

The Application of Blood Products in Plastic Surgery: A Systematic Review

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Background: Due to their minimal trauma and relative safety, blood products are becoming increasingly popular in medical aesthetics. In recent years, research on the application of blood products has also been increased. This article will summarize the research progress of emerging blood products in plastic surgery in recent years.
Methods: We searched the PubMed database for literature related to the application of blood preparation in plastic surgery over the past 5 years and summarized them.
Results: Commonly used in plastic surgery are platelet-rich plasma, platelet-rich fibrin, concentrated growth factor, platelet-poor plasma, and mesenchymal stem cells derived from blood products. They can be used for wound repair and skin and autologous fat transplantation, and can be combined with laser therapy and facial rejuvenation.
Conclusions: Understanding the application pathways of blood products in plastic surgery and their respective advantages and disadvantages can help us better choose and use them. (*Plast Reconstr Surg Glob Open* 2024; 12:e6005; doi: 10.1097/GOX.0000000000006005; Published online 24 July 2024.)

INTRODUCTION

With the development of plastic surgery, patients' demands for treatment are getting higher. Because the extraction of blood products is relatively less traumatic and they are obtained from the patient's own body, they are safer, more natural, more economical, and less likely to cause allergic reactions, thus becoming increasingly popular in medical aesthetics. In addition to the conventional use of blood products for blood storage, in recent years, there has been increasing research on blood products such as platelet-rich plasma (PRP), platelet-rich fibrin (PRF), concentrated growth factor (CGF), platelet-poor plasma (PPP), and mesenchymal stem cells (MSCs). This article will summarize the emerging blood products in aesthetic plastic surgery and summarize the research progress of blood products in the past 5 years.

MATERIALS AND METHODS

This systematic review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta Analyses guidelines. All articles were reviewed by three independent researchers, and eligible articles were selected. In the case of doubt, three people discussed together to reach a consensus. The author searched the PubMed database from March 24, 2019, to March 24, 2024, using the following Boolean string: (((plastic surgery) OR (reconstructive surgery)) OR (cosmetic surgery)) AND (((((((((((blood products) OR (plasma products)) OR (platelet products)) OR (leukocyte products)) OR (platelet-rich plasma)) OR (platelet-rich fibrin)) OR (concentrated growth factor)) OR (platelet-poor plasma)) OR (platelet extracellular vesicles)) OR (mesenchymal stem cells))). All randomized and nonrandomized controlled trials and retrospective cohort studies involving the application of blood products in the field of plastic surgery were included in this study. Exclusion criteria: (1) not related to plastic surgery or beauty, (2) not presented in English, (3) animal research, (4) case report, (5) system evaluation, (6) meta-analysis, and (7) letter to editor. Afterward, we conducted a systematic review of the included articles and summarized the progress of blood products in plastic surgery (Fig. 1 Table 1).

Role of PRP in Plastic Surgery

Mechanism and Introduction of PRP

PRP is mainly prepared by centrifugation of autologous whole blood with thrombin and calcium chloride, forming

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a “platelet gel” which is a plasma containing a large number of platelets prepared from autologous or allogeneic blood by centrifugation. Because the α -granules of platelets contain a large number of growth factors and cytokines, they can regulate the generation of new blood vessels, cell migration, proliferation, and differentiation and play an important role in tissue regeneration by combining with the appropriate matrix protein deposition. Platelet-derived growth factors can also mediate macrophage transformation to promote wound healing, and α -granules can also release antimicrobial proteins to reduce wound infection.^{1,2}

Progress in the Application of PRP in Plastic Surgery

Scar Treatment

Scars on the face after facial plastic and reconstructive surgery can affect the patient’s quality of life after surgery. Intradermal injection of PRP at the incision site after surgery can effectively reduce the width of postoperative scars, increase patient satisfaction, and improve the quality of life of patients.^{2,3} In addition, using PRP after

Takeaways

Question: What are the applications of blood products in plastic surgery?

Findings: Commonly used in plastic surgery are platelet-rich plasma, platelet-rich fibrin, concentrated growth factor, platelet-poor plasma, and mesenchymal stem cells derived from blood products.

