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# RFP Journal of Dermatology

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*Original Article*

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# An Interventional Prospective Study on Microdermabrasion the Solution to a Variety of Dermatological Conditions

**Hetal C Patel[1], Raksha Patel[2], Ashka D Shah[3], Grishma K Fumtiwala[4]**

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## ABSTRACT

***Introduction:*** Micrrodermabrasion (MDA) is an office procedure for various skin conditions with minimal invasion. This study's aim was to determine efficacy and side effects of MDA in different dermatoses.

***Method:*** This was an interventional prospective study including 45 subjects.

Inclusion criteria pertained to cases having superficial acne scars, superficial wrinkling, mild to moderate acne with post inflammatory hyper pigmentation, acanthosis nigircans and melasma who were ready for regular follow up biweekly among other things. Pre-procedural care included avoidance of certain procedures and priming of skin was done. Detailed history, examination and investigations were done for all patients.

Bimanual technique for MDA was used after giving proper position to the patient. Series of multiple linear sweeping movements were done using handpiece. 2nd pass was carried out perpendicular to the first pass.

Post procedural instructions were vigilantly given.

***Results:*** Out of the 45 cases enrolled, 20 were male and 25 were female of ages 11 to more than 40. No patients showed 100% improvement, minimal to moderate improvement was seen in maximum patients, while some patients of melasma, post acne scarring and mild to moderate acne showed no improvement at all.

Side effects like mild erythema persisting for one to two hours was seen in fifteen patients and irritation in eyes was seen in six patients which usually disappeared after washing.

***Conclusion:*** MDA is a simple and safe office procedure suited for superficial resurfacing problems that does not interfere with normal activities of the patient and has minimal side effect.

**Keywords:** Body polishing; Non invasive; Acne scars; Hyperpigmentation; Bimanual technique ; Aluminium oxide; Office procedure

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## INTRODUCTION

Microdermabrasion (MDA) popularly known as "body polishing" has been in trend since the past 20 years or so.[1] It is a minimally invasive epidermal resurfacing procedure used to treat uneven skin tones/textures, photoaging, striae, melasma and scars, including acne scars.[2] It is an office procedure and can be conveniently performed on outpatient basis.

As the name suggests, MDA literally means to wear away a small amount of superficial skin. It is a non-invasive non-surgical procedure used to revitalise and refresh skin.[3]

Abrasive crystals are propelled against the skin under the control of a handheld vacuum system, causing gentle mechanical abrasion of skin. New epidermis formed as a part of wound healing improves skin contour.[1]

The aim of this was to study the efficacy of MDA in different dermatoses and to study its adverse effects if any.

## MATERIAL AND METHOD

This is an interventional prospective study. Cases amenable to conditions like superficial acne scars, superficial wrinkles, hyperpigmentation, acanthosis nigricans were considered. Informed consent was taken. Total 45 cases with various clinical conditions were included and MDA was performed as per the protocol.

A detailed history regarding onset, duration, aggravating factors, sun exposure profile was taken.

Past history of tendency of hypersensitivity and keloid, and history of using oral or topical isotretinoin was taken in detail.

Routine investigations like complete blood count, blood sugar, lipid profile and thyroid function tests were done.

Each patient was examined thoroughly for distribution, morphology and configuration of lesions.

### *Inclusion criteria*

- Cases having superficial acne scars superficial wrinkling, mild to moderate acne with post inflammatory hyper pigmentation, acanthosis nigircans and melasma who were ready for regular follow up biweekly.
- Patients other than pregnant and lactating mothers.
- Patients who had not taken oral isotretinoin within last 1 year.
- No past history or family history of tendency of keloids or unusual scarring.

Patients were explained about the procedure and those who gave consent and were willing to come for regular treatment and follow up every two weeks up to 3 months were included.

Some patients having post inflammatory hyper pigmentation and post acne scarring were primed for 2 weeks with 0.012%- 0.025% topical retinoids for better results.

### *Pre procedure*

The patients were informed about the procedure in simple terms and possible side effects were explained.

Waxing, tweezing, electrolysis, laser treatment, injection of collagen and botox, any kind of chemical peels and facials were to be avoided for minimum of 7 days before the procedure.

Products like alpha hydroxy acid, salicylic acid, retinoids and topical acne medication were asked to be discontinued 2 days before the procedure.

Priming was done with topical tretinoin (0.012%-0.025%) for 2 weeks and it was discontinued 2 days prior to the procedure.

### *Technique*

*Position:* sitting if lesions were over neck, lying down if lesions were over face.

The hand piece was placed gently on the skin with its tip perpendicular to the skin surface.

*Bimanual technique:* stretch and steady the skin with one hand and move the hand piece gently with the other hand in a sweeping motion in the outward direction leaving uniform film of crystal on skin.

Series of multiple such linear sweeping movements were done segment wise to cover the entire face. Delicate skin over the eyelid and the vermillion border was not treated. Remaining aluminium oxide crystals were wiped before 2nd pass. 2nd set of pass was carried out in the direction perpendicular to the first set of pass with a similar technique.

Remaining crystals were wiped off and patients were instructed to clean the skin with water to remove any residue.

Moisturiser and sunscreen was applied locally after the procedure. The patient was allowed to step out 20 minutes after sunscreen application.

### *Post procedure*

*At home care:* Clean and moisturise the skin twice daily, use broad spectrum sunscreen daily before sun exposure, topical tretinoin and hydroquinone crude to be started three days after MDA & stopped two days prior to the follow up procedure.

These treatments were done every fifteen days. A fore mentioned pre procedural instructions were given.

