Comparative Outcomes of Sapphire FUE and DHI Techniques in Hair Transplantation: A Single-Centre Cohort Analysis

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Abstract

Background

Sapphire FUE (Follicular Unit Extraction) and DHI (Direct Hair Implantation) are the dominant techniques in contemporary follicular unit extraction hair transplantation. Direct comparative data on graft survival, healing, and patient-reported outcomes remain limited. This study compared clinical outcomes of Sapphire FUE and DHI at 12 and 24 months in a single-centre cohort.

Methods

A retrospective comparative cohort study was conducted at Vera Clinic, Istanbul, Turkey. Patients undergoing Sapphire FUE (Norwood III–V) or DHI (Norwood II–III) between January and December 2023 were identified from clinical records. The primary outcome was graft survival at 12 and 24 months, assessed by standardised trichoscopy. Secondary outcomes included healing time, inflammation score, patient satisfaction (5-point Likert scale), and complication incidence. Multivariable logistic regression adjusted for Norwood stage, graft count, and operative time.

Results

Of 447 enrolled patients, 384 completed 24-month follow-up (Sapphire FUE n = 241; DHI n = 143). Graft survival was 93.4% (95% CI 91.8–95.0%) versus 91.7% (95% CI 89.6–93.8%) at 12 months (p = 0.038; d = 0.29), and 91.8% (95% CI 89.9–93.7%) versus 90.2% (95% CI 87.8–92.6%) at 24 months (p = 0.041; d = 0.27). After adjustment, Sapphire FUE retained higher odds of graft survival at both time points (aOR 1.38, 95% CI 1.04-1.83; aOR 1.34, 95% CI 1.01-1.78). Healing was one day shorter with DHI (median 7 vs 8 days; p = 0.041). Inflammation score was lower with Sapphire FUE (median 2.1 vs 2.8; p = 0.009). Patient satisfaction did not differ at 12 or 24 months (p = 0.681 and p = 0.714).

Conclusions

Both techniques achieved graft survival within the clinically accepted range with equivalent patient satisfaction. Sapphire FUE was associated with a statistically

significant but clinically modest survival advantage and lower inflammation; DHI with faster healing. Technique selection should be guided by clinical indication rather than expectation of different patient-reported outcomes.

Keywords: hair transplantation; follicular unit extraction; sapphire FUE; direct hair implantation; DHI; graft survival

Introduction

Androgenetic alopecia is the most prevalent form of hair loss in men, affecting approximately 50% of males by the age of 50 and carrying well-documented impacts on self-esteem and psychological well-being [1, 2]. Follicular unit extraction (FUE) has become the dominant surgical approach to hair restoration over the past two decades, largely displacing follicular unit transplantation (FUT) due to its absence of a linear donor scar, shorter recovery period, and comparable graft survival outcomes [3, 4]. Within the FUE framework, several technical refinements have emerged that modify the recipient site creation process and the method of graft implantation. Two of the most widely adopted refinements in contemporary practice are Sapphire FUE and direct hair implantation (DHI).

Sapphire FUE modifies the recipient site creation step by substituting conventional steel blades with ultra-sharp V-shaped blades fashioned from synthetic sapphire crystal. The sapphire blade's V-shaped profile produces a smaller, cleaner incision with reduced lateral tissue displacement compared to rectangular steel instrumentation, resulting in lower vascular and dermal damage at the recipient site [5, 6]. The technique permits pre-planned channel mapping across the entire recipient area before graft implantation begins, making it particularly suited to large-area restoration requiring uniform density distribution. DHI, by contrast, employs a Choi implanter pen to combine channel creation and graft placement into a single simultaneous step, eliminating the interval between site creation and implantation. This approach reduces the duration of extra-corporeal graft exposure, a variable with established relevance to follicular viability [7], and confers a degree of implantation precision that is particularly advantageous in density augmentation procedures within areas of retained existing hair.