Meaning: Understanding the application of blood products in plastic surgery can help us better choose and use them.

subcutaneous incision surgery to treat acne can also effectively reduce the size of postoperative scars.⁴

Facial Rejuvenation Treatment

Facial skin aging is clinically related to a variety of features, including changes in skin elasticity and toughness, and reduced hydration. Hyaluronic acid (HA) is one of the

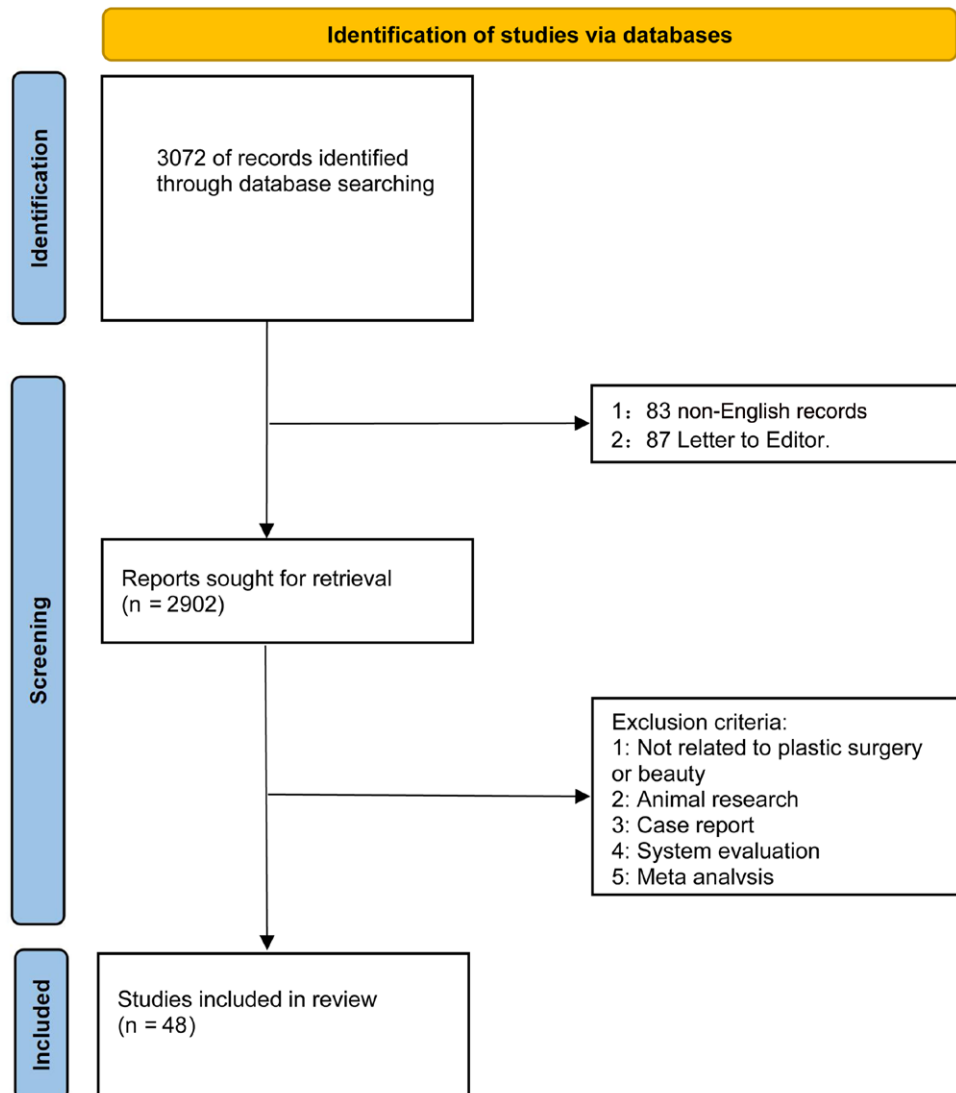


Fig. 1. Identification of studies via databases.

