International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	A REVIEW OF INVASIVE SKIN REJUVENATION METHODS IN AESTHETIC MEDICINE
DOI	https://doi.org/10.31435/ijitss.4(48).2025.4137
RECEIVED	12 October 2025
ACCEPTED	15 December 2025
PUBLISHED	29 December 2025
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

A REVIEW OF INVASIVE SKIN REJUVENATION METHODS IN AESTHETIC MEDICINE

Dorota Plechawska *(Corresponding Author, Email: plechawskad@gmail.com)*
University Teaching Hospital named after F. Chopin in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0006-1887-4699

Joanna Gerlach
University Teaching Hospital named after F. Chopin in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0008-2620-709X

Natalia Guzik
University Teaching Hospital named after F. Chopin in Rzeszów, Rzeszów, Poland
ORCID ID: 0009-0006-8782-4417

Joanna Kaźmierczak
Specialist Voivodeship Hospital of Saint Barbara No. 5 in Sosnowiec – Trauma Center, Sosnowiec, Poland
ORCID ID: 0009-0007-6865-400X

Anna Mandecka
Faculty of Medical Sciences in Katowice, Medical University of Silesia in Katowice, Katowice, Poland
ORCID ID: 0009-0000-1264-9809

Kornela Kotucha-Cyl
Specialist Hospital No. 2 in Bytom, Bytom, Poland
ORCID ID: 0009-0002-0417-6364

Weronika Komala
District Hospital in Chrzanów, Chrzanów, Poland
ORCID ID: 0009-0007-2294-0027

Karolina Witek
Specialist Hospital named after H. Klimontowicz in Gorlice, Gorlice, Poland
ORCID ID: 0009-0000-4508-2191

Marta Nowocień
Municipal Hospital in Zabrze, Zabrze, Poland
ORCID ID: 0009-0006-6403-9117

ABSTRACT

Invasive skin rejuvenation techniques such as microneedling, platelet-rich plasma (PRP), and fractional lasers are gaining popularity in aesthetic medicine. Their action is based on the stimulation of skin repair processes, primarily by stimulating collagen and elastin synthesis. Microneedling, also known as collagen induction therapy, improves skin structure and elasticity through controlled mechanical micro-damage. PRP, containing autologous growth factors, supports cellular regeneration and is used both as a monotherapy and in combination therapy. Fractional lasers—both ablative and non-ablative—operate through precise, thermal damage to the skin, enabling the treatment of wrinkles, scars, and discoloration. Despite their high effectiveness confirmed in clinical trials, limitations such as small patient groups, lack of standardized treatment protocols, and short follow-up periods hinder a comprehensive assessment of their effectiveness. The use of combined therapies demonstrates synergistic effects and may be an optimal treatment strategy for patients seeking lasting results while maintaining a high level of safety.

Study Purpose and Materials: The aim of this study is to analyse clinical trials published in the PubMed database between 2008 and 2025 regarding invasive skin rejuvenation techniques. This field is a rapidly developing area of aesthetic medicine, offering new therapeutic options for patients with signs of skin aging. The study focuses on assessing the effectiveness, safety profile, and clinical indications of three main methods: microneedling, platelet-rich plasma (PRP) therapy, and fractional lasers.

Summary: Microneedling, platelet-rich plasma (PRP), and fractional lasers are effective and safe methods of invasive skin rejuvenation. Their use, both as monotherapy and in combination therapies, improves skin quality and reduces wrinkles, scars, and discoloration. Despite promising clinical results, further studies with larger patient groups and standardized protocols are necessary to solidify their place in everyday aesthetic medicine practice.

KEYWORDS

Microneedling, Platelet-Rich Plasma, Fractional Lasers, PRP

CITATION

Dorota Plechawska, Joanna Gerlach, Natalia Guzik, Joanna Kaźmierczak, Anna Mandecka, Kornela Kotucha-Cyl, Weronika Komala, Karolina Witek, Marta Nowocień. (2025). A Review of Invasive Skin Rejuvenation Methods in Aesthetic Medicine. *International Journal of Innovative Technologies in Social Science*. 4(48). doi: 10.31435/ijitss.4(48).2025.4137

Introduction

Skin aging is a complex process determined by numerous factors, both endogenous (such as genetic factors and hormonal changes) and exogenous, including UV radiation, environmental pollutants, and oxidative stress [11]. These changes manifest as loss of elasticity, decreased skin density, reduced hydration, the presence of wrinkles, discoloration, and uneven epidermal texture. In response to growing patient expectations and technological advances, aesthetic medicine is developing minimally invasive procedures aimed at improving skin condition and slowing the aging process.

