implies a very significant cytokine release. By quantifying PDGF-BB, TGF-β1, and IGF-I within PPP (platelet-poor plasma) supernatant and PRF clot exudate serum. The analyses revealed that slow fibrin polymerization during PRF processing leads to the intrinsic incorporation of platelet cytokines and glycanic chains in the fibrin meshes. Moreover, during PRF processing, leucocytes could also secrete cytokines in reaction to the haemostatic and inflammatory phenomena artificially induced in the centrifuged tube. By quantifying five significant cell mediators within PPP supernatant and PRF clot exudate serum: three pro-inflammatory cytokines (IL-1β, IL-6 and TNF-α), one anti-inflammatory cytokine (IL-4) and a key growth promoter of angiogenesis (VEGF), the analyses revealed that PRF could be an immune regulation node with inflammation retrocontrol abilities. This result would imply that PRF, unlike the other platelet concentrates, would be able to progressively release cytokines during fibrin matrix remodelling. This concept also could explain the reduction of postoperative infections when PRF is used as a surgical additive and the clinically observed healing properties of PRF.

Advantages of PRF-

- ❖ The preparation of PRF (Choukroun's) is simple and effective, easily accessible by all clinicians.
- ❖ No risk of immunological reaction as preparation is made from autologous blood sample.
- ❖ PRF can be used alone at desired site or can be used along with the bone graft depending upon requirement, therefore increases healing of grafted bone.
- ❖ When compared to PRP (platelet rich plasma), PRF is more efficient.
- ❖ The natural fibrin structure of PRF with growth factors keep their activity for longer duration hence encourages tissue regeneration effectively.

Disadvantages of PRF

- ❖ The availability of amount of final preparation is less because autologous blood is used.
- ❖ The success of PRF at the site where it is used depends upon method of preparation and its accuracy.
- ❖ It is slightly difficult to store PRF for longer duration as it shrinks.
- ❖ Manipulation of PRF requires clinical experience.

IV. Conclusion

The platelet concentrates such as PRF is used in many ways, for different surgical procedures. Different biomaterials and autologous glues are available in market under the same name. However, PRFs can be regarded as dense fibrin biomaterial with biomechanical properties. A high density fibrin clot act as a biological healing matrix by release of cytokine and support cell migration, enhance patients natural ability of wound healing. Use of an autologous PRF treatment is a well-tolerated, can be a good choice for use in the face. More studies on the precise mechanism of action of PRF, development and recent advances in technique are ongoing.

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