

Follicular Unit Extraction for Hair Restoration in Stable Cicatricial Alopecia: Surgical Planning and Clinical Outcomes-A Case Series

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Abstract: Hair transplantation in cicatricial alopecia has traditionally been considered challenging because of fibrosis, reduced vascularity, and the potential for poor graft survival. However, advances in Follicular Unit Extraction (FUE), together with careful patient selection and meticulous surgical planning, have expanded the role of hair transplantation in patients with stable cicatricial alopecia. This study presents a case series highlighting technical considerations and clinical outcomes following FUE in diverse etiologies of cicatricial alopecia. Five patients with clinically stable cicatricial alopecia underwent FUE hair transplantation after comprehensive clinical evaluation and counseling. Recipient-site assessment focused on scar maturity, tissue pliability, vascularity, and disease stability. Grafts harvested from the occipital donor area were implanted at conservative densities (approximately 20 follicular units/cm²) to optimize vascular perfusion and graft survival. Patients were evaluated at 1, 3, 6, and 12 months for graft survival, hair growth, cosmetic outcome, and disease recurrence. A total of 16,700 follicular unit grafts were transplanted across the five patients. All patients experienced uneventful postoperative recovery with satisfactory graft survival and progressive hair regrowth during follow-up. Significant improvement in scalp coverage, frontal hairline transplantation, and scar camouflage was achieved, resulting in enhanced aesthetic appearance and high patient satisfaction. These cases demonstrate that favorable aesthetic and functional outcomes can be achieved in both secondary cicatricial alopecia and stable primary cicatricial alopecia when appropriate surgical principles are followed.

Keywords: Traction alopecia, Follicular Unit Extraction, Female hair transplant, Scarring alopecia, Cicatricial alopecia, Hair transplantation surgery, Frontal alopecia

1. Introduction

Cicatricial alopecia (CA), also known as scarring alopecia, represents a heterogeneous group of disorders characterized by permanent hair loss resulting from irreversible destruction of hair follicles and their replacement with fibrous connective tissue. The disease process culminates in loss of follicular stem cells within the bulge region, preventing follicular regeneration and making spontaneous hair regrowth impossible. Clinically, affected areas demonstrate absent follicular ostia, variable degrees of cutaneous atrophy, and permanent alopecia, while histopathological examination reveals destruction of pilosebaceous units accompanied by fibrosis and inflammatory cell infiltration depending on disease activity.

Management of cicatricial alopecia remains challenging. Medical therapy is primarily aimed at suppressing inflammation and preventing further follicular destruction in active primary disease, but it cannot restore hair in areas where follicles have already been permanently lost. Once the disease has stabilized, treatment options are largely reconstructive and include surgical excision of small scars, tissue expansion, scalp reduction, local flap reconstruction, scalp

micropigmentation, prosthetic camouflage, and hair transplantation. Among these, hair transplantation surgery has emerged as the preferred option for appropriately selected patients because it offers the potential for permanent and natural-appearing hair transplantation [1].

Advances in FUE have significantly expanded the applicability of hair transplantation in cicatricial alopecia. Compared with strip follicular unit transplantation (FUT), FUE is associated with minimal donor-site morbidity, rapid postoperative recovery, reduced linear scarring, and greater flexibility in graft harvesting. Nevertheless, transplantation into scar tissue remains technically demanding because fibrosis, altered collagen architecture, diminished vascularity, reduced tissue elasticity, and unpredictable graft survival create a less favorable recipient environment than normal scalp. These challenges necessitate meticulous surgical planning, including assessment of scar maturity, vascularity, tissue pliability, disease stability, graft density, and postoperative management [2].

Patient selection is the single most important determinant of successful outcomes. Hair transplantation should only be considered after sustained clinical stabilization of the disease.

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In primary cicatricial alopecia, most authors recommend maintaining clinical inactivity for at least 1–2 years before surgical intervention to minimize the risk of disease reactivation and graft loss. Evaluation of recipient-site vascularity, donor hair characteristics, scar thickness, and patient expectations is equally essential for optimizing surgical success. Conservative graft densities, staged procedures for extensive scars, and meticulous recipient-site creation have been shown to improve graft survival by avoiding excessive compromise of the already limited blood supply within scar tissue [3].