Despite the widespread clinical adoption of both techniques, the comparative evidence base remains limited. The majority of published studies examining Sapphire FUE or DHI outcomes are single-arm descriptive reports focusing on technique feasibility rather than direct comparative effectiveness [8, 9]. A 2024 retrospective study of 158 FUE patients documented graft survival exceeding 90% at 12 months, with over 85% of patients achieving survival rates above 95% [10]; however, this study did not include a DHI comparator arm, and sapphire blade use was not reported. Recipient site creation studies have demonstrated that hole and slit techniques produce comparable 12-month graft survival rates (94% vs 92%; Aktas et al., 2023 [11]), but these studies were not designed to compare Sapphire FUE and DHI as complete procedural systems. A critical

gap therefore persists: no adequately powered single-centre cohort study has directly compared graft survival, healing, and patient-reported satisfaction between Sapphire FUE and DHI at both 12 and 24 months, with confounding by Norwood stage addressed through multivariable modelling.

The aim of this study was to compare clinical outcomes of Sapphire FUE and DHI in a consecutive series of patients treated at Vera Clinic, Istanbul, Turkey, between January and December 2023, with follow-up at 12 and 24 months post-operatively.

Methods

Study Design

This was a single-centre retrospective comparative cohort study conducted at Vera Clinic, Istanbul, Turkey. Patients who underwent hair transplantation using either Sapphire FUE or DHI between January 2023 and December 2023 were identified from the clinical records database. The study was designed to compare graft survival, healing, and patient-reported outcomes between the two techniques in a real-world clinical population. The primary follow-up points were 12 months and 24 months post-operatively.

Setting

All procedures were performed at Vera Clinic, a dedicated hair restoration centre in Istanbul, Turkey. Vera Clinic performs both Sapphire FUE and DHI as its primary surgical techniques. Sapphire FUE was performed using ultra-sharp V-shaped sapphire blades for recipient site creation; DHI was performed using the Choi implanter pen technique. Graft extraction in both groups used micro-motor FUE punches (0.7–0.9 mm). Oxycure oxygen support was applied during graft holding in both groups as per standard clinic protocol.

Participants

Inclusion Criteria

Patients were eligible if they met all of the following:

- Male sex
- Age 25–60 years at the time of procedure
- Norwood-Hamilton classification stage II–V
- Donor density ≥ 60 follicular units per cm²
- First-time hair transplantation procedure (no prior surgical restoration)
- Assigned technique consistent with clinical indication: Sapphire FUE for Norwood III–V (broad area restoration); DHI for Norwood II–III (hairline refinement or density augmentation between existing hairs)

- 24-month follow-up data available

Exclusion Criteria

Patients were excluded if any of the following applied:

- Active scalp dermatological condition at the time of procedure
- Anticoagulant or antiplatelet therapy that could not be safely discontinued
- Diffuse unpatterned alopecia (DUPA)
- Hybrid procedure combining Sapphire FUE and DHI within the same session
- Technique-indication mismatch (e.g., Sapphire FUE assigned to a Norwood II patient or DHI assigned to a Norwood IV–V patient without documented clinical justification)
- Incomplete 24-month follow-up data

Norwood stage III represented a clinical overlap zone in which either technique was considered appropriate; allocation in this subgroup was determined by the operating surgeon in consultation with the patient, based on recipient area characteristics and density goals.

Participant Flow

A total of 623 patients were screened from the clinical records database. Of these, 176 (28.3%) did not meet inclusion criteria and were excluded. The remaining 447 patients were enrolled. At 24 months, 63 patients (14.1%) were lost to follow-up, leaving a final analytical cohort of 384 patients (241 Sapphire FUE; 143 DHI). The participant flow is summarised in Table 1.

Table 1. Participant flow.

Stage	n (%)
Patients screened	623
Did not meet inclusion criteria	176 (28.3%)
• Active scalp condition	41 (6.6%)
• Anticoagulant use	27 (4.3%)
• Diffuse unpatterned alopecia (DUPA)	33 (5.3%)
• Revision procedure	48 (7.7%)
• Technique-indication mismatch	27 (4.3%)
Enrolled (met all inclusion criteria)	447 (71.7%)
Lost to follow-up at 24 months	63 (14.1%)
Completed 24-month follow-up	384 (85.9%)
• Sapphire FUE group	241 (62.8%)
• DHI group	143 (37.2%)

Note: Technique-indication mismatch was defined as assignment of Sapphire FUE to Norwood II without documented clinical justification, or assignment of DHI to Norwood IV–V.

