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*Consensus Statement*

# Consensus statement on the surgical management of vitiligo

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## ABSTRACT

Vitiligo is a chronic skin disorder characterized by the loss of melanocytes, leading to depigmented patches on the skin. The global lifetime prevalence of vitiligo diagnosed by a physician or dermatologist was estimated at 0·36% in the general population, 0·67% in the adult population adults, and 0·24% in the child population. Vitiligo prevalence was higher in adults than in children across all regions. Central Europe and south Asia reported the highest prevalence 0·52% and 0·52%, respectively, in the general population. Vitiligo significantly impacts patients' quality of life, causing psychological distress and social stigmatization. While medical treatments such as corticosteroids and phototherapy exist, they often fail to achieve satisfactory repigmentation, particularly in extensive or recalcitrant cases. In recent years, surgical interventions have gained prominence as effective alternatives for managing vitiligo. Techniques such as autologous melanocyte transplantation, suction blister grafting, split-thickness skin grafting, and punch grafting offer promising repigmentation results. However, the lack of standardized protocols and guidelines for vitiligo surgery presents challenges in patient selection, procedural approaches, and post-operative care. This study aims to review current surgical techniques, assess patient-specific factors influencing surgical success, and evaluate long-term outcomes, including repigmentation rates and patient satisfaction. Key factors include disease stability, lesion characteristics, and the involvement of exposed areas. Moreover, the study emphasizes the importance of post-operative adjuvant therapy, such as topical tacrolimus and excimer therapy, to enhance surgical outcomes. By establishing evidence-based protocols for vitiligo surgery, this study seeks to improve treatment efficacy and patient care, addressing gaps in current practices and advancing the field toward more consistent and successful outcomes in vitiligo management.

**Keywords:** Vitiligo consensus, Surgical management of vitiligo, Consensus on vitiligo surgery

## INTRODUCTION

Vitiligo is a chronic skin disorder characterized by the progressive loss of melanocytes, resulting in depigmented patches on the skin and mucous membranes.[1] The global lifetime prevalence of vitiligo diagnosed by a physician or dermatologist was estimated at 0·36% (95% credible interval [CrI] 0·24-0·54) in the general population (28·5 million people [95% CrI 18·9-42·6]), 0·67% (0·43-1·07) in the adult population (37·1 million adults [23·9-58·9]), and 0·24% (0·16-0·37) in the child population (5·8 million children [3·8-8·9]). Vitiligo prevalence was higher in adults

than in children across all regions. Central Europe and south Asia reported the highest prevalence (0·52% [0·28-1·07] and 0·52% [0·33-0·82], respectively, in the general population).[2,3] However, the true prevalence remains uncertain due to the lack of comprehensive epidemiological studies. While not life-threatening, vitiligo significantly impacts patients' quality of life, leading to psychological distress, social stigmatization, and reduced self-esteem.[4]

Despite extensive research and the availability of various treatment modalities, including topical corticosteroids, phototherapy, and immunomodulators, achieving satisfactory repigmentation in vitiligo remains a significant challenge.[5] This is particularly true for patients with extensive or recalcitrant disease, where conventional therapies often yield suboptimal results.

In recent years, surgical interventions have emerged as promising alternatives for vitiligo management, offering the potential for durable and cosmetically pleasing repigmentation.[6] These surgical techniques aim to transplant melanocytes or melanocyte precursors from unaffected areas of the body to depigmented skin regions, thereby restoring pigmentation.

Autologous melanocyte transplantation, suction blister grafting, split-thickness skin grafting (STSG), and mini-punch grafting are among the surgical modalities commonly employed for vitiligo repigmentation. These techniques vary in complexity, invasiveness, and outcomes, necessitating careful consideration of patient-specific factors, including disease stability, lesion characteristics, and patient preferences.[6]

Despite the growing interest in vitiligo surgery, there remains a lack of standardized protocols and consensus regarding optimal surgical techniques, patient selection criteria, and post-operative management strategies. Variations in surgical approaches, donor site selection, and follow-up protocols across different centers underscore the need for unified guidelines to streamline clinical practice and optimize patient outcomes.

