Volume 4, Issue 5, May 2026 ISSN (E): 2938-3765

CLINICAL EFFICACY OF BIOLOGICAL AND REGENERATIVE THERAPY IN CICATRICIAL ALOPECIA

Abduvaliyev Begali Sherali ugli
Assistant of the Department of Dermatovenereology and
Allergology Fergana Medical Institute of Public Health

Abstract
Cicatricial alopecia (CA) is a heterogeneous group of inflammatory disorders causing irreversible destruction of hair follicle stem cells and their replacement by fibrous tissue, affecting approximately 3-7% of patients presenting to dermatology clinics. Pathogenesis involves lymphocyte- or neutrophil-mediated attack on the pilosebaceous unit, driven by JAK/STAT signaling, Th1/Th2/Th17 cytokine imbalance, and microbial dysbiosis. This review evaluates the quantitative clinical efficacy of biological agents, JAK inhibitors, and platelet-rich plasma in stabilizing disease activity and promoting residual follicular survival.

Keywords: Cicatricial alopecia, lichen planopilaris, frontal fibrosing alopecia, JAK inhibitor, tofacitinib, baricitinib, platelet-rich plasma, LPPAI score, follicular stem cell, pilosebaceous unit, IFN-γ, IL-17, fibrosis, TGF-β1, hair follicle regeneration.

Introduction

Cicatricial alopecia encompasses a clinically and histologically diverse group of inflammatory scalp disorders whose defining characteristic is the irreversible destruction of hair follicle stem cells residing in the follicular bulge region, followed by their replacement with fibrotic tissue. Once the bulge stem cell compartment and the adjacent sebaceous gland are obliterated, no spontaneous regeneration of the follicular unit is possible, making early intervention the only meaningful opportunity to preserve hair-bearing surface area. The condition is estimated to account for 3-7% of all alopecia cases seen in specialist dermatology clinics, with primary cicatricial alopecias (PCA) subdivided by the predominant inflammatory infiltrate into lymphocytic forms - including lichen planopilaris (LPP), frontal fibrosing alopecia (FFA), and pseudopelade of Brocq - and neutrophilic forms such as folliculitis decalvans and dissecting cellulitis of the scalp. The chronic, progressive nature of these conditions, combined with the irreversibility of established lesions and the limited efficacy of conventional corticosteroid-based protocols, has driven increasing interest in targeted biological therapies and regenerative approaches over the past decade.

Literature review

Lukowiak et al. (2025) published the most comprehensive narrative review to date of off-label biological and JAK inhibitor use in scarring alopecias, covering six major subtypes and consolidating evidence from 2018 through 2024. Wang et al. (2025, Journal of the European Academy of

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Dermatology and Venereology) conducted a systematic analysis of JAK inhibitor efficacy specifically in LPP and FFA, identifying baricitinib and tofacitinib as the best-evidenced agents in this class. A retrospective study by Moussa et al. (2022) on baricitinib in LPP patients provided the first structured multicenter dataset for this molecule in cicatricial disease. The efficacy of tofacitinib in a cohort of 74 biopsy-confirmed LPP patients was assessed by a single-center retrospective study at Shohadaye Tajrish Hospital, with quantitative LPPAI scoring as the primary outcome metric. A systematic review by Anudeep et al. (2022) surveyed regenerative cellular therapy across non-scarring and scarring alopecias, offering a cross-modal comparative framework. PRP-specific evidence in primary cicatricial alopecias was synthesized in a systematic review by Starace et al. (2022), which confirmed anti-inflammatory and proangiogenic effects of platelet-derived growth factors but underscored the absence of standardized preparation and dosing protocols as the principal barrier to evidence consolidation.

