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Microneedling in treatment of vitiligo

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Abstract:

Vitiligo is an acquired disease characterized by well-defined milky-white macules and patches in the skin secondary to loss of functioning melanocytes. It is the most prevalent depigmentation disease. Vitiligo can strike at any age, but it is most common in those between the ages of 20 and 30. Microneedling, also known as percutaneous collagen induction therapy, is a minimally invasive process that involves creating micro-punctures in the skin using many small needles. Microneedling triggers wound healing responses, which result in the production of cytokines and growth factors that aid in repigmentation. Microneedling is currently being used to aid in the administration of transdermal drugs. Many dermatological disorders, including vitiligo, have been treated by micro-needling. In this review, we aim to discuss different aspects of the use of micro-needling in the treatment of vitiligo.

Keywords: collagen induction therapy; micro-needling; vitiligo.

Introduction:

Vitiligo is a skin disorder that causes gradual melanocyte loss [(1).] It affects about 0.5 to 2.0 % of the population and has no predilection for gender or race[(2).] There are two forms of vitiligo: segmental and non-segmental. The latter type includes several variants such as acrofacial, mucosal, generalized, universal, and mixed[(3).] Genetic flaws, metabolic dysfunctions, autoimmunity, melanocyte adhesion impairments, and nervous system imbalances are just a few of the pathogenic causes [(4).]

Microneedling (Mn) is a minimally invasive process in which many small needles penetrate the skin to form micro-punctures[(5).] This causes platelet-derived growth factors to be released, resulting in neovascularization and neocollag-genesis. This procedure is referred to as percutaneous collagen induction therapy because it causes an increase in collagen and elastin synthesis[(6).]

The concept behind this treatment dates back to 1995 when Orentreich and Orentreich (1995)[(7)] employed dermal needling to heal scars in the form of subcision for the first time. This method minimized the appearance of scars by making subcuticular wounds using needles inserted beneath the skin [(5).] Now, microneedling is being used to help with transdermal drug administration[(8)]. Active acne vulgaris, acne scars, burn scars, striae distensae, rhytides, melasma, melanosis, hyperhidrosis, alopecia, and vitiligo are dermatological diseases treated by micro-needling[(9).]

Instruments of Microneedling:

1. **Standard medical derma roller:** It's a drumshaped roller with eight ro ws of 192 fine microneedles ranging i n length from 0.5 to 1.5 mm and diam eter from 0.1 mm.Silicon or medicalg rade stainless steel are used to make t he microneedles. It is used for acne scars for single use only([6]).

2. **Home care derma roller**: The needles in this variety are less than 0.15 mm long. It can be used to minimize pore size, fine wrinkles, and sebum production, as well as to transdermally deliver anti-aging medications([10]). Another device for use at home is the Beauty Mouse, which has 480 needles with a diameter of roughly 0.2 mm on three separate drums inside a computer mouse-shaped device. It is used to treat stretch marks on the abdomen and thighs, as well as cellulite on the arms, legs, and buttocks([11]).

3. **Derma-stamp:** This is a small derma roller with needle lengths ranging from 0.2 to 3 mm and a diameter of 0.12 mm that is used to treat localized scars such as varicella scars. The advantage of this method over the derma roller is that it allows for a more concentrated treatment of particular scars. It creates infusion channels in the skin by causing vertical penetration([11]).

4. **Dermapen:** It's an automated Mn device in the shape of a pen. For fractional mechanical resurfacing, this equipment uses disposable needles and guidelines to alter needle length. Nine, twelve, or thirty-six needles are stacked in rows on the tip. It operates in several speed modes in a vibrating stamp-like manner and is powered by a rechargeable battery([6]). It's utilized for a variety of patients since the needles are disposable, the needle tips are hidden inside the guide, and it's easier to treat tiny areas like the nose, around the eyes, and lips without hurting the surrounding skin because the needles are disposable. It is less painful, less expensive, and the entry depth may be adjusted([11]).