In recent years, three groups of treatments have gained particular importance: microneedling, platelet-rich plasma (PRP), and fractional lasers. Microneedling (collagen induction therapy, CIT) induces controlled microdamage, which stimulates the production of type I and III collagen, leading to improved skin firmness and structure [7,12]. PRP, an autologous concentrate rich in growth factors, supports tissue regeneration and angiogenesis, demonstrating a rejuvenating effect both as a standalone therapy and in combination with other methods [3,5]. Fractional lasers – both ablative (e.g., CO_2, Er:YAG) and non-ablative (e.g., Nd:YAG, picosecond lasers) – act through precise thermal damage, initiating remodeling of the epidermis and dermis [13,14]. Due to their documented effectiveness, short recovery time, and favorable safety profile, these methods have found widespread use in the treatment of wrinkles, acne scars, loss of skin firmness, and discoloration [5,10,15]. Despite promising results, significant limitations remain, including the lack of standardized treatment protocols, small study groups, and subjective assessment of therapeutic effects [7,23].

Overview of Invasive Skin Rejuvenation Methods

Microneedling

Mechanism of Action.

Microneedling, also known as collagen induction therapy (CIT), is a method involving precise, controlled skin damage using fine needles that penetrate the dermis to a depth of 0.5 to 2.5 mm. This action initiates fibroblast activation and increases the production of type I and III collagen and elastin, while minimally disrupting the epidermal layer. The result is improved skin texture and firmness, and a reduction in fine lines and wrinkles. [7, 10]

Indications and clinical effects.

Microneedling is used to treat a variety of aesthetic and dermatological defects, particularly those related to skin aging. The main indications for therapy are:

- photoaging of the skin (fine wrinkles, loss of elasticity),
- skin laxity on the face, neck, and décolleté,
- acne and post-traumatic scars,
- stretch marks,
- discoloration and melasma,
- enlarged pores, and overall improvement in skin quality. [7, 12]

Reports from clinical studies clearly confirm the beneficial effects of microneedling on improving skin quality and a high level of patient satisfaction. A randomized study using the split-face method, conducted by Żądło et al. (2019), compared the effectiveness of microneedling with the application of vitamin C for needle-free mesotherapy. After four treatments, a statistically significant improvement in skin parameters, such as hydration, elasticity, even skin tone, and reduction of discoloration, was observed – in favor of the microneedling site [7]. In another study (Fabbrocini et al. 2012), concerning wrinkles around the mouth, a significant reduction in wrinkle depth and improvement in skin firmness were observed after three treatments [10].

The effects of microneedling typically last from 4 to 6 months, with a series of 3–6 treatments spaced 4–6 weeks apart and follow-up treatments every 6–12 months recommended [12].

Complications and side effects.

Microneedling is widely considered a safe, minimally invasive procedure for improving skin quality. In clinical studies conducted on groups of patients with photoaging, scars, and other aesthetic defects, side effects were mild, time-limited, and transient.

The most commonly observed side effects include:

- short-term erythema and swelling (resolving within 24–72 hours),
- burning or skin tightness,
- mild exfoliation (2–3 days after treatment),
- pinpoint bleeding or microscabbing [7, 10, 12]. In a randomized, split-face study conducted by Żądło et al. (2019), evaluating microneedling in combination with vitamin C, no serious adverse events were observed. All participants experienced only transient, mild erythema and a feeling of skin tightness, which completely resolved within 48 hours [7].

In a study by Fabbrocini et al. (2012), which examined the treatment of wrinkles around the mouth, no lasting side effects were observed – the only complications were transient erythema and minor microbleeding. Patients rated the treatment as well-tolerated, and the adverse events resolved within 2 days [10].

Aust et al. (2010) emphasized that a higher risk of side effects (such as subcutaneous bleeding or vascular punctures) may occur when using needles longer than 2.0 mm. Greater caution is necessary in this group, especially in areas with higher vascular density [12]. Occasionally reported complications:

- post-inflammatory hyperpigmentation in patients with higher skin phototypes (IV-VI),
- herpes sore in patients with latent HSV-1 infection (antiviral prophylaxis is recommended),
- allergic contact reactions to ampoules of additionally used substances (e.g., vitamin C or peptides)[7, 12].

Platelet-Rich Plasma (PRP)

Mechanism of Skin Regeneration.

Platelet-Rich Plasma (PRP) is a platelet concentrate obtained by centrifugation of the patient's autologous blood. When administered intradermally, it releases growth factors such as PDGF, TGF-β, VEGF, EGF, and FGF, supporting neocollagenesis, angiogenesis, and skin regeneration [1].

Preparations such as Self-Growth Colony (SGC) have achieved higher concentrations of growth factors, which may translate into improved clinical efficacy [2].

