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Surgical Therapies and Micro Needling Roles in Treatment of Vitiligo: Review Article

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ABSTRACT

Background: One of the most prevalent skin disorders is vitiligo, which causes the skin to lose its color. Only patients whose vitiligo has not responded to medicinal treatment and whose condition has stabilized should consider surgical intervention. The goal of vitiligo microneedling is to produce cytokines and growth factors that are helpful for repigmentation, in a manner analogous to the wound healing response.

Objective: review of the literature on surgical therapies and micro needling roles in treatment of Vitiligo.

Methods: We looked for data on Surgical Therapies, Micro needling and Vitiligo, in medical journals and databases like PubMed, Google Scholar, and Science Direct. However, only the most recent or extensive study was taken into account between February 2005 and March 2021. References from related works were also evaluated by the writers. There were not enough resources to translate documents into languages other than English, hence those documents have been ignored. It was generally agreed that documents such as unpublished manuscripts, oral presentations, conference abstracts, and dissertations did not qualify as legitimate scientific study.

Conclusion: Only patients whose condition is stable despite medicinal therapy attempts undergo surgical procedures. Better effects have been shown in segmental rather than generalized vitiligo, therefore they are often reserved for hard-to-treat areas like the hands, feet, lips, and nipples. The combination of microneedling with a number of topical treatments, including Tacrolimus and 5-fluorouracil, has shown promising repigmentation outcomes.

Keywords: Micro needling, Surgical therapies, Vitiligo.

INTRODUCTION

Only about 0.5% of people worldwide are affected by vitiligo, the most prevalent epidermal depigmentory condition caused by the selective loss of epidermal melanocytes, and it shows no preference for either sex or skin color [(1)]. There are two basic types of vitiligo that can be identified in a clinical setting: non-segmental and segmental. Non-segmental vitiligo is the most common type of the skin condition, is characterized by an asymmetrical, non-dermatomal distribution and a slow, progressive start. The less common form of vitiligo known as segmental vitiligo (SV) typically manifests as a unilateral dermatomal distribution, with an early, quick onset and subsequent stabilization in a confined region [(2)].

A weakened cutaneous immune system, loss of photoprotective skin, and a marked decline in quality of life are all significantly linked to an early onset of vitiligo, which has a significant influence on patients' physical and mental health [(3)].

Generalized vitiligo, previously known in the international nomenclature as non-segmental vitiligo, is now commonly referred to simply as vitiligo. White spots that are symmetrical in appearance and increase in size over time or during flares are characteristic of this illness. Other than generalized vitiligo, there are two subtypes: segmental vitiligo and vitiligo that has yet to be categorized or characterized, which includes cases of localized disease and uncommon variants [(1)].

Vitiligo treatment is essential because of the negative effects the condition can have on patients' psychological well-being and quality of life. Objectives of treatment include slowing the growth of the disease, restoring normal pigmentation to the affected areas, and keeping the new pigmentation in place [(4)].

Despite the availability of many medical and surgical therapeutic alternatives, no definitive cure has been established, and the durability of repigmentation remains uncertain [(5)].

While repigmentation is always the top priority, stabilising the condition to prevent further loss of functional melanocytes and providing enough psychological support and quality of life are also important. Individual cases require careful consideration while determining the best course of treatment. Prior to beginning treatment, patients should be given honest information about the likelihood of therapeutic success. Also, let them know that therapy results might not show up for a while, and that preventative measures might be required [(6)].