This study aims to address this gap by providing a comprehensive review of the current consensus on vitiligo surgery. By synthesizing existing evidence and expert opinions, we aim to establish standardized protocols, enhance treatment efficacy, and improve patient satisfaction in the management of vitiligo.

### Aim

This study aims to provide a comprehensive review of the current consensus on vitiligo surgery, encompassing various surgical techniques, patient selection criteria, and post-operative management strategies.

### Objectives

1. Assessing patient-specific factors: To thoroughly evaluate patient-specific factors, such as disease stability, lesion characteristics, and individual patient expectations, which significantly influence the selection of the most appropriate surgical techniques for achieving repigmentation in vitiligo.
2. Evaluating efficacy and safety: To systematically assess the efficacy and safety profiles of various surgical interventions, including autologous melanocyte transplantation, suction blister grafting, STSG, and punch grafting, in promoting repigmentation in patients with vitiligo.
3. Standardizing protocols and guidelines: To develop standardized protocols and evidence-based guidelines for pre-operative assessment, selection of surgical techniques, and post-operative management in patients undergoing surgical interventions for vitiligo.
4. Determining long-term outcomes: To investigate long-term outcomes, such as repigmentation rates, color matching, and overall patient satisfaction, following surgical procedures for vitiligo.
5. Enhancing patient care: To improve the quality of care and enhance patient satisfaction in the management of vitiligo through the implementation of evidence-based surgical interventions and standardized clinical practices.

## MATERIALS AND METHODS

### Patient selection

#### *Inclusion criteria*

- Stable vitiligo: Patients with no new patches or enlargement of existing lesions for a minimum period of 1 year. However, in urgent social situations, such as imminent marriage or when patches are located in highly visible areas, the shorter duration of stability of lesion can be considered for surgical intervention with induced stability.

Practice Point 1: Are there any tests necessary for assessing lesional stability?

Answer: No specific tests are required; a detailed patient history regarding lesion stability is generally sufficient to determine surgical candidacy. Serial photography and dermoscopy are reliable tools for assessing stability, but the use of biomarkers or mini punch grafting to test stability is generally deemed unnecessary.

- Non-response to medical treatment: Patients who have not achieved satisfactory repigmentation despite consistent adherence to conventional medical treatments, including topical corticosteroids, phototherapy, and immunomodulators.

- Exposed areas: Priority was given to patients with vitiligo affecting exposed areas, such as the face, hands, and other visible parts of the body, where cosmetic outcomes are of significant concern.

**Patient factors**

- Age of patient: Patients of all age group can be considered for surgery with special considerations for age group below 15 years and above 60 years of age [Table 1].
- Type of vitiligo: Both segmental and non-segmental vitiligo patients were considered. Segmental vitiligo, typically localized and stable, was often deemed optimal for surgical intervention. Long-standing segmental vitiligo is particularly suitable for surgery unless the disease is evolving, in which case medical management with or without phototherapy may be necessary.
- Area of involvement: Patients with both focal and extensive areas of depigmentation were included. Surgical techniques were adapted according to the size and extent of the affected areas. For extensive body surface area (BSA) involvement, it is advisable to prioritize surgery on exposed areas (100–300 sq cm) first, followed by covered areas. In rare cases, for extensive vitiligo, surgery on more than 300 sq cm may be considered based on priority [Table 2].

Practice Point 2: Which surgery is preferred for an area less than 100 sq cm?
Answer: Majority seniors believes in Non-cultured epidermal cell suspension (NCES), followed by mini-punch grafting (MPG), ultrathin split thickness skin graft (SSS) and Follicular unit extraction (FUE)

Practice Point 3: Which surgery is preferred for area between 100- 300 sq cm?
Answer: Majority of the experts prefers NCES, followed by tissue grafting and lastly FUE

- Anatomical location of patches: The anatomical location of vitiligo patches were carefully considered, with distinctions made between hairy areas (e.g., scalp, beard) and non-hairy areas (e.g., face, neck, hands).
- Treatment History:

Practice Point 4: Can surgery be performed if the patient is on immunosuppressants?
Answer: It is advisable to wait at least one year after the completion of immunosuppressant therapy before considering surgical intervention, except in cases of social emergencies

Practice Point 5: Is adjuvant therapy necessary?
Answer: Yes, adjuvant therapy is recommended. Topical tacrolimus with or without phototherapy is commonly used, with initiation times varying post-surgery (30% after wound healing, 30% after 4 weeks, 20% after 3 weeks, and 10% after 2 weeks). Excimer therapy is preferred by 80% of practitioners over narrowband ultraviolet B (UVB), while 50% consider oral cyclosporine post-surgery.