PRP and SGC Preparation

PRP Preparation Process:

1. Collect the patient's blood into tubes with an anticoagulant (most often sodium citrate).
2. Double centrifugation method:
    - Stage I (approx. 1200 rpm for 10 minutes) → separation of red blood cells from plasma.
    - Stage II (approx. 3000 rpm for 10 minutes) → concentration of platelets in the lower plasma layer. [3]
3. Single centrifugation method:
    - Centrifugation parameters: 1500 rpm for 5–10 minutes
    - This results in the separation of components into lower, middle, and upper layers:
        - lower - contains erythrocytes,
        - middle - contains a layer of leukocytes,
        - upper - contains plasma with dispersed platelets. [4,5]
4. Collection of the PRP fraction from the lower plasma layer in the case of the double centrifugation method – typically approximately 3–5 ml, or from the upper plasma layer in the case of the single centrifugation method – typically approximately 3–6 ml.
5. Optional activation of PRP (e.g., with calcium chloride), which initiates platelet degranulation and the release of growth factors. [3]

SGC – Self-Growth Colony

SGC is a modern form of autologous preparation that – unlike PRP – does not contain living platelets, but only naturally released growth factors and cytokine proteins derived from blood cells subjected to controlled metabolic stress.

Preparation process:

1. Blood collection into special tubes containing a gel separator.
2. Centrifugation: separation of serum and cell pellet.
3. Collection of plasma with mononuclear cells (PBMCs).
4. Incubation of cells under environmental stress conditions (37°C, 5% CO_2, without nutrients) for 3 days.

– During this time, active release of cytokines and growth factors into the medium occurs.

5. Collection of the supernatant (SGC) containing growth factors – without blood cells and platelets [2].

Clinical data: effectiveness and durability of effects.

Platelet-rich plasma (PRP) has a beneficial effect on skin condition thanks to the presence of growth factors that stimulate fibroblasts and collagen synthesis. Numerous clinical studies confirm improved skin elasticity, reduction of fine lines, increased skin hydration and smoothness, and subjectively perceived improvement in appearance. In a study conducted on a group of 22 patients who underwent three intradermal PRP treatments three weeks apart, improvements in skin texture, firmness, and elasticity were noted. The results were assessed based on both the patients' subjective perceptions and skin elasticity measurements using the Cutometer® device. The results were maintained for up to 12 weeks after treatment.[5]

A study conducted on patients with dark circles under the eyes, in which PRP was used as an adjunct therapy to CO_2 laser therapy, demonstrated that PRP accelerated skin regeneration and reduced inflammation, resulting in a faster return to normal skin appearance and more visible clinical effects after a single treatment cycle.[4]

Another study evaluated the effectiveness of freeze-dried platelet-rich plasma. Despite the product's increased stability, the clinical effects were minimal or absent over an 8-week follow-up period, suggesting that freeze-drying the plasma reduced its biological activity compared to freshly prepared PRP. [3]

Standalone and combined use.

Standalone use (monotherapy)

PRP can be used as the sole therapeutic agent in rejuvenation treatments. The most common method is intradermal administration using needle mesotherapy. Previously described studies using freshly prepared PRP [5] and lyophilized platelet-rich plasma [3] demonstrate the superiority of fresh plasma over lyophilized plasma, despite the greater stability of the lyophilized preparation. Three administrations of fresh PRP resulted in improved skin structure, firmness, and elasticity. These effects lasted for up to 12 weeks [5].

Use in Combination Therapy

PRP is often combined with other skin rejuvenation methods, which can lead to better treatment results.

a) PRP + Fractional CO_2 Laser

In a study aimed at rejuvenating the infraorbital area, platelet-rich plasma was used as an adjunct to CO_2 laser therapy. This, compared to laser therapy alone, resulted in faster healing, less redness, and better cosmetic results in patients receiving combined therapy with PRP [4].

b) PRP + Microneedling

Also, in a study using platelet-rich plasma combined with microneedling, a better improvement in skin texture was achieved than with PRP or microneedling alone, thanks to increased penetration of growth factors into the deeper layers of the skin [5]. c) PRP + Hyaluronic Acid (HA)

Another study compared three groups of patients: those treated with PRP alone, hyaluronic acid alone, and those undergoing combined therapy with these products. The best clinical results and patient satisfaction were achieved in the group receiving combined platelet-rich plasma and HA. Improvements were assessed using FACE-Q questionnaires and biomechanical skin tests – "Combined PRP and HA therapy showed superior aesthetic outcomes and hydration levels" [6].

Fractional Lasers (Ablative and Non-Ablative)

Technological Differences and Mechanism of Action.