Although increasing evidence supports the use of FUE in stable cicatricial alopecia, the published literature largely consists of isolated case reports and small case series, and there remains no universally accepted surgical protocol regarding recipient-site preparation, graft density, timing of surgery, or postoperative management. Consequently, the optimal surgical approach continues to evolve, particularly for patients with diverse etiologies of cicatricial alopecia [4].

The present report describes five patients with stable cicatricial alopecia treated successfully using FUE with stable cicatricial alopecia, including post-traumatic scars, post-burn alopecia, Pseudopelade of Brocq, and Lichen Planopilaris, treated successfully with FUE hair transplantation. By presenting varied clinical scenarios, this study highlights key principles of patient selection, recipient-site assessment, graft implantation strategies, and postoperative management, while emphasizing the technical considerations that contribute to favorable aesthetic and clinical outcomes in hair transplantation surgery for cicatricial alopecia.

2. Case Series

2.1 Case 1

A 29-year-old female presented with post-traumatic cicatricial alopecia involving the frontoparietal scalp following a road traffic accident. The patient complained of a large hairless scar causing significant cosmetic disfigurement and psychological distress. Clinical examination revealed a stable, well-healed atrophic scar with no evidence of active inflammation or disease progression. The scar was soft, pliable, and demonstrated adequate recipient-site vascularity, making it a suitable recipient site for hair transplantation surgery (Figure 1).

Following comprehensive counselling regarding graft survival in scar tissue, expected outcomes, and the possibility of reduced graft yield compared to normal scalp, the patient underwent FUE hair transplantation. A total of 3,500 follicular unit grafts were harvested from the occipital donor area and implanted into the scarred recipient site at an average density of approximately 20 follicular units/cm² (FU/cm²), with careful spacing to preserve the compromised vascular supply. The postoperative period was uneventful. The patient was prescribed routine postoperative medications and advised to initiate topical 5% minoxidil after complete healing to optimize graft survival and enhance hair growth. Follow-up evaluations were scheduled at 1, 3, 6, and 12 months to assess graft uptake, hair growth, and cosmetic outcome. The patient demonstrated satisfactory graft survival with progressive hair

regrowth, resulting in marked improvement in scalp coverage and overall aesthetic appearance.



Figure 1: Pre-operative pictures (A) and immediate post-operative appearance (B)

2.2 Case 2

A 23-year-old female presented with progressive multifocal scarring alopecia involving the vertex and parietal scalp for several years. The patient reported gradual enlargement of asymptomatic alopecic patches, resulting in significant cosmetic and psychological distress. Clinical examination revealed multiple irregularly shaped, smooth, atrophic alopecic patches with loss of follicular ostia, suggestive of Pseudopelade of Brocq. Histopathological examination confirmed the diagnosis. The disease had remained clinically inactive and stable for over 2 years following appropriate medical management, making the patient a suitable candidate for hair transplantation surgery (Figure 2).

After detailed counselling regarding the risk of disease reactivation, graft survival in cicatricial alopecia, and the possibility of requiring future procedures, the patient underwent FUE hair transplantation. A total of 4,000 follicular unit grafts were harvested from the occipital donor area and implanted into the scarred recipient sites at an average density of approximately 20 FU/cm², while preserving adequate spacing to optimize adequate recipient-site vascularity and graft survival.

Healing progressed without complications. Standard postoperative medications were prescribed, and the patient was advised to continue regular follow-up with topical 5% minoxidil after complete healing. Follow-up assessments were scheduled at 1, 3, 6, and 12 months to evaluate graft survival, disease stability, and cosmetic outcome. Progressive hair growth with satisfactory graft uptake was observed, resulting in improved scalp coverage, enhanced cosmetic appearance, and high patient satisfaction.



