

## Trans Ungual Drug Delivery: A Drug Delivery through Nail

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### ABSTRACT

With the advancements in the technology, there are changes taking place with respect to the drug delivery systems too. These drug delivery systems are categorized by the way they can be administered. The trans unguinal drug delivery systems are the drug delivery systems that came into existence for treating the nail infections or the disorders or the diseases that are caused or occurred in the nail. The approaches for a successful drug delivery through the nail, the traditional medicaments, advancements that arose with the latest technology, disorders associated with nail are discussed in this review

**Keywords:** Drug delivery systems; Trans unguinal drug delivery systems; Nail infections

### INTRODUCTION

Any medicament, biomedical device or any formulation that tends to relieve in an appropriate dosage form is known as a drug delivery system as it enables the therapeutic system and helps in giving relief or minimizing the illness. The purpose of the researchers to change the administration way or to bring new forms into existence of the drug is to target and target the site of action according to the needs of the body during treatment, as well as the rate before age, the type of disease and the intake of other medications of the patient, also with respect to the drug profile and pharmacokinetic parameters [1,2]. Drug modifications to improve drug efficiency and patient convenience and compliance. Based on the route of administration, there are many drug delivery systems that aids human's sufferings and with the advancements in technologies, there is also advancement in the science and technology and most importantly in pharmaceutical research [3]. With this note, there comes a delivery system that tends for the drug delivery through nail, such a delivering pattern is known to be as Trans unguinal Drug Delivery Systems (TUDDS) or Ungual Drug Delivery System (UDDS). In detail, "Trans" means "through" and "Ungual" means "nails". Therefore, this UDDS's came into existence for delivering the drug in a targeted form to treat the nail related diseases. As we know, topical delivery systems are highly preferred as they show the desired activity with no many side effects. The TUDDS gives human nails as a hydrophilic barrier, which can be used as a drug for the treatment of nail diseases and a new way to cause these abnormal indications [4-6]. Common abnormalities include onychomycosis, nail psoriasis, yellow nail syndrome, and paronychia and so on. The basic requirement of any pathological condition is a medicine in an appropriate dosage form. Although the nail barrier has a physiology that limits drug absorption, certain physical and

chemical modifications can be made to support drug delivery. Lacquer, tooth enamel, nail polish and other forms of antifungal drugs are used to enhance the effect of drugs on mechanical deformation or fungal infections. Electrochemical techniques and necessary surgical procedures are believed to enhance the best medical treatment. This article examines various nail diseases and methods of treating them with new nail drug delivery systems.

The nail's plate is responsible for the formulation to penetrate it. Because it is strong enough, penetration becomes difficult, and only a small portion of topical medication passes through it. Therefore, the effective therapeutic concentration has not been reached. In order to successfully deliver the active pharmaceutical ingredient (API) through the nail, the anatomy and physiology of the barrier needs to be considered. Get the right amount of medicine more effectively at the right time and at the right place. The nail plate is the most visible part of the nail device, made up of densely packed and highly keratinized dead cells. It also varies from person to person. The plate can be small, large, wide, narrow, hard, smooth, ribbed, thin, etc. Diseases of the nail unit range from relatively harmless conditions (such as pigmentation in heavy smokers) to pain and weakness that can occur in the nail unit, malnutrition, hypertrophy, inflammation, and infection [7-10]. These conditions will affect the body, society and psychology of the patient and seriously affect the quality of life. It is well known that many nail diseases are difficult to cure, require long term treatment, and recurrence is common. Oral therapy has inherent disadvantages of systemic adverse reactions and drug interactions, while local therapy is limited by the low permeability of the nail plate. The main goal is to develop a formulation that can deliver the drug without any restrictions that affect it (such as poor permeability); this will help alleviate the suffering of people affected by nail diseases.

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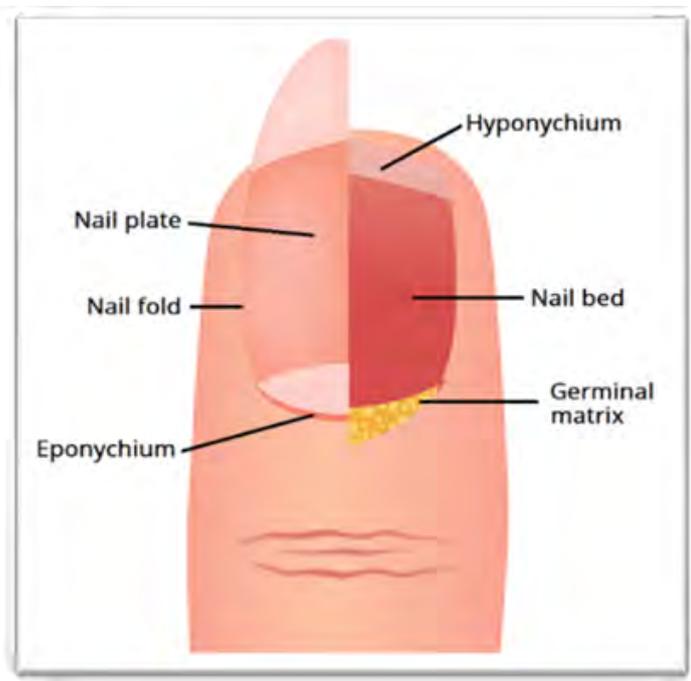
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## PHYSIOLOGY OF HUMAN NAIL

Human nails represent an obstacle to guessing. Not only are they pleasing in appearance, they also give a certain degree of recognition to the individual's overall well-being. The science and technology related to the human nail part is a microcosm of the development and innovation of new drug types. When a patient suffers from pathological conditions such as anaemia, every doctor will draw a simple inference [11,12]. The nail anatomy is as follows; (Figure 1)



**Figure 1:** Anatomy of nail

- Nail matrix or nail root, the back or proximal part of the nail, located under the skin folds.
- Eponychium or stratum corneum, the living skin covers about 20% of the nail plate.
- Paronychia is the skin covering both sides of the nail plate.
- Hyponychium, the farthest or farthest edge of the nail unit.
- Nail plate, the nail plate is mainly composed of keratin; it is a special protein that can produce most of the nail plate.
- Nail bed is the pink tissue area that supports the entire nail plate.
- Lunula, is the dim blue white crescent shape at the bottom of the nail plate.