Ablative and non-ablative fractional lasers differ in their interaction with tissue. Ablative lasers, such as the CO_2 (carbon dioxide) laser and the Er:YAG (erbium) laser, remove fragments of the epidermis and upper layers of the dermis by evaporating the water contained in the cells. In this process, the generated micro-damages in the skin lead to skin renewal and stimulate regenerative processes, including collagen production, which improves its elasticity, density, and appearance [13, 15]. In the case of the CO_2 laser, ablation is intense because the energy emitted by the device is strongly absorbed by the water contained in the tissues, resulting in their evaporation. This process leads to the removal of damaged cells and the activation of new collagen production. The Er:YAG laser, on the other hand, generates shorter pulses, operates with greater precision and a shallower penetration depth, making it less invasive than the CO_2 laser and reducing the risk of damage to adjacent skin structures [13]. Fractional non-ablative lasers (e.g., Nd:YAG or picosecond lasers) target deeper layers of the skin without damaging the outer layers. Their mechanism of action involves generating microscale "columns" of heat in the skin, which initiate remodeling processes by stimulating collagen and elastin synthesis, leading to improved skin structure and texture. Because the integrity of the epidermis is preserved, the procedure is associated with a shorter recovery period and a low risk of side effects [16, 17]. A good example is the picosecond laser, which, thanks to its ultrashort pulses, is highly effective in removing tattoos and treating pigmentation lesions. It works by breaking down pigment molecules in the skin in an extremely short time, enabling their effective removal with minimal damage to surrounding tissues [14].

Application in reducing wrinkles, scars, and discoloration.

In wrinkle treatment, both ablative fractional lasers, such as CO_2 and Er:YAG, and non-ablative lasers, including Nd:YAG and picosecond lasers, are highly effective. Ablative lasers act on the superficial layers of the skin, removing dead cells and initiating regenerative processes, including the production of new collagen. This results in wrinkle smoothing and improved skin texture and firmness. The CO_2 laser is particularly effective in reducing deeper wrinkles and improving skin firmness, but its use is associated with a longer recovery period [13]. The Er:YAG laser, which emits light with a shorter wavelength, is characterized by greater precision, making it a better choice for patients with thin or sensitive skin. Additionally, it causes less tissue inflammation, which translates into shorter healing and recovery times compared to a CO_2 laser [15].

Non-ablative lasers, such as Nd:YAG and picosecond lasers, penetrate deeper layers of the skin without damaging its outer structure, significantly shortening the recovery period. The Nd:YAG laser is particularly

effective in reducing wrinkles resulting from loss of elasticity, as it stimulates collagen synthesis and contributes to improved skin firmness and elasticity [16]. The picosecond laser, primarily used in rejuvenation treatments, effectively reduces fine lines, smoothing facial lines and improving the overall structure and texture of the skin [14].

Fractional lasers are highly effective in treating various types of scars, including acne, post-surgical, and hypertrophic scars. Ablative lasers, such as CO_2 and Er:YAG, remove damaged skin layers and stimulate regenerative processes, smoothing and evening out the surface of scars. Due to its intense penetration and ability to deeply reshape tissue, the CO_2 laser is particularly effective in treating deeper scars [13]. The Er:YAG laser has a shallower operating range, making it particularly useful in treating milder skin lesions, such as acne scars or superficial surgical scars [15].

Non-ablative lasers, such as Nd:YAG and picosecond lasers, effectively support scar treatment by inducing collagen production in the deep dermis. Because they do not damage the outer layers of the epidermis, their action is less invasive, reducing the risk of new scars and pigmentation disorders such as hypopigmentation. The Nd:YAG laser is particularly effective in treating hypertrophic and keloid scars, thanks to its ability to penetrate deeply and improve the elasticity of affected tissues [16]. The picosecond laser is highly effective in treating acne scars, especially when the lesions are superficial and require delicate, precise correction [14].

Fractional lasers play a significant role in the treatment of skin discolorations, such as age spots, melasma, and post-inflammatory hyperpigmentation. Ablative lasers, such as CO_2 and Er:YAG, are particularly effective in reducing pigmentation lesions, especially those located deeper. By removing layers of skin containing excess melanin and stimulating epidermal regeneration, rapid and long-lasting therapeutic effects can be achieved [13, 15].

Non-ablative lasers, such as the picosecond laser, are highly effective in treating superficial discolorations, such as sun spots or age spots. Thanks to its ability to precisely break down pigment molecules in an extremely short time, it is possible to remove pigmented lesions without damaging the skin surface. This type of treatment is associated with minimal downtime and a low risk of complications [14]. The Nd:YAG laser is also used to treat discolorations, particularly those with deeper lesions such as melasma. Its action contributes to evening out skin tone and reducing the visibility of pigmentation spots [16].

Side Effects

Ablative lasers, such as CO_2 or Er:YAG, are more invasive because they remove superficial layers of skin. This type of intervention may carry the risk of various side effects. The most commonly observed side effects include:

Redness and swelling: Intense redness and swelling of the skin often occur after the treatment, which usually resolves spontaneously within a few days to a week [13].

Scabbing and dry skin: The treatment may result in the formation of scabs, which usually separate spontaneously within 5–7 days. During this period, the skin may become dry and require intensive moisturizing [15].

Hypopigmentation or hyperpigmentation: Removal of superficial layers of skin may result in pigmentation disorders, manifesting as excessive lightening (hypopigmentation) or darkening (hyperpigmentation) of the treated areas. The risk of these changes is particularly increased in procedures performed on skin exposed to intense sunlight [13,16]. Scarring: Although rare, improper post-procedure skin care or an excessive inflammatory response can lead to scarring, including hypertrophic or keloid scars. Therefore, proper post-procedure care and strict adherence to treatment recommendations are crucial [17].