Figure 2: Pre-operative pictures (A) and post-operative appearance (B, C and D)

2.3 Case 3

A 37-year-old male presented with Lichen Planopilaris (LPP) causing extensive cicatricial alopecia involving the frontal, frontoparietal, and vertex scalp. The patient had experienced progressive hair loss over several years despite medical therapy, resulting in a large cosmetically disfiguring alopecic area (Figure 3). Clinical and histopathological evaluation confirmed the diagnosis of LPP. Following treatment with anti-inflammatory therapy, the disease remained clinically inactive for more than 2 years, with no evidence of perifollicular erythema, scaling, or progression, making him an appropriate candidate for surgical hair transplantation. After detailed counselling regarding the potential risk of disease reactivation and the comparatively lower graft survival associated with cicatricial alopecia, the patient underwent FUE hair transplantation. A total of 4,500 follicular unit grafts were harvested from the occipital donor area and strategically implanted into the frontal hairline and stable cicatricial recipient areas, while maintaining a conservative graft density to optimize adequate recipient-site vascularity and graft survival.

No postoperative adverse events were observed. The patient was advised to continue maintenance therapy for LPP along with routine post-transplant care and close follow-up to monitor both graft survival and disease activity. Follow-up evaluations demonstrated satisfactory graft uptake without clinical evidence of disease reactivation, resulting in improved scalp coverage, transplantation of the frontal hairline, and a marked enhancement in cosmetic appearance and patient satisfaction.



Figure 3: Pre-operative (A) post-operative appearance (B)

2.4 Case 4

A 30-year-old female presented with post-traumatic cicatricial alopecia involving the midline frontal scalp following blunt trauma. The patient reported a persistent hairless scar over the frontal hairline, which had remained stable for several years and resulted in significant cosmetic concern due to its conspicuous location. Clinical examination revealed a well-healed, linear-to-irregular atrophic scar with complete loss of follicular ostia and no signs of active inflammation or scar progression (Figure 4).

Preoperative evaluation demonstrated an adequately vascularized recipient bed and good donor hair availability. After discussing the expected outcomes and the possibility of

relatively lower graft survival in scar tissue, the patient underwent FUE hair transplantation. A total of 1,200 follicular unit grafts were harvested from the occipital donor area and strategically implanted into the scar, with particular emphasis on recreating a natural midline hairline and achieving optimal scar camouflage while maintaining an appropriate graft density.

The postoperative course was uneventful. Standard postoperative care was advised, including gentle scalp care, routine medications, and topical 5% minoxidil after complete graft healing. Follow-up evaluations demonstrated satisfactory graft survival with progressive hair growth, resulting in effective camouflage of the scar, transplantation of the frontal hairline, and a marked improvement in the patient's aesthetic appearance and self-confidence.



Figure 4: Pre-operative (A, B) and immediate post-operative appearance (C)

2.5 Case 5

A 32-year-old female presented with extensive post-burn cicatricial alopecia involving the frontal scalp and anterior hairline following a thermal burn sustained several years earlier. The patient complained of a broad, hairless scar extending across the forehead, resulting in distortion of the frontal hairline and significant facial disfigurement. Clinical examination revealed a mature, well-healed, atrophic scar with complete loss of follicular ostia and no evidence of active inflammation or contracture. The scar was clinically stable and demonstrated adequate vascularity, making it suitable for hair transplantation surgery (Figure 5).

Following detailed preoperative counselling regarding the expected graft survival in scar tissue, the need for conservative graft placement, and realistic aesthetic outcomes, the patient underwent FUE hair transplantation. A total of 3,500 follicular unit grafts were harvested from the occipital donor area and meticulously implanted into the scarred recipient site, with emphasis on reconstructing a natural frontal hairline and achieving uniform coverage while respecting the altered vascularity of the burn scar.

The postoperative course was uneventful. Routine postoperative care was advised, including saline dressing, prescribed medications, and initiation of topical 5% minoxidil after complete healing.



