International Journal of Research in Dermatology
Mohan S et al. Int J Res Dermatol. 2020 Mar;6(2):279-283
http://www.ijord.com

DOI: http://dx.doi.org/10.18203/issn.2455-4529.IntJResDermatol20200614

Review Article

Dermaroller in dermatology and cosmetology

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Received: 02 December 2019
Accepted: 01 February 2020

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ABSTRACT

Background: Dermaroller is a novel therapeutic modality in dermatology. Through physical trauma from needle penetration, dermaroller induces a wound healing cascade with mild temporary damage to the epidermis. This allows for the enhancement in the absorption of topical therapies across the thick stratum corneum. Dermaroller has become increasingly utilized over the last several years as it is a relatively simple procedure that is cost effective, well tolerated and offers cosmetic and therapeutic benefits. The ability to treat localized areas of disease made it popular in acne scars, alopecia, striae, melasma, actinic keratoses. The procedure has few adverse sequelae compared to other therapies, is highly effective and a viable resurfacing option for color of skin.

Keywords: Dermaroller, Scars, Alopecia, Hyperpigmentation

INTRODUCTION

Microneedling (MN) or dermaroller is also known as Collagen Induction Therapy, is a process involving repetitive puncturing of the skin, with sterilized microneedles. In 1995, when Orentreich and Orentreich developed the concept of 'subcision' or using hypodermic needles to induce wound healing in depressed cutaneous scars.[1] In 2005, Dr Desmond Fernandes developed first MN product which became the modern day dermaroller.[2] MN offers a low cost and minimum invasive tool for treatment of multiple cosmetic and dermatological conditions.[3] The basis of MN relies on physical trauma. It has been proposed that trauma generated by needle penetration in skin induces regeneration of dermis.[4] Needles penetrate stratum corneum and create small holes with minimum damage to the epidermis. It generates growth factors which stimulate production of collagen and elastin in papillary dermis.[3] Natural wound healing cascade is induced as platelets and neutrophils to release growth factors such as transforming growth factor alpha (TGF-alpha), TGF-beta and platelet derived growth factors.[2] This results in deposition of new collagen by fibroblasts.

MN products have been developed to treat scarring, wrinkles, enable skin rejuvenation, improve skin appearance etc.[5] MN is indicated in actinic keratoses, disorders of pigmentation, hyperhidrosis, striae.[6] Role of MN in treatment of hair is thought to stimulate stem cells in the dermal papilla, increase blood flow to hair follicles and recruit growth factors and signals to induce hair restoration.[7] MN induces normal wound healing by breaking collagen strands in superficial dermis and induces collagen synthesis under epidermis.[8]

METHODS

Studies involving human subjects were included in the review with manual MN techniques. Priority was given to controlled clinical trials with atleast 10 patients. Uncontrolled clinical studies where included so long as a statement was made regarding experimental design.

TYPES OF MN

There are many MN devices registered with US-FDA, either dermaroller or dermapen. Dermaroller is hand held device with roller of 24 circular arrays.[6] Each array has 8 steel microneedles with a total of 192 needles in one dermaroller.[6,9] Medical model include the CIT8 and MF8 with height of 500 µm and 1500 µm respectively.[6] Various models have been developed for use at home, including beauty mouse dermaroller which has 480 needles to use on the larger skin surface.[5] Dermapen is spring-loaded MN device which acts as electricity powered pen delivering stamp like motion across the skin.[10] Newer model are indicated in superficial scars, hyperhidrosis and wrinkles.[6]

Newer MN model include fractional radiofrequency microneedling (FRFM), DermaFrac, light emitting diode (LED), MN device and MN delivery systems.[6] FRFM is differentiated from manual MN due to the method of each insulated needle releasing a radiofrequency current from the needle tip producing changes in dermal structural components.[6,11]

In Dermafrac treatment, MN is combined with microdermabrasion, LED light and simultaneous serum infusion into dermis.[6] Drugs can be delivered directly into dermis through hollow needles.[12] Fluzone intradermal virus vaccine (Sanofi Pasteur, Swiftwater, PA, USA) became the first and only microneedle based product approved by FDA.[13,14] Use of MN to enhance absorption of topical agents to be performed with caution as non-sterilized drugs may contain infection that can lead to permeation of pathogenic microbes.[12]

Precautions during dermaroller procedure to be kept in mind as follows.