Comparison of the effectiveness of methods

Criterion	Microneedling
Clinical effectiveness	Moderate to high effectiveness in improving texture, firmness, and reducing fine lines; >80% of patients report satisfaction with the results [7, 8]
Durability of effects	4–6 months after a series of treatments; requires maintenance every 6–12 months [9]
Safety	High safety profile; minimal side effects (erythema, swelling); no serious complications [10]
Recovery time	1–3 days (erythema, burning sensation); rarely peeling or punctate crusting [11]

Criterion	PRP monotherapy	Combination therapy (e.g. PRP + CO_2 laser / HA / microneedling)
Clinical effectiveness	Moderate improvement in skin firmness, elasticity and hydration (after 2–3 treatments)[3, 5]	Greater improvement in skin quality, wrinkle depth and color after just 1–2 sessions [4, 6]
Durability of effects	3–6 months (requires booster treatments) [3, 5]	Typically 6–12 months (longer lasting effects, especially with HA and laser) [4, 6]
Safety	Very high – no allergic reactions, minimal risk of infection [3, 5]	Also high; slightly more side effects after laser (erythema, swelling) [4, 6]
Recovery time	Short (1–2 days, local swelling, redness) [3, 5]	Medium (2–5 days for microneedling, 5–7 days for CO_2 laser) [4, 6]
Cost of therapy	Lower – PLN 500–1000 per treatment [5]	Higher – PLN 1,200–2,500 per procedure depending on the combined method [4, 6]

Criterion	Ablative lasers	Non-ablative lasers
Clinical effectiveness	Very high effectiveness in improving skin quality, reducing wrinkles, scars, and discoloration. Quick results in a single treatment (e.g., CO_2, Er:YAG) [13]	High, but the effects may be more subtle and require multiple sessions. Primarily used for improving skin texture, treating discoloration, and tattoo removal (e.g., Nd:YAG, picosecond laser) [14]
Durability of effects	Long-lasting effects, up to 1–2 years depending on the treatment. The effects can last longer due to the stimulation of collagen production [15]	Typically, the effects last shorter than ablative treatments (e.g., 6–12 months). A series of treatments is often required to achieve and maintain optimal results [16]
Safety	Very high, but associated with a higher risk of complications such as infection, scarring, and discoloration. Care should be taken in patient selection [17]	High, minimized risk of complications. Less invasive, but side effects (e.g., redness, swelling) may still occur. Lower risk of scarring and hypopigmentation [18]
Recovery time	Long-term (from several days to several weeks), depending on the type of laser. Swelling, crusting, and redness may occur after the treatment [19]	Shorter (usually 1–3 days). Significantly less irritation and rapid skin regeneration after the treatment [20]
Cost of therapy	Higher, due to the advanced technology and intensive nature of the procedure. The cost can range from several thousand to several dozen thousand złoty for a series of treatments [21]	Lower cost compared to ablative methods. They often require multiple treatments, but the cost per treatment is lower [22]

Discussion

Limitations of available studies (e.g., small sample sizes, lack of standardization).

Microneedling

Studies on microneedling exhibit a number of significant methodological limitations. Many are based on small sample sizes [7] and lack standardization of treatment parameters, such as needle penetration depth or the number of treatment sessions [23]. Furthermore, patient follow-up is typically short, limited to 4–12 weeks [7, 23]. A small number of studies are randomized, and the assessment of treatment effectiveness is primarily based on subjective satisfaction scales, often without the use of objective and validated measurement tools [7]. These limitations emphasize the need for further, better-designed clinical trials.

PRP

In everyday clinical practice, there is still a lack of standardization of procedures for PRP harvesting, including the choice of centrifugation method (single vs. double), varying platelet concentrations, platelet activation methods, and the number of recommended treatment sessions. Therefore, it is crucial to continuously improve physician competence and adherence to evidence-based recommendations, which allows for increased treatment effectiveness and predictable results [3, 5].

Ablative and Non-Ablative Lasers

The available scientific data on the use of fractional lasers are subject to a number of significant methodological limitations. Many studies are based on small patient groups, significantly limiting the ability to extrapolate results to a wider population. The lack of standardized treatment protocols, varying treatment parameters and device types, and inconsistent efficacy criteria hinder direct comparison of results between studies. Furthermore, the limited number of randomized trials, frequent lack of control groups, and short follow-up periods negatively impact the reliability and reproducibility of the obtained data. The diversity of patient demographic characteristics and the insufficient number of analyses regarding the long-term safety of the procedures also constitute significant limitations. To obtain more reliable and comprehensive information, further studies with larger populations and longer follow-up periods are necessary [13, 15].

Conclusions

Practical Implications for Aesthetic Medicine Physicians.