Variables

Primary Outcome

The primary outcome was graft survival rate at 12 and 24 months post-operatively, defined as the proportion of transplanted follicular units demonstrating terminal hair growth at each follow-up assessment. Graft survival was assessed by trichoscopy using the FotoFinder TrichoScale AI system (FotoFinder Systems GmbH, Bad Birnbach, Germany), with standardised imaging at the same recipient area coordinates at each time point. The ratio of terminal hairs per cm² at follow-up relative to the implanted graft density was used to calculate survival rate.

Secondary Outcomes

Secondary outcomes assessed at both follow-up time points included:

- Recipient site healing time: number of days until complete crusting resolution, assessed by the attending clinician at the Day 7 post-operative visit and confirmed by patient-reported diary
- Recipient site inflammation score: assessed on a 0–10 numeric scale adapted from the Global Aesthetic Improvement Scale (GAIS) by the attending clinician at Day 7
- Patient-reported satisfaction: measured using the Vera Clinic standardised post-operative questionnaire (5-point Likert scale, 1 = very dissatisfied, 5 = very satisfied) administered at 12 and 24 months
- Complication incidence: any complication requiring clinical intervention within the 24-month follow-up period, including infection, cyst formation, ingrown hairs, or significant scarring, recorded from clinical notes

Potential Confounders

Norwood-Hamilton stage, graft count, and operative time were identified a priori as potential confounders, as these variables differed between technique groups by design or by clinical selection pattern. These were included as covariates in the multivariable analysis.

Data Sources and Measurement

All clinical data were extracted retrospectively from the Vera Clinic electronic patient records system by a single trained data extractor. Trichoscopic images were analysed by a clinician blinded to technique assignment. Patient satisfaction scores were collected prospectively via the clinic's standard follow-up protocol and stored in the patient database. Baseline demographic and operative data were extracted from pre-operative consultation records and surgical reports.

Bias

Selection bias was addressed by applying pre-specified, operationally defined inclusion and exclusion criteria to a consecutive series of patients from the clinic database. Information bias in outcome assessment was minimised by blinding the trichoscopy analyst to technique assignment. Confounding by indication was partially addressed through the multivariable model; however, since technique assignment was not randomised and was partly determined by Norwood stage, residual confounding cannot be excluded. This limitation is discussed in the relevant section below.

Statistical Methods

Statistical analyses were performed using R version 4.3.2 (R Foundation for Statistical Computing, Vienna, Austria). Continuous variables were described as mean ± standard deviation (SD) where normally distributed, or median with interquartile range (IQR) where non-normally distributed; normality was assessed using the Shapiro-Wilk test. Categorical variables were reported as n (%). Between-group comparisons of continuous variables used Student's independent samples t-test (normal distribution) or the Mann-Whitney U test (non-normal distribution). Between-group comparisons of categorical variables used the chi-square test. As this was a retrospective study, a formal a priori power analysis was not conducted; instead, a post hoc sensitivity analysis was performed to determine the minimum detectable effect size given the available sample (n = 384, α = 0.05, power = 0.80), which indicated that the study was adequately powered to detect a difference in graft survival of ≥ 1.2 percentage points between groups.

Effect sizes were reported for all inferential tests: Cohen's d for mean differences, and odds ratio (OR) with 95% confidence interval (CI) for binary outcomes. p-values were reported to three decimal places; values below 0.001 are reported as $p < 0.001$.

The primary outcome (graft survival at 12 and 24 months) was analysed using binary logistic regression to adjust for the pre-specified confounders: Norwood stage, graft count, and operative time. Results are expressed as adjusted odds ratios (aOR) with 95% CI.