**Table 1:** Surgical consideration in patients below 15 years and above 60 years of age.

| Patient age | Factors to be considered for surgery |
|---|---|
| Children under 10 years | Only if patches on cosmetically sensitive areas, segmental vitiligo over exposed sites, and patient cooperation. |
| Adolescents (10–15 years): | Only in the case of segmental vitiligo |
| Geriatric patients (>60 years) | Can be operated keeping co-morbidities in mind |

**Operation criteria**

- Qualifications: Surgery should be performed by a dermatologist certified by the National Medical Council with adequate training in vitiligo surgery, either during postgraduate studies or at a dedicated vitiligo workshop. Additionally, hands-on training under the guidance of an experienced dermatosurgeon is recommended.

**Operation theatre**

- Setting: Outpatient dermatosurgery theaters are suitable for procedures performed under local anesthesia, provided they are equipped with the necessary tools for handling emergencies. For extensive BSA surgeries, a hospital setting with anesthetist support for light sedation is essential. In rare cases, a tertiary hospital setup with laboratory facilities may be required.

**Anesthetic backup**

- Requirement: Anesthetic backup is essential for large BSA surgeries, though it is recommended to have anesthetic backup available as well for all surgeries.

**Pre-operative assessment**

- Comprehensive evaluation: Patients should undergo a thorough pre-operative assessment, including:
  - Detailed history and physical examination to confirm the stability of vitiligo and non-response to medical treatments
  - Basic blood tests (Hemogram, Liver function test (LFT), Renal function test (RFT), viral markers)

and skin biopsies as needed
- Evaluation of patient expectations and psychological readiness for surgery
- Pre-operative medications (e.g., antibiotics, Non steroidal anti inflammatory drugs (NSAIDs), cyclosporine) may be advised as needed.

**Anesthesia**

- Techniques: Local infiltration or topical anesthesia is usually sufficient. General anesthesia may be required for extensive vitiligo surgeries or when operating on painful areas, using a combination of lignocaine and bupivacaine under sedation.

**Dermabrasion**

Motorized dermabrasion gives good results as compared to laser abrasion, which results in better cosmetic results. At the same time, laser dermabrasion can be used for bony areas and larger recipient areas [Table 3].

**Mini-punch grafting (MPG)**

The procedure involves harvesting tissue from concealed areas of the body, typically the upper thigh or gluteal region, using manual punches or an electric motor. The goal is to maximize the number of grafts obtained from[7] a small donor area. Once collected, the grafts are kept in normal saline before being transferred to the prepared recipient sites, and both the donor and treated areas are secured with dressings for up to 7 days.

The current recommendation is to use same size punches for both donor and recipient areas.

Additionally, for stabilizing the grafts post-transplant, surgical glue can be used, which is extremely helpful in difficult areas like lips, eyelids, etc. (as per consensus).

Recent studies suggest that the pigmentation process may be expedited, and cobblestoning can be minimized by the use of MPG which is graft sizes lesser than 1 mm.

Practice Point 6: How to prevent cobblestoning?
Answer: Using an electric micro-drill for graft extraction
I.e. motorised hair transplant punches with precise dimensions (0.5–0.7 mm in diameter and 1.5–1.8 mm deep) can minimized these issues

Practice Point 7: How to treat cobblestoning?
Answer: Common complications associated with this method include cobblestoning and the polka dot effect, which can affect the cosmetic results. However, advancements in the technique, such as pinhole ablation using $CO_2$ laser can help in treatment of cobblestoning. 2–3 s of $CO_2$ laser beam is projected in the centre of the lesion to achieve depth of 2 mm, thus resolving the lesion.