Table 1. Application of Blood Products in Plastic Surgery

Author	Material	Usage	Follow-up Time	Conclusion
Menchisheva et al ²	PRP	Injecting into the sutured wound after facial plastic surgery and reconstruction	30 d/90 d	The treatment group showed a significant reduction in scar width, increased patient satisfaction with treatment, and improved quality of life
Refahee et al ³	PRP	Injecting PRP into muscles and skin after cleft lip repair surgery	6 mo	Injecting PRP can improve wound healing and reduce scar tissue formation
Shetty et al ⁴	PRP	PRP at the incision site after treating acne with subcutaneous incision surgery	3 mo	PRP can effectively reduce the size of postoperative scars after using subcutaneous incision surgery to treat acne
Hersant et al ⁵	PRP	Injected in combination with HA on the face	1/3/6 mo	Compared with simply using HA or PRP, combining the two can achieve more significant results
Azaryan et al ⁶	PRP	Combined injection with HA for the treatment of skin photoaging	Immediately	PRP can increase the therapeutic effect of HA on skin photoaging treatment
Zhang et al ⁷	PRP	Combined with oral tranexamic acid for the treatment of melasma	6 mo	The combination of tranexamic acid and local injection of PRP can increase the therapeutic effect on melasma and reduce recurrence
Jin et al ⁸	PRP	Combining PRP with HADM for the treatment of GCMN	12 mo	Combining PRP with HADM can be used to treat GCMN
Gupta et al ⁹	PRP	Used in the donor area of skin transplantation	Assess the degree of pain at 6/10/16h postsurgery, and assess wound healing at 14 d postsurgery	The use of PRP can reduce postoperative pain and accelerate wound healing
García-Sánchez et al ¹⁰	PRP/PRGF	Used in the donor area of skin transplantation	5/8 d	The use of PRP can reduce postoperative pain and accelerate wound healing
Ali et al ¹¹	PRP	Used in the donor area of skin transplantation	21 d	The use of PRP can reduce pain and itching in the donor site after skin transplantation
Zheng et al ¹²	PRP	Combined with Meek microskin transplantation	10 d	Combining PRP with Meek microskin transplantation can promote the generation of blood vessels at the base of Meek microskin, thereby improving the survival rate and fusion rate of the transplant
Dhua et al ¹³	PRP	Provide PRP in the transplantation of Split-thickness skin	3 mo	PRP contributes to the survival and wound healing of split-thickness skin after transplantation
Gokkaya et al ¹⁴	PRP	Store skin that needs to be transplanted	10/20 d	Compared with using physiological saline to preserve transplanted skin, using PRP to preserve transplanted skin can make the transplant look better macroscopically
Ly et al ¹⁵	PRP	Combined treatment with AD for refractory wounds	NA	The combination of PRP and AD can also promote the healing of refractory wounds
Darwish et al ¹⁶	PRP	Combined use with PELNAC to treat skin wounds	6 mo	The combination of PELNAC and PRP in the treatment of skin injuries can promote the healing of skin wounds
Nagy Mohamed et al ¹⁷	PRP	Promote wound healing	6 mo	Using PRP can accelerate wound healing
Feng et al ¹⁸	PRP	Promote wound healing	2/4 mo	Using PRP can accelerate wound healing
Menchisheva et al ¹⁹	PRP	Promote wound healing	1 d/5 d	Using PRP can accelerate wound healing
Liao et al ²⁰	PRP	Promote healing of refractory wounds	30 d	For patients with poor overall condition who cannot provide autologous PRP, the use of allogeneic PRP can also improve wound healing
Rani et al ²¹	aPRP, PRPc	Promote fracture healing	2/6/12 mo	PRP can promote fracture healing, and there is no significant difference in the effect between aPRP and PRPc
Görgü et al ²²	PRP	Facial injection and treatment of hair loss	Immediately	Compared with using sodium citrate to prepare PRP, using acid citrate dextrose-A as an anticoagulant for preparing PRP can alleviate pain in patients during PRP injection
Wu et al ²³	PRPF	Combined treatment with minoxidil for AGA	6 mo	The combination treatment of PRPF and minoxidil is more effective than using PRPF alone and minoxidil

(Continued)

