Evaluating Platelet-Rich Therapy for Facial Aesthetics and Alopecia: A Critical Review of the Literature

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Background: Despite the growing popularity of platelet-rich plasma, existing evidence supporting its efficacy remains controversial due to the lack of large-scale studies and standardized protocols for preparation and application. This article reviews its use in facial rejuvenation, fat grafting, acne scarring, and androgenic alopecia. Emphasis is placed on comparing methods of platelet-rich plasma preparation and application across studies.
Methods: A systematic review was performed for articles published between 2006 and 2015. All clinical studies and case reports that addressed platelet-rich plasma alone and/or in combination with fat grafting for facial rejuvenation, acne scarring, or androgenic alopecia were included.
Results: Of the 22 articles included in the analysis, seven studies used platelet-rich plasma alone for facial rejuvenation, seven in combination with fat grafting, two for treatment of acne scarring, and six for treatment of androgenic alopecia. Individual study procedures, means of evaluation, and significant results are summarized. Although the majority of studies in this review report positive results, significant variation exists in preparation protocols and in the number and frequency of clinical treatments.
Conclusions: The majority of studies report positive results for all indications evaluated in this review, but the procedure is limited by the lack of a standardized method for preparation and application of platelet-rich plasma. The extent to which significant variability in platelet-rich plasma preparation and/or application methods may affect clinical outcomes is not completely clear. In the interim, we present a consolidation of platelet-rich plasma treatment techniques and outcomes currently in use to help guide physicians in their clinical practice. (*Plast. Reconstr. Surg.* 141: 1115, 2018.)

Platelet-rich plasma has been extensively applied in a variety of clinical settings, including oral maxillofacial surgery, orthopedic surgery, cardiothoracic surgery, and wound care. The secretory α-granules within platelets release various growth factors, including platelet-derived growth factor, vascular endothelial growth factor, basic fibroblast growth factor, epidermal growth factor, and fibroblast growth factor.[1] These growth factors induce tissue regeneration, collagen formation, reepithelialization, and angiogenesis.[1]

Platelet-rich plasma is theorized to promote wound healing by means of induction of mild inflammation, which stimulates collagen production and increases skin thickness. Dermatologists and plastic surgeons are using the natural healing properties of platelets to improve the appearance and overall health of skin.[2] Used either alone or in combination with fat grafting, platelet-rich plasma has been adopted as a treatment for aging facial skin, acne scarring, and androgenic alopecia.

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Despite its popularity, existing evidence to support the clinical efficacy of platelet-rich plasma is limited. The majority of studies to date lack consistent reporting of treatment parameters, use of adequate controls, and objective outcomes.[3] The variety of existing protocols and devices currently in use for platelet-rich plasma preparation is associated with corresponding variations in concentrations of platelets and growth factors,[4] and although classification systems have been proposed to improve comparison across studies, they have yet to be widely adopted.[5–7] The goal of this review is to summarize (1) current approaches to the preparation and application of platelet-rich plasma in facial aesthetics, (2) significant findings, and (3) critical gaps in the literature that need to be addressed in future research.

PATIENTS AND METHODS

Using the search terms "platelet rich plasma" and "platelet rich therapy," a comprehensive literature search was performed in the MEDLINE (PubMed) and Cochrane databases published between 2006 and 2015. Articles were subsequently appraised in accordance with the following inclusion criteria: (1) application of platelet-rich plasma either alone or in combination with fat grafting in at least one subset of patients for facial rejuvenation (i.e., wrinkle reduction, improvement of skin tonicity or pigmentation, overall aesthetic experience); (2) clinical reports or case studies; and (3) accessed in English. Exclusion criteria were as follows: (1) application of platelet-rich plasma in combination with other treatment modalities (e.g., lasers, additional growth factors, hyaluronic acid, finasteride, minoxidil) in all subsets of patients; (2) noncosmetic indications (i.e., alopecia areata, burns, or trauma reconstruction); (3) cosmetic indications outside of the face and scalp; and (4) not accessible in English.