## RESULTS

Out of the 45 cases enrolled, 20 were male and 25 were female of ages 11 to more than 40. (Table 1) 31% patients had mild to moderate acne with post inflammatory hyper pigmentation, 31% had acne scars. 11.1% had hyper pigmentation, 8.8% had

melasma, 8.8% had acanthosis nigricans and 8.8% had rhytides. (Image 1) No patients showed 100% improvement, minimal to moderate improvement was seen in maximum patients, while some patients of melasma, post acne scarring and mild to moderate acne showed no improvement at all. (Table 2) (Figure 1)

Side effects like mild erythema persisting for one to two hours was seen in 15 patients and irritation to eyes was seen in six patients which usually disappeared after washing the eyes.

**Table 1:**

| Age (in years) | Sex | | Total (n=45) |
|---|---|---|---|
| | Male n=20 | Female n=25 | |
| 0-10 | - | - | - |
| 10-20 | 4 | 4 | 8 |
| 21-30 | 11 | 14 | 25 |
| 31-40 | 4 | 6 | 10 |
| >40 | 1 | 1 | 2 |

**Table 2:**

| Scale of Improvement | Conditions | | | | | |
|---|---|---|---|---|---|---|
| | Mild to moderate acne and post inflammatory hyperpigmentation | Post acne scarring | Hyper -pigmentation | Melasma | Acanthosis nigricans | Rhytides |
| | n=14 | n=14 | n=5 | n=4 | n=4 | n=4 |
| No (0%) | 04 (28.5%) | 03(20%) | - | 02(50%) | - | - |
| Minimal (25%) | 04(28.5%) | 04(28.5%) | 01(20%) | 02(50%) | 02(50%) | 02(50%) |
| Moderate (50%) | 07(46%) | 07(50%) | 02(40%) | - | 02(50%) | 02(50%) |
| Marked (75%) | - | - | 02(40%) | - | - | - |
| Maximum (100%) | - | - | - | - | - | - |

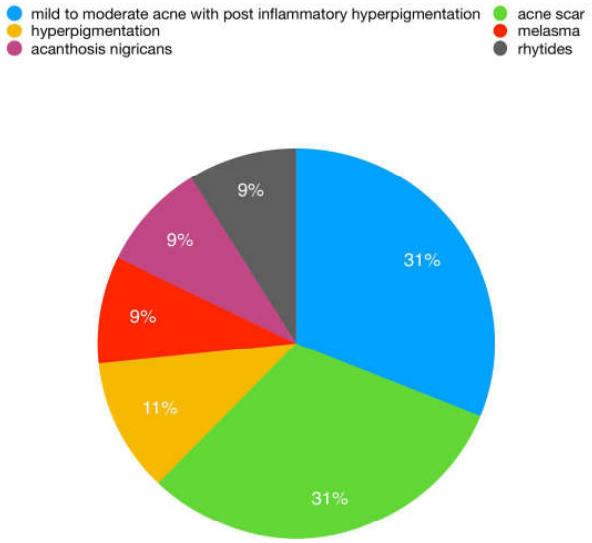


Fig. 1: pie chart showing indications for which microdermab .-rasion was done

## DISCUSSION

Facial skin resurfacing can be traced back to Egyptian times, where royals sand blasted their skin in an attempt to rejuvenate their face.[4] From rocks, shells, pumice etc. used in the yester years to using the sophisticated MDA therapy now, this procedure has always been popular with the patients.[4] The principal behind MDA has been the same throughout the timeline.[1]

In the current scenario, MDA is indicated in a lot of conditions like superficial acne scars, post inflammatory hyper pigmentation, rejuvenation of photo damaged skin and blemished skin, stretch marks, melasma, acanthuses nigricans and many more. (grimes 2006)

In this procedure aluminium oxide crystals or other abrasive substances are blown onto the face and then vacuumed off, using a single handpiece.[1] The depth of the peel can be variable, but most of the times only the stratum corneum of the epidermal layer is abraded.[1,6] This depth depends upon the particle size and the speed of the handpiece. With only mild erythema(redness)and oedema (swelling) there is minimal downtime making MDA a lunchtime procedure.[1,6]

Sodium chloride, sodium bicarbonate and magnesium oxide crystals are cheaper options which can be used. On the downside these are less effective.[5,6]

Amongst non-crystal methods diamond tipped devices are the most recent ones. These are preferred by the patient due to lesser pain and are better for us as they require lesser maintenance, shorter procedure time, and are more hygienic.[1, 7]

The ultimate results are due to a combination of mechanical disruption of stratum corneum, partial epithelization and stimulation of epidermal turnover, vasodilatation of dermal blood vessels, dermal oedema and remodelling of dermal collagen.[4,5,8]

Histopathologically, thinning of stratum corneum, increased thickness of dermis and epidermis, even and regular distribution of melanosomes, flattening of rete ridges and remodelling of collagen, elastic tissue and dermal oedema is seen, Vascular ectasia with perivascular mononuclear cellular infiltrate is seen too.[3,5,6] (Fig. 1)

MDA should be strictly avoided in inflammatory acne, active bacterial or viral infection, incase of keloidal tendency, and history of use of isotretinoin in last one year.[5,9]

Side effects like erythema, oedema, increased skin sensitivity, petechiae, purpura, drying, transient hyper pigmentation, blue grey discolouration, infection, acute urticarial reaction, scarring, foreign body reaction to aluminium chloride crystals, respiratory-pulmonary fibrosis, ophthalmic-conjunctival congestion, eye irritation, superficial punctate keratitis can be troublesome.[1,9,10]