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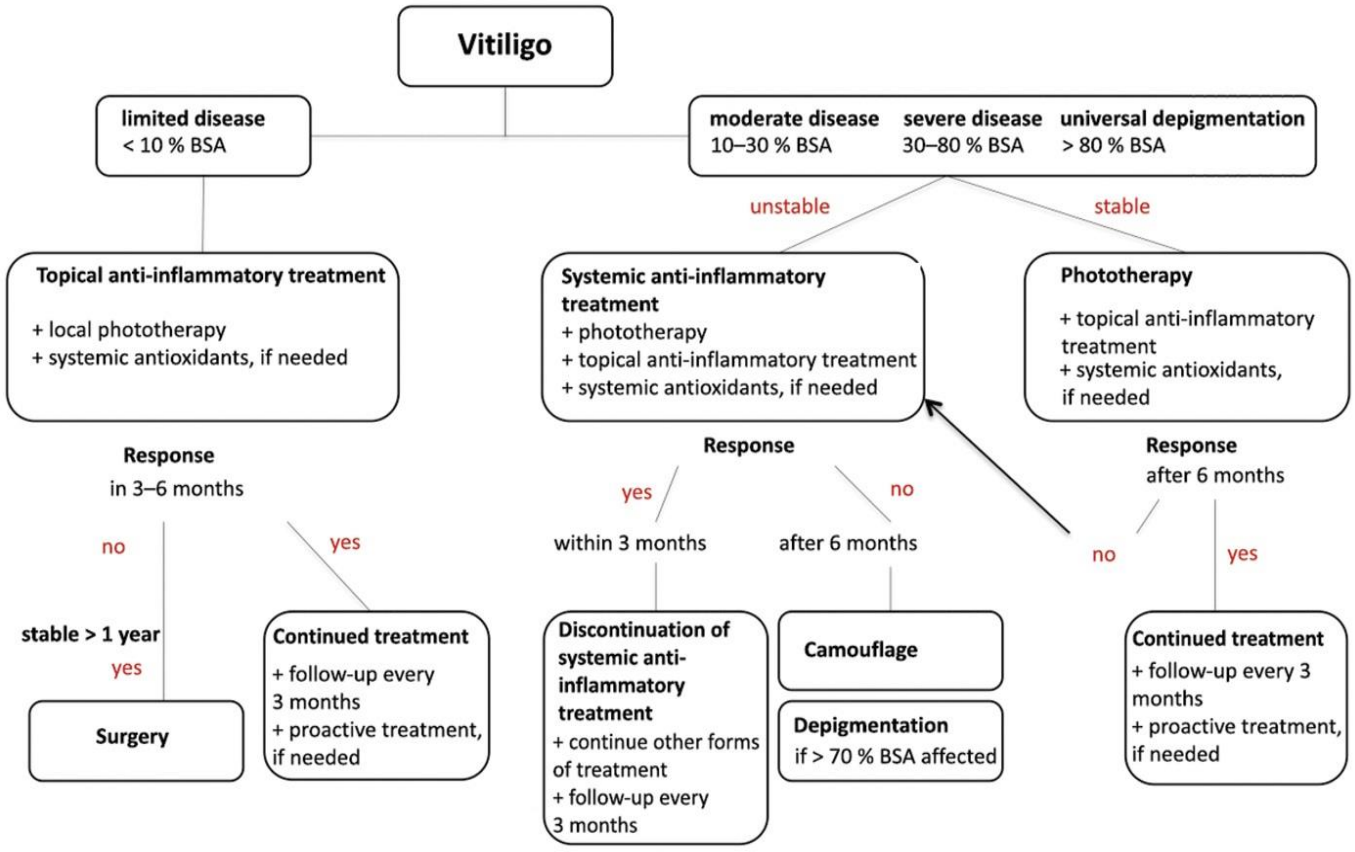

Figure (1): Treatment algorithm for vitiligo [(6)].

Surgical therapy:

Only patients whose condition is stable despite medicinal therapy attempts undergo surgical procedures. Better outcomes have been shown in segmental rather than generalised vitiligo. Therefore they are often reserved for treating particularly challenging areas like the hands, feet, lips, and nipples. Before beginning any surgical treatments for vitiligo, all patients should be informed of the Koebner phenomenon. If your vitiligo has been stable for at least 6 months, no new patches of depigmentation have appeared, and no existing patches have grown in size. Patients must be carefully chosen, the disease must be stable, and the Koebner phenomenon must not be present for surgical therapy to be effective [(7)].