Titles and abstracts of relevant articles were screened. If the titles and abstracts did not provide enough information for inclusion or exclusion, the full text was evaluated. Data extraction was performed on all eligible articles. For studies in which a range of values was provided, the mean was used for analysis. Obtained data were managed and analyzed using Excel (Version 15.38; Microsoft Corp., Redmond, Wash.).

RESULTS

The initial search identified 4015 articles. After assessment of titles and abstracts, 145 articles remained and the full text was evaluated based on inclusion and exclusion criteria. Twenty-two studies[8–29] identified met inclusion criteria: seven that evaluated the use of platelet-rich plasma alone for facial rejuvenation,[13,16,20,23,25,26,29] seven in combination with fat grafting,[8,9,11,17,22,24,28] two for treatment of acne scars,[12,21] and six for treatment of androgenic alopecia.[10,14,15,18,19,27]

Protocols for platelet-rich plasma preparation varied widely across studies. A mean ± SD of 24.1 ± 13.2 ml of whole blood was collected from patients in the 20 studies that reported.[9–18,20–29] Six studies centrifuged the whole blood twice,[8,12,20–22,26] 12 centrifuged once,[9–11,13–15,17,23,25,28,29] and four did not describe the centrifugation process.[8,16,19,24] Four studies reported use of a separator gel during the centrifugation process.[15,23,25,29] Two followed the protocol described by Choukroun et al.,[30–32] in which whole blood is centrifuged into three layers and the middle layer consisting of a platelet-rich fibrin clot is extracted.[9,17] Nine reported use of a commercial device or kit.[10,11,13–16,22,24,28] Fifteen studies added an exogenous activator, typically at a ratio of 0.1 ml activator per 0.9 ml of plasma,[10–15,17,18,20–23,25,27,28] 10 used calcium chloride,[11,17,18,20–23,25,27,28] two used calcium gluconate,[12,15] and two did not specify the type of calcium used.[10,14] Only Kang et al. explicitly reported on not using a platelet activator[16]; six studies did not indicate whether one was used.[8,9,19,24,26,29] A mean of 4.7 ± 2.8 ml of platelet-rich plasma was prepared in the 15 studies that reported.[9–11,14–17,20,21,23–26,28,29] Among the 15 studies that reported both the starting volume of whole blood and ending volume of platelet-rich plasma, a mean of 22.9 ± 15.0 percent of platelet-rich plasma was obtained from the whole blood.[9–11,14–17,20,21,23–26,28,29] Eight studies reported the platelet concentration in the platelet-rich plasma produced,[10,12,14–16,24,26,27] yet only two studies standardized the platelet concentration in platelet-rich plasma before clinical application.[24,26]

Results were assessed at multiple time points with a mean follow-up period of 8 ± 7 months. Seventeen studies assessed results based on pretreatment and posttreatment photographs.[10,12–21,23,25–29] Results were assessed by the physician or investigators in 19 studies,[8,10–12,14–23,25–29] of which seven studies reported use of blinded evaluators.[10,14,16,20,21,26,28] Patient satisfaction and/or patient self-assessment was measured in 17 studies.[8–10,12–16,18–21,23–26,29] Three studies performed histopathologic evaluations using immunohistochemistry.[10,13,14] Two studies that evaluated platelet-rich plasma for androgenic alopecia used the hair-pull test.[18,27] Other methods of assessment included Skin Surface Analyzer (Courage and Khazaka Electronic GmbH, Cologne,

Germany; and Dataderm International GmbH, Remigen, Switzerland)[20] to quantify wrinkles; Mexameter (MX18) and Corneometer (CM825) probes of the Cutometer MPA 580 device (Courage and Khazaka Electronic GmbH, Cologne, Germany)[20] to measure melanin content and epidermal stratum corneum hydration, respectively; spectrophotometry[16] for erythema and melanin indices; Vectra XT 3D Volumetric Analysis Imaging (Canfield Imaging Systems, Fairfield, N.J.)[24] to measure volume changes; and TrichoScan digital image analysis (Tricholog GmbH, Freiburg, Germany; and Datinf GmbH, Kriftel, Germany)[10,14] digital image analysis to measure hair growth.