The process is painless, requiring no down time and hence barely affecting the patients social life. The procedure can be repeated at short intervals, thus allowing us to evaluate the obtained result and then deciding the timing for further sittings. It is a simple procedure that does not required any anaesthetic.[11]

Spencer et al noted minimal response in 7 out of 10 cases, and mild response in 2 out of 5 cases in his study on MDA in hyper pigmentation.[12]

A study carried out by Dr. Maggie Schwarz at new york, has shown excellent efficacy for MDA in treating melasma when a combination depigmenting regimen is added. According to the results of a study of 50 patients with melasma, at 2 years of follow up, 20% patients reported more than 95% clearing and 60% reported 60%-95% clearing of melasma.[13]

Arielle et al reported successful treatment of melasma using a combination of MDA and Q-Switched Nd:YAG Lasers.[14]

In a study carried out by coimbra m, 20 patients with rhytides with a series of eight MDA treatments at 1 week intervals were enrolled. 17 subjects completed the entire study protocol. They observed improvement in fine rhytides. All patients were very satisfied with the treatment.[15]

Hence it can be said that MDA is a painless lunchtime procedure with minimal side effects, and is safe in fitzpatrick skin types 4 and 6. It can be repeated at short intervals as and when needed without disrupting the patients social life.

## CONCLUSION

MDA is a simple and safe office procedure that does not interfere with normal activities of the patient and has minimal side effect.

MDA seems to be a legitimate resurfacing technology that is particularly suited for superficial resurfacing problems such as fine lines, mild acne scars and hyperpigmentation.

It is a non-aggressive technique with a high safety profile. It is a slow acting procedure which requires repeated maintenance sessions for continued effect.

***Conflicts of Interest:*** None.

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*Original Article*

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# Role of Suction Assisted Epidermal Blister Grafting in Wound Management

**K SriHarsha Reddy[1], Ravi Kumar Chittoria[2], Nishad Kerakada[3], Neljo Thomas[4],**

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## ABSTRACT

Skin grafts are commonly used in plastic and reconstructive surgery. Chronic wounds are linked to a patient's delayed healing and increased morbidity. Flaps, skin grafting, temporary alternatives for dressings, and other types of wound coverage are available. In this case study, we tested the efficiency of a novel approach of Suction Assisted Epidermal Blister Grafting for a raw area cover.

**Keywords:** Body polishing; Non invasive; Acne scars; Hyperpigmentation; Bimanual technique ; Aluminium oxide; Office procedure

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## INTRODUCTION

Chronic wounds require skin transplants for covering following sufficient wound preparation (WBP). Split thickness skin grafts (STSG), full thickness skin grafts, pixel grafting, and mild grafting are all examples of skin grafts. STSGs necessitate anesthesia and an operating room because the dermatome harvester extracts the graft in the plane between the papillary (superficial) and reticular (deep) dermis, exposing the sensory nerves and dermal appendages that are necessary for donor site healing, causing postoperative pain. Additionally, donor site bleeding, infection, and pruritis can all slow healing.1 When only the epidermis is required for superficial wounds, epidermal skin grafting is utilized. Because only the epidermal layer is removed from the donor site, it avoids many donor site issues and eliminates the need for an operating theatre. We describe our experience with harvesting Suction Assisted Epidermal Blister Grafting (SEBG) for the treatment of raw areas in this study.

## MATERIALS AND METHODS

This study was conducted in the Department of Plastic surgery in a Tertiary care center in South India. Departmental ethical clearance and consent from the subject were obtained. The details of the patient in study are as follows: 40 year old male (known diabetic) with history of left lower cellulitis for which he underwent debridement and subsequent split-thickness skin grafting; now has small residual 1.2x1 cm raw area (figure 1). The

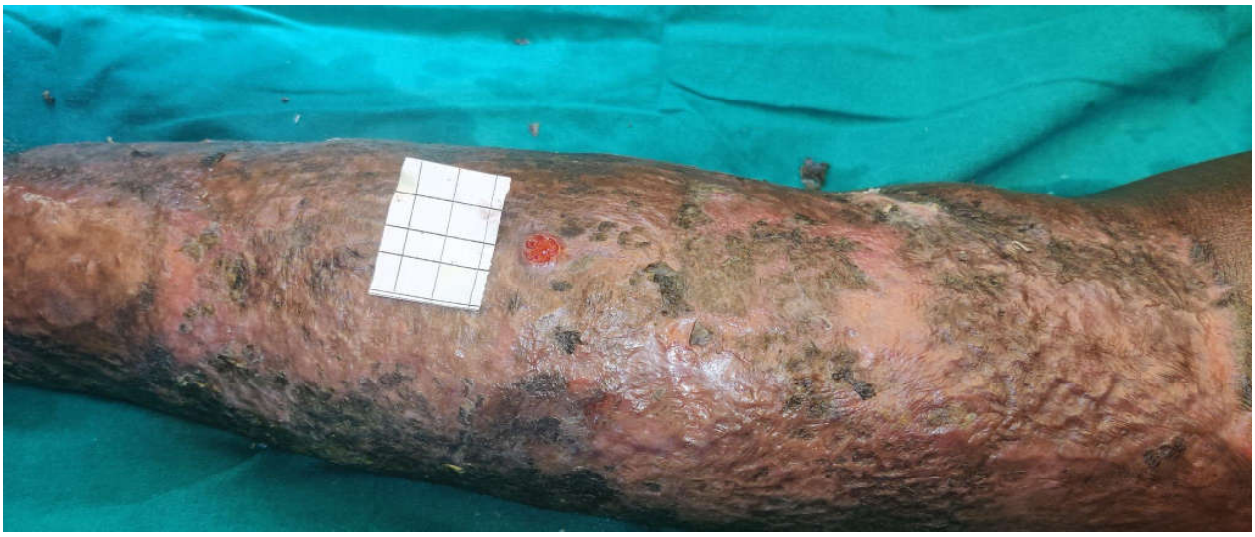

**Fig. 1:** Residual raw area 1.2x1cm

Suction Assisted Epidermal Blister Grafting was done by using the cut end of a 2ml syringe to raise a blister in the epidermo-dermal plane (figure 2). The epidermal graft was taken by using a size 15 blade and harvesting the epidermis alone. The harvested graft was applied into the raw areawith the help of 2-octyl cyanoacrylate adhesive.