Microneedling

Microneedling is a valuable therapeutic tool in aesthetic medicine, particularly in the treatment of photodamage, acne scars, and improving overall skin quality. Based on the reviewed studies, this technique has a favourable risk-to-effectiveness ratio and high patient acceptability.

Research indicates that after a series of 3–4 microneedling treatments, noticeable improvements in facial skin elasticity, texture, and tone can be achieved, as confirmed, among others, by the previously discussed split-face study using vitamin C [7]. The persistence of effects for 4–6 months also allows for the planning of maintenance sessions every six months [7, 12].

Clinical studies have not reported any serious complications. The most common side effects include temporary redness, peeling, and fine crusting. Therefore, microneedling can be successfully used in patients who require a rapid recovery and avoid more invasive procedures [7, 12]. Available literature data indicates that combining microneedling with the application of active substances such as vitamin C or hyaluronic acid, as well as platelet-rich plasma (PRP), can produce a synergistic effect. This combined approach promotes the intensification of skin regeneration processes and may contribute to the prolongation of the achieved therapeutic results [7].

The selection of microneedling parameters – such as the depth of needle penetration, the number of planned sessions, and the use of adjunctive preparations – should be individually tailored to the clinical problem, skin phototype, and epidermal thickness. Particular caution should be exercised in patients with phototypes IV-VI due to the increased risk of post-inflammatory hyperpigmentation [12].

Although the technique is relatively simple, its implementation requires strict hygiene guidelines, especially with puncture depths >1.5 mm. Treatments should be performed by or under the supervision of qualified medical personnel, minimizing the risk of infection and vascular complications [12].

PRP

The use of platelet-rich plasma, both as a standalone method and in combination with other therapeutic techniques, is gaining popularity in aesthetic medicine. Clinical trial data confirm both the safety profile and effectiveness of this form of therapy, making it a valuable tool in the daily work of physicians specializing in this field.

PRP is an autologous product, making it safe with minimal risk of allergic reactions, infections, or adverse immunological reactions. Therefore, platelet-rich plasma treatment can be safely offered to a wide range of patients, including those with a history of allergies [5].

PRP monotherapy can be effective for patients who desire improved skin elasticity, hydration, and firmness, as well as the smoothing of fine lines and wrinkles. Combination therapies, such as PRP combined with a CO_2 laser, hyaluronic acid (HA), or microneedling, demonstrate higher efficacy and are particularly recommended for patients with symptoms of photoaging, acne scars, and thin, sagging skin on the face and neck. [4, 6].

The results of PRP therapy typically become noticeable 2–3 weeks after the treatment, with the full therapeutic effect achieved after several sessions. It is important to inform the patient that the effectiveness of the method requires a series of treatments (usually 3–4) and booster treatments every 6–12 months. The cost of PRP treatment as a monotherapy is moderate, but in the case of combined therapies – for example, with hyaluronic acid or laser treatments – higher costs and a longer recovery period should be considered, which should be taken into account when selecting a patient for the procedure [3].

Ablative and Non-Ablative Lasers

Fractional lasers – both ablative and non-ablative – are an important therapeutic element in aesthetic medicine practices, providing effective treatment options for wrinkles, scars, and pigmentation disorders. However, to achieve the best therapeutic results and reduce the risk of side effects, it is necessary to consider a number of key practical aspects when planning and performing treatments.

Choosing the appropriate type of laser should depend on the patient's skin phototype, the nature of the lesion being treated, and the desired therapeutic outcomes. Ablative lasers, such as CO_2 and Er:YAG, provide significant results in reducing deep wrinkles and scars, but are associated with a longer healing period. Non-ablative lasers, including Nd:YAG and picosecond lasers, are less invasive and have a shorter recovery time, although achieving comparable results may require more treatments [13,15]. Due to individual patient needs, it is important to tailor treatment parameters to the patient's skin phototype, skin problem, and medical history. Selecting appropriate laser settings, such as penetration depth, power, and number of treatments, is crucial for treatment effectiveness and minimizing the risk of complications [16,17].

To ensure patient safety, physicians should pay particular attention to the risk of potential complications, such as hypopigmentation, hyperpigmentation, infection, and scarring. Proper post-treatment care, including avoiding exposure to UV radiation, using photoprotective products, and maintaining adequate hydration, is crucial. These measures significantly reduce the likelihood of adverse effects and support the healing process. [14]

Proper patient education regarding the treatment process, expected recovery time, and possible side effects is also a crucial element of effective therapy. Patient understanding of the potential risks and realistic results of the treatment plays a key role in building patient satisfaction and promoting optimal therapeutic outcomes [18]. Although fractional laser treatments can provide relatively rapid improvement in skin condition, long-term evaluation of the results is crucial. Physicians should recommend regular follow-up visits and, if necessary, maintenance treatments to prolong the results. Long-term studies are still needed to better assess the safety and persistence of treatment effects, thus enabling more precise tailoring of treatment to individual patient needs [19].