Although mild injection-related complications such as transient erythema, edema, and bruising were noted in some studies, no studies reported any serious permanent complications. All 22 studies assessed in this review found the application of platelet-rich plasma to have beneficial effects in terms of clinical improvement and/or patient satisfaction. The variety of outcome measures precluded the comparison of results across studies.

Facial Rejuvenation

The application of platelet-rich plasma without fat grafting (Table 1) for rejuvenation of aging facial skin was evaluated in 143 patients across seven studies.[13,16,20,23,25,26,29] Four studies performed a total of three treatments, once every 2 to 4 weeks[13,16,23,29]; the remaining three studies performed only one treatment.[20,25,26] Among the seven studies, a mean of 19.1 ± 10.5 ml of whole blood was collected to prepare a mean of 3.2 ± 2.5 ml of platelet-rich plasma. A mean of 2.7 ± 1.5 ml was used per individual treatment; however, sites of application did vary. The infraorbital area, nasolabial folds, and crow's feet areas were the most commonly injected; other areas of treatment included the forehead/malar region, the preauricular region, and the jaw region. All studies performed intradermal injections; in addition, Yuksel et al.[29] used a Dermaroller (Cynergy, Carson City, Nev.) and draped each patient's face in gauze soaked in platelet-poor plasma for 30 minutes. Follow-up periods ranged from 1 week to 1 year.

Fat Grafting

Platelet-rich plasma–assisted fat grafting (Table 2) was evaluated in 437 patients across seven studies.[4,5,7,13,18,20,24] Of the six studies that explicitly reported on the methodology of platelet-rich plasma preparation, a mean of 35.7 ± 12.8 ml of whole blood was collected, which yielded a mean of 5.2 ± 2.0 ml of platelet-rich plasma.[9,11,17,22,24,28] Five studies reported the ratio of fat to platelet-rich plasma used in the procedure, which ranged from 2:1 to 10:1 (e.g., 2.0 ml of fat to 1 ml of platelet-rich plasma) with a mean ratio of 5.8 ± 3.4 ml of fat to 1 ml of platelet-rich plasma.[11,17,22,24,28] The nasolabial folds and malar regions were the most commonly injected areas. Other areas of treatment included the cheekbones and temporal region. In six studies, results were evaluated after a single platelet-rich plasma–assisted fat grafting procedure.[8,9,11,17,24,28] Park et al.[22] performed one additional treatment session of platelet-rich plasma injections without fat grafting 1 week after the initial procedure. Two studies separated patients who underwent platelet-rich plasma–assisted fat grafting in conjunction with a face-lifting procedure from those who received platelet-rich plasma–assisted fat grafting alone.[9,28] All participants in the study performed by Sasaki[24] underwent a face lift. The follow-up period ranged from 1 month to 2 years.

Acne Scars

The application of platelet-rich plasma for acne scars (Table 3) was evaluated in 57 patients across two studies.[12,21] Both studies collected 10 ml of whole blood from the peripheral vein of each subject. In the study performed by Nofal et al.,[21] 2 ml of platelet-rich plasma was injected intradermally into the atrophic skin scars of a subset of 15 subjects. In a different subset of 15 subjects, 0.5 to 1 ml of platelet-rich plasma was applied using a microneedling device—rolled six times in four directions. Treatment was administered at three different sessions, in 2-week increments. In the study performed by Chawla,[12] a microneedling device (microneedles 1.5 to 2 mm in length; 192 needles on a roller drum) was rolled four to five times in four directions on the faces of 27 patients, followed by topical application of 0.5 to 2 ml of platelet-rich plasma to half of the face of each patient. This procedure was repeated four to five times at each treatment session. A total of four treatments were performed in 4-week increments.

