Microneedling Using Dermaroller A Means Of Collagen Induction Therapy

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Abstract:
Collagen induction therapy using dermaroller a form of microneedling is gaining popularity for the treatment of scars, wrinkles and stretch marks as it is cheap, effective and lacks the side effects of other modalities for the same.

INTRODUCTION

Microneedling, a form of collagen induction therapy was introduced in 1997 as a new treatment modality using a device called dermaroller. It was used as an indication for scars and wrinkles.

Important milestones in its development are:

1995 - Orentreich and Orentreich described subcision or dermal needling for scars.
1997 - Camirand and Doucet described needle dermabrasion using tattoo pistol to treat scars.
2006 - Fernandes developed percutaneous collagen induction (PCI) therapy with dermaroller to initiate the natural post traumatic inflammatory cascade by rolling needles vertically, horizontally, and diagonally with pressure over the treated area.

Many therapies like CO2 laser resurfacing, dermabrasion that offers a significant improvement in facial scars are invariably associated with considerable morbidity and downtime interfering with the daily activities of patients in post treatment period, while treatment with microdermabrasion and non ablative resurfacing with lasers are associated with the minimal or no downtime, do not show the same level of efficacy. Deep chemical peeling used for the treatment for scars ablate the epidermis with subsequent reepitheliazation, which may render the skin more sensitive to photodamage and dyschromia.

Dermaroller in contrary do not damage the skin or remove the epidermal layer. One single microneedling causes tiny wound in skin and as a result of post traumatic response platelets are released, which produce a series of growth factors that promotes the body's own production of collagen and elastin. It is a safe alternative for the treatment of post-burn injury, wrinkles, stretch marks and for smoothing of skin without the risk of dyspigmentation or scarring.

INSTRUMENT

It is a simple hand held drum shaped roller consisting of handle with a cylinder studded with 192 fine stainless steel microneedles all around in eight rows 0.5-1.5mm in length and 0.1mm in diameter. The microneedles are synthesized by reactive ion etching techniques on silicon or medical grade stainless steel.

The quality, hardness and sharpness of needles are important property of good skin needling device. High ratio of tip length vs diameter of 13:1 is an important property of good needles. The depth of neocollagensesis was found to be average 5 – 600 micrometers with 1.5 mm length needle. It is presterilised by gamma irradiation. Medical grade stainless steel makes the needles non-allergenic to human tissue. Re-sterilization of the dermaroller in an autoclave or using ultrasound is prohibited because needles would lose their sharpness and may detach from the roller.

Roller should be kept in isopropyl alcohol all the time.

INDICATION

1. Wrinkles: Wrinkles occurs when the skin loses suppleness and tightness as it ages. It is seen more commonly in areas of skin which are...
Stretched regularly such as around the eyes (crows feet), forehead and mouth. By renewing the production of collagen the skin becomes plumped out, thicker and retains its elasticity.

2. Scars:
   a. Acne scars – Atrophic, boxcar, rolling and pitted scars.
      Grade 2 and 3 rolling/box car scars respond better. Good to excellent response is achieved in 88.7% patients studied by Majid, in rolling or boxcar scars and moderate response was seen in pitted scars. Grade 4 scar did not respond as well as Grade 2 and Grade 3. Linear and deep pitted scars also do not respond well which are difficult to treat by laser as well and requires surgical corrections.
   b. Postburn scar

3. Stretchmarks

4. Mesotherapy – Microneedling when used to puncture skin will bypass the stratum corneum and create transient aqueous transport pathways of micron dimensions and enhance the transdermal permeability. These micropores are orders of magnitude larger than molecules dimensions and therefore readily permit the transport of hydrophilic macromolecules.

   In androgenetic alopecia and alopecia areata, 1 ml of 5% minoxidil is applied and roller is rolled over the scalp. It enhances upto 40 times more absorption of substance compared to topical creams.

5. Cellulite–With thickening of skin epidermal layer will become tighter and firmer giving younger and healthier look.

6. Lax skin on arms, abdomen, neck, thighs, areas between breast and buttocks.

7. To tighten skin after liposuction.

   **CONTRAINDICATION**
   1. Active acne, herpes labialis.
   2. Chronic skin disease like eczema and psoriasis
   3. Blood clotting disorders and patient on any anticoagulant therapy like warfarin, heparin or other oral anticoagulants, as it can cause uncontrolled bleeding.

4. Rosacea

5. Skin malignancy, Moles or warts and Solar keratosis: as the needles may disseminate abnormal cells by implantation.

6. Patients who have not pretreated their skin with vitamin A.

7. Patients on Aspirin should discontinue it atleast three days before the treatment.

**PATHOPHYSIOLOGY OF COLLAGEN INDUCTION THERAPY**

Needles pierce the stratum corneum, create holes without damaging epidermis. Each pass of rolling produce 16 micro punctures/cm². Rolling with dermaroller over an area for 15 times results in approximately 250 holes/cm². Microneedling aims to stimulate collagen production (Figure 1), by producing microwounds and initiating the normal post-inflammatory chemical cascade. There are 3 phases in the bodies wound healing process which follow each other in predictable fashion described:

![Figure 1. Induction of Collagen by microneedling](image)

1. Platelets and neutrophils release growth factors such as, TGFβ, platelet derived growth factor, connective tissue activating protein, connective tissue growth factor which all increase the production of intercellular matrix.