Study	Type of therapy	Clinical Conclusions
[5]	PRP and PRP + microneedling	PRP is effective in monotherapy, but the combination with microneedling gave better results
[3]	PRP (lyophilized)	Clinically insignificant effects; fresh PRP is more effective
[4]	PRP + CO_2 laser	Better healing, shorter recovery time, higher patient satisfaction
[6]	PRP + HA	The best aesthetic effects and skin hydration, longer clinical effect
[7]	Microneedling + Vitamin C (split-face, RCT)	Significant improvement in skin hydration, elasticity and tone on the microneedled side; no serious side effects.
[10]	Microneedling (lip area, 3 sessions)	Reduction of wrinkles around the mouth and improvement of skin firmness; side effects limited to transient redness and pinpoint bleeding.
[13, 15, 21]	CO_2 laser	CO_2 laser is effective in treating wrinkles and scars, improving skin texture and stimulating collagen production, but requires a long recovery period and is associated with a higher risk of complications such as discoloration and infection.
[19]	CO_2 and Er:YAG laser	The combination of CO_2 and Er:YAG lasers offers synergistic effects in skin resurfacing, improving skin texture and removing acne scars, with a longer recovery time.
[14, 17, 18, 22]	Picosecond Laser	Picosecond therapy is effective in removing tattoos and discolorations, offering a faster recovery time and a lower risk of complications compared to traditional lasers. It is safe and effective, affecting deeper layers of the skin without removing the superficial epidermis. Picosecond laser therapy is effective in treating photoaging, reducing wrinkles, and improving skin quality, with minimal recovery time.
[16, 20]	Nd:YAG laser	The Nd:YAG laser is effective in treating deep discolorations, in anti-aging therapy, as well as in reducing dilated blood vessels and revitalizing the skin, requiring a short recovery period and with minimal risk of complications.

Funding: The study did not receive external funding.
Institutional Review Board Statement: Not applicable.
Informed Consent Statement: Not applicable.
Data Availability Statement: Not applicable.
Acknowledgements: Not applicable.
Conflict of Interest: The authors declare no conflicts of interest.
Declaration of the use of generative AI and AI-assisted technologies in the writing process: While preparing this work, the author(s) utilized OpenAI's Chat Generative Pre-trained Transformer to assist with correcting spelling, punctuation, grammar, and stylistic issues. Following the use of this tool, the author(s) reviewed and revised the content as necessary and take full responsibility for the final substance of the publication.