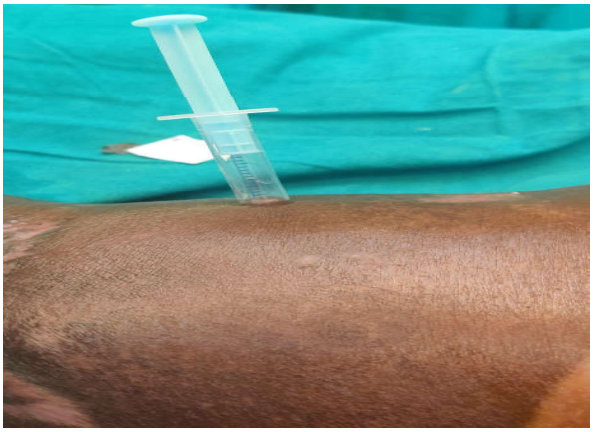

**Fig. 2:** Suction-Assisted Bleb Raising

## RESULT

There was complete wound healing of the recipient area (figure 3) as well as the donor area at the end of 3 weeks.

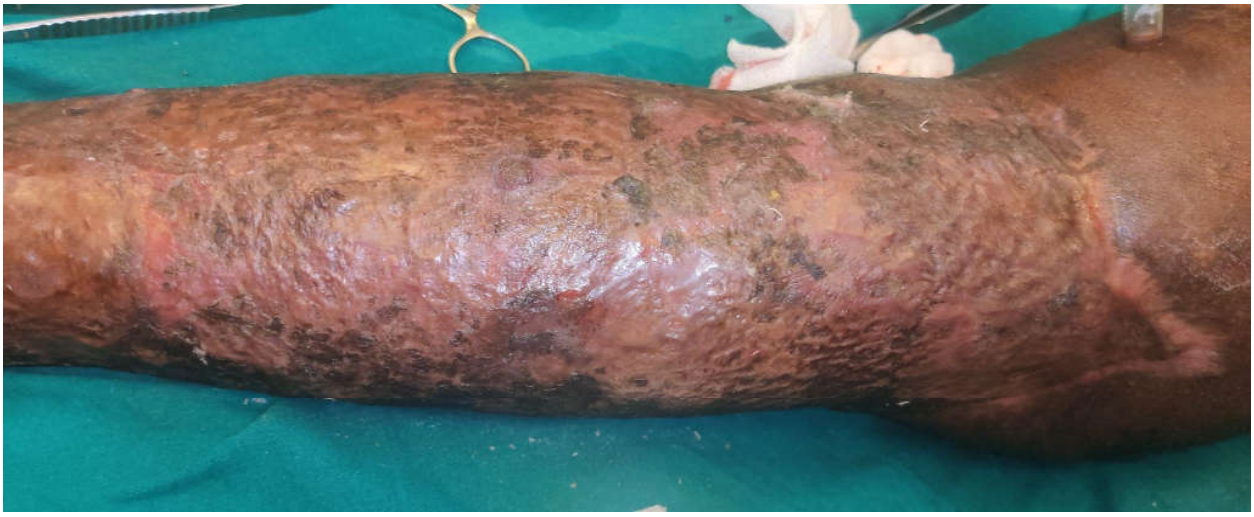

**Fig. 3:** Post grafting (3rd week) of SEBG graft on raw area

## DISCUSSION

Kiistala and Mustakallio[1] introduced epidermal grafting using suction blisters in human skin in 1964, and Falabella[2] utilized it to treat vitiligo. SEBG, or autologous suction blister epidermal grafting, has been used to treat persistent vitiligo and other secondary leukodermas, as well as difficult to heal lesions such as burns and lower limb ulcers.[3-7] Scarring does not form since the donor site's dermis is not injured, albeit some pigmentation loss may occur. The upper thigh is the best place to start. Because the dermal plexus is not disrupted, no bleeding occurs, making it ideal for individuals taking anticoagulants.

Suction blister epidermal grafting techniques result in epidermal division at the lamina lucida, uneven hemidesmosome rupture, and cytoplasmic vacuole development in keratinocytes.[8] The epidermis' essential structure is preserved, and the dermis is unaffected.[8] Separation at the dermal-epidermal (DE) junction and transfer of the whole, intact basal layer to the recipient site is required for success.

The precise mechanics of epidermal transplant acceptance are unknown. Costanzo et al[6] proposed that epithelialization begin at the ulcer's edge as the primary strategy. Other authors[9–11] claimed that epidermal grafts do not "take" to the underlying granulation tissue, but that re-epithelialization occurs at the wound borders. This edge effect, according to Costanzo et al[6], could be caused by growth factors released by grafted keratinocytes. In vitro analysis of epidermal grafts obtained utilizing the epidermal harvesting technology revealed that migratory basal layer keratinocytes and melanocytes proliferate in vivo, according to a recent study. Viable basal cells produced key growth factors important for controlling wound healing responses, including vascular endothelial growth factor (VEGF), hepatocyte growth factor (HGF), granulocyte colony stimulating factor (G-CSF), platelet-derived growth factor (PDGF), and transforming growth factor alpha, according to a study of intact microdome roofs derived from healthy human subjects (TGF alpha).