Androgenic Alopecia

For androgenic alopecia (Table 4), platelet-rich plasma was evaluated in 84 patients across six studies.[10,14,15,18,19,27] Among the six studies, a mean volume of 22.6 ± 8.3 ml of whole blood was collected from participants. Among the three studies reporting the volume of platelet-rich plasma prepared from the whole blood, a mean of 8 ± 1.4 ml of platelet-rich plasma was harvested at each session.[10,14,15] Three studies report using "nappage" technique (multiple injections in a linear pattern approximately 1 cm apart) to inject platelet-rich

Table 1. Studies Evaluating Platelet-Rich Plasma Alone for Facial Rejuvenation

Study	Centrifugation			Additional Features	Activating Agent	Initial Volume of Whole Blood (ml)	Final Volume of PRP (ml)	PRP-to–Whole Blood Ratio (%)	Volume of PRP Applied (ml)	Application Sites	Treatment Timeline (wk)*	Follow-Up (wk)	Significant Results
	No. of Steps	Speed	Time (min)										
Redaelli et al., 2010[23]	3	500 rpm	5	Gel separation	$CaCl_2$	16	2	12.5	3.08	Face, neck	0, 4, 8	4	Improved skin texture and elasticity, increased volume, deceased acne scars, increased patient satisfaction
Sclafani, 2010[25]	1	1100 rpm	6	Gel separation	$CaCl_2$	18	8	44.4	1.5	Nasolabial folds	0	1, 2, 6, 12	Decreased wrinkles
Yuksel et al., 2014[29]	1	3200 rpm	8	Gel separation	NA	8	1.5	18.8	1.5	Forehead, malar area, jaw, crow's feet	0, 2, 4	12	Patient noted improved appearance, skin firmness-sagging and wrinkle state; physician noted improved skin firmness-sagging
Mehryan et al., 2014[20]	2	1. 1700 *g* 2. 2000 *g*	1. 6 2. 5	NA	$CaCl_2$	10	1.5	15	1	Infraorbital area and crow's feet	0	1, 4, 12	Improved infraorbital color homogeneity; physician noted improvement, increased patient satisfaction
Kang et al., 2014[16]	NA	NA	NA	MyCells Kit	None	12	1	8.3	NA	Infraorbital area	0, 4, 8	12	Decreased wrinkles, improved skin tone, decreased erythema and melanin
Díaz-Ley et al., 2015[13]	1	500 *g*	8	PRGF-Edoret	PRGF activator	36	NA	NA	NA	Face	0, 3, 6	3, 6, 12	Increased dermal thickness, reduced solar elastosis
Sevilla et al., 2015[26]	2	1. 380 *g* 2. 270 *g*	20	NA	NA	34	5	14.7	5	Nasolabial folds	0	24, 52	Decreased severity of nasolabial folds

PRP, platelet-rich plasma; NA, not available; $CaCl_2$, calcium chloride; PRGF, plasma rich in growth factors.
*0 indicates time point of initial treatment.