5. **DermaFrac:** It's a novel Mn modification that includes microdermabrasion and deep tissue serum infusion at the same time. It targets wrinkles, fine lines, hyperpigmentation, and superficial scars, as well as aging and sun-damaged skin, acne, enlarged pores, uneven skin tone, wrinkles, fine lines, and hyperpigmentation. When all four modalities are used, a full-face treatment takes about 45 minutes[12].

6. **Microneedle delivery systems:** Microneedle delivery systems provide a painless and minimally invasive means of transdermal drug administeration, such as vaccinations[13]. The microneedles which are available for this purpose are solid, coated, dissolveing, and hollow polymer microneedles synthesized by microfabrication technique[11]. The numerous materials utilised to create these microneedles include silicon, metals such as titanium, natural and synthetic polymers, and polysaccharides. They're used to pierce the top layer of skin, then apply a topical solution and deliver the drug directly to the dermis[13].

7. **Fractional radiofrequency microneedling:** Special needles enter the skin and emit radiofrequency currents from the needle tips, causing hot zones in the dermal structural components and accessory glands[14]. This triggers long-term dermal neoelasto-

genesis and neocollagenesis. The needles' depth ranges from 0.5 mm to 3.5 mm, allowing them to penetrate different levels of the dermis[15]. The intensity and duration of the energy pulse can be adjusted without causing injury to the epidermis. It comes with a disposable tip that contains 49 gold-plated needles. Scar treatment, hyperhidrosis treatment, and skin regeneration are some of the indications[6].

Mechanism of action of micro-needling

Microneedling is generally painless and enables homogeneous drug administration as compared to intralesional injecttions. It improves drug delivery through the skin by the insertion of the drug directly into the vascularized dermis. It can cause a 47 percent extension of the follicular infundibulum resulting in the drug's higher epidermal barrier penetration. It clears the infundibulum from scales and sebum residues[16].

Microneedling is used for enhancing the absorption of topical immunomodulator drugs. The use of an Mn device on the skin might cause tiny holes to grow in the stratum corneum. This method is used to improve drug absorption, increase efficacy, and shorten the duration of treatment. It also maintains the epidermis largely intact, speeds up recovery, and reduces infection and scarring concerns [17].

Contraindication and adverse events of micro-needling

Patients with blood clotting issues and those on anticoagulant therapy should avoid micro-needling. Microneedling is also avoided in cases of skin cancer, moles, warts, and solar keratosis since the needles have the potential to implant aberrant cells. Mn is also contraindicated in patients with eczema, impetigo, or herpes labialis, as well as those who have a high keloidal tendency or who are undergoing chemo or radiotherapy[6].

Microneedling can worsen dermatoses such as lichen planus and psoriasis, as well as trauma that leads to koebnerization. Potential erythema and irritation are common side effects, but they normally go away after a few hours. Post-inflammatory hyperpigmentation, acne worsening, herpes reactivation, systemic hypersensitivity, and allergic granulomatous reactions are among the other side effects reported. The use of a nonsterile device can result in local infections [13].

Microneedling monotherapy in vitiligo

The principle for Mn is to be used as a drug delivery method through the stratum corneum[18]. It causes vitiliginous pigmentation by melanocytes transfer from pigmented areas to depigmented areas with the needle [19]. Furthermore, skin perforation during Mn triggers processes such as wound healing, which produces cytokines and growth factors that help with repigmentation ([20]).

Melanocytes migrate from pigmented areas to vitiliginous lesions as a result of mechanical trauma, resulting in further melanocytic autoinoculation. Microtrauma may also enhance cutaneous melanophages and hyperpigmentation by causing damage to the basal cell layer. All of these help in melanogenesis ([21]).

Using a five grading scale to assess repigmentation, two clinical trials proved that micro-needling is effective in treating vitiligo ([22, 23]). A total of 57 patients with localized stable vitiligo for at least 3 years were included. Topical anesthetic cream (lidocaine) was applied to the lesion. An electronic dermapen with needle thickness varying from 1 or 1.5 to 2 mm according to the skin thickness was applied until bleeding appears. The patient received 6 to 12 sessions with 2

weeks interval [22, 23]. A clinical response was seen in 38.5% of patients among which 17.5% had excellent repigmentation. The best response was seen on the face followed by the trunk[23].