In general, there are three distinct categories of surgical procedures:

1. Tissue grafts, examples include the suction blister graft, full thickness punch graft (minigraft), and follicular unit grafting, all of which entail transplanting the epidermis and dermis in their entirety.

2. Cellular grafts, that inject specialized sorts of cells, suspension of the outer root sheaths from non-cultured hair follicles, epidermal cellular graft, transplantation of cultured melanocytes, and so on are all examples of such procedures.

3. Surgical procedures that do not include grafting contain tattoo-pen micropigmentation, therapeutic wounding, excision, and primary closure [(8)].

Tissue grafting technique:

1-Suction blister grafting:

Donor sites for skin grafts can become discoloured and scarred. Raising subepidermal blisters with clear, non-inflammatory transudate and maintaining low suction pressures for enough time periods is described as a method of suction blister grafting that reduces scarring at the donor site. Typically, a suction device or syringe with a three-way cannula is used to produce the blister. After the dermabrasion, this graft is applied to the vitiligo spot. Vitiligo in curved or junctional areas like the lips, nipples, or eyes can be treated safely and effectively [(8)].

2-Split thickness grafting:

A dermatome, Humby's knife, Silver's knife, or even a basic shaving blade can be used to harvest a thin split thickness graft from a donor site for this grafting technique. Partial thickness grafting allows for the treatment of larger regions of vitiligo in a single session than the suction blister method [(9)].

Another type of split thickness skin transplant is the smash graft, which consists of little fragments of the graft that are mashed together like paste. It allows for

the use of thicker grafts and the coverage of a broader recipient location [10].

At the recipient location, a dermal and epidermal flap is raised; the split skin graft is positioned below the flap; and the margins are sealed with cyanoacrylate [10].

3-Full thickness punch graft (minigraft):

Mini-grafting, also known as punch grafting, entails transplanting punch biopsies of properly pigmented skin (often measuring 1-2 mm in thickness) into areas affected by vitiligo. It takes a long time and may cause complications like scarring or cobblestones at the donor site [7].

In recent years, several motorized punch grafting systems have been introduced to the market, making this procedure more accessible, cost-effective, and successful than ever before [8].

4-Follicular unit grafting:

Donor hair is extracted from the scalp (often the occipital or retro auricular region), trimmed above the bulb, and then transplanted to the recipient area [11]. Recipient pigmentation is supplied by melanocytes located in the bulb. The beauty benefits of this technique are second to none, and it also aids in the treatment of polio. This method has the drawbacks of being time-consuming, requiring expertise, and being limited to places with hair.

Cellular grafts:

1- Non-cultured epidermal suspension:

The split-thickness graft is taken from the donor site and placed in a specific medium for incubation overnight. The following day, the cells are suspended using centrifuges and trypsin-EDTA. After the recipient site has been prepared by dermabrasion and a collagen dressing has been placed, this suspension is smeared over the area. The primary benefit of this method is the ability to treat an area that is five to ten times larger than the donor location [10].

2- Cultured epidermal cellular graft:

Cells are isolated from split-thickness, ultra-thin, or suction blister sheets, and then grown in vitro for 15-30 days. Re-culturing keratinocytes and melanocytes may speed up the process of re-epithelialization, and expanding cell lines allow for the treatment of a region much greater than the donor site. It's not cheap and you'll need professional help [12].

3 -Cultured melanocyte transplantation:

The melanocytes can be grown from a split thickness graft by incubating it in culture media. In order to treat vitiligo, these melanocytes are transplanted to an area that has been treated with dermabrasion. Treating a wide area with one split-thickness skin transplant has its advantages, but the operation is complex and requires high-tech lab equipment [10].