Table 1. Continued

Author	Material	Usage	Follow-up Time	Conclusion
Qu et al ²⁴	PRPF	Using PRPF and PRP to treat AGA	6 mo	Compared with PRP, PRPF has a better therapeutic effect on AGA
Abdelkader et al ²⁵	PRP	Application of PRP pretreatment of hair follicles before hair transplantation	6 mo	When transplanting hair follicles, pretreatment with PRP can significantly increase hair density and thickness before implantation
Elariny et al ²⁶	PRP	Combining PRP with FUE for the treatment of scar hair loss	3/6/12 mo	When treating scar hair loss, combining PRP with FUE does not improve the survival rate of hair grafts
Wang et al ²⁷	PRP	Combined CO ₂ laser treatment for acne scars	1 mo	Combining CO ₂ laser treatment with PRP treatment for acne scars can increase efficacy and reduce the occurrence of adverse events
Dai et al ²⁸	PRP	Combined CO ₂ laser treatment for proliferative scars after burns	3/6 mo	Combining CO ₂ laser treatment with PRP treatment for proliferative scars after burns can increase efficacy and reduce the occurrence of adverse events
Godara et al ²⁹	PRP	Combined CO ₂ laser treatment for posttraumatic scars	4 wk	Combining PRP with CO ₂ laser does not have a significant advantage compared with using CO ₂ laser alone
Zhang et al ³⁰	PRF	PRF combined with autologous fat filling	3 mo	PRF combined with autologous fat filling can shorten the recovery time of postoperative patients, but it has no effect on the volume of fat retention
Zhang et al ³²	PRF	PRF combined with autologous fat filling	6 mo	PRF combined with autologous fat filling can improve the survival rate of transplanted fat
Yan et al ³³	PRF	PRF combined with autologous fat filling	6 mo	PRF combined with autologous fat filling can improve the survival rate of transplanted fat
Alkerdi et al ³⁴	PRF	PRF combined with autologous fat filling	12 mo	PRF combined with autologous fat filling can improve the survival rate of transplanted fat
Hu et al ³⁵	PRF	Injecting PRF into the face	6/12 wk	Facial injection of PRF can effectively improve skin texture
Zhao et al ³⁷	CGF	Injecting CGF to treat AGA	6 mo	Injecting CGF into the hair loss area of AGA patients can effectively increase their hair density, follicle density, and hair diameter
Tan et al ³⁸	CGF	Combining CGF with minoxidil for the treatment of AGA	3 mo	CGF can increase the efficacy of minoxidil in the treatment of AGA
Tan et al ³⁹	CGF	Inject CGF into the skin that needs to be expanded	4/8/12 wk	Injecting CGF into the skin can increase the thickness and area of the skin that needs to be expanded
Wang et al ⁴⁰	CGF	Promoting nerve recovery after mandibular surgery	1/3 mo	Local use of CGF after mandibular surgery can promote the recovery of sensory nerves in the lower lip
Gad et al ⁴¹	PPP	Combined CO ₂ laser treatment for striae distensae	3 mo	PPP combined with CO ₂ laser therapy can improve the efficacy of CO ₂ laser in treating striae distensae
Cai et al ⁴²	PPP	Combining PPP with Erbium fractional laser treatment	3 mo	PPP can promote the effectiveness of Erbium fractional laser in treating skin aging
Tsai et al ⁴³	PPP	Treating facial aging	3 mo	PRP performs better in improving overall skin condition, whereas PPP is more effective in improving superficial wrinkles
Neinaa et al ⁴⁴	PPP	Treatment of suborbital pigmentation	3 mo	PPP can effectively improve suborbital pigmentation, and its efficacy is superior to PRP
Kim et al ⁴⁵	Conditional medium for hUCBMSC	Combined AFL treatment for enlarged pores or wrinkles	3 wk	The combination of hUCBMSC conditioned medium and AFL in the treatment of enlarged pores or wrinkles can accelerate wound healing
Harsono et al ⁴⁶	hUCBMSC and its conditioned medium	Treating keloids	15 wk	hUCBMSC and its conditioned medium can reduce scar volume

PRPc, cord blood PRP.

main components of the human extracellular matrix, and the reduction in HA levels has been proven to be closely related to skin aging. Compared with simply injecting PRP or HA, injecting PRP and HA together into the face can make the effect of facial rejuvenation more obvious, significantly improve facial appearance and skin elasticity, and can enhance the treatment effect on photoaged skin.^{5,6} Oral tranexamic acid is an effective method for treating melasma. The therapeutic effect of locally injecting PRP into the lesion while taking oral tranexamic acid is superior to simply taking oral tranexamic acid, and it can reduce the recurrence of melasma.⁷