Table 2. Studies Evaluating Platelet-Rich Plasma–Assisted Fat Grafting

Study	Centrifugation			Additional Features	Activating Agent	Initial Volume of Whole Blood (ml)	Final Volume of PRP (ml)	PRP-to–Whole Blood Ratio (%)	Volume of PRP Applied (ml)	Application Sites	Treatment Timeline (wk)*	Follow-Up (wk)	Summary of Significant Results
	No. of Steps	Speed	Time (min)										
Cervelli et al., 2009[11]	1	1100 *g*	10	Cascade Esforax System	$CaCl_2$	18	9	50	2.5	Cheeks, zygomatic region, glabellar area, temporal area, nasolabial folds, infraorbital area, buccal region, mandibular region	0	72	Improved aesthetic improvement, increased patient satisfaction
Park et al., 2012[22]	1	3000 rpm	10	Prosys kit	$CaCl_2$	25	NA	NA	2	Cheeks	0, 1†	12, 96	Improved contour maintained at 2 yr
Keyhan et al., 2013[17]	1	3000 rpm	10	Choukroun protocol	$CaCl_2$	50	5	10	9.5	Cheeks, cheekbones	0	4, 52	Greater graft resorption with PRP/fat than PRF/fat
Braccini et al., 2013[9]	1	3400 rpm	10	Choukroun protocol	NA	50	5	10	NA	Cheeks, cheekbones, chin	0	NA	Increased patient satisfaction, decreased fat resorption
Willemsen et al., 2014[28]	1	3000 rpm	15	Biomet Gravitational Platelet Separation System III	$CaCl_2$	27	3	11.1	10	Temporal region, crow's feet anterior part of cheek, malar eminence, suborbicularis oculi fat, tear trough, central part of midface, nasolabial folds, marionette folds	0	12, 96	Decreased recovery time, improved aesthetic outcome
Abdali et al., 2014[8]	NA	NA	NA	NA	NA	NA	NA	NA	NA	Nasolabial folds	0	24	Improved nasolabial fold, increased patient satisfaction
Sasaki, 2015[24]	NA	NA	NA	Harvest SmartPrep	NA	44	4	9.1	5	Deep medial cheek, medial suborbicularis, lateral suborbicularis, superficial nasolabial, and superficial medial compartments	0	4, 12, 24, 36, 52	Improved graft retention

PRP, platelet-rich plasma; NA, not available; $CaCl_2$, calcium chloride; PRF, platelet-rich fat.
*0 indicates time point of initial treatment.
†Second treatment consisted of platelet-rich plasma alone without fat grafting.

Table 3. Studies Using Platelet-Rich Plasma in Treatment of Acne Scarring

Study	Centrifugation			Activating Agent	Initial Volume of Whole Blood (ml)	Final Volume of PRP (ml)	PRP-to–Whole Blood Ratio (%)	Volume of PRP Applied (ml)	Technique	Treatment Timeline (wk)*	Follow-Up (wk)	Summary of Significant Results
	No. of Steps	Speed	Time (min)									
Nofal et al., 2014[21]	2	1. 175 *g* 2. 1750 *g*	1. 10 2. 15	$CaCl_2$	10	2	20	1. 2 2. 0.5–1	1. Injection 2. Microneedling	1. 0, 2, 4 2. 0, 2, 4	1. 2, 4, 6 2. 2, 4, 6	Improved acne scars and increased patient satisfaction in patients treated by means of both injection and microneedling
Chawla, 2014[12]	2	1. 1500 rpm 2. 3700 rpm	1. 10 2. 10	Calcium gluconate	10	NA	NA	2 (half face)	Microneedling	0, 4, 8, 12	4, 8, 12, 16	Improved acne scars and increased patient satisfaction

PRP, platelet-rich plasma; NA, not available; $CaCl_2$, calcium chloride.
*0 indicates time point of initial treatment.

plasma, typically 0.1 ml/cm^2.[15,18,27] Most studies performed four treatments (mean, 4.0 ± 1.0 treatments), with sessions ranging from once weekly to once monthly (mean, 2.1 ± 1.0 weeks).

DISCUSSION

With a growing trend toward more natural solutions to achieve a younger appearance, the autologous solution of platelet-rich plasma appeals to patients seeking a minimally invasive treatment that is both safe and well tolerated. Within dermatology and plastic surgery, platelet-rich plasma is hypothesized to induce mild inflammation and trigger the healing cascade to increase collagen production, extracellular matrix formation, and recruitment of additional cells to the site of injury.[2] This technique directly targets the degeneration of the extracellular matrix and collagen network in aged skin. Studies within this review confirmed platelet-rich plasma to be beneficial for rejuvenating aging facial skin. Results showed improvements in the volume, texture, and tone of facial skin and decreases in the appearance of wrinkles.