In our study, the advantages of Suction-Assisted Epidermal Blister Graftingis that it can be easily taken, easy to apply, less pain on taking graft, and it allows the donor site to heal. However the disadvantage is that there is less amount of the graft available and it takes a considerable amount of time (1-2 hours) for the blister to be raised in the epidermo-dermal plane.

## CONCLUSION

In our study, we found that the Suction Assisted Epidermal Blister Grafting is as efficacious as split thickness skin grafting using a Humby's knife or a dermatome, especially for covering relatively small raw areas. As this is a novel method, further large scale randomized control study is required to comment on its efficacy.

***Conflicts of interest:*** None

***Authors' contributions:*** All authors made contributions to the article.

***Availability of data and materials:*** Not applicable.

***Financial support and sponsorship:*** None.

***Consent for publication:*** Not applicable

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*Review Article*

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# Conventional Vs Transdermal Drug Delivery System

**Sandhiya V[1], Praveen Kumar M[2], Prasanth Raj C N[3], Nirmal P[4], Mano A[5], Suhaib I[6]**

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## ABSTRACT

Many medications are now administered orally; however they are not as effective as they should be. Beyond the local application site, transdermal delivery technology is being explored to treat a wide range of diseases. Because of reduced first pass metabolism, avoidance of an adverse gastrointestinal environment, and the potential to provide extended and regulated drug delivery, transdermal drug administration offers substantial benefits over oral treatment. Transdermal drug delivery systems (TDDS) are topically applied patches that release medications for systemic effects at a predetermined and regulated rate. It works by putting a medication inside a patch and wearing it for a long time on the skin. As a result, a steady concentration of medication remains in the bloodstream for an extended period of time. TDDS products include Scopolamine, Nicotine, Testosterone, Fentanyl, and Clonidine. Numerous active compounds with variable molecular size and structure cannot be maintained in transdermal form, despite their many benefits.

**Keywords:** Transdermal patch, Skin, Permeation pathways, Matrix.

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## INTRODUCTION

### *Transdermal Drug Delivery System*

Drug delivery system (DDS) is a generic term for a series of physicochemical technologies that can control delivery and release of pharmacologically active substances into cells, tissues and organs, such that these active substances could exert optimal effects.[1,2] In other words, DDS covers the routes of administration and drug formulations that efficiently deliver the drug to maximize therapeutic efficacy while minimizing any side effect[3-5] Depending on the delivery route, there are many types of administration modalities, such as oral administration, transdermal administration, lung inhalation, mucosal administration, and intravenous injection.[6]

At present, the most common form of delivery of drugs is the oral route administration. This route has notable advantages like easy administration, pain free, cheap but unfortunately it has some flaws namely poor bioavailability due to hepatic metabolism and the tendency to produce rapid blood level spikes, leading to a need for high and/or frequent dosing, which can be both cost prohibitive and inconvenient.[7]

To overcome this weakness, transdermal drug delivery system (TDDS) was developed, which has improvement in therapeutic efficacy and safety of drugs by more precise (targeted site), spatial and temporal placement within the body thereby reducing the size, number of doses and fewer side effects.

A transdermal drug delivery system (TDDS) represents the most attractive method among other conventional forms. TDDS is commonly used instead of oral medications or topical creams. Furthermore, TDDS is more capable of surpassing hepatic first pass metabolism, the degradation of the drug substance when it reaches the liver, which reduces the effect of the drug sustaining

steady blood levels for a longer time frame, and reduced gastrointestinal discomfort. Thus, TDDS offers competitive advantages over traditional methods that improve bioavailability and patient compliance.

To acquire the principle of the transdermal drug delivery system, one must first understand the morphological, biophysical and physicochemical properties of the skin, as well as the qualities that contribute to the barrier function and rate of drug entry into the body via skin.

### *Skin*

The skin is the largest organ of the body, with a total area of about 20 square feet. The skin is made up of three layers: Epidermis (outermost layer), dermis (inner layer), and subcutaneous tissues (deepest layer).

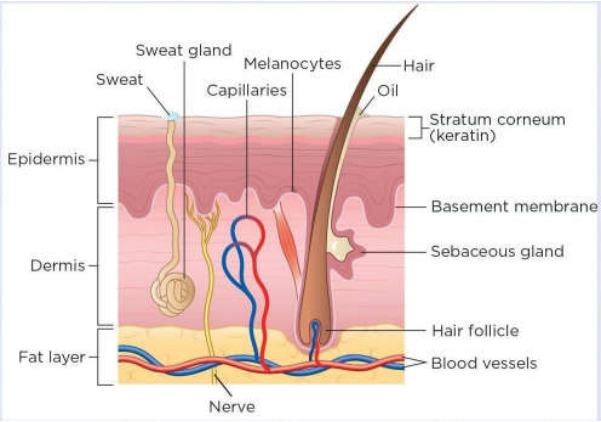


**Fig. 1:** Anatomy of skin.[16]

### *Epidermis*

The epidermis is composed of two layers: Stratum corneum (nonviable epidermis) and viable epidermis.[8] The epidermis contains no blood vessels, and cells in the deepest layers are nourished almost exclusively by diffused oxygen from the surrounding air[9] and to a far lesser degree by blood capillaries extending to the outer layers of the dermis. The main types of cells that make up the epidermis are Merkel cells, keratinocytes, with melanocytes and Langerhans cells also present. The epidermis can be further subdivided into the following strata (beginning with the outermost layer): corneum, lucidum (only in the palms of hands and bottoms of feet), granulosum, spinosum, and basale. Cells are formed through mitosis at the basale layer. The daughter cells (see cell division) move up the strata, changing shape and composition as they die due to isolation from their blood source. The cytoplasm is released and the protein keratin is inserted.

