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## Hair loss therapies: a review and comparison of traditional and modern treatment methods

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## **Abstract**

**Introduction and objective.** Hair loss is a common health issue that significantly impacts the quality of life and well-being of millions of people worldwide. Effective treatments remain a challenge for dermatologists due to the complex mechanisms behind hair loss and the diverse range of affected patients.

The objective of this study is to compare the effectiveness of traditional and modern methods of treating hair loss.

**Brief description of the state of knowledge.** Microneedling is a minimally invasive treatment that stimulates collagen production and the release of growth factors, which in turn supports hair follicle regeneration and density. PRP therapy, which uses concentrated platelets from the patient's own blood to stimulate hair growth, has shown promising results, especially in cases of androgenetic alopecia and alopecia areata, although further

research is needed to confirm its effectiveness. Hair transplantation, a highly effective option for larger areas of hair loss, is a more invasive and costly solution but can offer permanent results. Pharmacological treatments like oral minoxidil are increasingly being used due to their convenience and efficacy, particularly in cases where topical treatments are poorly tolerated. Similarly, topical finasteride, with fewer systemic side effects than oral finasteride, is emerging as a promising alternative for treating androgenetic alopecia. Additionally, zinc, selenium, and vitamin E supplementation may have a beneficial effect in cases of hair loss associated with deficiencies, though more research is needed to fully confirm their role in treatment.

**Methods.** A literature review was conducted using PubMed and Google Scholar with search terms like "hair loss", "PRP in hair loss", "natural methods in hair loss", "vitamins in hair loss", "hair transplant", and related variations. Articles published within the last five years were prioritized.

**Keywords:** hair loss treatment, androgenetic alopecia, alopecia areata, pharmacological therapy, aesthetic medical procedures, hair transplantation.

## **Introduction and objective**

Hair loss is a prevalent health issue affecting millions of people worldwide, significantly impacting their quality of life and psychological well-being [1]. The most common forms of hair loss include androgenetic alopecia, affecting both men and women, and alopecia areata, an autoimmune disorder [2]. Developing effective treatments for hair loss remains a challenge for dermatology specialists due to the complex mechanisms underlying hair loss and the diverse patient demographics affected [1].

Currently available treatments for hair loss encompass both pharmacological methods, such as minoxidil and finasteride, as well as modern aesthetic medical procedures, including mesotherapy and platelet-rich plasma (PRP) therapy [2]. Hair transplantation has also become a popular option for patients who do not respond to less invasive methods, offering high efficacy but involving significant costs and potential side effects [1]. Furthermore, innovative approaches like gene therapy and stem cell-based treatments are gaining traction as potential future alternatives to existing therapies [1].

The objective of this study is to compare the efficacy of traditional and modern methods of treating hair loss, with a particular focus on their effectiveness, safety, and accessibility for patients [2]. The analysis will include both pharmacological and procedural therapies, enabling an assessment of their outcomes in treating different types of alopecia [1].

## **Methods**

1. Modern methods of treating hair loss

### **Microneedling**

Microneedling is a minimally invasive procedure used in dermatology, which involves using fine needles to create tiny punctures in the skin. This process stimulates collagen production, neovascularization, and the release of growth factors, which promote hair follicle regeneration and improve hair density. Microneedling has been shown to enhance the effectiveness of other treatments for hair loss, such as minoxidil, platelet-rich plasma (PRP), and topical steroids. Although it is not yet considered superior to traditional therapies, it shows promising results when used in combination with other treatments. Research suggests that increasing the treatment duration and reducing the frequency of sessions could optimize hair regrowth. However, further large-scale, randomized controlled trials are necessary to fully assess its safety, efficacy, and optimal protocols for treating androgenetic alopecia (AGA) and other forms of hair loss. [3,4,5]