Methodology

Study design. A structured narrative review was conducted. Literature searches were performed in PubMed/MEDLINE, Scopus, Web of Science, Cochrane Library, and eLIBRARY.ru for publications between January 2015 and April 2025. Primary search terms included: "cicatricial alopecia treatment," "lichen planopilaris JAK inhibitor," "frontal fibrosing alopecia tofacitinib baricitinib," "primary cicatricial alopecia PRP," "biologics scarring alopecia," "LPPAI score outcomes," "follicular stem cell regeneration," and "hair follicle fibrosis mechanism." Inclusion criteria required studies to report quantitative outcome measures - specifically LPPAI, SALT, or investigator-assessed progression scores - with minimum follow-up of 12 weeks and at least 10 patients per cohort. Systematic reviews and meta-analyses were incorporated regardless of cohort size. Preclinical and animal studies were included only where they provided mechanistic data directly relevant to the clinical interventions under review.

Classification of disease subtypes addressed. The review focused on lymphocytic PCAs, particularly LPP and its frontotemporal variant FFA, as these subtypes carry the largest body of evidence for biological and regenerative intervention. These conditions are pathogenetically characterized by CD4/CD8 T lymphocyte-mediated destruction of the follicular epithelium in the isthmus and infundibulum. FFA, now widely regarded as a clinical variant of LPP, predominantly affects postmenopausal women and is distinguished by its characteristic pattern of progressive frontotemporal hairline recession, eyebrow loss, and facial papules. Both conditions display upregulated JAK/STAT signaling as a common thread linking immune activation to follicular destruction.

Outcome measurement tools applied. The Lichen Planopilaris Activity Index (LPPAI) served as the primary composite outcome measure. LPPAI integrates subjective symptoms (pruritus, pain, burning) scored on 10-point visual analog scales with objective clinical signs (erythema, perifollicular scale, spreading) scored 0-3 by the examining physician, and trichoscopic findings of active disease. The total score ranges from 0 to 10, with values below 2.0 considered to indicate disease quiescence and values above 5.0 indicating high-activity disease. Secondary outcome parameters included trichoscopic density measurements (follicular units/cm), dermoscopic inflammatory regression (reduction in perifollicular erythema and scale), and patient-reported outcomes via DLQI and VAS-

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

pruritus scales. JAK inhibitors - systemic. Tofacitinib (pan-JAK inhibitor, primarily JAK1/JAK3) at 5 mg twice daily and baricitinib (JAK1/JAK2 inhibitor) at 2-4 mg once daily were evaluated as oral systemic agents for refractory LPP and FFA. Treatment duration across reviewed studies ranged from 16 weeks to 18 months. JAK inhibitors - topical. Tofacitinib 2% cream applied twice daily to active scalp margins was evaluated in open-label series as an alternative with reduced systemic exposure. Biologics - off-label. Dupilumab (IL-4Rα antagonist), secukinumab (IL-17A antagonist), and ustekinumab (IL-12/23 antagonist) were reviewed in case-series and retrospective cohorts in patients with concurrent atopic comorbidities or Th2/Th17-dominant immunophenotypes. Platelet-rich plasma (PRP). Autologous PRP was prepared at platelet concentrations of 4-6 times the patient's circulating baseline (typically yielding 600,000-1,500,000 platelets/μL) and injected intradermally at 0.1 mL/cm into active scalp margins at 4-week intervals for 12-16 weeks. The primary growth factors implicated in the mechanism include PDGF, VEGF, EGF, TGF-β1, and IGF-1.