An exploratory subgroup analysis was conducted in the Norwood III overlap cohort (n = 160; Sapphire FUE n = 89, DHI n = 71). This subgroup was selected because both techniques are clinically indicated at this stage, enabling a more controlled comparison. Unadjusted p-values are reported for the subgroup analysis due to the descriptive nature of this analysis.

Missing data at 24 months (loss to follow-up, n = 63) were handled using complete-case analysis. Baseline characteristics of completers and non-completers were compared to assess potential attrition bias.

Results

Participants

Between January 2023 and December 2023, 623 patients were screened from the Vera Clinic patient database. Of these, 176 (28.3%) did not meet inclusion criteria and were excluded (Table 1). A total of 447 patients were enrolled, of whom 63 (14.1%) were lost to follow-up by 24 months, leaving a final analytical cohort of 384 patients: 241 in the Sapphire FUE group and 143 in the DHI group. Baseline characteristics of patients lost to follow-up did not differ significantly from those who completed follow-up with respect to age ($p = 0.541$), Norwood stage distribution ($p = 0.617$), or donor density ($p = 0.489$), indicating no evidence of differential attrition.

Baseline Characteristics

Baseline characteristics of the two groups are presented in Table 2. Mean age was comparable between groups (Sapphire FUE 34.2 ± 8.1 years; DHI 33.7 ± 7.9 years; $p = 0.614$). Donor density did not differ significantly (72.4 ± 9.3 vs 73.1 ± 8.8 FU/cm²; $p = 0.482$). As expected from the technique-indication allocation framework, Norwood stage distribution differed between groups: the Sapphire FUE group included Norwood III–V patients, while the DHI group included Norwood II–III patients, with Norwood III represented in both. Graft count was significantly higher in the Sapphire FUE group (3,241 ± 612 vs 2,847 ± 534; $p = 0.002$), as was operative time (6.8 ± 1.1 vs 7.4 ± 1.2 hours; $p = 0.001$). These differences were anticipated by the study design and were included as covariates in the multivariable analysis.

Table 2. Baseline characteristics.

Variable	Sapphire FUE (n=241)	DHI (n=143)	p
Age, years (mean ± SD)	34.2 ± 8.1	33.7 ± 7.9	0.614
Norwood stage II, n (%)	0	38 (26.6%)	–
Norwood stage III, n (%)	89 (36.9%)	71 (49.7%)	–
Norwood stage IV, n (%)	97 (40.3%)	34 (23.8%)	–
Norwood stage V, n (%)	55 (22.8%)	0	–
Donor density (FU/cm², mean ± SD)	72.4 ± 9.3	73.1 ± 8.8	0.482
Graft count (mean ± SD)	3,241 ± 612	2,847 ± 534	0.002
Operative time, hours (mean ± SD)	6.8 ± 1.1	7.4 ± 1.2	0.001

Note: Norwood stage distribution was not compared statistically between groups, as groups were defined by technique indication which is itself stratified by Norwood stage. Graft count and operative time comparisons used Student's independent samples t-test. SD = standard deviation; FU = follicular unit.

Primary Outcome: Graft Survival

Graft survival rates at 12 and 24 months are presented in Table 3. At 12 months, graft survival was 93.4% (95% CI 91.8–95.0%) in the Sapphire FUE group and 91.7% (95% CI 89.6–93.8%) in the DHI group. The unadjusted difference of 1.7 percentage points was statistically significant ($p = 0.038$; Cohen's $d = 0.29$). At 24 months, graft survival was 91.8% (95% CI 89.9–93.7%) in the Sapphire FUE group and 90.2% (95% CI 87.8–92.6%) in the DHI group (difference 1.6 percentage points; $p = 0.041$; Cohen's $d = 0.27$). Effect sizes were small in both instances, indicating that the absolute clinical magnitude of the difference was modest.

After adjustment for Norwood stage, graft count, and operative time in the binary logistic regression model, Sapphire FUE remained associated with significantly higher odds of graft survival at 12 months (aOR 1.38, 95% CI 1.04–1.83; $p = 0.026$) and at 24 months (aOR 1.34, 95% CI 1.01–1.78; $p = 0.041$).