The combined therapy of vitiligo using micro-needling:

1. **Microneedling with topical tacrolimus**

   Micro-needling in combination with tacrolimus has been found to be a safe and effective vitiligo treatment [24]. A recent study evaluating combined Mn with tacrolimus against tacrolimus monotherapy for the treatment of vitiligo found that the combination regimen produced better results[21]. Repigmentation of more than 75 percent was seen in 50 percent of patients in the combination regimen group, compared to 29.2 percent in the tacrolimus monotherapy group.

2. **Microneedling with topical calcipotriol plus betamethasone**

   In one clinical research, Mn with calcipotriol (0.05 mg/g) + betamethasone (0.5 mg) was compared to tacrolimus in the treatment of vitiligo[25]. Microneedling was administered to symmetrical patches over bony prominences and acral regions every two weeks for 12 sessions, followed by calcipotriol with betamethasone or tacrolimus application. In the treatment of vitiligo, microneedling with topical calcipotriol with betamethasone outperformed Mn with tacrolimus. The elbows (n = 3, 99 percent repigmentation) and extremities (n = 8, 83.3 percent repigmentation) had excellent results, while the acral areas (n = 6, 50 percent repigmentation) had moderate results. The knees (n = 8, 67.5 percent repigmentation) had the lowest repigmentation rates.

3. **Microneedling with narrowband ultraviolet B**

   In comparative research with 60 individuals with acrofacial vitiligo[26], the efficacy of Mn with narrowband ultraviolet B (NB-UVB) was investigated. 70 percent of the combination group (Mn + NB-UVB) showed excellent repigmentation.

4. **Microneedling with Latanoprost**

   Dermaroller was utilized with Latanoprost (LT), a PGF2 compound, followed by NB-UVB in a previous pilot study[27]. The number of lesions with more than 75% repigmentation on the LT side after treatment was substantially higher than the control lesions (tacrolimus side). On resistant vitiligo patches, the efficacy of Mn in conjunction with LT and NB-UVB has been investigated[28]. Patients were divided into two groups: Mn (4 sessions at 1-week interval) plus LT and NB-UVB, and LT plus NB-UVB without Mn. In the latter study, 37.8% of the treated patches showed satisfactory to very good repigmentation. However, there was no statistically significant difference in the repigmentation rate between the two groups.

5. **Microneedling with 5-fluorouracil**

   Over the course of 6 months (12 sessions), a study evaluated 5-fluorouracil versus tacrolimus with Mn (through dermapen) and was followed up on for 3 months[24]. In the acral sections, 40% of the patches treated with 5-fluorouracil improved dramatically, whereas the patches treated with tacrolimus showed no response. Mn with 5-FU had better effects than Mn monotherapy in another research, increasing efficacy by 3.8 times[22].

6. **Microneedling with trichloroacetic acid (TCA) 70%**

A prospective comparative study assessed the efficacy of TCA with Mn versus 5-FU in nonsegmental vitiligo[29]. TCA was administered to the first set of patients immediately after Mn until an ivory white uniform frothing appeared. In the second group, 0.01 to 0.02 mL 5-FU was injected intradermally at 1 cm intervals in vitiligo regions, with a maximum dose of 250 mg each session. For two months, both groups received treatment every two weeks. The findings revealed that 43.8 percent of patients improved from good to excellent (repigmentation >50%), with no significant difference between the two groups.

Conclusion

There is a growing interest in the use of Mn in the treatment of vitiligo. Microneedling is generally a safe minimally invasive modality of treatment of vitiligo. The combination of Mn with other medications used previously in the treatment of vitiligo may represent a new treatment option for patients with vitiligo. Such a combination may help improve the overall efficacy and shorten the duration of therapy. However, well-designed studies are needed for the standardization of treatment protocols and to establish a consensus about the use of Mn in the therapy of vitiligo.

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