Pathomechanistic findings relevant to targeted therapy. The inflammatory cascade driving lymphocytic PCA is initiated by antigen presentation to CD4 helper T cells by Langerhans cells in the follicular epithelium, followed by cytotoxic CD8 T cell recruitment to the peri-isthmic zone. IFN-γ, secreted by lesional T cells, activates the JAK1/JAK2-STAT1 axis in follicular keratinocytes, inducing expression of MHC class II antigens on epithelial cells - a process that removes immune privilege from the hair follicle and amplifies autoantigen presentation. IL-17 from Th17 cells promotes neutrophil recruitment in mixed-infiltrate variants, while TGF-β1, present in PRP platelet α-granules at concentrations of 40-80 ng/mL, drives fibroblast differentiation and progressive peri-follicular collagen deposition. The convergence of JAK1/2-mediated IFN-γ signaling and STAT3-mediated IL-6 and IL-17 activity on the follicular stem cell compartment provides the molecular basis for JAK inhibitor efficacy in these conditions. Tofacitinib outcomes - LPP. In the largest published retrospective cohort (n = 74 biopsy-confirmed LPP patients; 83.3% female; mean age 46.6 8.0 years), tofacitinib 5 mg twice daily produced a mean LPPAI reduction from 6.82 at baseline to 2.14 at week 16, representing a 68.6% decrease in composite disease activity ($p < 0.001$). Disease stabilization, defined as LPPAI 2.0, was achieved in 61 of 74 patients (82.4%). Trichoscopic evidence of active inflammation - perifollicular erythema and tubular scaling - resolved completely in 48 patients (64.9%) within 24 weeks. Treatment-resistant disease requiring dose escalation was observed in 11 patients (14.9%). The most frequently recorded adverse effects were nausea (8.1%) and mild elevation of liver enzymes returning to normal without dose adjustment (5.4%). Serious infections occurred in 4.8% of patients receiving long-term oral JAK inhibitor therapy across the broader reviewed literature. Baricitinib outcomes - FFA. In the prospective multicenter baricitinib trial for FFA in postmenopausal women, LPPAI scores decreased from a mean of 6.18 at screening to 2.26 by week 12, representing a 63.4% reduction. Patient-reported perception of scalp hair growth improved significantly from baseline, though objective trichoscopic follicular density measurements did not yet show statistically significant changes at 12 weeks, consistent with the expected lag between inflammatory suppression and measurable follicular recovery. Frontotemporal hairline stabilization was confirmed in 92.1% of patients with FFA or FFA/LPP overlap in a separate topical tofacitinib series: 31.6% demonstrated objective improvement and 60.5% showed stabilization, while only 7.9% continued to progress. In the baricitinib retrospective study by Moussa et al. (2022, n = 20 LPP patients), disease activity improvement was documented in 85% of patients at 6-month follow-

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

up, with LPPAI reduction from 5.9 to 2.3. Among off-label biologics, the available dataset remains limited to case series and small retrospective cohorts. In the systematic review by Lukowiak et al. (2025), 9 studies evaluating JAK inhibitors across CA subtypes identified tofacitinib as both safe and effective for CA with an overall favorable signal. Dupilumab showed clinical benefit in patients with LPP and concurrent atopic dermatitis, suggesting IL-4/IL-13-driven Th2 polarization as a relevant pathogenic contributor in a subset of patients. Secukinumab demonstrated disease stabilization in isolated cases of LPP with pronounced Th17 signatures, though cohort sizes of 3-7 patients preclude robust conclusions. PRP outcomes in cicatricial alopecia. Evidence for PRP in PCA is considerably more limited than in non-scarring alopecias. In a case study of a patient with multi-treatment-resistant FFA receiving PRP injections (3 mL of standardized Mayo Clinic protocol PRP) every 4 weeks for 16 weeks, minimal improvement in LPPAI was observed with no statistically significant change in follicular unit density. However, a reduction in perifollicular erythema and scaling was noted clinically, suggesting a possible anti-inflammatory rather than regenerative primary mechanism. In mixed non-scarring alopecia cohorts, PRP produced a mean increase in hair density of 45.9 hairs/cm above baseline values after three treatment cycles, with microscopic confirmation of increased Ki-67 keratinocyte proliferation and greater small vessel density around follicles ($p < 0.05$). The systematic review by Starace et al. confirmed that PRP is a promising adjunct in PCA patients with residual follicular activity at disease margins, but has no meaningful effect on fully fibrotic zones where the stem cell compartment has been eliminated.

Discussion

The clinical data reviewed here reveal a consistent and important distinction between what JAK inhibitors and regenerative therapies can and cannot accomplish in cicatricial alopecia. JAK inhibitors - particularly tofacitinib and baricitinib - address the primary pathological event: ongoing T lymphocyte-mediated destruction of viable follicular units. The 68.6% LPPAI reduction achieved with tofacitinib at 16 weeks and the 82.4% disease stabilization rate in the largest published cohort represent outcomes that far exceed those obtainable with conventional intralesional triamcinolone or hydroxychloroquine protocols, and they arrive significantly faster. Critically, this efficacy is mechanistically rational: by blocking JAK1/JAK2/JAK3-mediated signal transduction, tofacitinib interrupts IFN-γ-STAT1 activation in follicular keratinocytes, restoring immune privilege to the follicular epithelium and halting the positive-feedback cycle of autoantigen presentation that drives progressive destruction.

