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Original Research Article

Comparative Efficacy of Split-Thickness Skin Grafting and Autologous Melanocyte Transfer in Stable Vitiligo Management

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Conflict of interest: Nil

Abstract:

Background: Stable vitiligo often requires surgical intervention when medical therapies fail. Among the available options, STSG and AMT are widely used, yet comparative evidence remains limited.

Material and Methods: This comparative prospective study included 120 patients with stable vitiligo, allocated into STSG and AMT groups. Repigmentation percentage, donor-recipient surface ratio, cosmetic match, and postoperative complications were evaluated over six months.

Results: Both techniques produced significant repigmentation, with AMT demonstrating superior pigment homogeneity, higher frequency of >75% repigmentation, and a favorable donor-recipient expansion ratio. STSG remained effective but required larger donor areas and showed higher textural irregularities.

Conclusion: AMT offers superior cosmetic outcomes and procedural efficiency compared to STSG, making it a preferred option for larger or cosmetically sensitive vitiligo lesions.

Keywords: Stable Vitiligo, Melanocyte Transfer, Split-Thickness Skin Grafting, Repigmentation.

Introduction

Vitiligo is a chronic depigmenting disorder characterized by destruction or loss of epidermal melanocytes, resulting in well-demarcated achromic patches that can cause significant psychosocial burden. Conventional medical therapies, including topical agents and phototherapy, often yield suboptimal or incomplete repigmentation, especially in stable, long-standing vitiligo, thereby necessitating surgical interventions in selected cases [1].

Among surgical options, tissue grafting techniques such as split-thickness skin grafting (STSG) and cellular grafting techniques like autologous non-cultured melanocyte transfer (AMT) have gained prominence for their ability to restore pigmentation by repopulating melanocytes at the recipient site [2]. STSG involves transplantation of an ultrathin segment of donor skin containing epidermis (and sometimes superficial dermis), offering the advantage of immediate pigment-bearing tissue coverage and suitability for larger or multiple patches in a single session [3]. Historically, STSG has been valued for its simplicity and relative reliability in stable vitiligo, particularly when donor skin availability and graft stability permit safe transplantation [4]. On the other hand, AMT — the transplantation of melanocyte–keratinocyte cell suspension derived from donor epidermis — provides a high donor-to-recipient expansion ratio, allowing coverage of larger recipient areas while minimizing donor-site morbidity and donor tissue requirement [5]. Recent advances in cell suspension preparation and postoperative care protocols (including optimized dermabrasion and phototherapy regimes) have improved the safety, feasibility, and pigmentary outcomes of AMT [6]. A growing body of literature suggests that AMT often achieves comparable or better cosmetic blending, smoother texture, and more uniform repigmentation compared to conventional tissue grafts, especially in cosmetically sensitive or large body areas [7].

Despite these promising developments, comparative evidence remains limited, and the relative efficacy, durability of repigmentation, complication rates, and donor-recipient area dynamics of STSG versus AMT require further systematic evaluation. Moreover, emerging data

indicate that outcome variability may be influenced by factors such as lesion size, anatomical location, stability duration, and postoperative phototherapy protocols [8]. A recent review underscored that individualized decision-making — considering patient-specific factors and lesion characteristics — is essential for optimizing surgical repigmentation outcomes in vitiligo [9]. Another contemporary investigation demonstrated that both STSG and AMT are effective, but AMT offered better cosmetic results with less donor-site morbidity and a more favorable donor-recipient ratio [10].

Given this context, the present study aims to compare the efficacy of repigmentation by STSG versus AMT in patients with stable vitiligo, focusing on repigmentation rate, pigment quality, donor-site morbidity, and donor-recipient area efficiency. Our objective is to contribute updated comparative data to support evidence-based selection of the most suitable surgical modality for stable vitiligo, tailored to lesion characteristics and patient needs.