**Suction blister epidermal grafting (SBEG)**

Suction blister epidermal grafting (SBEG) procedure involves the separation of the epidermis through the creation of blisters using suction. SBEG works by using various suction devices that apply negative pressure to form blisters, the roof of which can then be used for grafting. This method is widely recognized for its simplicity and safety, making it particularly suitable for use around sensitive areas such as the lips, nipples, and eyelids. Suction blister grafting gives best results on areas like nipple, lips and eyelids but can also be used on bony prominences if there is a small patch as third preference, 1st being non cultured epidermal suspension, 2$^{nd}$ being Mini punch grafting

A notable advantage of SBEG is that it has been simplified. A syringe, with the plunger removed, can be utilized to create the necessary suction by adhering one end to the skin and connecting the other end to a suction device through a needle hub.

Practice Point 8: How to decrease blister formation time?
Answer: Typically, blister formation takes between 1.5 and 2 h, although this can be shortened by modifications like: Increasing temperature, reducing diameter, hair dryer, tumescent anesthesia, normal saline injection, etc.

Practice Point 9: What is the pressure needed to create blisters?
Answer: Typically between 300 and 500 mmHg negative pressure constantly for 1.5–2 h.

Consequently, techniques have been developed to optimize blister formation, which includes the use of Hijama cups and specialized automated devices like the CelluTome for epidermal graft harvesting.

SBEG is associated with a very low risk of scarring, making it suitable for blister formation on nearly any body part, with the thigh and forearm being the most commonly chosen sites.

**Ultrathin STSG**

Ultrathin STSG for vitiligo requires the use of thin (0.15–0.3 mm) thickness of the harvested donor tissue. The thighs, buttocks, back, arms, or forearms are commonly selected as donor sites for graft collection. A sliver's knife for harvesting the donor skin is typically used for this purpose, ensuring that the skin flap maintains uniform thickness throughout and electric dermatome for abrading the recipient skin. Proper surgical expertise is crucial to ensure the procedure is performed successfully.

The therapeutic outcomes depend on the graft thickness. Thinner skin flaps, compared to thicker ones, were associated with fewer side effects, such as scarring or infection. Although it has a good efficiency in treating relatively large areas of vitiligo, the recipient area to donor area ratio remains 1:1. Ultrathin STSG does have some limitations, including

potential mismatch in color, texture, and milia formation between the grafted and surrounding skin.

Practice Point 10: How to minimize the shrinkage of the Graft?
Answer: A masher is the device used to mesh the skin graft, which involves creating small, regular perforations in the graft. this process allows the graft to expand, converting a larger surface area, and improves drainage of fluids like blood and exudates under the graft. Also, ultra thin grafts lack dermis and so it doesn't shrink.

### *Jodhpur technique*

The Jodhpur Technique is a refined approach to vitiligo surgery, where the donor area is smeared with a thick layer of antibiotic ointment (2% mupirocin). The donor area, is then dermabraded using the manual dermabrasion or electric motor. The ointment smeared serves to entrap the epidermal component consisting of keratinocytes, melanocytes, free melanin, fibroblasts, etc. This paste composed of a cellular mixture, is collected with a spatula and then spread on the prepared recipient site.[8]

Post-operative care involves protecting the treated areas for 7–10 days, after which initial repigmentation is typically observed within 2–4 weeks.

This technique is particularly suited for treating stable vitiligo in focal or exposed areas due to its simplicity, cost-effectiveness, and high success rates. It offers minimal donor site morbidity and uses basic equipment, making it accessible even in resource-limited settings. While it is highly effective for small, localized lesions, its application to larger areas can be more challenging. The Jodhpur Technique has gained recognition for its reproducibility and promising outcomes, making it a valuable option for dermatologists managing stable vitiligo cases.

However, a modification in these techniques to avoid the associated comorbidities at 2 sites (donor and recipient) was proposed. This technique involves receiving the graft from the perilesional pigmented skin to eliminate the pain at the donor site. The comorbidities are restricted to a single site, making it an effective method for small patches.[9]

## Hair follicle graft

A novel approach to vitiligo treatment involves the transplantation of hair follicles, capitalizing on their reserve of melanocytes. During repigmentation in vitiligo patients, there is a noticeable increase in inactive melanocytes, which tend to accumulate in the outer sheath of hair follicles. These melanocytes, through processes of division, proliferation, and maturation, contribute to renewed pigment production in the affected skin areas.