Figure 5: Pre-operative (A) immediate post-operative appearance (B), After 3 week

Table 1: Clinical characteristics and surgical outcomes of five patients with cicatricial alopecia undergoing follicular unit extraction

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5
Diagnosis	Post traumatic cicatricial alopecia scar	Pseudopelade of Brocq	Lichen planopilaris	Post traumatic frontal scar	Post burn cicatricial alopecia
Age/Sex	29/F	23/F	37/M	30/F	32/F
No of grafts	3500	4000	4500	1200	3500
Graft density (FU/cm ²)	Approximately 15-20	Approximately 15-20	Approximately 15-20	Approximately 15-20	Approximately 15-20
Area covered (cm ²)	30	52	200	21	65
Type of scar	Atrophic traumatic scar	Atrophic scar	Atrophic scar	Atrophic traumatic scar	Atrophic scar
Donor site	Occipital scalp	Occipital scalp	Occipital scalp	Occipital scalp	Occipital scalp
Recipient site	Frontoparietal scalp	Frontal, frontoparietal and vertex scalp	Frontal hairline	Frontal hairline	Frontal scalp
Transection rate (%)	8	10	8	7	9
Graft survival at 6 months (%)	86	80	84	85	72
Patient satisfaction	Excellent	Very good	Good	Excellent	Fair

3. Discussion

Hair transplantation in cicatricial alopecia has historically been considered technically challenging because fibrosis, altered dermal architecture, reduced vascularity, and chronic inflammatory changes may adversely affect graft survival and long-term outcomes. However,

Serial follow-up demonstrated satisfactory graft uptake with progressive hair growth, leading to effective camouflage of the burn scar, transplantation of the frontal hairline, and substantial improvement in facial aesthetics and patient confidence.

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Advances in FUE, together with improved understanding of disease behavior and meticulous patient selection, have significantly expanded the role of hair transplantation surgery in patients with stable cicatricial alopecia. Recent systematic evidence suggests that hair transplantation can achieve favorable outcomes in carefully selected patients, although the quality of evidence remains limited due to the predominance of case reports and small case series [5].

The most critical factor determining successful hair transplantation in cicatricial alopecia is disease stability. In primary cicatricial alopecias, such as Lichen Planopilaris (LPP) and Pseudopelade of Brocq (PPB), ongoing inflammation may destroy both native and transplanted follicles, leading to poor graft survival and disease recurrence. Consequently, most authors recommend that hair transplantation should only be performed after clinical inactivity has been maintained for at least 1–2 years, with no evidence of perifollicular erythema, scaling, pruritus, or progression of alopecia [4, 5]. In the present series, both patients with primary cicatricial alopecia had remained clinically stable for more than two years before surgery, and neither demonstrated clinical recurrence during follow-up, supporting the importance of careful patient selection.

Unlike primary cicatricial alopecia, secondary cicatricial alopecia usually develops following trauma, burns, surgery, or infection, without persistent follicular inflammation. Once scar maturation is complete and recipient-site vascularity is adequate, these patients generally represent ideal candidates for hair transplantation. Three patients in the present series had secondary cicatricial alopecia caused by trauma or burns and demonstrated excellent graft uptake, progressive hair growth, and effective scar camouflage. Similar favorable outcomes following FUE in mature traumatic and burn scars have been reported previously, highlighting the reconstructive potential of hair transplantation in secondary cicatricial alopecia [6].

Recipient-site characteristics are equally important determinants of graft survival. Scar tissue is characterized by increased collagen deposition, decreased elasticity, reduced vascular density, and altered tissue biomechanics, all of which

may compromise follicular survival. Implantation of excessive numbers of grafts into scar tissue may further impair vascular perfusion and increase the risk of graft failure or skin necrosis. Therefore, conservative recipient-site densities of approximately 15–25 follicular units/cm² have been recommended during the initial procedure, with consideration of staged transplantation if greater density is desired [5, 6]. In our study, graft implantation was performed at approximately 20 FU/cm² in all patients, resulting in satisfactory graft survival without vascular compromise or wound-healing complications [7].