They eventually reach the corneum and slough off (desquamation). This process is called "keratinization". This keratinized layer of skin is responsible for keeping water in the body and keeping other harmful chemicals and pathogens out, making skin a natural barrier to infection.

### *Dermis*

The dermis is the layer of skin beneath the epidermis that consists of connective tissue and cushions the body from stress and strain. The dermis is tightly connected to the epidermis by a basement membrane. It also harbours many nerve endings that provide the sense of touch and heat. It contains the hair follicles, sweat glands, sebaceous glands, apocrine glands, lymphatic vessels and blood vessels. The blood vessels in the dermis provide nourishment and waste removal from its own cells as well as from the stratum basale of the epidermis.[10]

The dermis is structurally divided into two areas: a superficial area adjacent to the epidermis, called the papillary region, and a deep thicker area known as the reticular region.[10]

### *Hypodermis*

The hypodermis is also known as subcutaneous tissue, is not part of the skin, but lies below the dermis of the cutis. Its purpose is to attach the skin to underlying bone and muscle as well as supplying it with blood vessels and nerves. It consists of loose connective tissue, adipose tissue and elastin. The main cell types are fibroblasts, macrophages and adipocytes (subcutaneous tissue contains 50% of body fat). Fat serves as padding and insulation for the body.[10]

The sweat glands (2-5 million) produce sweat (pH 4.0-6.8) and may also secrete protein or antibodies. Their main function is to aid heat control; approximately 400 glands per square centimeter are particularly concentrated in the palms and soles. Sebaceous glands are most numerous and largest on the face, forehead, ear, on the midline of the back and anogenital surfaces, but it is not present on palms and soles. The glands vary in size from 200-2000 um in diameter. The nose contains a maximum amount of sebaceous glands because it secretes sebum an oily material

from cell disintegration. The primary components are free fatty acids, glycerides, cholesterol, esters of cholesterol, and squalene. It acts as a source of the stratum corneum plasticizing lipid & skin lubricant and maintains an acidic condition on the skins outer surface.[11]

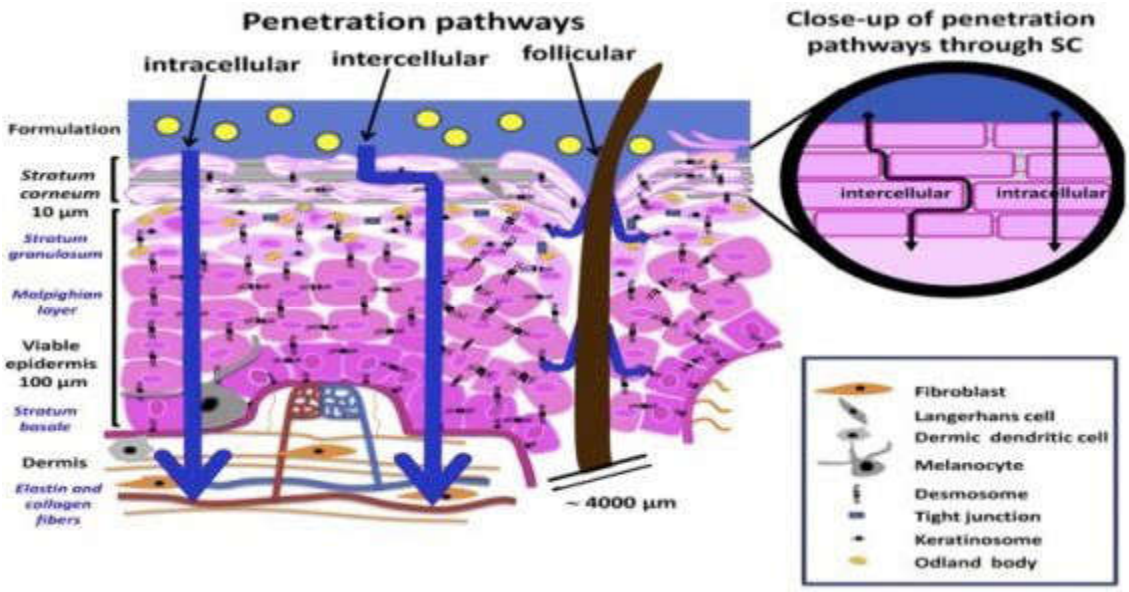


**Fig. 2:** Drug penetration pathway.[8]

### *Drug permeation*

The transepidermal and transappendegeal channels are the two probable routes for medication entry via intact skin. The transepidermal pathway involves molecules passing through the stratum corneum, a multi-layered, multi-cellular barrier with a complex architectural design. Intra-or inter-cellular transepidermal penetration are two different types of transepidermal penetration. Hydrophilic or polar solutes can be transported intracellularly through corneocytes, terminally developed keratinocytes. Diffusion of lipophilic or non-polar solutes through the continuous lipid matrix is enabled through transport via intercellular gaps. Molecules move through sweat glands and past hair follicles on their way to the scalp via the transappendegeal route.

## TRANSDERMAL PATCHES

A transdermal patch is a medicated adhesive patch that is placed on the skin to deliver a specific dose of medication through the skin and into the bloodstream. This patch provides a controlled release of the medication into the patient, usually through either a porous membrane covering a reservoir of medication or through body heat melting thin layers of medication embedded in the adhesive.[7]

Scopolamine patches was first transdermal drug delivery for systemic delivery which was approved by U.S. FDA in 1979, which was used to treat motion sickness. After a decade in 1991 nicotine patches were introduced and became huge success. Later on many drugs were introduced in TDDS form.