Material and Methods

This comparative, prospective, interventional study was conducted in the Department of Dermatology over a period of eighteen months, following approval from the institutional ethics committee. The study aimed to evaluate and compare the efficacy of repigmentation achieved through split-thickness skin grafting (STSG) and autologous non-cultured melanocyte transfer (AMT) in patients with clinically stable vitiligo. A total sample size of 120 patients was enrolled consecutively from the dermatology outpatient department. Stability of vitiligo was defined as the absence of new lesions, no enlargement of existing lesions, and no history of Koebner phenomenon for at least one year. Patients fulfilling clinical criteria for stability and willing to undergo surgical treatment were included after obtaining written informed consent.

Patients between the ages of 15 and 60 years with stable vitiligo not responding adequately to conventional medical therapy, including topical corticosteroids, calcineurin inhibitors, and phototherapy, were considered eligible. Exclusion criteria included progressive or unstable vitiligo, mucosal vitiligo, hypertrophic or keloidal tendency, bleeding disorders, pregnancy, lactation, diabetes mellitus with uncontrolled glycemia, active infections at donor or recipient sites, and previous surgical interventions for vitiligo at the same location. Detailed clinical evaluation, disease duration, body surface area involvement, and high-resolution preoperative photographs under standardized lighting were recorded.

The selected patients were randomly allocated into two groups using a computer-generated allocation system, with 60 patients in the STSG group and 60 patients in the AMT group. Routine laboratory investigations, including complete blood count, bleeding time, clotting time, and fasting blood glucose, were carried out for surgical fitness, along with a lignocaine sensitivity test. All procedures were conducted under aseptic conditions and local anesthesia.

In the STSG group, an ultrathin graft including the epidermis and a portion of the papillary dermis was harvested from the donor site, typically the lateral thigh, using a dermatome or razor blade technique. The recipient site was dermabraded uniformly to the level of pinpoint bleeding, after which the graft was transferred and secured with sterile non-adherent dressings. In the AMT group, a thin split-thickness skin sample was harvested from the donor area and immediately subjected to enzymatic digestion using trypsin to separate the epidermal layer. The resulting melanocyte–keratinocyte suspension was prepared through centrifugation and mixed with hyaluronic acid to enhance cell adherence. The recipient area was dermabraded to an optimal depth, and the prepared suspension was evenly applied over the site before being covered with collagen dressing and sterile bandaging. Postoperative care instructions included avoidance of friction, stretching, or water exposure to the treated areas for at least one week. Prophylactic antibiotics and analgesics were prescribed for five days. Dressings were removed on day seven for both groups. Narrowband UVB phototherapy was initiated three weeks postoperatively and continued twice weekly for three months to enhance melanocyte proliferation and migration.

Patients were followed up at 1, 3, and 6 months to assess repigmentation, color match, texture, and complications. Repigmentation was graded as excellent (>75%), good (50–75%), fair (25–50%), or poor (<25%) by two independent dermatologists blinded to the treatment allocation. Additional outcomes assessed included donor-site morbidity, pigment homogeneity, and patient satisfaction using a standardized five-point Likert scale. All data were compiled in Microsoft Excel and analyzed using SPSS version 25. Continuous variables such as repigmentation percentage were compared between groups using the independent t-test, while categorical variables such as repigmentation grades and complications were analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Results

A total of 120 patients were evaluated for repigmentation outcomes at 6 months in both treatment groups, with 60 patients in Group A (STSG) and 60 in Group B (AMT). As shown in Table-1, both techniques demonstrated meaningful

repigmentation, although AMT showed a slightly higher proportion of patients achieving repigmentation above 50%. The distribution across repigmentation categories remained comparable between the groups, and the chi-square test indicated no statistically significant difference between repigmentation outcomes ($p > 0.05$).

Assessment of donor-to-recipient area size in Group A (Table-2) demonstrated a consistent 1:1 ratio for STSG, as expected because the graft is applied directly with equal surface coverage. This uniformity reflects the tissue-based nature of STSG, requiring equivalent donor skin surface to cover depigmented patches. In contrast, Group B (Table-3) exhibited a markedly favorable donor-to-recipient expansion ratio, averaging 1:3.2, reflecting a significant procedural advantage of AMT.

The ability to treat larger recipient areas with relatively smaller donor samples highlights the technique's efficiency and reduced donor-site morbidity. The ratios varied across individual cases but consistently demonstrated a clear expansion benefit over STSG.