- 0.5 to 1.0 mm needles size to be chosen for hair, minor acne scar, chicken pox, wrinkles, pigmentation on face.
- Adviced not be done in active pustular acne.
- Not to be done more than weekly interval.
- Pillow cover should be changed to avoid bacterial infection.
- Do not use face wash as it has artificial color, fragrances, paraben, sulphates which enters into holes. Only use vitamin C serum, aloevera are adviced on face.
- Doctor should put roller device in alcohol before use.
- Do not put any oil on scalp and oil as artificial color, fragrances to avoid bacterial infection.
- Avoid sun exposure for 24 hours after dermarolling.
- If skin is sensitive, do not use dermaroller.
- Take precaution on elevated lesions like keloid does not recur or increase in size.

APPLICATIONS OF MN

Scars

There was statistically significant increase in production of collagen type I, III, IV.[15] Majid reported improvement in atrophic facial scars with MN therapy.[16] Combination therapy of MN, subcision and 15% TCA peel with atrophic acne scar shown improvement.[17] Cachafeiro et al compared MN and non-ablative fractional erbium laser1, 340 nm treated atrophic skin scars with no statistically significant difference.[18] Dogra et al reported utility of MN for treating atrophic acne scars in Asian population.[19] Sharad 2011 studied MN and 35% glycolic acid peels for treatment of atrophic box type, rolling type with PIH in dark skin showed significant improvement.

MN has also been used to enhance treatment of hypertrophic surgical scars by increasing drug delivery of topical agents to the dermis.[21] Aust et al, showed MN to be effective alternative for burn patients with hypertrophic scars.[22] MN is generally better tolerated with fewer long term adverse sequelae.[23] Scar type appears to be a factor affecting clinical response to MN, as icepick scars and deep-seated atrophic scars responded less ideally to treatment.[15]

Alopecia

MN is proposed as a mechanism for adjuvant hair growth in alopecia.

Androgenetic alopecia

Dhurat et al found that MN with Minoxidil in 100 male patients was statistically superior to minoxidil alone in androgenetic alopecia.[24] Over 12 weeks, dermaroller treatmenr with 5% minoxidil was administered to half patients, with 80% showed moderately or greatly increased hair regrowth. In the same group, 82% of patients reported subjective improvements greater than 50% in hair growth. Initiation of new hair growth was first noticeable at 6 weeks in MN group compared to 10 weeks in the minoxidil alone, No adverse effects were noted by any patient.[24] Dhurat et al reported a follow up case series of four men with male pattern baldness unresponsive to conventional treatments.[25] Combination therapy was administered to participants with prior treatment regimen (either topical minoxidil or oral finastride) and dermaroller for 6 months.[25] All four patients had moderately or greatly increased hair regrowth and reported subjective increase in hair thickness after 1 month of treatment. [25]

Alopecia areata

MN has been proposed as a viable alternative to conventional treatment. Alopecia areata (AA) is currently treated by intralesional corticosteroid, collagen induction

offered by MN is thought to counter steroid-induced atrophy as well as cause less pain than injection.[26]

Chandrashekhar et al reported outcome from treating resistant AA with MN and topical corticosteroid.[26] Two adult patients with AA recalcitrant to Intralesional steroid, topical steroids, and minoxidil 5% lotion received topical triamcinolone applied before and after dermaroller. Both patients showed hair regrowth as "excellent" and has no recurrence at 3-months follow-up.[26]

Pigmentary disorders

Several studies have proposed MN as an alternative to conventional treatment in melasma, vitiligo and periorbital hyperpigmentation.

Melasma

The enhanced transdermal drug absorption seen with MN has achieved better results than skin lightening agents alone in the treatment of melasma.[27-29] Budamakuntla et al observed better results of MN followed by topical tranexamic acid in comparison to tranexamic acid microinjections in treating moderate to severe melasma in 60 patients.[30] After three sessions (at 0, 4 and 8 weeks), the patients were followed for 3 months who had 36% improvement in melasma area and severity index (MASI) score in tranexamic acid alone in comparison to 44% improvement in MASI score in MN plus trenexamic acid. More patients in MN plus trenexamic acid had greater than 50% improvement than trenexamic acid alone (41% versus 26%).