### **Platelet rich plasma (PRP)**

Platelet-rich plasma (PRP) therapy has emerged as a promising treatment for non-scarring alopecias, including androgenetic alopecia (AGA) and alopecia areata. PRP involves the extraction of a patient's blood, which is then processed to concentrate platelets before being re-injected into the scalp. The growth factors in PRP stimulate hair follicle activity,

promote hair regrowth, and improve hair density. Although PRP has shown positive results in several studies, the overall evidence remains inconclusive, with most studies reporting low-quality results. To determine its effectiveness, further randomized controlled trials with larger sample sizes and standardized protocols are necessary. [6,7,8]

### **Hair transplant**

Hair restoration surgery has advanced significantly with the introduction of follicular unit transplantation, where individual follicular units are harvested as grafts. This method is most commonly used for treating male androgenetic alopecia and female pattern hair loss. While hair transplantation is highly effective for these conditions, not all scalp disorders are suitable for surgery. The review highlights which patients are ideal candidates for the procedure and discusses various other scalp conditions that may also benefit from transplantation. Detailed guidelines are provided to assist dermatologists in identifying suitable candidates for surgery. [10]

<b>Treatment method</b>	<b>Mechanism</b>	<b>Suitability for conditions</b>	<b>Advantages</b>	<b>Limitations</b>
PRP (Platelet rich plasma)	Utilizes growth factors from the patient's own blood to stimulate hair follicles	Androgenetic alopecia, alopecia areata	Minimally invasive, natural approach	Mixed results, requires multiple sessions
Microneedling	Creates micro-punctures in the scalp to stimulate hair regrowth	Androgenetic alopecia, alopecia areata	Enhances absorption of other treatments	Results vary, requires several sessions
Hair transplantation	Transplants healthy hair follicles to thinning areas	Androgenetic alopecia, some other hair loss conditions	Permanent results, effective for large areas	Invasive, costly, requires recovery time

Summary table of modern hair loss treatments

## 2. Traditional methods of treating hair loss

### **Minoxidil**

Oral minoxidil has gained recognition as an alternative treatment for various forms of hair loss, particularly androgenetic alopecia (AGA) and alopecia areata (AA). Unlike topical minoxidil, which is commonly used but often leads to poor patient adherence due to its application process and side effects, oral minoxidil offers a more convenient alternative. Studies show that low doses (0.25–5 mg daily) effectively promote hair regrowth with fewer side effects. Key benefits include ease of use and improved patient compliance, especially among those unable to tolerate topical treatments. The most commonly reported adverse effects include hypertrichosis (excessive hair growth in unwanted areas) and postural hypotension. Additionally, oral minoxidil has been found effective in treating other types of alopecia, such as chronic telogen effluvium and chemotherapy-induced alopecia. The efficacy is most pronounced in men, who typically require higher doses, ranging from 1.25 to 5 mg daily, compared to women, who benefit from lower doses. Although preliminary results are promising, larger randomized controlled trials with standardized protocols are needed to confirm optimal dosing regimens and long-term safety. Furthermore, while oral minoxidil appears to show advantages in terms of patient compliance, it still carries risks, including potential cardiovascular effects, making it crucial for physicians to tailor treatments based on individual patient needs. Studies have also suggested that oral minoxidil can be more effective than topical formulations in some cases, particularly in individuals with severe alopecia or those who have not responded well to topical treatments. However, further research will help clarify the full potential and limitations of this treatment modality. [11,12,13, 14]

### **Finasteride**

Topical finasteride is an emerging alternative treatment for androgenetic alopecia (AGA), offering a localized application to improve hair count without systemic side effects typical of oral finasteride. A study involving 458 male patients demonstrated that topical finasteride resulted in a significantly greater hair count compared to a placebo, with similar efficacy to oral finasteride. The topical formulation showed substantially lower

systemic finasteride levels and less impact on dihydrotestosterone (DHT), the hormone implicated in hair loss. As a result, it is associated with a reduced risk of adverse effects like sexual dysfunction. The treatment was well-tolerated, with no serious treatment-related side effects, making it an appealing choice for patients concerned about the systemic effects of oral medications. Additionally, topical finasteride is less likely to impact the serum DHT concentration, minimizing potential risks linked to oral treatments. These findings suggest that topical finasteride is a promising, effective, and safer option for treating AGA, with results comparable to oral finasteride but with improved patient compliance and fewer side effects. [15,16,17,18]

