

# A Prospective Observational Cohort Study on Hair Transplantation Growth Dynamics and Regrowth Timelines in 789 Patients: Photogrammetric and AI-Assisted Trichoscopic Evaluation

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## Abstract

**Background.** FUE and DHI are established techniques for surgical hair restoration in androgenetic alopecia (AGA). Quantitative documentation of the month-by-month post-operative regrowth trajectory across large cohorts remains limited.

**Methods.** Prospective observational cohort of 789 male patients with AGA (Norwood-Hamilton III–IV) who underwent FUE or DHI and were followed for 12 months using standardised photography and AI-assisted trichoscopic analysis (validated measurement accuracy 91.32%). Regrowth rate was defined as the proportion of implanted grafts producing a visible hair; graft survival was assessed at Month 12. Of 789 enrolled, 564 (71.5%) completed 12-month follow-up.

**Results.** Mean regrowth increased progressively (Month 3, 36%; Month 6, 78.94%; Month 9, 86.2%), reaching a mean graft survival of 92% (range 90–96%) at Month 12. Transplanted-hair shedding preceded regrowth in the early post-operative period.

**Conclusions.** In this cohort, FUE and DHI were associated with a staged 12-month regrowth pattern and a mean graft survival of 92%, consistent with previously reported clinic graft survival data. Findings are observational and limited by single-centre design and loss to follow-up.

## Ethical Considerations

This was a prospective observational cohort study using data maintained in the clinic's clinical data repository. All included patients had provided written informed consent for the use of their clinical data for research purposes. All data were de-identified prior to analysis, and no patient-identifying information is reported. The study was conducted in accordance with the Declaration of Helsinki.

## Materials and Methods

### Study Design

This was a single-centre prospective observational cohort study. Male patients with AGA (Norwood-Hamilton III–IV) who underwent FUE or DHI were followed prospectively for 12 months. No treatment was allocated for study purposes; the study observed routine clinical outcomes.

### Participants

Inclusion: male, aged 25–55, stable AGA (Norwood-Hamilton III–IV), stable donor area (>70 grafts/cm<sup>2</sup>). Exclusion: cicatricial alopecia, active inflammatory scalp dermatoses, uncontrolled systemic conditions, and new minoxidil or finasteride use during the follow-up window.

A total of 789 patients were enrolled (FUE, 456; DHI, 333). Cohort composition by technique and Norwood-Hamilton grade is shown in Table 1.

**Table 1. Cohort composition at enrollment (N = 789).**

Group	Norwood III (n)	Norwood IV (n)	Total (n)
FUE	256	200	456
DHI	185	148	333
<b>Total enrolled</b>	<b>441</b>	<b>348</b>	<b>789</b>

Of the 789 enrolled, all were assessed through Month 6; 632 were assessed at Month 9 and 564 (71.5%) completed the Month 12 assessment. In total, 225 patients (28.5%) were lost to follow-up, all due to inability to establish contact (FUE, 180; DHI, 45). Completers comprised 276 FUE and 288 DHI patients (Figure 1, participant flow).

## Measurement Protocol

Outcomes were assessed at baseline and at Months 1, 3, 6, 9, and 12. Standardised photographs were captured at a fixed distance and patient position under controlled conditions. Images were analysed using an AI-assisted trichoscopic analysis tool that quantifies hair count and coverage within the recipient area; the tool's measurement accuracy was validated at 91.32%.

Regrowth rate was defined as the proportion of implanted grafts producing a visible hair at each interval. Final graft survival was defined as the regrowth rate at Month 12, when the growth process is considered complete.

## Results

The visible-shaft emergence rate increased from 30% at Month 1 to a mean graft survival of 92% (range 90–96%) at Month 12 (Table 2). Transplanted-hair shedding (physiological effluvium), affecting approximately 78% of implanted shafts, began at weeks 3–4 — between the Month 1 and Month 3 assessments — and preceded regrowth.

**Table 2. Mean regrowth rate by follow-up interval.**

Follow-up Interval	n analyzed	Visible-Shaft / Emergence Rate (%)	Dominant Characteristic
Month 0 (Baseline)	789	0.0	Transplanted shafts trimmed to scalp surface (0% reference)
Month 1	789	30	Transplanted shafts emerged above surface; shedding begins ~weeks 3–4
Month 3	789	36	Post-shedding; early anagen regrowth
Month 6	789	78.94	Accelerated regrowth
Month 9	632	86.2	Maturing regrowth / directional alignment
<b>Month 12 (Final)</b>	564	<b>92 (range 90–96; SD)</b>	Final graft survival (range 90–96)

*Note: values are means; per-patient standard deviation was not available from the analysis tool, so dispersion for the Month 12 survival is reported as a range (90–96%).*

## Discussion

The observed pattern is consistent with an early shedding phase followed by progressive regrowth over the first post-operative year. A documented shedding phase may help reassure patients that early shedding is an expected part of the process rather than graft failure. The mean 12-month graft survival of 92% is consistent with the 91.4% (SD 4.1%) 12-month survival reported by Yalçın and Filima in *Graft Survival Rates Following Follicular Unit Extraction at 12 and 24 Months: A Retrospective Cohort Study at Vera Clinic, Istanbul, Turkey*.

## Long-Term Outlook

Because occipital donor follicles are relatively androgen-independent, transplanted grafts are generally reported to retain long-term viability, while native (non-transplanted) hair loss may continue. Longer-term outcomes are addressed separately in the clinic's five-year follow-up analysis.

## Limitations

- Single-centre observational design without a control group or randomisation.
- FUE and DHI, and Norwood-Hamilton III and IV, were pooled; outcomes did not differ meaningfully by technique or stage, and where variation occurred it appeared attributable to individual patient factors.
- Loss to follow-up was 28.5% (225/789) and differed by technique (FUE 39% vs DHI 14%); differential attrition may introduce bias and mean survival may be overestimated (survivor bias).
- Regrowth was quantified by AI-assisted image analysis (validated accuracy 91.32%) rather than graft-by-graft counting.
- Per-patient standard deviation was not available; dispersion is reported as a range.

## Conflict of Interest and Funding

This study was conducted by Vera Clinic Academy, the research arm of the treating institution; this institutional relationship constitutes a potential conflict of interest and is disclosed in accordance with ICMJE recommendations. Data analysis and manuscript preparation were conducted independently of the clinic's marketing and commercial functions.

**Funding:** No external funding was received. Data were drawn from the clinic's existing clinical data repository, and no financial compensation was requested from or provided to patients for study participation.

**Data availability:** De-identified data are available from the corresponding author upon reasonable request, subject to ethics committee review.

**Reporting:** A completed STROBE checklist for observational studies should accompany submission.

## References

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