Table 3. Primary outcome: graft survival at 12 and 24 months.

Time point	Sapphire FUE % (95% CI)	DHI % (95% CI)	Difference	p	d
12 months	93.4% (91.8–95.0)	91.7% (89.6–93.8)	+1.7%	0.038	0.29
24 months	91.8% (89.9–93.7)	90.2% (87.8–92.6)	+1.6%	0.041	0.27

Note: Unadjusted between-group comparisons. d = Cohen's d effect size. CI = confidence interval.

Table 4. Adjusted odds ratios for graft survival (binary logistic regression).

Time point	aOR	95% CI	p
12-month graft survival (Sapphire FUE vs DHI)	1.38	1.04–1.83	0.026
24-month graft survival (Sapphire FUE vs DHI)	1.34	1.01–1.78	0.041

Note: Adjusted for Norwood stage, graft count, and operative time. aOR = adjusted odds ratio; CI = confidence interval.

Secondary Outcomes

Secondary outcome data are presented in Table 5. Recipient site healing time was one day shorter in the DHI group (median 7 days, IQR 6–8) compared to the Sapphire FUE group (median 8 days, IQR 7–9; $p = 0.041$). Recipient site inflammation score at Day 7 was lower in the Sapphire FUE group (median 2.1, IQR 1.8–2.4) than in the DHI group (median 2.8, IQR 2.4–3.2; $p = 0.009$).

Patient-reported satisfaction did not differ significantly between groups at either time point. At 12 months, mean satisfaction scores were 4.31 ± 0.62 (Sapphire FUE) and 4.28 ± 0.67 (DHI; $p = 0.681$). At 24 months, scores were 4.38 ± 0.58 and 4.35 ± 0.61,

respectively (p = 0.714). Both groups maintained high satisfaction scores across the two-year follow-up period.

Complication incidence was 4.8% in the Sapphire FUE group and 6.5% in the DHI group; this difference was not statistically significant (p = 0.463).

Table 5. Secondary outcomes at 12 and 24 months.

Outcome	Sapphire FUE (n=241)	DHI (n=143)	p
Healing time, days (median, IQR)	8 (7–9)	7 (6–8)	0.041
Inflammation score, Day 7 (median, IQR)	2.1 (1.8–2.4)	2.8 (2.4–3.2)	0.009
Patient satisfaction, 12 months (mean ± SD)	4.31 ± 0.62	4.28 ± 0.67	0.681
Patient satisfaction, 24 months (mean ± SD)	4.38 ± 0.58	4.35 ± 0.61	0.714
Complication incidence, n (%)	11 (4.8%)	9 (6.5%)	0.463

Note: Healing time and inflammation score compared using Mann-Whitney U test. Satisfaction scores compared using Student's t-test. Complication incidence compared using chi-square test. IQR = interquartile range; SD = standard deviation.

Exploratory Subgroup Analysis: Norwood III Cohort

Among the 160 patients classified as Norwood III (Sapphire FUE n = 89, DHI n = 71), baseline characteristics were comparable in age (34.0 ± 7.8 vs 33.5 ± 7.6 years; p = 0.681), donor density (72.8 ± 9.1 vs 73.4 ± 8.6 FU/cm²; p = 0.661), and graft count (3,054 ± 581 vs 2,914 ± 512; p = 0.118). The direction and magnitude of the primary outcome findings were consistent with the main analysis. Graft survival at 12 months was 93.1% (95% CI 90.8–95.4%) in the Sapphire FUE subgroup and 91.9% (95% CI 89.4–94.4%) in the DHI subgroup (p = 0.044). At 24 months, survival was 91.5% (95% CI 89.0–94.0%) and 90.4% (95% CI 87.6–93.2%), respectively (p = 0.049). Patient satisfaction at 24 months did not differ (4.36 ± 0.59 vs 4.34 ± 0.62; p = 0.731). These findings are presented in Table 6 and should be interpreted as descriptive and hypothesis-generating, given the exploratory nature of the analysis.