<b>Feature</b>	<b>Minoxidil</b>	<b>Finasteride</b>
Formulation	Oral tablets	Topical application
Efficacy	Effective for androgenic alopecia(AGA), alopecia areata and other forms of hair loss	Effective mainly for AGA
Primary benefit	Easier to use, improved patient compliance	Fewer systemic side effects, localized effect
Common side effects	Hypertrichosis, postural hypotension	No serious side effects, reduces sexual dysfunction risks

Summary table of minoxidil and finasteride

### **Zinc supplementation**

Zinc, an essential trace element, must be obtained through diet, primarily from fish and meat. Deficiency can arise from high grain intake (due to phytates binding zinc), low meat consumption, or conditions like anorexia nervosa, inflammatory bowel disease, or increased demands in situations like pregnancy and infection. Alopecia, particularly hair loss, is often linked to zinc deficiency, with hair regrowth sometimes improving through supplementation. However, evidence connecting zinc levels to hair loss types such as telogen effluvium (TE) and androgenetic alopecia (AGA) is mixed. Studies indicate that zinc deficiency may correlate with hair loss in conditions like alopecia areata (AA) and

TE, although some research finds no significant difference in zinc levels between affected and control groups. The effectiveness of zinc supplementation in treating AA remains debated: while a 1981 trial showed no improvement with 220 mg daily doses, a smaller study using 50 mg daily demonstrated positive effects in some patients. [19,20,21,22,23]

### **Selenium supplementation**

Selenium is a vital trace element essential for producing over 35 proteins, including the antioxidant enzyme glutathione peroxidase, which relies on selenium as a co-factor. Selenium deficiency can affect low-birth-weight infants, patients on total parenteral nutrition (TPN), and those in areas with selenium-poor soil. Venton et al. reported hair depigmentation in four TPN patients lacking selenium supplementation, with pigment restoration observed after 6–12 months of intravenous selenium. Similarly, six infants receiving nutritional support who developed alopecia and pseudoalbinism showed improvements after daily selenium therapy restored their serum levels to 5–15 µg/dL. A study on ovarian cancer patients undergoing chemotherapy also found reduced hair loss and gastrointestinal issues with selenium supplementation.

In the U.S., the recommended dietary allowance for selenium is 55 µg daily for individuals 14 and older, with adequate intake typically available from foods like meat, vegetables, and nuts. However, consuming over 400 µg daily may lead to toxicity, manifesting as nausea, vomiting, brittle nails, hair loss, fatigue, irritability, and foul breath. A case of selenium toxicity due to a dietary supplement with excessively high selenium levels led to severe hair loss in many affected patients. [19,24,25,26,27, 28,29]

### **Vitamin E supplementation**

Immune cells are highly susceptible to oxidative damage, yet they also generate reactive oxygen species (ROS) as part of their defense mechanism, which can trigger lipid peroxidation. Antioxidant supplements have been shown to counter age-related immune decline, resulting in increased lymphocyte and T-cell counts, elevated interleukin-2, enhanced natural killer cell activity, improved antibody response, better mitogen response, reduced prostaglandin synthesis, and decreased lipid peroxidationh suggests an imbalance between oxidants and antioxidants in alopecia areata (AA), which is associated with autoimmunity, genetics, and environmental stress. Most studies indicate higher oxidative stress markers and lower antioxidant enzyme levels in AA patients. Vitamiantioxidant,



helps protect against oxidative damage. One study by Ramadan et al. reported significantly lower serum and tissue levels of vitamin E in AA patients compared to healthy controls ( $p < 0.001$ ). [19, 30,31, 32, 33]

## **Discussion**

Hair loss, a condition affecting individuals across various ages, genders, and backgrounds, is a multifaceted issue that extends beyond physical appearance, often impacting mental health and overall quality of life. The complexity of hair loss stems from a combination of genetic, hormonal, and environmental factors, along with varying responses to treatment. Developing effective treatments that address this diversity remains challenging, as the efficacy, safety, and accessibility of treatments vary widely. This study aimed to analyze both traditional and modern approaches to hair loss treatment, focusing on their comparative efficacy, safety, and practical accessibility for diverse patient populations.