However, JAK inhibitors cannot reverse fibrosis that has already replaced destroyed follicular units. This limitation defines the therapeutic window within which they are effective: early intervention, while active follicles remain at the lesion margin and are at risk but not yet eliminated, is the only context in which disease modification - as opposed to mere symptomatic relief - is achievable. LPPAI-guided monitoring is therefore not merely a research tool but a practical clinical necessity, allowing the treating physician to identify and act on disease activity before irreversible follicular loss expands further.

The role of regenerative therapies in this framework is more nuanced. PRP's primary mechanism in cicatricial disease is anti-inflammatory, mediated by TGF-β1 and TGF-β - growth factors present in platelet α-granules - which attenuate pro-inflammatory cytokine expression and support angiogenesis

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

in peri-lesional tissue. This mechanism is biologically appropriate at the active disease margin, where residual follicles are threatened but not yet destroyed, and where improved microcirculation may reduce the ischemic component of follicular stress. The finding that PRP significantly increases hair density in non-scarring alopecias (45.9 hairs/cm at three treatment cycles, with histological confirmation of Ki-67 bulge cell proliferation) does not translate directly to cicatricial disease, where the bulge stem cell pool has been depleted - but it does suggest that PRP may serve a meaningful adjunctive role at the perilesional interface when used in combination with immunosuppressive therapies that first stabilize the inflammatory attack. The combination of a JAK inhibitor to suppress active inflammation and PRP to support residual follicular survival and peri-lesional vascularity represents a logically grounded combination strategy that warrants formal evaluation in randomized trials. Similarly, the observed efficacy of dupilumab in LPP patients with atopic comorbidities raises the possibility that molecular phenotyping of PCA patients - distinguishing predominantly Th1/JAK-driven from Th2-driven and mixed cases - could guide more precise biological selection, improving response rates beyond those achievable with a uniform treatment algorithm.

Cicatricial alopecia demands early, targeted intervention before irreversible follicular fibrosis establishes itself. JAK inhibitors, particularly tofacitinib and baricitinib, achieve clinically meaningful disease stabilization in 82-92% of LPP and FFA patients with LPPAI reductions exceeding 63% at 12-16 weeks. PRP serves as a rational anti-inflammatory adjunct at perilesional margins but cannot restore destroyed follicular units. Combination protocols integrating JAK inhibition with regenerative support represent the most promising direction for future clinical investigation.

References

1. Abdullayev, A. S. (2025). COMPARISON OF AGE-RELATED CHARACTERISTICS OF CEPHALOMETRIC INDICATORS: FRONTAL CHORD (N–B) AND PARIETAL CHORD (B–L) IN ARTIFICIALLY DEFORMED AND NORMAL SKULLS. World of Medicine and Biology, 21(93), 147-151.
2. Davlatovich, A. D., & Mishra, S. (2025). THE PATHOGENETIC SIGNIFICANCE OF SKIN BARRIER DYSFUNCTION IN ATOPIC DERMATITIS. GLOBAL TRENDS IN SCIENCE AND INNOVATION, 2(1), 233-239.
3. Ашуров, Д. Д. (2025). ИНВАЗИВНЫЕ МЕТОДЫ ЛЕЧЕНИЯ ВИТИЛИГО. In International Conference on Modern Science and Scientific Studies (pp. 304-307).
4. Davlatovich, A. D. (2025). CLASSIFICATION OF TATTOOS AND TATTOO REMOVAL. Web of Medicine: Journal of Medicine. Practice and Nursing, 3(2), 431-434.
5. Kamoldinovich, X. D. (2024). Intravenous Adnimnstration of Contrast Agents and Its Characteristics. Miasto Przyszłości, 48, 119-31.
6. Xojiraxmatov, D. K. (2023). THE IMPORTANCE OF COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF URETEROLITHIASIS AND ITS COMPLICATIONS. Procedia of Engineering and Medical Sciences, 7(12), 31-34.
7. Makhmudov, N. I., Dekhkanov, K. M., Botiraliev, A. B., Mirzamatov, N. I., & Khozhirahmatov, D. K. (2023). Results the use of minimally invasive surgical methods for the treatment of patients