The hair follicles are harvested for transplantation from the occipital scalp, temporal scalp, pubic region, and beard area. The follicles are then grafted into pre-formed wells in the affected area, spaced 3–5 mm apart. Tools such as an 18 G, a needle or hair transplant implantation device can be used for this purpose. The donor and recipient sites are covered with dressings, which are removed after about 1 week. Initial signs of repigmentation are usually observed around 2 weeks after the follicles have been grafted.

This technique uses simple equipment, though the repigmentation results may vary. It is very helpful for treating hairy areas and patches with leukotrichia.

## Cellular grafts

### *Cultured melanocyte keratinocyte graft*

The procedure involves harvesting a thin epidermal graft trypsinization to separate the epidermis from the dermis, and melanocytes are cultured in a medium enriched with various factors to obtain high-purity cells. The newer culture media are devoid of carcinogenic potential and hence can be used more safely. However, it is time-consuming taking around 21 days to complete the cell culture cycles, and needs an expensive laboratory setup for the same. This makes it difficult for a clinician to use it frequently. However, large areas can be treated with relatively small donor areas.

The majority of the experts believe that cultured melanocyte grafts possess the risk of carcinogenic potential under certain condition.[10]

### *Non-cultured melanocyte graft*

Practice Point 11: Is Dulbecco's Modified Eagle Medium (DMEM) mandatory in NCES?
Answer: According to newer modifications, ringer lactate or phosphate buffer can be used in place of DMEM

Practice Point 12: Is it necessary to use trypsin inhibitor in NCES?
Answer: According to newer modifications, phosphate buffer saline, patient's serum, or ringer's lactate solution can be used in place of trypsin inhibitor

Non-cultured epidermal suspension is a promising technique for treating stable vitiligo, offering a quicker alternative to cultured melanocyte transplantation. The procedure involves harvesting a small piece of skin from a normally pigmented, low-exposure area, such as the inner thigh or buttock. This skin is treated with an enzyme like trypsin to separate the epidermis from the dermis, and the resulting epidermal cells, which include melanocytes and keratinocytes, are suspended in DMEM. The affected area is prepared through dermabrasion, and the cell suspension is applied directly to the depigmented patches. This method has shown positive results in repigmentation with fewer steps than cultured melanocyte grafting, though risks such as infections, scarring, and pigmentation irregularities remain.

**Table 2:** Top 3 Surgical options for the following body regions (according to experts).

| Area | 1st option | 2nd option | 3rd option |
|---|---|---|---|
| Eyebrow | Follicular unit extraction | Mini punch grafting | Non cultured epidermal suspension |
| Lips | Mini punch grafting | Suction Blister graft | Non cultured epidermal suspension |
| Bony prominence and acral areas | Mini punch grafting | Non cultured epidermal suspension | Follicular unit extraction |
| Palms and soles | Mini punch grafting | Non cultured epidermal suspension | Suction Blister graft |
| Genitals | Follicular unit extraction | Mini punch grafting | Non cultured epidermal suspension |
| Peri areolar area | Mini punch grafting | Suction Blister graft | Non cultured epidermal suspension |

**Table 3:** Classification of surgical methods for the treatment of vitiligo.

| Tissue Grafts | Cellular Grafts |
|---|---|
| Mini-punch graft | Cultured melanocyte graft |
| Suction blister epidermal graft | Cultured epidermal graft |
| Split-thickness skin graft | Non-cultured epidermal melanocyte suspension |
| Jodhpur technique | Non-cultured follicular root sheath suspension |
| Hair follicle graft | |

Practice Point 13: Importance of hot and cold trypsinization?
Answer: It doesn't make any difference in repigmentation rate.

Practice Point 14: Preferred method for recipient size debridement?
Answer: Motorized dermabrader is the first choice of most of the experts followed by ablative lasers for larger areas, bony prominence and genitals

Practice Point 15: Role of platelet rich plasma (PRP) in the melanocyte nourishment media?
Answer: Consensus experts believes in no role of PRP in medium nourishment

Practice Point 16: Role of PRP in recipient site dressing?
Answer: Minority of the experts believes in PRP for faster healing and nourishment of the graft, but the majority are against it.