REFERENCES

1. Hui Q, Chang P, Guo B, Zhang Y, Tao K. The clinical efficacy of autologous platelet-rich plasma combined with ultra-pulsed fractional CO_2 laser therapy for facial rejuvenation. *Rejuvenation Res*. 2017;20(1):25-31. doi:10.1089/rej.2016.1823
2. Chan GKL, Guo MS, Dai DK, Lai QWS, Fung KWC, Zheng BZ, et al. An optimized extract, named self-growth colony, from platelet-rich plasma shows robust skin rejuvenation and anti-ageing properties: A novel technology in development of cosmetics. *Skin Pharmacol Physiol*. 2021;34(2):74-85. doi:10.1159/000513052
3. Everts PA, Pinto PC, Girão L. Autologous pure platelet-rich plasma injections for facial skin rejuvenation: Biometric instrumental evaluations and patient-reported outcomes to support antiaging effects. *J Cosmet Dermatol*. 2019;18(4):985-95. doi:10.1111/jocd.12802
4. Elnehrawy NY, Ibrahim ZA, Eltoukhy AM, Nagy HM. Assessment of the efficacy and safety of single platelet-rich plasma injection on different types and grades of facial wrinkles. *J Cosmet Dermatol*. 2017;16(1):103-11. doi:10.1111/jocd.12258
5. Gawdat HI, Tawdy AM, Hegazy RA, Zakaria MM, Allam RS. Autologous platelet-rich plasma versus readymade growth factors in skin rejuvenation: A split face study. *J Cosmet Dermatol*. 2017;16(2):258-64. doi:10.1111/jocd.12341
6. Hersant B, SidAhmed-Mezi M, Aboud C, Niddam J, Levy S, Mernier T, et al. Synergistic effects of autologous platelet-rich plasma and hyaluronic acid injections on facial skin rejuvenation. *Aesthet Surg J*. 2021;41(7):NP854-NP865. doi:10.1093/asj/sjab061
7. Zasada M, Markiewicz A, Drożdż Z, Mosińska P, Erkiert-Polguj A, Budzisz E. Preliminary randomized controlled trial of antiaging effects of l-ascorbic acid applied in combination with no-needle and microneedle mesotherapy. *J Cosmet Dermatol*. 2019;18(3):843-9. doi:10.1111/jocd.12727
8. Hong JY, Ko EJ, Choi SY, Li K, Kim AR, Park JO, et al. Efficacy and safety of a novel, soluble microneedle patch for the improvement of facial wrinkle. *J Cosmet Dermatol*. 2018;17(2):235-41. doi:10.1111/jocd.12426
9. Aust MC, Reimers K, Repenning C, Stahl F, Jahn S, Guggenheim M, et al. Percutaneous collagen induction: minimally invasive skin rejuvenation without risk of hyperpigmentation—fact or fiction? *Plast Reconstr Surg*. 2008;122(5):1553-63. doi:10.1097/PRS.0b013e318188245e
10. Fabbrocini G, De Vita V, Pastore F, Annunziata MC, Cacciapuoti S, Monfrecola A, et al. Collagen induction therapy for the treatment of upper lip wrinkles. *J Dermatolog Treat*. 2012;23(2):144-52. doi:10.3109/09546634.2010.544709
11. Fernandes D, Signorini M. Combating photoaging with percutaneous collagen induction. *Clin Dermatol*. 2008;26(2):192-9. doi:10.1016/j.clindermatol.2007.09.006
12. Aust MC, Fernandes D, Kolokythas P, Kaplan HM, Vogt PM. Percutaneous collagen induction therapy: an alternative treatment for scars, wrinkles, and skin laxity. *Plast Reconstr Surg*. 2008;121(4):1421-9. doi:10.1097/01.prs.0000304612.72899.02
13. Qian MK, Kaminer M, Liao IC, Wangari-Olivero J, Paturi J, Chen Y, et al. A multi-component reaction peptide augmenting the anti-aging benefits of non-ablative laser procedure. *J Drugs Dermatol*. 2025;24(2):188-95. doi:10.36849/JDD.8066
14. Yuan Y, He Y, Fang J, Zhang M, Wu Q. Comparison of the fractionated Nd:YAG 1064-nm picosecond laser with holographic optics and the fractional CO_2 laser in atrophic acne scar treatment: a prospective, randomized, split-face study. *Int J Dermatol*. 2025;64(1):85-91. doi:10.1111/ijd.17296
15. Salameh F, Daniely D, Kauvar A, Carasso RL, Mehrabi JN, Artzi O. Treatment of periorbital wrinkles using thermo-mechanical fractional injury therapy versus fractional non-ablative 1565 nm laser: A comparative prospective, randomized, double-arm, controlled study. *Lasers Surg Med*. 2022;54(1):46-53. doi:10.1002/lsm.23494
16. Grema H, Raulin C, Greve B. "Skin rejuvenation" durch nichtablative Laser- und Lichtsysteme. Literaturrecherche und Übersicht. *Hautarzt*. 2002;53(6):385-92. doi:10.1007/s00105-002-0364-6
17. Wat H, Shek SSY, Yeung CK, Chan HH. Efficacy and safety of picosecond 755-nm alexandrite laser with diffractive lens array for non-ablative rejuvenation in Chinese skin. *Lasers Surg Med*. 2019;51(1):8-13. doi:10.1002/lsm.23014
18. Dou W, Yang Q, Yin Y, Fan X, Yang Z, Jian Z, et al. Fractional microneedle radiofrequency device and fractional erbium-doped glass 1,565-nm device treatment of human facial photoaging: a prospective, split-face, random clinical trial. *J Cosmet Laser Ther*. 2021;23(5-6):142-8. doi:10.1080/14764172.2022.2033783
19. Mohamadi F, Pourgholi E, Vahabi SM, Hosseini F, Mahmoudi H, Ehsani A, et al. Comparative analysis of erbium:glass 1550 nm and combined erbium:YAG & Nd:YAG lasers for perioral rejuvenation: a prospective study. *Lasers Med Sci*. 2025;40(1):291. doi:10.1007/s10103-025-04540-6
20. Dou W, Yang Q, Yin Y, Fan X, Qiu L, Yang Z, et al. A randomized, split-face controlled trial on the safety and effects of microneedle fractional radiofrequency and fractional erbium-doped glass 1,565-nm laser therapies for baggy lower eyelids. *J Cosmet Laser Ther*. 2021;23(5-6):105-12. doi:10.1080/14764172.2021.2001532
21. Marcus BC. Nonablative and hybrid fractional laser skin rejuvenation. *Facial Plast Surg Clin North Am*. 2020;28(1):37-44. doi:10.1016/j.fsc.2019.09.003
22. Saluja R, Gentile RD. Picosecond laser: Tattoos and skin rejuvenation. *Facial Plast Surg Clin North Am*. 2020;28(1):87-100. doi:10.1016/j.fsc.2019.09.008
23. Aust MC, Reimers K, Kaplan HM, Stahl F, Repenning C, Scheper T, et al. Percutaneous collagen induction—regeneration in place of cicatrisation? *J Plast Reconstr Aesthet Surg*. 2011;64(1):97-107. doi:10.1016/j.bjps.2010.03.038