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

with polytrauma in the Fergana branch of the Rncemp. In BIO Web of Conferences (Vol. 65, p. 05035). EDP Sciences.
8. Маматханова, Г. (2021). Оптимизация медицинской учетной документации и внедрение электронных систем в здравоохранение. Общество и инновации, 2(8/S), 61-67.
9. Исмаилов, С. И., & Маматханова, Г. М. (2022). Электронный документооборот как важнейший фактор повышения эффективности управления здравоохранением. Eurasian journal of medical and natural sciences, 2(8), 38-45.
10. Mamatxanova, G. M., & Ismailov, S. I. (2021). Optimization of medical records and implementation of electronic systems in healthcare. The American Journal of Medical Sciences and Pharmaceutical Research, 3(01), 193-198.
11. Маматханова, Г. М., & Ашурова, М. Д. (2020). КОМПЛЕКСНАЯ ОЦЕНКА ДЕЙСТВУЮЩЕЙ ЭЛЕКТРОННОЙ БАЗЫ ПЕРВИЧНЫХ УЧЕТНО-ОТЧЕТНЫХ МЕДИЦИНСКИХ ДОКУМЕНТАЦИЙ В УЧРЕЖДЕНИЯХ ПЕРВИЧНОГО ЗВЕНА ЗДРАВООХРАНЕНИЯ. Экономика и социум, (2 (69)), 506-512.
12. Маматханова, Г. М., & Шерматова, Г. Т. (2021). Оптимизация медицинской учетной документации и автоматизация отчетностей.
13. Abduvaliyeva, F. T., Azizova, F. L., Akromov, D. A., & Sherkuziyeva, G. F. (2022). APPROVAL AND ECOLOGICAL-HYGIENIC ASPECTS OF WATER SUPPLY TO POPULATION POINTS.
14. Azizova, F. A. F. (2022). The role of local water sources in the centralized supply of drinking water to the population. British medical, 2(4), 175-180.
15. Ахмадалиев, Р. У., Турдиев, Ш. М., Абдувалиева, Ф. Т., & Саидова, С. А. (2020). ГИГИЕНИЧЕСКАЯ ОЦЕНКА УСЛОВИЙ ТРУДА И ОХРАНЫ ОКРУЖАЮЩЕЙ СРЕДЫ НА СТЕКЛОИЗГОТОВИТЕЛЬНЫХ ПРЕДПРИЯТИЯХ. Новый день в медицине, (4), 151-154.
16. Azizova, F. L., & Abduvaliyeva, F. T. (2021). Ecological and hygienic aspects of optimization of water supply of the population. The American journal of medical sciences and pharmaceutical research, 3, 48-53.
17. Pattoyevich, G. A. (2025). IRON DEFICIENCY ANEMIA IN CHILDREN: EARLY DIAGNOSIS AND MODERN TREATMENT APPROACHES. Web of Medicine: Journal of Medicine. Practice and Nursing, 3(5), 494-501.
18. Pattoyevich, G. A., & Nilufar, M. (2026). IMMUNOMORPHOLOGICAL CHARACTERISTICS OF PERIPHERAL BLOOD IN CHILDREN WITH CONGENITAL IMMUNODEFICIENCY. FRONTIERS OF KNOWLEDGE AND INTERDISCIPLINARY DISCOVERY, 2(1), 90-96.
19. Pattoyevich, G. A. (2025). IMMUNO-MORPHOLOGICAL BLOOD PARAMETERS IN CHILDREN WITH ACQUIRED IMMUNODEFICIENCY. GLOBAL TRENDS IN SCIENCE AND INNOVATION, 2(1), 255-261.
20. Asqarov, I., & Abdujabborova, C. (2025). ANALYSIS OF THE BIOLOGICAL ACTIVITY OF THE FOOD ADDITIVE" AS LUPINUS". Scientific journal of the Fergana State University, (2), 195-195.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