### Hair follicular outer root sheath (ORS) suspension

Outer root sheath (ORS) suspension is a method used in vitiligo surgery where hair follicles are harvested from the occipital scalp, as the ORS is rich in melanocytes. These melanocytes are processed into a suspension using trypsin or collagenase digestion, which helps in effectively separating them. This suspension is then transplanted onto depigmented areas.

Compared to NCES, ORS covers larger areas, with each follicle covering up to 1 $cm^2$. The technique may also require the use of a trypsin inhibitor post-digestion.

### Key considerations

- Leukotrichia: Patients with white or grey hairs in the depigmented area may have poorer outcomes, as these follicles lack melanocytes. Addressing leukotrichia is important to ensure complete pigmentation in the treated area.
- Ringer lactate is enough to stop the digestion process by trypsin.

Overall, the ORS technique allows larger treatment areas compared to NCES, offering a promising option for vitiligo patients.[11]

## POST-OPERATIVE MEDICATIONS AND FOLLOW-UP

- Monitoring and follow-up: Patients should undergo regular post-operative monitoring to assess repigmentation rates, color match, and any adverse events.
- Hyperpigmentation: Post-surgery, areas around grafts may show hyperpigmentation due to increased melanin production. Topical depigmenting agents such as hydroquinone or retinoids can help lighten these areas.
- Hypopigmentation: In cases where repigmentation is slow or incomplete, treatments like excimer laser or narrowband UVB (NbUVB) can be initiated to stimulate melanocytes.
- Follow-up: Regular follow-ups are essential to monitor graft take, healing, and any pigmentation changes.
- Dressing removal: Typically, the first dressing is removed 7 days post-surgery. Care should be taken to ensure the grafts are not disturbed during this period.
- When to start cyclosporine: In cases where immune modulation is necessary, cyclosporine can be considered, starting at 1–2 weeks post-operative, based on individual response and consultation with a specialist.
- Excimer laser: Can be started after healing is complete (approximately 2–3 weeks post-surgery) to promote repigmentation in treated areas.
- NbUVB: As per the majority of the experts, treatment can begin after wound healing to stimulate repigmentation and boost melanocyte activity. Sessions are typically administered 2–3 times a week.

- Serial photography: Documenting the progression using standardized photography helps in monitoring the success of the grafts and overall repigmentation. Photos are usually taken before the procedure and at regular intervals during follow-up, like every 4 weeks, to assess changes accurately.
- Subsequent surgery: If needed, 2nd surgery can be planned after 6 months of previous surgery as per experts.

## CONCLUSION

Vitiligo surgery is becoming increasingly sought after as more patients seek effective treatment options, and there is a growing need for more dermatologists to perform these procedures. Fortunately, the learning curve for vitiligo surgery is relatively straightforward, making it accessible for practitioners to learn and master. Setting up for these surgeries is not overly expensive, as it primarily requires developing fine surgical skills and attention to detail rather than heavy investment in equipment.

Dermatologists must learn all the different surgical techniques available, as each case of vitiligo is unique and may require a personalized approach. While cellular grafting methods, like melanocyte-keratinocyte transplants, are gaining popularity due to their potential for excellent results, tissue grafting, such as punch and split-thickness grafting, remains the mainstay treatment. These methods are versatile and effective, particularly for stable vitiligo, and continue to be widely used.

By acquiring expertise in various vitiligo surgery techniques, dermatologists can tailor their approach to suit individual patients, ensuring better outcomes and expanding the availability of these life-changing procedures.

### Authors' contributions

Dr Yogesh Bhingradia, Dr Somesh Gupta, Dr Dipti Ghia, Dr Samkit Shah, Dr Nandita Patel: Involved in writing the manuscript, conducting surveys, providing experts inputs and conceptualization of manuscript. Rest all the authors were involved in providing the experts inputs and conceptualization of the manuscript. Rest all the authors were involved in providing the experts inputs and conceptualization of the manuscript.

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Institutional Review Board approval is not required.

### Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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