Skin Transplantation

Human acellular dermal matrix (HADM) transplantation can treat giant congenital melanocytic nevi (GCMN) in children, and its combination with PRP treatment can improve the survival rate of transplant vessels.⁸ In addition, during the process of skin transplantation, the donor site often experiences delayed healing and segmental pain and itching at the donor site. Using PRP or PRGF at the donor site can effectively reduce postoperative pain and accelerate healing in the donor area.^{9–11} Combining PRP with Meek microskin grafting can promote the formation of blood vessels at the base of Meek microskin, thereby increasing the survival and fusion rate of the graft.¹² Split-thickness skin is widely used because it is easy to obtain, and using PRP at the recipient site is beneficial for wound healing.¹³ In addition, using a sterile gauze pad soaked in PRP to preserve the transplanted skin can make the graft look more vigorous macroscopically.¹⁴ The combination of PRP and artificial dermis can also promote the healing of refractory wounds and improve the cure rate.¹⁵ PELNAC (Gunze Co., Ltd., Kyoto, Japan) is a dermal substitute. When used in combination with PRP in the treatment of skin injuries, it can shorten the formation of new blood vessels and promote wound healing.¹⁶

Treatment for Wound Healing

PRP can increase the production of fibroblasts, macrophages, and collagen fibers, thereby improving wound healing.^{17–19} However, when the patient's condition is very poor and it is impossible to provide whole blood to collect PRP, allogeneic PRP can be used to treat refractory wounds, which can also promote wound healing.²⁰ Furthermore, for patients with fractures, the use of autologous PRP (aPRP) can promote fracture healing and alleviate pain. When aPRP cannot be extracted under specific conditions, cord blood PRP can be used as a substitute for aPRP, and there is no significant difference in the therapeutic effects of both.²¹ Different patients perceive pain differently when injected with PRP. Compared with using sodium citrate (Na-citrate) to prepare PRP, using acid citrate dextrose-A as an anticoagulant for PRP preparation can reduce the pain felt by patients during PRP injection.²²

Treatment for Hair Loss

PRP is a novel adjunctive method for treating androgenetic alopecia (AGA). However, recent years have found that compared with PRP, PRP plus basic fibroblast growth

factor (PRPF) has a more pronounced therapeutic effect on AGA. The combined treatment of PRPF and minoxidil has a superior effect than using PRPF and minoxidil alone.^{23,24} During hair follicle transplantation, pretreating the follicles with PRP before implantation can significantly increase hair density and thickness.²⁵ Follicular unit extraction can be used to treat scar-induced hair loss. However, current research suggests that combining follicular unit extraction and PRP injections does not significantly affect the survival rate of hair grafts.²⁶

Treatment for Laser Therapy

CO₂ laser can be used to treat acne scars and hypertrophic scars after burns. Local injection of PRP during laser treatment can effectively improve scars, reduce the occurrence of adverse events, and make the treatment effect more pronounced.^{27,28} However, when CO₂ laser and PRP are used together to treat scars from burns or trauma, the combined PRP treatment does not have additional advantages over using CO₂ laser treatment alone.²⁹

Role of PRF in Plastic Surgery

Mechanism and Introduction of PRF

PRF generally considered the second generation of platelet products after PRP. The decomposition of platelets in PRP is relatively fast, and the concentration of local growth factors will rise in a short time, but the lasting effect is not ideal. However, PRF can play a role in the continuous release of growth factors over a longer period of time. Moreover, the preparation of PRF does not require the addition of any anticoagulant or thrombin, it is easier to obtain compared with PRP and PRGF, and it does not inhibit tissue regeneration and can reduce the possibility of cross-contamination. It can also avoid hypersensitivity reactions induced by anticoagulants.^{30,31}

Progress in the Application of PRP in Plastic Surgery

In Fat Transplantation Treatment

Avoiding fat absorption is a major challenge in autologous fat transplantation. The combined use of PRF during autologous fat filling can help increase the survival rate of fat after transplantation.^{32–34} However, some scholars have pointed out that the combination of PRF and autologous fat filling can only shorten the recovery time of patients after surgery and does not affect the volume of remaining fat.³⁰

