

## Research on the Novel Empty Core Needle Transdermal Drug Delivery Mode and the Corresponding Advantages

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### Abstract

In this paper, we conduct research on novel empty core needle transdermal drug delivery mode and the corresponding advantages. Compared with the traditional mode of drug delivery, transdermal drug delivery system advantages obvious: drug absorbed from the digestive tract, intestinal factors such as interference, "the first effect" can avoid liver can maintain the stability of the human body blood drug concentration to increase effectiveness. This paper analyzes the issues from the two aspects. (1) Transdermal Therapeutic System Analysis; (2) Microneedles in Transdermal Drug Delivery. By considering the experimental analysis, we conduct the numerical simulation on the mentioned issues. The experiment result verifies and reflects the general properties of the designed methodology that will enhance the overall research performance of the related topics.

**Keywords:** Drug Delivery, Empty Core Needle, Transdermal, Corresponding Advantages, Mode.

### Introduction

Transdermal drug delivery system refers to the skin to give medicine and cause the systemic therapy effect of the controlled release preparations that is one of the third generation research focuses in the development of drug preparation. In 1979 the FDA approved the first TTS scopolamine patch, marked the transdermal drug delivery research into a new stage. Compared with the traditional mode of drug delivery, transdermal drug delivery system advantages obvious: drug absorbed from the digestive tract, intestinal factors such as interference, "the first effect" can avoid liver can maintain the stability of the human body blood drug concentration to increase effectiveness; Easy to use, safe, and reduce the drug adverse reaction. The figure one demonstrates the features.

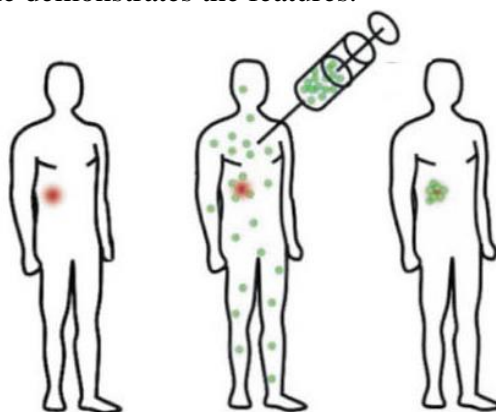


Figure 1. The Features of the TDD.

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In this paper, we conduct research on novel empty core needle transdermal drug delivery mode and the corresponding advantages. Micro needle transdermal drug delivery mechanism is the use of micro needle wear skin epidermis cuticle into the specific depth, formation of tiny channels, in fact, drugs through the channel into the systemic circulation, which can effectively promote drug percutaneous penetration and accumulation in a specific location. Compared with other methods of the transdermal drug delivery, micro needle has its unique advantages. (1) Physical channel produced by micro needle for micron level, no damage to the skin. (2) Micro needle can also be combination with the other methods, further improve the drug transdermal penetration ability. (3) Transdermal enhancers the boronization agent, iontophoresis, electrically induced holes compared to methods such as physical channel produced by micro needle puncture of the skin, are more likely to make the macromolecular substances through the skin. Due to the depth of the puncture is not enough to touch the nerve endings, and micro fine needle, so almost holds no pain feeling.

Empty core needle can like needles conveying liquid into the skin, as also can be like a real core needle used for preprocessing the skin, but to convey various liquid preparation. Using hollow empty core needle conveying liquid enters the skin generally fall into one of two ways: one is to use a single hollow micro needle, it is similar to the traditional hypodermic needles and its biggest advantage is painless, patient compliance is good; Another is to use a set of air core needle array, this type of the hollow micro needle can make the liquid preparation one-time arrived in wider areas, in some cases, than subcutaneously work more quickly and has high bioavailability. In the later sections, we will discuss these issues in detail.

## **The Proposed Methodology and Approach**

**The Transdermal Therapeutic System Analysis.** Drug's transdermal absorption, site into the systemic circulation from go through a series of dynamic process, the absorption process is different from any other way, so it's also do not belong to the first order kinetics absorption, metabolism, won't appear obvious phenomenon of "peak valley" (due to the effect of storage and limit of the corneous layer). The whole dynamic process of drug absorption: site of the stratum corneum by here live drugs from the skin, the dermis (table), absorbed by the capillaries. To enter the bloodstream play effect, as namely the drug must pass a cuticle and living skin layer.