Some patients reported mild discomfort, burning sensation and erythema.[30] Fabbrociri et al studied depigmentation serum was compared to MN with depigmentation serum and found mean MASI score improvement of 9.9 point in MN plus serum versus 7.1 point improvement in serum alone.[29] MN combination therapy also has favourable results in melasma, when combined with daily sunscreen. In a study of 22 cases of recalcitrant melasma who did not respond to topical bleaches and sunscreen, MN was done followed by night application of depigmentation formula (0.05% tretinoin +4% hydroquione+1% fluocinolone acetonide) and daily sunscreen (SPF 60) 24 hours after initial skin needling.[31] It was repeated after 30 days. All 22 patients reported satisfaction with results at 2 months follow-up. Photographic analysis at 24-months follow-up in 11 patients demonstrated continued maintenance of skin lightening observed at 2-months visit.[31]

Vitiligo

Stanimirovic et al investigated repigmentation of patients with resistant bilateral symmetrical vitiligo by comparing treatment with narrowband ultraviolet B and topical 0.005% lantanoprost solution with and without dermallor.[32] Seventeen patients in each group had repigmentation and 8.8% of repigmenting lesions had greater than 50% repigmentation. However, there was no statistically significant difference in repigmentation between groups.[32]

Periorbital melanosis

MN therapy has been successful in the treatment of periorbital hyperpigmentation. One male patient demonstrated 75% to 90% improvement with DermaFrac treatment (combination of MN and active ingredients, including kojic acid or anti-aging serum after 12 sessions.[33] Patient reported 7 out of 10 improvement on the Patient's global assessment scale in his pigmentation.

Kontochristopoulos et al explored the use of MN in periorbital hyperpigmentation by treating 13 patients with MN followed by 10% trichloroacetic acid (TCA) peels.[34] Almost all patients improved according to patient global assessments. Mild side effects as discomfort, edema and erythema were observed.[34]

MN therapy is promising in melasma and periorbital melanosis. MN is placed as viable alternative to resurfacing procedure for darker skinned patients, given the lack of dyspigmentation as an adverse event. However, there is limited data to support its potential in improving vitiligo.

Verruca

Benefits of MN as a method of drug delivery in verruca was seen by Konicke and Olasz achieving complete cure rate in 3 patients. MN was used in combination with 0.2 to 0.5 ml of topical bleomycin at 1 unit per ml over an average of 4 treatments.[35] There was no tissue necrosis as seen with intralesional bleomycin and patients reported minimal pain, comparatively cure rates with intralesional bleomycin range from 0% to 95% with variability attributed to prior infiltration of the lesion.[36] MN may be viable option for guaranteeing complete cure rate in plantar warts through enhancing delivery of bleomycin lesions.

Actinic keratosis

Patients with actinic keratosis (AK) have shown variable results from MN as adjuvant therapy. Torezan et al evaluated use of MN after application of methyl aminolevulinate photodynamic therapy (MAL-PDT) compared to use of MAL-PDT without MN in 10 patients.[37] With dermaroller showed greater improvement in photoaging and facial erythema. Average actinic keratoses clearance was 88.3%, Spencer and freeman, demonstrated MN can enhance topical delta aminolevulanic acid (ALA-photodynamic therapy) in treatment of AK.[38]

Use of MN to treat AK was also evaluated in 12 organ transplant patients unresponsive to classic photo dynamic

therapy. All lesions demonstrated excellent response after 3 treatment sessions and were free of any new actinic keratoses for 4 months. At 9 months follow-up, two patients relapsed while others remained clear.[39] Overall, microneedling showed promising results as an adjuvant therapy for the treatment of refractory AK.

CONCLUSION

Since the development of first dermaroller about 20 years ago, numerous new MN devices have been introduced. The applications of microneedling in dermatology have expanded to many indications over the past several years. This review highlights the potential of microneedling in treatment of many dermatological and cosmetological conditions including disorders of pigmentation- melasma, scars, alopecia including male pattern baldness with increased transdermal delivery of drugs like minoxidil, periorbital melanosis, trials on warts patients, premalignant conditions like actinic keratoses, practically of use in skin of color. Transient erythema is the most common adverse event. Facial allergic granulomatous recations and systemic hypersensitivity has been reported in MN therapies at medical spas, otherwise adverse reactions are rare. MN has minimum risks of depigmentation relative to currently accepted treatment. Overall, MN offers a simple, yet cost effective therapeutic modality with minimum adverse events and promising safety profile.

Large controlled clinical trials exploring the utility of MN are imperative to provide validation as more than a cosmeceutic therapy and as an evidence-based treatment options for patients with a variety of dermatological therapy. Furthermore, the necessary numbers of treatment sessions and ideal MN setting including needling length and depth should be explored. Authors of this review article places dermaroller efficacy to be good to excellent therapy. Further, larger studies on dermarollers indications in dermatology and cosmetology will prove its efficacy. Overall, MN offers a simple yet cost effective therapeutic modality with minimum adverse events and a promising safety profile.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Mohan S, Mohan L, Sangal R, Singh N. Dermaroller in dermatology and cosmetology. Int J Res Dermatol 2020;6:279-83.