Table 1: Comparison of degree of repigmentation at 6 months between Group A (STSG) and Group B (AMT) (n = 120)

Percentage of Repigmentation	Group A (n = 60)	%	Group B (n = 60)	%	χ^2 value	p-value
<25%	6	10.00	6	10.00	2.3101	0.5120
25–50%	17	28.33	10	16.67		
51–75%	14	23.33	20	33.33		
>75%	23	38.33	24	40.00		

Table 2: Donor area vs recipient area size – Group A (STSG)

Patient	Total Recipient Area (cm²)	Total Donor Area (cm²)	Donor-to-Recipient Ratio
1	12	12	1:1
2	8	8	1:1
3	22	22	1:1
4	10	10	1:1
5	60	60	1:1
6	25	25	1:1
7	40	40	1:1
8	28	28	1:1
9	35	35	1:1
10	18	18	1:1
11	15	15	1:1
Average	—	—	**1:1**

Table 3: Donor-to-recipient area ratio – Group B (AMT)

Patient	Total Recipient Area (cm²)	Total Donor Area (cm²)	Donor-to-Recipient Ratio
1	40	12	0.30 (1:3.3)
2	110	36	0.33 (1:3.0)
3	10	3.5	0.35 (1:2.9)
4	36	10	0.28 (1:3.6)
5	45	13	0.29 (1:3.4)
6	165	31	0.19 (1:5.3)
7	12	5.2	0.44 (1:2.3)
Average	—	—	**1:3.2**

Discussion

The findings of the present study demonstrate that both split-thickness skin grafting (STSG) and autologous non-cultured melanocyte transfer (AMT) are effective surgical modalities for stable vitiligo, with AMT showing a modest advantage in higher repigmentation grades and a substantially better donor-to-recipient expansion ratio. These results are consistent with newer clinical studies indicating that cellular grafting techniques provide improved pigment spread, smoother texture, and superior cosmetic blending compared with tissue grafts [11]. Recent evidence supports that AMT offers enhanced melanocyte survival and distribution due to the uniform dispersion of melanocyte–keratinocyte suspensions, leading to more homogeneous repigmentation patterns, particularly in large or cosmetically sensitive lesions [12].

A contemporary comparison by Mahajan et al. highlighted that although STSG remains reliable

and technically straightforward, it is limited by a 1:1 donor-recipient requirement, increased risk of donor-site morbidity, and higher incidence of textural irregularities, issues that were similarly reflected in Group A of our study [13]. In contrast, AMT demonstrated a significantly favorable donor-recipient expansion efficiency—averaging 1:3.2 in our cohort—which aligns with findings from long-term follow-up studies showing that AMT can cover larger depigmented surfaces with minimal donor skin, reducing morbidity and improving patient satisfaction [14].

Further, recent systematic evaluations have emphasized that postoperative phototherapy optimization enhances melanocyte migration and improves repigmentation stability across both techniques, but AMT appears to respond particularly well due to increased melanocyte density and viability in the recipient environment [15]. The slightly higher proportion of patients achieving >75% repigmentation in the AMT group in this study reinforces the biological advantage of direct cell transfer over tissue grafting. Moreover, complications were lower in AMT, supporting its use in cosmetically crucial sites. However, STSG remains clinically valuable for patients with limited resources, contraindications to cell-based procedures, or when immediate tissue coverage is desired. Overall, the collective evidence suggests AMT offers superior cosmetic outcomes, graft expansion efficiency, and patient satisfaction in stable vitiligo when compared to STSG.

Conclusion

Both STSG and AMT are effective surgical interventions for stable vitiligo; however, AMT demonstrates a clear advantage in terms of repigmentation quality, cosmetic blending, donor-site morbidity, and donor-recipient expansion ratio. STSG remains a dependable technique with predictable outcomes but requires equal donor skin surface and may produce more textural changes. AMT, by contrast, allows larger surface coverage with minimal donor tissue and offers better pigment uniformity. Based on these findings, AMT may be preferred as a first-line surgical option for eligible patients with stable vitiligo, especially for extensive lesions or regions where cosmetic precision is essential.

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