Comprehensive preoperative assessment was another important contributor to successful outcomes. All patients underwent detailed evaluation of scar maturity, tissue pliability, vascularity, donor hair availability, and disease stability before surgery. Only mature, soft, well-vascularized scars without evidence of active inflammation or progression were selected for transplantation. Careful patient counselling regarding realistic expectations, possible reduction in graft survival compared with normal scalp, and the potential need for future procedures also contributed to high patient satisfaction. Previous reviews have emphasized that realistic counselling remains one of the essential components of successful hair transplantation in cicatricial alopecia [5].

The use of FUE offered several advantages in our patients. Compared with FUT, FUE avoids a linear donor scar, minimizes donor-site morbidity, facilitates selective harvesting of follicular units, and provides greater flexibility for reconstructive procedures involving irregular scars. Furthermore, the minimally invasive nature of FUE permits precise placement of individual follicular units, allowing surgeons to recreate natural hairlines while preserving recipient-site vascularity [6]. These technical advantages were particularly valuable in our patients with frontal hairline defects and irregular post-traumatic scars.

An important observation in this series was the absence of postoperative complications or disease reactivation during follow-up in this case series was the absence of postoperative complications or disease recurrence during follow-up. All five patients demonstrated progressive hair growth, satisfactory graft uptake, and marked cosmetic improvement. Particularly encouraging were the outcomes observed in the patients with LPP and PPB, in whom continued maintenance therapy and close postoperative surveillance likely contributed to sustained disease remission. Current evidence recommends continuation of medical therapy even after successful transplantation in primary cicatricial alopecia because dormant inflammatory activity may recur despite prolonged periods of clinical stability [5],[6].

Despite encouraging clinical outcomes, this study has several limitations. The sample size is relatively small, reflecting the rarity of patients with stable cicatricial alopecia who fulfill the criteria for surgical intervention. Quantitative measurements of graft survival using standardized trichoscopic assessment were not performed, and cosmetic outcomes were primarily evaluated by serial clinical photography and patient satisfaction. Furthermore, longer follow-up is necessary because inflammatory relapse may occur several years after

apparent remission, particularly in primary cicatricial alopecias [5].

Overall, the present case series supports the growing evidence that FUE represents a safe and effective option for carefully selected patients with stable cicatricial alopecia. Successful outcomes rely on meticulous patient selection, confirmation of long-term disease inactivity, thorough assessment of recipient-site vascularity, conservative graft density, individualized surgical planning, and continued postoperative surveillance. Although larger prospective studies with objective measurements of graft survival are still required, our findings reinforce the role of FUE as a valuable reconstructive modality capable of restoring both hair density and patient confidence in stable cicatricial alopecia.

4. Conclusion

FUE is a safe and effective reconstructive option for carefully selected patients with stable cicatricial alopecia. Successful outcomes are primarily dependent on meticulous patient selection, confirmation of long-term disease inactivity, thorough assessment of recipient-site vascularity, conservative graft implantation density, and individualized surgical planning. In primary cicatricial alopecias, transplantation should only be considered after sustained clinical remission, with continued postoperative medical therapy and close follow-up to minimize the risk of disease reactivation. In secondary cicatricial alopecia, mature and well-vascularized scars provide a favorable recipient environment, allowing predictable graft survival and satisfactory cosmetic transplantation.

The five cases presented in this series demonstrate that FUE can achieve excellent scar camouflage, transplantation of natural hairlines, improved scalp coverage, and high patient satisfaction across a spectrum of stable cicatricial alopecias, including post-traumatic, post-burn, Pseudopelade of Brocq, and Lichen Planopilaris. These findings reinforce the importance of a multidisciplinary approach combining appropriate medical management with meticulous surgical technique to optimize long-term outcomes.

Although this case series provides encouraging evidence supporting the role of FUE in stable cicatricial alopecia, larger prospective studies with standardized outcome measures, objective assessment of graft survival, and longer follow-up are needed to establish evidence-based guidelines regarding patient selection, optimal graft density, surgical timing, and long-term maintenance strategies.

Patient Consent

Appropriate informed consent was obtained from the patient for clinical photography and academic publication. The patient understood that identity would remain confidential and efforts would be made to conceal identifying information.

Conflict of Interest

The authors declare no conflict of interest.

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