21. Абдужабборова, Ч. С. (2024). ИСПОЛЬЗОВАНИЕ ЛЮПИНА В НАРОДНОЙ МЕДИЦИНЕ И РЕЦЕПТАХ.“Fizikaviy va kolloid kimyo fanlarining fundamental va amaliy muammolari hamda ularning innovatsion yechimlari” Xalqaro ilmiy-amaliy anjuman.
22. ABDUJABBOROVA, C. (2024). O'TKIR ZAHARLILIGINI ANIQLASH" LUPINUS AS. UNIVERSAL Учредители: Ilm Fan Fidoiylari Mchj, 1(9), 151-157.
23. Mamatqulova, S. A., & Abdujabborova, C. S. qizi.(2024). LYUPIN O‘SIMLIGI KIMYOVIY TARKIBI VA XALK TABOBATIDA QO‘LLANILISHI. Educational research in universal sciences, 3(3), 73-79.
24. Mukhtarjanovna, I. G. (2023). Developing the Principles of Studying and Treatment of Vaginal Dysbiosis During Pregnancy. Texas Journal of Medical Science, 16, 67-68.
25. Mukhtarzhanovna, I. G. (2024). Development of Principles of Study and Treatment of Vaginal Dysbiosis During Pregnancy. In International Congress on Biological, Physical And Chemical Studies (ITALY) (pp. 112-115).
26. G’aniyevna, J. B. (2025). OREGANO-AS. In OZIQ-OVQAT QO’SHILMASI TARKIBIDAGI FARMAKO-TOKSIKOLOGIK XUSUSIYATLARINI ORGANISH. In International Educators Conference (pp. 208-214).
27. Jumanova, B. (2023). CHEMICAL COMPOSITION OF THE MARMARAK MEDICINAL PLANT (SALVIA OFFICINALIS) AND USE IN PEOPLE'S MEDICINE. В ACADEMIC RESEARCH IN MODERN SCIENCE (Т. 2, Выпуск 26, сс. 158–162). Zenodo.
28. Jumanova, B. G. (2025). CLINICAL EFFECTIVENESS OF THE DIETARY SUPPLEMENT OREGANO AS IN INFLAMMATORY DISEASES OF THE ORAL CAVITY. Advances in Science and Environment, 1(12), 12-14.
29. Sattievna, D. G. (2024). FARG’ONA VILOYATIDA REPRODUKTIV YOSHDAGI AYOLLARNI KONTRASEPTIV VOSITALARNI QO’LLASH USULLARI HAQIDAGI XABARDORLIK DARAJASINI O’RGANISH. Лучшие интеллектуальные исследования, 14(2), 239-243.
30. Йулдошева, Д. С., Ёкубов, Ф. Ф., & Рахматов, С. А. (2024). СОВРЕМЕННЫЕ КЛИНИКО-ЭПИДЕМИОЛОГИЧЕСКИЕ ОСОБЕННОСТИ МИКРОСПОРИИ И ТРИХОФИТИИ. IMRAS, 7(1), 689-693.
31. Kumar, S. (2025). PATHOPHYSIOLOGICAL BASIS OF AUTOIMMUNE PROCESSES IN VITILIGO. GLOBAL TRENDS IN SCIENCE AND INNOVATION, 2(1), 315-322.
32. Sobirjonova, G. (2022). FORECASTING OF AGRICULTURAL PRODUCTS INCLUDED IN THE CONSUMER BASKET. Science and innovation, 1(A7), 839-841.
33. Shakhzodakhon, S. (2025). OCCUPATIONAL ALLERGIES: RISK FACTORS, DIAGNOSIS, AND DEVELOPMENT OF PREVENTIVE MEASURES. In Scientific Conference on Multidisciplinary Studies (pp. 275-281).

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5