4-Non-cultured hair follicle outer root sheath suspension:

Hair follicular grafts are typically acquired from the occipital scalp using 1 mm punches. This is shipped to the lab in a saline solution and treated with trypsin-EDTA upon arrival. This is centrifuged to separate the cells. After the recipient site has been dermabraded and coated with a meshed collagen sheet, this suspension is applied. There is a lower chance of scarring or keloid formation with this method, and just a little amount of donor tissue is needed, but the results are no better than those achieved with non-cultured epidermal transplants [10].

Non-grafting surgical techniques:

1-Therapeutic Wounding: Method relies on iatrogenic wounding's ability to set off an intrinsic pro-pigmenting cytokine cascade, which in turn encourages the movement of melanoblasts. There is a greater chance of scarring with this method [10].

2- Excision and primary closure: In this method, vitiligo lesions are cut out and sewn back together using traditional surgical procedures [12].

3- Micropigmentation: When using a tattoo pen, inert, external pigments are deposited in the dermal papillary layer [12].

4- Corrective Camouflaging: They cover up any imperfections while you're getting medical care or after surgery but before you've fully healed. In addition, it provides an additional therapeutic option for people who have not responded to standard treatment [12].

Micro needling:

Percutaneous collagen induction (PCI), or micro needling, is a minimally invasive technique used to treat a wide variety of skin disorders [13].

Mechanism of action in vitiligo

Stimulating a wound healing response with microneedling for vitiligo can boost the production of repigmenting cytokines and growth factors including transforming growth factor (TGF-), platelet-derived growth factor (PDGF), and inflammatory mediators like leukotriene C4. Moreover, microneedling causes microtraumas to the basal cell layer, which leads to an increase in dermal melanophages and ultimately helps with repigmentation. In addition, the autoinoculation of melanocytes from the needle tips stimulates their migration from a melanocyte's reservoir at the periphery of the vitiliginous patch or any perifollicular pigment within the lesion to the depigmented portions. Melanogenesis activation may involve all of these factors [14].

Applications of micro needling in vitiligo:

1- Microneedling monotherapy:

Microneedling was found to be successful in curing vitiligo in two separate clinical trials [15, 16]. Fifty-seven individuals were recruited, all of whom had experienced at least three years of stable localised vitiligo. The lesion was treated with a topical anaesthetic cream (lidocaine). Depending on the

thickness of the patient's skin, a 1 mm, 1.5 mm, or 2 mm electronic dermapen was used to prick the skin until pinpoint bleeding occurred. The patient attended between 6 and 12 sessions, with 2-week intervals in between each. 45% of patients showed some sort of clinical response, with 17.5% showing outstanding repigmentation on a five-grade scale. The most responsive part of the body was found to be the face, followed by the spinal column [16].

2- Microneedling with topical tacrolimus:

The use of tacrolimus in conjunction with microneedling has been shown to be an effective treatment for vitiligo [17]. A study by **Ebrahim *et al.*** [16] compared the effectiveness of tacrolimus monotherapy to that of the combination regimen for treating vitiligo, and concluded that the combination regimen was superior. Half of patients treated with the combination regimen experienced repigmentation of greater than 75%, compared to just 29.2% of those treated with tacrolimus monotherapy.

3- Microneedling with topical calcipotriol plus betamethasone:

Microneedling with 0.05 mg/g of calcipotriol and 0.5 mg of betamethasone was compared to tacrolimus in a clinical study of vitiligo. These mixtures were administered in 12 sessions, twice weekly, across symmetrical patches covering bony protrusions and acral areas. The results of this investigation showed that repigmentation rates were lowest around the knees, highest around the elbows and shoulders, and moderate around the acra [18].

4- Microneedling with latanoprost and NB-UVB:

Previously, a pilot trial used a dermaroller in combination with Latanoprost (LT), a PGF2 drug, followed by NB-UVB. The percentage of LT-side lesions that repigmented by more than 75% following treatment was significantly higher than that of control lesions (tacrolimus side) [19].