In Facial Rejuvenation Treatment

Injecting PRF into the face can effectively improve skin texture.³⁵

Role of CGF in Plastic Surgery

Mechanism and Overview of CGF

CGFs are regarded as the third-generation platelet concentrate succeeding PRP and PRF. The preparation of CGF does not necessitate the addition of any exogenous anticoagulants or thrombin, which can decrease tissue regeneration inhibition and the likelihood of cross-contamination. Compared with PRF, CGF comprises a more dense and abundant growth factor fibrin matrix. Furthermore, the fibrin arrangement in CGF is relatively

loose, allowing for the slow release of growth factors with the degradation of fibrin.³⁶

Progress in the Application of CGF in Plastic Surgery

Treatment of Hair Loss

Injecting CGF into the hair loss area of patients with androgenic alopecia can effectively increase the patient's hair density, follicle density, and hair diameter.³⁷ Moreover, the combined use of CGF and minoxidil can increase the therapeutic effect of minoxidil, providing patients with faster and more lasting hair growth.³⁸

In Skin Expansion

Skin expanders can aid in generating extra skin for repair or replacement due to skin loss from diseases, injuries, or surgery. The growth capacity of the skin is limited, yet injecting CGF into the skin requiring expansion can assist in increasing the thickness and area of the expanded skin.³⁹

Facilitating Sensory Recovery

Reduced lower lip sensation after mandibular osteotomy is a common postoperative complication. The postoperative local application of CGF can expedite the alleviation of diminished lower lip sensation.⁴⁰

Role of PPP in Plastic Surgery

Mechanism and Introduction of PPP

Although the concentration of platelets and their growth factors in PRP is much higher than in PPP, the fibrin concentration in PPP is higher, and fibrin is more likely to exist in a bundle form. This leads to the formation of an insoluble network structure, which can provide a scaffold for platelets and act as a substrate for the sustained release of growth factors. This kind of scaffold assists in the positioning of growth factors, essentially increasing the local concentration at the ideal site, guiding tissue regeneration.⁴¹

Progress in the Application of PPP in Plastic Surgery

Treating Facial Aging

Erbium fractional laser treatment for facial aging is widely recognized. Combining this method with PPP injections can more effectively improve facial skin aging, enhancing the treatment outcome.⁴² Additionally, injecting PPP and PRP can ameliorate facial wrinkles. Research by Tsai et al⁴³ found that PRP is more effective in improving overall skin conditions, whereas PPP is more effective in improving superficial wrinkles. Injecting PPP under the orbital area can also effectively improve under-eye pigmentation, with a therapeutic effect superior to that of PRP injections.⁴⁴

Treating Scars

CO₂ lasers can be utilized to treat striae distensae, and the concurrent injection of PPP can enhance the therapeutic efficacy of CO₂ lasers.⁴¹

Other

Besides the above-mentioned substances, ablative CO₂ fractional laser (AFL) can treat enlarged pores or

skin wrinkles. Using the conditioned medium of human umbilical cord blood-derived mesenchymal stem cells (hUCBMSC) can expedite wound healing post-AFL treatment, reduce redness, and effectively shorten recovery time.⁴⁵ Additionally, injecting hUCBMSC or the conditioned medium of hUCBMSC into keloids can decrease the volume of the keloids.⁴⁶

DISCUSSION

The application of blood products has emerged as a novel treatment approach in plastic and aesthetic surgery. The reasons include the relatively less invasive extraction of blood products and their origin from the patient's own body, which makes them safer, more natural, more cost-effective, and less likely to trigger allergic reactions. In this article, we provide an overview of emerging blood products in plastic and aesthetic surgery and summarize the advancements in blood product research over the past 5 years. (See table, Supplemental Digital Content 1, which displays the application of blood products in plastic surgery. <http://links.lww.com/PRSGO/D374>.)