The addition of platelet-rich plasma to lipofilling procedures is supported by in vivo studies, which demonstrate vascular endothelial growth factor, fibroblast growth factor, and platelet-derived growth factor inducing early angiogenesis, migration of adipogenic mesenchymal cells, and de novo adipogenesis.[33] Particularly during the period of ischemia after fat injection, when adipose cells are most susceptible to necrosis, the proangiogenic activity of platelet-rich plasma may be the critical mechanism underlying the improved fat graft retention, observed by studies in this review.[33] Whether or not platelet-rich plasma was used as an adjunct to face lifting, the addition of platelet-rich plasma to fat grafting procedures resulted in maintained facial volume.

The benefits of platelet-rich plasma in the context of acne scarring were first observed by Redaelli et al.,[23] who used intradermal injections of platelet-rich plasma for facial skin rejuvenation. Two studies examined in this review confirmed the improvement in the appearance of atrophic acne scars when platelet-rich plasma is applied by means of either microneedling or intradermal injection.[12,21] In a more recent split-face study, the combination of both intradermal injections and microneedling with platelet-rich plasma enhanced clinical outcomes when compared to microneedling with distilled water.[34] Larger controlled trials are needed to better assess which method of application is most likely to maximize aesthetic improvement and recovery.

Table 4. Studies Using Platelet-Rich Plasma as Treatment for Androgenic Alopecia

Study	Centrifugation			Additional Features	Activating Agent	Initial Volume of Whole Blood (ml)	Final Volume of PRP (ml)	PRP-to–Whole Blood Ratio (%)	Volume of PRP Applied (ml)	Technique	Treatment Timeline (wk)*†	Follow-Up (wk)	Summary of Significant Results
	No. of Steps	Speed	Time (min)										
Gkini et al., 2014[15]	1	1500 *g*	5	RegenKit BCT-3; gel separation	Calcium gluconate	16	6	37.5	0.75 per cm^2	Nappage	0, 3, 6, 24	3, 6, 12, 24, 52	Increased hair density, increased patient satisfaction
Khatu et al., 2014[18]	2	1. 1500 rpm 2. 2500 rpm	1. 6 2. 15	NA	$CaCl_2$	20	NA	NA	2.5 total	Nappage	0, 2, 4, 6	12	Increased hair count, negative hair-pull test, increased patient satisfaction
Marwah et al., 2014[19]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0, 1, 2, 3, 4, 5	NA	Little improvement by means of physician assessment despite increased patient satisfaction
Cervelli et al., 2014[10]	1	1100 *g*	10	Cascade Esforax System	Calcium	18	9	50	0.1 per cm^2	NA	0, 4, 8	2, 12, 36	Increased hair count, hair density, epidermal thickness, number of follicles, $Ki67^+$ keratinocytes of epidermis, hair follicular bulge cells and blood vessels around follicles
Singhal et al., 2015[27]	2	1. 1500 rpm 2. 2500 rpm	1. 6 2. 15	NA	$CaCl_2$	20	NA	NA	10 total	Nappage	0, 2, 4, 6	12	Improved hair counts, hair thickness, hair root strength, and overall alopecia
Gentile et al., 2015[14]	1‡	1. 1150 *g* 2. 1200 rpm	1. 10 1. 10	1. Cascade Esforax System 2. PRL Platelet Rich Lipotrasfert system	Calcium	1. 39 2. 60	1. 9 2. 9 ml PRP	1. 50 2. 15	0.1 per cm^2	Nappage	0, 30 days, 60 days	12	Increased hair count, hair density, epidermal thickness, number of follicles, $Ki67^+$ keratinocytes of epidermis, hair follicular bulge cells and blood vessels around follicles

PRP, platelet-rich plasm; NA, not available; $CaCl_2$, calcium chloride.
*0 indicates time point of initial treatment.
†Unless otherwise indicated.
‡Two protocols reflect use of two different platelet-rich plasma commercial systems.