The advantage of transdermal drug delivery is: (1) it can produce lasting, constant, and can control the blood drug concentration as phantom avoid liver on drug first metabolic degradation effect; (3) reduce the patient's pain and trouble; (4) in the case of the problems can simply, quickly stop drug delivery; (5) it can reduce dosing frequency and dose and reduce side effects. At the same time its drawbacks with good skin allergies and skin barrier function.

For the TTS system, the sorbefacient plays a significant role. At present, from the traditional Chinese medicine (TCM) to find a new transdermal absorption promoting agent is one of the direction of research, research is more eucalyptus oil, menthol, borneol and turpentine, etc. Studies show that menthol can obviously promote salicylic acid and paracetamol, 5-fluorouracil transdermal absorption, eucalyptus oil, peppermint oil and turpentine on 5-fluorouracil has a promoting effect of transdermal absorption that can be organized as the following aspects.

- Precursor drugs and the transdermal absorption. In penetrating the skin at the same time, the precursor of all kinds of enzyme in the skin tissue metabolism is transformed into an active matrix.
- Ion electroosmosis method and transdermal absorption. Ion current electroosmosis method is used to bring ion transport and research confirmed that the application of ion electroosmosis method can significantly increase the speed of ionic drug's transdermal delivery system.
- Cyclodextrin inclusion and transdermal absorption. Cyclodextrin preparations for transdermal absorption, can improve the drug's transdermal absorption performance, control drug release

rate. Water soluble cyclodextrin can promote difficult soluble drugs from the release of basic hydrophobic substrate that alkylation cyclodextrin inclusion can promote water-soluble drugs through the stratum corneum.

- Liposomes and transdermal absorption. Liposomes can provide selective drug delivery, drug drug concentrations of liposome gel to the five times higher than the traditional gel. Local application of liposome sterone and that the drug concentration is higher in the epidermis, the hypothalamus area is low, that liposomes can enhance local pharmacological activity and get reduce the systemic side effects.

**The Microneedles in Transdermal Drug Delivery.** Microneedle and promote infiltration mechanism and some other physical and infiltration method has essential difference. Iontophoresis, electrically induced holes method such as waveguide, ultrasonic import, pressure into implementation of the results of the orderly arrangement are disrupted skin stratum corneum lipids, increase the permeability of drugs on the skin cutin layer. Micro needle in contrast, it caused the fact on stratum corneum channel, the channel is visible, perpendicular to the skin. The figure 2 demonstrates general distribution of the microneedles system in transdermal drug delivery.