PRP is a prevalent blood product that plays an important role in tissue regeneration by modulating neovascularization, cell migration, proliferation, and differentiation. Studies have shown that PRP applications in plastic surgery include scar treatment, facial rejuvenation, skin transplantation, wound healing, hair loss treatment, and laser therapy, among others. However, the efficacy of PRP might be compromised when the patient's condition is extremely poor, making it difficult to collect whole blood for PRP extraction. In such cases, homologous allogeneic PRP can be used to treat intractable wounds. Furthermore, the preparation of PRP necessitates the addition of anticoagulants, which might potentially interfere with the wound's natural healing process.⁴⁷ Moreover, approximately 95% of the growth factors in PRP are quickly released upon the addition of calcium chloride, resulting in a lack of sustained release of growth factors.³⁶

PRF is considered to be the second-generation platelet product after PRP. The preparation of PRF does not necessitate the addition of any anticoagulants or thrombin, making it easier to acquire compared with PRP, and it can minimize the likelihood of cross-contamination. Moreover, it can prevent hypersensitivity reactions triggered by anticoagulants.³⁶ However, PRF has characteristics such as a short half-life and difficulty in preservation, which significantly restrict its clinical application.³⁶

CGF is considered the third generation of platelet concentrate following PRP and PRF. Compared with PRF, CGF contains a denser and more abundant growth factor fibrin matrix. The preparation of CGF does not require the addition of anticoagulants and has a longer duration of action, but at a higher preparation cost. Additionally, the fibrin arrangement in CGF is relatively loose, which allows the growth factors within it to be gradually released as the fibrin degrades, thereby achieving persistent promotion of fibroblast, endothelial cell, and osteoblast proliferation. However, the platelet count in CGF can be influenced by the blood's pH value, and the preparation time and blood volume can also impact the outcome of

CGF preparation.^{36,48} Compared with PRP, the applications of PRF and CGF in plastic surgery are still limited and await further development.

PPP has a higher fibrin concentration, and the fibrin is more likely to exist in a bundle-like form, forming an insoluble net-like structure. This can provide a scaffold for platelets and serve as a basis for the sustained release of growth factors. As PPP contains a lower quantity of platelets, its use reduces platelet-related adverse reactions comparatively. In the treatment of under-eye circles and tear troughs, the injection of PPP can allow for rapid filling of the treated area. Compared with PRP, PPP filling can lead to better improvements in skin texture and enhanced clinical results.⁴⁴ For treatments that require growth factors to promote fat volume retention and wound healing, the therapeutic efficacy of PPP is inferior to materials such as PRP. Besides, hUCBMSC and its conditioned medium also have applications in plastic surgery. Mesenchymal stem cells (MSCs) possess the ability to differentiate in multiple directions, and in theory, they can differentiate into various types of cells, thereby being used for precise repair. However, the extraction, transportation, and expansion of MSCs are time-consuming, labor-intensive, and difficult to carry out, and their application is greatly restricted due to potential risks such as tumor induction, immune reactions, and mutations. The use of MSCs' conditioned medium is safer, but compared with MSCs, the conditioned medium of MSCs requires multiple injection treatments, extending the treatment duration. Currently, the application of blood products in plastic surgery mainly involves plasma and platelets, with less application in white and red blood cells. Moreover, the preparation procedures and specific mechanisms of action of blood products are not yet standardized, with various preparation methods, which still need further investigation. Additionally, there is some misuse of blood products in clinical practice, which could potentially lead to infections, coagulation disorders, excessive wound scabbing, allergic reactions, and the spread of infectious diseases. Therefore, their selection in clinical settings requires a comprehensive assessment before careful use. Despite increasing evidence indicating the existence of cells with multiple differentiation potentials in the peripheral blood, their use as an alternative source for autologous stem cells is still significantly limited due to the current inability to isolate them using standardized procedures and the restrictions on their in vitro expansion.⁴⁷

CONCLUSIONS

Blood products, due to their ability to be obtained from the patients themselves and their minimal invasiveness, are widely used in plastic and aesthetic treatments. This study provides a detailed exploration of the application and progress of blood products in plastic surgery, including the use of PRP, PRF, CGF, PPP, and MSCs. These blood products have demonstrated value in scar treatment, facial rejuvenation, skin grafting, and wound healing. However, the use of blood products in plastic surgery is not yet mature, and the preparation procedures and specific mechanisms of action have not been

standardized, necessitating further research. Overall, the prospects for the application of blood products in plastic surgery are broad, and they hold promise for delivering improved treatment outcomes for patients.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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