Microneedling in combination with light therapy (LT) and narrow band ultraviolet B (NB-UVB) has been studied for its potential to treat vitiligo in refractory areas. Microneedling (four sessions separated by one week), light therapy (LT), and nebulized broad-spectrum ultraviolet B (NB-UVB) were compared in one group, and in the other, LT and NB-UVB were used alone in the other. 3-8% of the treated areas repigmented adequately too effectively in the latter research. The rate of repigmentation did not differ significantly between the two groups [20].

5- Microneedling in combination with 5-FU biotherapy:

The effectiveness of microneedling in combination with 5-fluorouracil (5-FU) was evaluated in two studies. **Attwa *et al.*** [15] revealed that adding 5-FU to microneedling boosted its effectiveness by 3.8 times compared to microneedling alone. **Mina *et al.*** [17] showed superior repigmentation and a greater number of clinical responses when 5-FU was used in conjunction with microneedling compared to tacrolimus. 40% of the acral areas and 57.1% of the bony prominence areas exhibited excellent to good outcomes from the 5-FU (repigmentation >75%) (Elbow and knees).

6- Microneedling with NB-UVB and PDT, or with triamcinolone acetonide:

The effectiveness of microneedling with narrowband ultraviolet B (NB-UVB) was studied in a randomised clinical trial involving sixty patients with acrofacial vitiligo. 69% percent of those exposed to both Mn and NB-UVB had good to outstanding repigmentation [21].

7- Microneedling vs full surface laser dermabrasion for autologous cell suspension grafting in non-segmental vitiligo:

When preparing the grafting bed for autologous cell suspension grafting in non-segmental vitiligo, a comparison of microneedling with full-surface erbium laser dermabrasion revealed that needling alone was ineffective. Also, no repigmentation occurred in any patient who underwent microneedling treatment. Half of the patients treated with laser-assisted dermabrasion and then suspended in hyaluronic acid had excellent repigmentation after the procedure [22].

8- Trichloroacetic acid 70%:

In a study comparing the efficacy of TCA with microneedling and 5-FU in non-segmental vitiligo, TCA was administered to the first group of patients immediately after microneedling until a homogeneous ivory layer appeared. Using a volume of 0.01 to 0.02 mL per session, 250 mg of 5-FU was injected intradermally at 1 cm intervals over vitiligo patches in the second group. Both groups received treatment for a total of two months at a frequency of twice per month. There was also no statistically significant difference in the percentage of patients whose outcomes improved from good to excellent (repigmentation >50%) [23].

9- Narrowband UVB (NB-UVB) light therapy after hair transplantation and CO_2 laser or microneedling:

The efficacy of hair transplantation, CO_2 laser, and microneedling followed by NB-UVB in the treatment of stable and refractory palmar-plantar vitiligo is compared. Hair follicular grafts with pigment were harvested from the scalp on day zero and implanted in areas affected by vitiligo. Using a CO_2 laser with a wavelength of 10 600 nm, a pulse energy of 100 MJ, and a spot density of 200 pcm^2 in static mode to perform individual fractions), were administered to left-sided lesions on days 30 and 4, while microneedling (1.5-2 mm) was performed on right-sided lesions until bleeding occurred, on days 60 and 4, respectively. On day 40, both sides were exposed to NB-UVB. No statistically significant variation in repigmentation diameter (0.25 mm) was found between the two sides [24].

CONCLUSION

Only patients whose condition is stable despite medicinal therapy attempts undergo surgical procedures. Better effects have been shown in segmental rather than generalized vitiligo, therefore they are often reserved for hard-to-treat areas like the hands, feet, lips, and nipples. The combination of microneedling with a number of topical treatments, including Tacrolimus and 5-fluorouracil, has shown promising repigmentation outcomes.

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