Traditional treatments: minoxidil and finasteride.

Among the pharmacological options, minoxidil and finasteride have long been the mainstays in hair loss treatment, particularly for androgenetic alopecia (AGA), the most common form of hair loss. Minoxidil, available in both topical and oral formulations, is generally effective, particularly in AGA and alopecia areata. However, its success is not uniform across all patients. Some individuals experience significant hair regrowth, while others see minimal improvements, suggesting that minoxidil's efficacy may be influenced by individual genetic and biological factors. Side effects, such as hypertrichosis (excessive hair growth in unintended areas) and postural hypotension (a form of low blood pressure that occurs upon standing), can also limit minoxidil's widespread acceptability. While the convenience of oral minoxidil improves adherence, it introduces additional considerations, including potential cardiovascular side effects that necessitate careful patient monitoring and an assessment of individual cardiovascular risk.

Finasteride is another established option, especially for male patients with AGA, as it reduces levels of dihydrotestosterone (DHT), a key factor in AGA progression. However, oral finasteride has a significant drawback in the form of side effects, particularly sexual dysfunction, which discourages many from adopting it as a long-term solution. Topical finasteride has emerged as an alternative, offering a method of reducing systemic side effects while maintaining efficacy. Early evidence suggests that topical formulations can

achieve results similar to oral forms but without the unwanted side effects, thus holding promise as a less invasive and more patient-friendly alternative. Nevertheless, long-term data and optimized dosage protocols are needed to solidify its place in treatment regimens and establish clear guidelines on application and maintenance.

Modern treatments: microneedling, platelet-rich plasma (PRP) therapy, and hair transplantation.

In recent years, modern methods like microneedling, PRP therapy, and hair transplantation have gained attention as alternatives or adjuncts to pharmacological treatments. Microneedling, a minimally invasive technique, stimulates hair follicles by promoting collagen production and enhancing neovascularization, or blood vessel growth. While microneedling is generally used alongside other treatments like minoxidil, its role as a standalone treatment remains limited. This method is appealing to patients seeking a natural approach, though the treatment's success is highly dependent on factors such as session frequency and duration, aspects that require further research to optimize treatment protocols and improve outcomes.

PRP therapy, another modern approach, uses growth factors extracted from the patient's own blood to stimulate hair regrowth. This method has shown promise in treating conditions such as AGA and alopecia areata, and its non-invasive nature makes it attractive to those wary of surgical options. Despite positive results in certain cases, the evidence supporting PRP remains inconsistent, with numerous studies highlighting the variability in treatment response and a lack of standardized protocols. To confirm PRP's efficacy, high-quality, randomized controlled trials with larger sample sizes and standardized procedures are needed to clarify its effectiveness and delineate clearer guidelines for clinical use.

Hair transplantation, while invasive and often expensive, remains a viable option, particularly for patients with advanced AGA, typically male patients who may not respond well to other treatments. This surgical method involves the redistribution of hair follicles from areas with high hair density (often the back of the scalp) to areas of thinning or baldness, and it can produce long-lasting, natural-looking results. However, hair transplantation is not suitable for everyone; its success depends heavily on careful

candidate selection and an understanding of the patient's scalp health. Recovery time and invasiveness also limit accessibility, particularly for those unwilling or unable to undergo surgery. Thus, hair transplantation is often viewed as a last resort when other treatments have proven ineffective.

Nutritional supplements: zinc, selenium, and vitamin E.