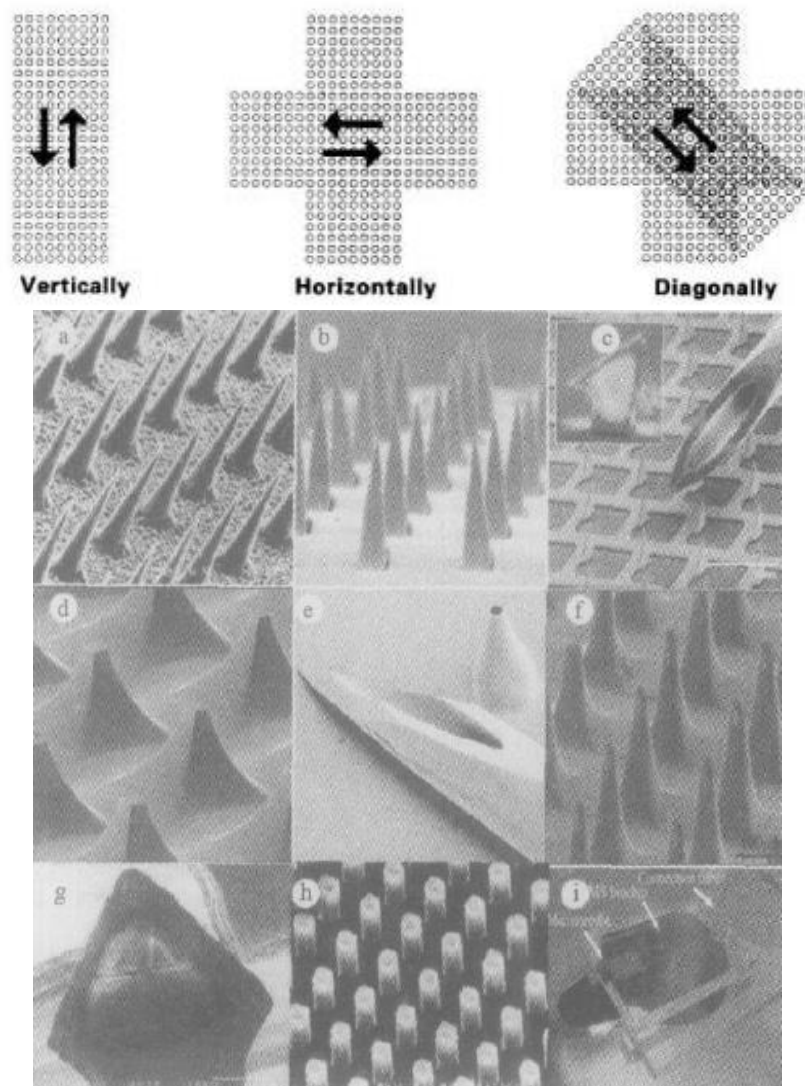


Figure 2. The Distribution of the Microneedles System in Transdermal Drug Delivery.

Due to the silicon processing technology rapid development, the early micro needle more revolves around silicon processing technology research. But because the silicone material is brittle, and do not

suit for mold to copy, so the focus of the recent years, the research of the micro needle gradually transferred to the metal and polymer materials. From the perspective of the micro needle structure MEMS micro needle can be classified into the same plane and plane two kinds of structure forms. With the advantage of planar micro needle preparation can reduce the structure than the difficulty of the preparation. For different planar micro needle, its special three-dimensional structure determines the preparation of a tough, but it has array structure advantage, to improve the area of micro needle and improve the general ability of the percutaneous drug delivery. According to the review, there are still some basic challenges of the issues that have not been dealt with.

- Micro needle medicine: how to make the micro needle load more drugs, how to ensure that micro needle carrying drugs are cleaned by the skin off when inserted into the skin and in the process of preparing the micro needle how to maintain the stability of the drug, also needs to be scholars to do further research.
- Micro needle retention time: the use of the micro needle inserted into the skin for transdermal drug delivery, whether should be maintained in the skin, if need to leave how to determine the retention time, and how does not affect the daily activities under the condition of its retention in the skin is still a focus in the study of late.
- Micro needle insertion: different people of general different RACES, different professional skin thickness, in different parts of the body skin thickness also have bigger difference, how to make the micro needle better breakthrough the limitation of skin viscoelasticity, etc.
- Despite the micro needle is thought to be painless, but it is inserted into the skin depth is one of the main factors that cause pain. No nerve in the cuticle, epidermis layer neural started to come through, and have a lot of nerve in the dermis, as mentioned above, do not have the same shape and length of various it is difficult to guarantee the micro needle insertion depth was just right.
- Due to micro injection volume is small, special shape, rupture occurred in itself in the process of inserting skin is possible, although preparation of micro needle are good biocompatibility of material selection and silicon metal, but it's hard to tell these materials for a long time to stay within the skin doesn't cause any adverse reaction.

By considering the experimental analysis, we conduct the numerical simulation on the mentioned issues. The result is shown in the figure three. Due to the Fresnel diffraction, with the increase of the depth of the lithography, near the substrate graphics width will increase, and the depth, the greater the effect. The depth of lithography increase will also affect the precision of surface: in lithography depth is small, width on the photoresist surface graphics will become bigger, but with the increase of depth of lithography, graphics width on upper surface became smaller, the substrate of secondary electron effects on the precision of lithography, graphic precision can achieve submicron scale.

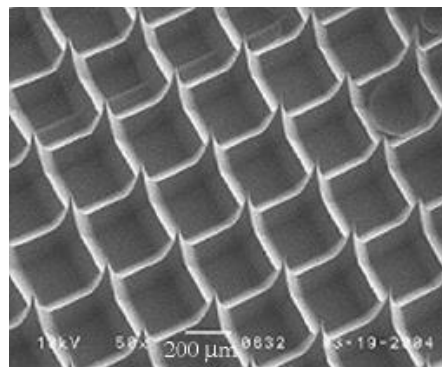


Figure 3. The Experimental Result on the Microneedles.

## Conclusion

In this paper, we conduct research on novel empty core needle transdermal drug delivery mode and the corresponding advantages. The development of new drug release system is the development of new compounds entity cost little, cycle short, quick effect, transdermal drug delivery system security control that has a broad market prospects, the original transdermal drug or small molecules of low concentration, and promote impregnation method is limited to join chemical and permeability agent or ion import. For dealing with this challenge, this paper proposes the novel perspective of the empty core needle transdermal drug delivery mode that will promote the overall performance.

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