The success of platelet-rich plasma for restoring hair growth has sparked great interest, with several recent meta-analyses showing improved hair growth.[35,36] In this review, hair growth was substantially increased in all but one study,[19] which still observed improved patient satisfaction in all study participants. Despite the small sample sizes of reviewed studies, the use of objective outcome measurements—hair counts, dermoscopic photomicrographs, and immunohistochemistry—significantly strengthen evidence supporting the use of platelet-rich plasma for treatment of androgenic alopecia. Androgenic alopecia is perhaps the most convincing indication for treatment with platelet-rich plasma.

Overall, this review found methods of platelet-rich plasma preparation and application to vary widely, with multiple studies lacking a description of the exact protocols of platelet-rich plasma preparation before clinical application. Classification systems have been proposed to clarify identification of various products of platelet-rich plasma preparations and improve documentation of study methodology, but they have not been widely adopted.[5–7] Furthermore, the importance of each proposed parameter on the clinical efficacy of platelet-rich plasma in aesthetic medicine is not known. Each factor in the preparation of platelet-rich plasma (e.g., centrifugation, commercial kit, activators) needs to be evaluated, and its clinical effects need to be compared to those of platelet-rich plasma prepared using a simplified method. Although this has been attempted in vitro, the clinical outcomes are unknown in aesthetic medicine.[37–39]

Furthermore, the positive results discussed in this review lacked standardized objective assessment of skin quality before and after treatment, which hinders quantitative meta-analysis. Recently, improved instruments to measure aesthetic outcomes have been developed and may help validate future studies. For facial aesthetic treatments, the FACE-Q is a validated tool for assessing patient-reported outcomes and patient satisfaction. The five-point photonumeric Allergan Skin Roughness Scale[40] was developed in accordance with U.S. Food and Drug Administration requirements to measure facial skin texture and is similar to the Wrinkle Severity Rating Scale.[41]

Although anecdotal reports indicate that multiple treatments are necessary and that treatment effects are transient, these theories have yet to be rigorously studied. Sclafani evaluated the effects of one treatment at multiple time points and found a maximum benefit at 1 to 2 months after injection.[25] Prospective controlled trials with long-term follow-up (2 years) are needed to determine whether the effects of one platelet-rich plasma treatment are transient.

To date, the question of whether platelet-rich plasma's cocktail of growth factors generates a more youthful appearance has not been definitively answered. Within our systematic review, the majority of studies support platelet-rich plasma as a beneficial treatment in facial aesthetics. The variety of treatment protocols in use seem to be effective, but outcomes may be slightly influenced by the preparation technique selected. In addition, platelet-rich plasma appears to be safe, with a low risk profile. Although there is a theoretical risk of injecting high-density platelet solution into a vessel, there were no cases of such complication observed in this literature search. Therefore, although platelet-rich plasma may not be the panacea of facial rejuvenation, there exists a place for this treatment in plastic surgery.

CONCLUSIONS

As demonstrated in this review, positive effects of platelet-rich plasma have been observed in the context of aging facial skin, fat grafting, acne scarring, and androgenic alopecia. Despite rising interest among patients and practitioners, existing data on the efficacy of platelet-rich plasma are limited by the lack of standardization across platelet-rich plasma preparation protocols, application methods, and outcome metrics. Prospective controlled trials with quantifiable outcome metrics are needed to determine the method of platelet-rich plasma preparation and application most likely to produce optimal clinical results. In the interim, this review presents a consolidation of platelet-rich plasma treatment techniques currently in use, to help guide physicians in their own clinical practice.

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