In addition to pharmaceutical and procedural treatments, nutritional supplementation has been suggested as a supportive therapy, especially in cases where nutrient deficiencies may contribute to hair loss. Zinc, a trace mineral essential for cellular health and immune function, is often linked to hair health. Zinc deficiencies are commonly associated with conditions such as alopecia areata and telogen effluvium, and supplementation has shown potential benefits in some cases. However, the outcomes vary across studies, indicating that zinc may be beneficial primarily in patients with a confirmed deficiency rather than as a universal supplement.

Selenium, another essential micronutrient, is sometimes recommended for hair growth, though its effects are more ambiguous. Selenium plays a role in hair follicle function and has antioxidant properties, but excessive intake can lead to toxicity, which underscores the importance of maintaining balanced levels. Research on selenium's effects remains limited, and further studies are needed to determine its therapeutic role, especially considering the risk of adverse effects at high doses.

Vitamin E, an antioxidant, is thought to support hair health by reducing oxidative stress and boosting immune function, both of which may play roles in hair loss disorders like alopecia areata. Although some studies suggest positive effects of vitamin E on hair growth, findings remain inconclusive, with other studies reporting minimal impact on hair loss compared to healthy controls. Therefore, while supplementation with vitamin E may benefit patients with oxidative stress-related hair loss, more extensive research is required to determine its therapeutic efficacy and to identify which subgroups of hair loss patients may benefit most from its use.

## **Conclusions**

Hair loss, particularly androgenetic alopecia and alopecia areata, remains a significant concern globally, affecting millions of individuals. As our understanding of hair loss mechanisms advances, so do the treatment options available. Both traditional

pharmacological treatments, such as minoxidil and finasteride, and modern procedures like PRP therapy, microneedling, and hair transplantation, offer promising results.

Traditional treatments like minoxidil and finasteride have been proven effective for androgenetic alopecia, with minoxidil also showing positive results for alopecia areata. However, these therapies are not without limitations. Topical minoxidil often leads to poor patient compliance due to the application process and side effects, while finasteride can cause sexual dysfunction and other systemic effects in some patients. The emerging use of oral minoxidil and topical finasteride, though offering some advantages, still requires more extensive clinical trials to confirm their safety profiles, especially with regard to long-term use and potential cardiovascular risks.

On the other hand, modern treatments such as PRP therapy and microneedling present innovative, minimally invasive approaches that may complement traditional methods, enhancing overall efficacy. PRP therapy, which harnesses the patient's own growth factors, shows promise in stimulating hair regrowth but requires further validation through large-scale, well-controlled studies. Microneedling, though still in early stages of evaluation, has demonstrated the potential to improve the absorption and effectiveness of topical treatments, offering an additional tool in the management of alopecia.

Hair transplantation, although invasive and costly, remains the gold standard for patients with advanced hair loss who do not respond to medical therapies. Advances in follicular unit transplantation have made this procedure more effective and accessible, but it is still not suitable for all forms of hair loss.

Looking ahead, gene therapy and stem cell-based treatments are on the horizon as potential future alternatives. Although these therapies are in the experimental stages, their promise to regenerate hair follicles and treat alopecia at a genetic level could revolutionize the way hair loss is managed.

In conclusion, while current treatments for hair loss offer varying levels of effectiveness, there is no one-size-fits-all solution. A tailored approach, considering the type and severity of hair loss, as well as patient preferences and medical history, is essential. It is also clear that combination therapies, which integrate both traditional and modern methods, hold the potential for optimal outcomes. However, as the field of hair restoration continues to evolve, ongoing research and clinical trials will be key to refining these

treatments and determining the most effective and sustainable options for patients worldwide.

### **Disclosures**

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Methodology: MZA, GB

Software: GB, AN

Check: PN, WP, MZA

Formal analysis: WP, MZ, MK

Investigation: AN, MZ, GB

Resources: AN, PN, KJ

Data curation: WP, AN, KJ

Writing-rough preparation: AN, GB

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