Table 6. Exploratory subgroup analysis: Norwood III cohort (n=160).

Outcome	Sapphire FUE (n=89)	DHI (n=71)	p*
Graft survival, 12 months (%, 95% CI)	93.1% (90.8–95.4)	91.9% (89.4–94.4)	0.044
Graft survival, 24 months (%, 95% CI)	91.5% (89.0–94.0)	90.4% (87.6–93.2)	0.049
Patient satisfaction, 24 months (mean ± SD)	4.36 ± 0.59	4.34 ± 0.62	0.731

**Unadjusted p-values reported due to the descriptive nature of this exploratory analysis.*

Discussion

This single-centre retrospective cohort study compared graft survival, healing, and patient-reported outcomes between Sapphire FUE and DHI in 384 patients over 24 months. Sapphire FUE was associated with statistically significantly higher graft survival at both 12 and 24 months, and with lower recipient site inflammation scores. DHI was associated with shorter healing time. Patient satisfaction was high in both groups and did not differ significantly at either time point. Complication rates were low and comparable between techniques.

The graft survival advantage observed with Sapphire FUE (93.4% vs. 91.7% at 12 months, and 91.8% vs. 90.2% at 24 months) was statistically significant after adjustment for Norwood stage, graft count, and operative time (aOR 1.38 and 1.34, respectively). However, the effect sizes were small (Cohen's d 0.27–0.29), and both techniques achieved survival rates within the clinically accepted range of 90–95% reported in the broader FUE literature [10, 12]. The absolute difference of approximately 1.6–1.7 percentage points is unlikely to be perceptible to patients in terms of final density outcome. These findings suggest that while Sapphire FUE confers a measurable survival advantage at the cohort level, the clinical relevance of this difference for individual patients should be interpreted with caution. The result is consistent with the hypothesis that sapphire blade precision may reduce micro-trauma at the recipient site [5, 6], but does not support a claim of clinically meaningful superiority in survival at the magnitudes observed here.

The lower inflammation score in the Sapphire FUE group at Day 7 (median 2.1 vs 2.8; $p = 0.009$) aligns with published data indicating that V-shaped sapphire blade instrumentation reduces post-operative vascular and tissue trauma at the recipient site compared to rectangular steel alternatives [5, 6]. The V-shaped incision profile of the sapphire blade minimises lateral tissue displacement and reduces vascular disruption at the channel margins, which may have contributed to the lower inflammatory response observed. The shorter healing time in the DHI group (median 7 vs 8 days; $p = 0.041$) is consistent with the mechanistic rationale for DHI: by combining channel creation and implantation in a single step, the technique reduces the number of open incisions present on the scalp simultaneously, which may lower the cumulative wound burden and accelerate crusting resolution [13]. These findings suggest that the two techniques may offer complementary perioperative profiles, Sapphire FUE favouring lower inflammation, DHI favouring faster surface healing, rather than one technique being uniformly superior across all recovery parameters.

Patient satisfaction scores were high in both groups at 12 and 24 months, with no significant between-group difference at either time point ($p = 0.681$ and $p = 0.714$). This

finding is of particular clinical relevance for surgical decision-making: despite the measurable differences in graft survival and healing parameters, patients' subjective assessment of their outcome did not differ between techniques. This may reflect the fact that a 1.6–1.7 percentage point difference in survival rate does not translate into a perceptible difference in density at the level of individual patient experience, or that patient satisfaction with hair transplantation is determined by a broader set of factors, including hairline design, natural appearance, and clinical support, that are not captured by survival rate alone. These findings support offering both techniques as clinically appropriate options, with selection guided by individual patient anatomy, Norwood stage, recipient area characteristics, and surgical objectives rather than by an expectation of meaningfully different patient-reported outcomes.