2. Monocytes then release growth factor to increase the production of collagen, elastin, glycosaminoglycans. After 5 days of injury – a fibronecin matrix forms with an alignment of
fibroblast that determines the deposition of collagen, which remains for 5 – 7 years and tightens naturally.

3. It also increases gene and protein expression of collagen, glycosaminoglycans and growth factors, vascular endothelial growth factor, epidermal growth factor, fibroblast growth factor which are relevant for skin regeneration.

Neovascularization and neocollagenesis following treatment leads to reduction of scars.

HISTOPATHOLOGY

Histopathology shows normal stratum corneum, thickened epidermis and normal rete ridges at one year interval after the treatment in postburns scars. Skin becomes thicker with greater than 400 % increase in collagen deposition and significantly more elastin. Collagen fibre bundles qualitatively increases, thickens and more loosely woven in both papillary and reticular dermis. It appears to have laid down in normal lattice pattern than in parallel bundles as in scar tissue.

PREOPERATIVE CARE

Patients skin should be prepared preoperatively for atleast 1 month with vitamin A and vitamin C cream twice a day to maximize dermal collagen formation described by Aust. Vitamin A, is a retinoic acid is an essential vitamin for skin. It expresses its influence on 400-1000 genes that control proliferation and differentiation of all major cells in epidermis and dermis. Vitamin A may control the release of TGFβ3 in preference to TGFβ1 and TGF β2 . Vitamin C, is essential for production of normal collagen.

Percutaneous collagen induction and vitamin A switch on the fibroblast to produce collagen and therefore increases the need for vitamin C.

PROCEDURE

Area to be treated is anesthetised with topical anaesthesia i.e EMLA and covered with cellophane tape for 45 minutes to 1 hour. EMLA removed using normal saline. The skin of face is stretched by one hand while the other is used to roll the instrument over in a direction perpendicular to that of stretching force.

Roller is rolled 15-20 times in horizontal vertical and both oblique directions. In deep seated scar base of the scar is to be treated till pin point bleeding occurs, which should be from the base of scar.

Saline pads are kept over treated area.

Topical antibiotic cream is applied

Whole procedure takes 15-20 minutes

Treatment is to be repeated after 4-6 weeks.

POSTOPERATIVE CARE

Treated area is swollen and superficially bruised. To absorb the bleeding and serous discharge, it should be covered with cool, damp swabs that are replaced for 2 hours.

Topical antibiotic cream (mupirocin) is applied for few days to minimize the chance of bacterial infection.

Avoid sun exposure & harsh chemicals or any cosmetic procedure over the face for atleast for one week.

SIDE EFFECTS OR RISKS

They are almost neglible

1. Pain.

2. Reactivation of herpes simplex.

3. Impetigo.

4. Allergic contact dermatitis to the material used in needles.

5. Exposure to blood.

6. Poor quality needles of the roller device often result in bending at needle tips after repeated treatments, which results in more tissue damages and haemorrhage with linear hypertrophic scars or post inflammatory hyperpigmentation. Over aggressive needling may also cause scarring using a tattoo gun but not with special barrel of needles.

ADVANTAGES

1. It has a short healing time.

2. It can be used in any type of skin and on all area of body where lasers and deep peels cannot be performed

3. It is a convenient office procedure and cost effective than other alternative therapy

4. Well tolerated and accepted by patients.

5. No risk of post—inflammatory hyperpigmentation

Interleukin10 was increased after PCI therapy while expression of MCIR(Melanocortin I receptor) gene coding for a melanocyte stimulating hormones indicates a faint down regulation upto 2 weeks post operatively, therefore in opposite to dermabrasion, PCI therapy appear to have lower risk of dyspigmentation.

6. Microneedling can be combined with other acne scar treatment like subcision, chemical peeling, microdermabrasion and fractional resurfacing giving maximum benefits. Combination with glycolic acid peels showed improvement in skin texture and post acne pigmentation in moderately deep scar of grade 2 and grade 3.
7. It does not damage the skin histology, rather epidermis may show more dermal papillae.
8. Technique is easy to master.
9. Can be done on people who have had laser resurfacing or have very thin skin.

OTHER TYPES OF DERMAROLLER

1. DERMASTAMP – It is a miniature version of dermaroller. Needles are 2mm in length with a diameter of only 0.1mm. They are used for localised scars eg.post herpetic scars, varicella scars, post traumatic scars.
2. HOME CARE DERMAROLLERS – They are less than 0.15 mm in length .Mainly used for transdermal delivery of substances like lipopeptides and other antiageing products.
3. AUTOMATED ROLLERS – They are battery driven with disposable heads, can be used in more than one patient as disposable heads needs only to be changed. Pressure applied on scars here are uniform.
4. Scalp roller: It uses titanium needles unlike steel needles used in other rollers, used to treat thinning hair.

REFERENCES