### *Components of TDDS*

- Liner: Protects the patch while it is being stored. The liner is removed before use.
- Drug: Active ingredient is present with direct contact to the liner.
- Adhesive: Its purpose is to adhere the patch's components together as well as to adhere the patch to the skin. It should be easily removed from the smooth surface without leaving any residue.
- Backing: The backing materials must be flexible while also having a high tensile strength.
- Permeation Enhancer: These compounds are useful for increasing stratum corneum permeability by interacting with structural stratum corneum components such as proteins or lipids in order to achieve higher therapeutic levels of the drug. They change the protein and lipid packaging of the stratum corneum, chemically altering the barrier functions and

increasing permeability.

- Polymer Matrix: Polymers are the main component of TDDS, controlling drug release from the device. Polymer matrices can be made by dispersing the drug in a liquid or solid state synthetic polymer base.

### *Criteria for TDDS*

- Drug must be high lipophilic (ideal log PO/W ≈ 2).
- Drug must have low molecular weight, below 500 Dalton.
- Must also have low melting point, below 150 °C.
- Sufficient solubility in water at pH 6 to 7.4 (e.g., ≈ 0.05 to 1mg/ml if target delivery rate is in the mg range per day).
- Formulation ingredients must not close drug specific pathways. For example, it has been shown that shunt diffusion plays a major role in caffeine absorption, provided that pores are not closed by ingredients like waxes before drug application.[12]
- The formulation of passive systems must enhance drug partitioning into and transport across the skin layers, maintain a nearly constant drug activity gradient throughout the skin over the specified application duration, and ensure a high drug depletion rate of the patch from a physicochemical standpoint.
- Selecting and designing a polymer is a difficult undertaking that necessitates a full understanding of the surface and bulk properties of the polymer that can provide the appropriate chemical, interfacial, mechanical, and biological functions.
- All device ingredients must be well tolerated by the skin and support continuous medication penetration through the skin at a repeatable rate for the duration of the application.
- While considering the TDDS route, one must take a notice on immune and inflammatory cells of the dermis which react on any mechanically or chemically induced irritation.
- The transcellular pathway requires repeated drug partition and diffusion across structured bilayers, and seems to be usually less important.

### *Types of transdermal patches*

*There are different types of transdermal patches:*

- Matrix
- Reservoir
- Drug in adhesive
- Multilaminate

### *Matrix*

The matrix system, also known as a monolithic device, has a drug layer made of a semisolid matrix that contains a drug solution or suspension. This patch's sticky layer partially covers the drug layer and surrounds it.

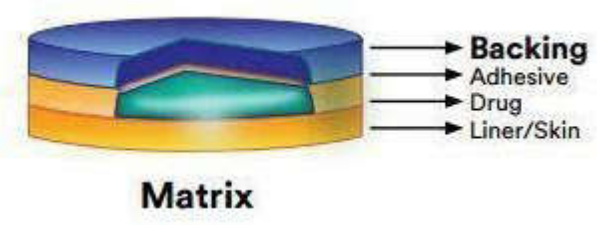


**Fig. 3:** Matrix patch.[15]

### *Reservoir*

Unlike the single layer and multi-layer drug-in-adhesive systems, the reservoir transdermal system has a separate drug layer. The drug layer is a liquid compartment containing a drug solution or suspension that is separated by the adhesive layer. The drug reservoir is completely encapsulated in a shallow compartment molded from a drug-impermeable metallic-plastic laminate, with a rate-controlling membrane made of a polymer (like vinyl acetate) on one surface.[13,14] This patch is also backed by the backing layer.

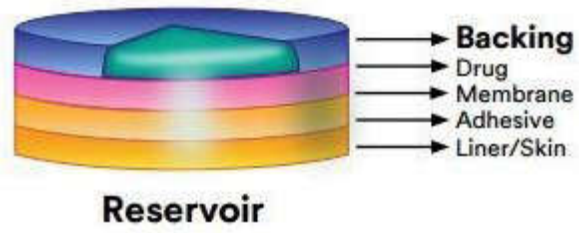


**Fig. 4:** Reservoir patch.[15]

### *Drug in adhesive*

The adhesive layer of this sort of patch is responsible for adhering the multiple layers together, as well as the overall system to the skin, containing the

medicine, and releasing the drug. A temporary liner and a backing surround the adhesive layer.

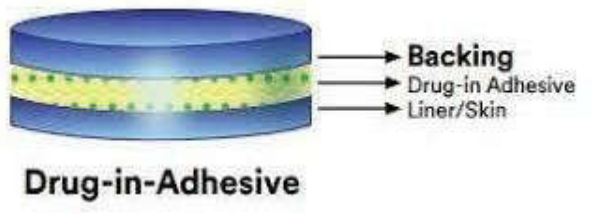


**Fig. 5:** Drug in adhesive.[15]

*Multilaminate*

The multi-layer drug-in-adhesive patch is similar to the single-layer system but it differs in that it adds another layer of drug-in-adhesive, usually separated by a membrane. One layer is for immediate release of the drug and the other is for control release of drug from the reservoir[13] This patch also has a temporary liner-layer and a permanent backing. The drug release from this depends on membrane permeability and diffusion of drug molecules.