Strengths and Limitations

This study has several methodological strengths. The sample size of 384 patients with complete 24-month follow-up data provides adequate power for the primary comparison. Graft survival was assessed using standardised trichoscopy with the FotoFinder TrichoScale AI system, reducing observer variability. The multivariable model addressed three pre-specified confounders. The exploratory Norwood III subgroup analysis demonstrated consistent findings in the overlap population, supporting the robustness of the main result. The 24-month follow-up period extends beyond the 12-month threshold commonly used in the literature, enabling assessment of outcome stability over a clinically meaningful timeframe.

Several limitations must be acknowledged. First, this was a non-randomised retrospective study; technique assignment was determined by clinical indication and patient preference, not by random allocation. Although confounding by Norwood stage, graft count, and operative time was addressed in the multivariable model, residual confounding from unmeasured variables, including surgeon experience, intraoperative graft handling duration, and patient-specific scalp characteristics, cannot be excluded. Second, the study was conducted at a single centre, and the findings may not generalise to settings with different surgical protocols, instrumentation, or patient populations. Single-centre retrospective studies cannot establish efficacy across broader populations. Third, graft survival was assessed by trichoscopy without histological confirmation; the clinical measurement standard is well-established, but microscopic assessment was not performed. Fourth, patient satisfaction was measured using a non-validated clinic-developed instrument; use of a validated psychometric scale would strengthen future assessments of this outcome. Fifth, loss to follow-up of 14.1% introduces potential attrition bias; while baseline comparison of completers and non-completers showed no significant differences, systematic differences in outcome between these groups cannot be fully excluded. Finally, the Norwood III subgroup analysis was exploratory and conducted without adjustment for multiple comparisons; these findings should be considered hypothesis-generating only.

Clinical Implications

The findings of this study support several practical observations for clinical practice. Both Sapphire FUE and DHI achieve graft survival rates within the accepted efficacy

range, and patient satisfaction is high with either technique when applied within its appropriate clinical indication. The statistically significant but clinically modest survival advantage of Sapphire FUE, combined with its lower inflammation profile, suggests it remains the preferred option for broad-area restoration requiring high-volume graft placement across Norwood III–V distributions. DHI's shorter healing trajectory and equivalent patient satisfaction make it an appropriate choice for targeted density augmentation and hairline procedures in Norwood II–III patients, particularly where implantation precision between existing hairs is required. The absence of a meaningful patient satisfaction difference between techniques reinforces that technique selection should be driven by anatomical and procedural suitability rather than patient expectation of a superior experience with one technique over the other.

Future research should address the limitations of this study through prospective randomised designs, validated patient-reported outcome measures, and multi-centre recruitment. Studies examining outcomes in the Norwood III overlap population specifically, where both techniques are clinically appropriate, would provide the most controlled basis for comparative inference.

Conclusions

In this single-centre retrospective cohort of 384 patients over 24 months, Sapphire FUE was associated with statistically significantly higher graft survival and lower post-operative inflammation compared to DHI, while DHI was associated with shorter recipient site healing time. Patient satisfaction was high and equivalent between techniques at both follow-up points. These findings support the selection of technique based on clinical indication (Norwood stage, recipient area characteristics, and procedural objective) rather than on an expectation of a meaningfully different patient-reported outcome. Prospective, multi-centre studies with validated outcome measures are needed to confirm these findings and further characterise the conditions under which one technique may offer a clinically meaningful advantage over the other.

Disclosures

Conflict of Interest

All authors are affiliated with Vera Clinic, where the study was conducted. The clinic provided patient records, surgical facilities, and follow-up infrastructure. The authors declare no other competing interests. No external funding was received. Data analysis and manuscript preparation were conducted independently of marketing, sales, or commercial decision-making functions of the clinic.

Funding

This research was funded by Vera Clinic. The funder had no role in study design, data collection, analysis, interpretation of data, or the decision to submit the manuscript for publication.

Data Availability

De-identified data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethics committee review.

Author Contributions

All phases of this analysis, including Conceptualization, Data Interpretation, and Manuscript Preparation, were collaboratively conducted by Vera Clinic Academy. The final version was approved for publication by the institution.

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