The developing piece of the nail is the piece of the proximal nail under the epidermis that is as yet subcutaneous, and it is the lone living piece of the nail. In vertebrates, the length and development pace of nails are identified with the length of the end phalanges. In this way, among individuals, the nails of the pointer became quicker than the nails of the little finger; nails grew multiple times quicker than toenails. In people, nails develop at a normal pace of 3 mm (0.12 inches) each month. Fingernails need 3 to a half year to completely recover and toenails need 12 to year and a half [13,14]. The real development rate relies upon elements like age, sex, season, practice level, diet, and heredity. Nails fill quicker in summer than in some other season. Nails will at this point don't develop after death; the skin becomes dried out and fixed, which

causes the nails to have all the earmarks of being developing [15,16].

### Pathophysiology of human nail

The nail is a complex structure, because it will be affected by various diseases, these diseases will cause certain pathophysiological parameters and will further help us to understand the drug delivery system of the nail. Studying your treatment has given us a clearer understanding of drug elimination and the pharmacokinetic parameters that need to be studied. Few abnormalities that trigger to nail's unhealthy are;

1. Thickening of nail
2. White lines on the nail
3. Brittle or dryness of nail
4. Concavity of nail

The diseases that are interlinked with the nail infections are listed below in the following Table 1, Onychomycosis is a fungal nail infection, where patches are seen which accounts 5% of the population is suffering with this infection. Psoriasis is a disease which is characterized by the thickening of the epidermal layer of the skin and seen in about 3% to 5% of the total population. Onychatrophia is a condition where the nail plate is loosen and becomes sometimes comes away. Leuconychia is a scenario where the tiny bubbles are seen as If air is trapped in the layers of the nail plate. Onychogryposis is a condition where the nail plate is thickened and nails turn into the claw type and may lead to the trauma. Koilonychia is a type of the nail disorder which raises the ridges and sometimes, seen in case of the result of the anaemia. Melanonychia are like the pigmented bands that are seen and are generally described as the moles, which is usually a form of nail matrix. Onychorrhhexis are the vertical ridges that are raised and Paronychia is the inflammation of the nail folds, which is generally the injury in the proximal nail fold [17-19].

Nails Dieases
Onychomycosis
Nail Psoriasis
Paronychia
Yellow nail syndrome
onychatrophia
leuconychia
Leuconychia totalis
Leuconychia partialis
Leuconychia striata
Leuconychia punctata
Longitudinal leukonychia
onychogryposis
Koilonychia
Melanonychia
Paronychia
Onychorrhhexis

**Table 1:** List of common nail infections or diseases

## Approaches of TUDDS

There are several approaches laid one by one, for treating the transungual drug delivery. Few of them were discussed as follows;

**Topical application:** The oral route of administration is not preferred as the drug associated for treating the nail infections or disorders may cause the side effects in the GI tract. The topical route is the most preferred route of administration as there will be direct application of the medicament and has the fastest therapeutic activity. For the drug to show its activity, it must meet the criteria as there are barriers to reach the layers under the nail to recover.

**Chemical penetration enhancement:** The most common strategy for enhancing the drug delivery, the agents with the keratolytics and thiolytic agents are used. These agents generally increase the permeability. Therefore, for the chemical modifications of keratin, the topical monotherapies are used as they can be of less efficient.

**Physical penetration enhancement:** There are studies that are conducted for enhancing the drug penetration. In one study, scientists carried out the iontophoresis of prednisolone sodium phosphate across the thumb and they tried to find out the time course of prednisolone in plasma. Still, there are studies are going on and to be made though.

**Traditional medicaments for TUDSS:** In traditional medicaments, the medicated nail lacquers are well known. These nail lacquers are used to improve or to enhance the nails irrespective of the color. This actually prevents from the fungal infections.

## RECENT ADVANCEMENTS IN TUDSS

There are several formulations already existing in the form of the nail lacquers, nail patches etc. With the advancements in the technology, there are also advancements in the drug delivery through nails. Some of the recent technologies which have become like an open book are as follows;

- a. Electro chemotherapy
- b. Nano patch nail fungus
- c. Mesoscissioning technology

**Electro chemotherapy:** The aim of this therapy is to provide an active method of drug delivery across the nail plate in which it helps to increase the success rate and it decreases the duration of treatment of nail disorders. Same like transdermal iontophoresis, the mechanisms that contribute to enhance the drug delivery of the drugs. Generally, other iontophoteric methods are under investigation.

**Nano patch nail fungus:** This technology uses the AC/DC electrochemistry and generally it is targeted and actively push the antifungal drugs through the cuticle of the nail, a place where fungus growth is seen.

**Mesoscissioning technology:** This technology makes a microfluidic conduit through nail that too in a specific range. Here, the pathways can be created by making cut which is painless.

## CONCLUSION

There might be no serious downfall in the population with the nail diseases or the disorders, but there is the necessity in the development of the drugs or the drug delivery systems for curing or for minimizing the effects. The common disorders, traditional medication along with advanced therapies are

discussed.

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