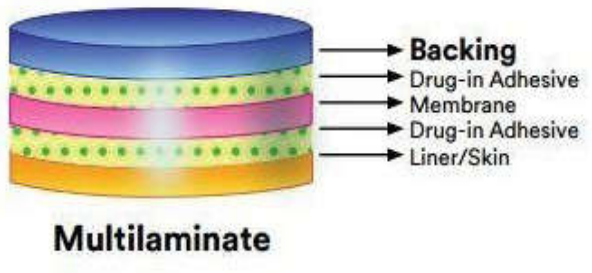


**Fig. 6:** Multilaminate patch.[15]

*Vapor patches*

In a vapor patch, the adhesive layer not only serves to adhere the various layers together but also to release vapor. Vapor patches release essential oils for up to 6 hours and are mainly used for decongestion. Other vapor patches on the market improve quality of sleep or aid in smoking cessation.[13]

*Advantages of transdermal patches:*

- Dosing frequency is being reduced.
- More consistent plasma levels.
- Useful for potent medicines.
- Bioavailability has been improved.
- Reduction of negative effects.
- The ability to discontinue drug administration simply by removing the transdermal delivery system from the skin (patch).
- It provides a continuous infusion of the medicine over a long period of time.
- Probably more difficult to abuse than any other preparation.
- Patient compliance is enhanced, and inter- and intra-patient variability is reduced because of the simpler treatment regimen.

*Disadvantages of transdermal patches:*

- There's a chance that the application site will irritate you.
- Drugs or excipients cause skin irritation or contact dermatitis.
- Because of the skin's low permeability, the number of medications that can be given this way is limited.
- Physicians must be educated and patients/ parents must be directed.
- For penetration into the stratum corneum, the medication must have the desired physicochemical qualities.
- The skin's barrier function varies from one area to the next on the same individual, from person to person.
- The patch will not stay to the skin for long period due to heat, cold, sweating (perspiring), and showering.
- Bathing or swimming causes patches to peel off completely; patches can also fall off when walking.

Why TDDS is used in alternative for conventional delivery system?

TDDS is an ongoing research topic. It has been offered as an alternative to needle based immunizations since the medication is given directly to immunogenic Langerhans cells on the skin. Transdermal medication delivery allows for targeted drug release into the patient's bloodstream, resulting in fewer systemic side effects and, in certain cases, increased efficacy over other dosage forms. Because of its ease of use, it is often used as a substitute for intravenous anesthetics and oral opioids. This alternative route for medicine delivery offers a less expensive and more convenient option to address diseases.

Topical medications are medications which are applied on the skin that rely on passive diffusion into the skin itself, creating a local effect. Whereas transdermal medications refer to medications that are applied to the skin but involve skin penetration enhancing compounds or technology that increase the amount of drug that can cross the skin barrier, often to the point that the drug can enter the systemic circulation and exert effects in areas other than the site of application.[15] Transdermal products use a variety of techniques to improve penetration through the Stratum Corneum, the skin's principal barrier, allowing enough medication to reach systemic circulation or deeper underlying tissues.

### *Transdermal Market*

Transdermal medication delivery devices are being utilized to treat a variety of illnesses, including chronic pain, central nervous system problems, and cardiovascular disease. The global market for transdermal medicines is being driven by the growing incidence of targeted illnesses and greater use of contraceptives.

As said the market for transdermal products has been steadily increasing, and this trend is expected to continue in the near future. TDD products are continuing to provide actual therapeutic value to patients all across the world. According to P&S market research, TDDS market is forecasted to cross over USD 7.5 billion around 2023. In the United States, more than 35 TDD products have been approved for sale, and roughly 16 active components have been approved for usage in TDD products around the world. North America is a significant revenue generator in the transdermal drug delivery systems market.

The TDDS market is experiencing the fastest growth in demand due to advances in healthcare and spending in India and China.

**Table 1:** Showing FDA approved drugs for TDDS.

| Year | Generic Names | Indication |
|---|---|---|
| 1979 | Scopolamine | Motion sickness |
| 1984 | Clonidine | Hypertension |
| 1990 | Fentanyl | Chronic pain |
| 1991 | Nicotine | Smoking cessation |
| 2007 | Rotigotine | Parkinson's disease |

## CONCLUSION

Transdermal medication delivery systems have been proven to be a safe and effective method of drug delivery. Scientists with a high rate of achievement are exploiting their potential role in controlled release all over the world. Transdermal delivery is a surprising successful mode of administration if a medication has the proper balance of physical chemistry and pharmacology. Transdermal medication administration allows for site - specific treatment, reducing or eliminating diseases, adverse medication reactions, drug/drug interactions, and side effects that can lead to GI, hepatic, renal, or other difficulties. It has the potential to remove the use of needles for the administration of a wide range of pharmaceuticals in the future. TDDS has a lot of potential because it can be used to turn both hydrophobic and hydrophilic active substances into promising medications. Greater understanding of the diverse mechanisms of biological interactions as well as polymers is essential to optimise this drug delivery method. Because of the TDDS's numerous benefits, several new studies are now being conducted to include newer medicines into the system. Transdermal medication administration is becoming the most generally recognized method of drug administration because to recent technological developments and the integration of the drug to the site of action without rupturing the outer membrane. This article provides valuable information on how transdermal medicines are better than conventional drugs. At the moment, global sales of TDDS are lower than those of conventional forms, but we hope that the TDDS will make a name for itself.

***Conflicts of interest:*** None

***Authors' contributions:*** All authors made contributions to the article.

***Availability of data and materials:*** Not applicable.

***Financial support and sponsorship:*** None.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

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[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

**Corporate (collective) author**

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

**Unpublished article**

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

**Personal author(s)**

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

**Chapter in book**

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O,

Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

**No author given**

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

**Reference from electronic media**

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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