

Science and Technology in Developing Novel Handheld System for Comprehensive Facial Skin Treatment

Mahmoud El Sherif*

Photonics, Inc, Past: Drexel University, USA

***Corresponding author:** Mahmoud El Sherif, Photonics, Inc, Past: Drexel University, USA

ARTICLE INFO

Received: 📅 October 03, 2025

Published: 📅 October 14, 2025

Citation: Mahmoud El Sherif. Science and Technology in Developing Novel Handheld System for Comprehensive Facial Skin Treatment. Biomed J Sci & Tech Res 63(3)-2025. BJSTR. MS.ID.009909.

Introduction

For the past few decades, science and engineering were under extensive research to explore ways and techniques on skin enhancement and treatment, especially, on facial skin applications. This has resulted in the development of a number of technologies applied in novel systems to improve skin conditions. Each system is designed to improve the health conditions of a specific skin layer and/or property. Wherein, the skin has three primary layers; epidermis, dermis, and hypodermic [1]. The epidermis is the outermost layer, which is a tough barrier against pathogens, dehydration, and ultraviolet radiation. It constantly sheds dead cells and replenishes itself from below. The dermis is the middle layer that provides strength and elasticity to the skin. It contains collagen, blood vessels, nerves, and hair follicles. The skin hypodermic layer is the deepest layer composed of fat and connective tissue, which provides insulation, cushions muscles and bones, and stores energy. Therefore, each developed system is focusing on the treatment of a specific skin layer (or layers) properties, and patients are always directed to use one or more of these developed techniques depending on the patients skin conditions.

Facial skin treatment was the area of the body that attracted much attention, and many systems were developed to improve and enhance the skin conditions and/or appearance. Several techniques and technologies were used in developing a number of systems that are now in the market and used extensively. Some of them are using one of the mechanical procedures; microdermabrasion, micro-needling, or massaging. While others are using laser, microwaves (MW), or radio frequencies (RF) treatment techniques, and so on. As an example of

mechanical procedures, microdermabrasion, using diamond-tipped wands, is used to cleanse and exfoliate facial dead skins [2,3]. In another procedures, a plate or roller equipped with large number of micro needles is used to create micro holes into the skin surface to facilitate the deep penetration of serum [4], which will be applied in the next procedure. On the other hand, lasers or MW/RF signals are used for facial skin treatment focusing on different skin properties. The application of laser in the visible band, at specific wavelengths, which has a high skin absorption property, is used to generate non-injuring heat. This is used to stimulating blood flow in the outer tissue layer. The laser treatment is used for skin tightening to repair sagging skins, and other properties. Each of these mechanical, optical, or MW/RF procedures have to be followed by another but critical procedure. After the completion of any of these, mechanical, laser, or MW/RF procedures a proper serum has to be applied immediately to the skin surface, while the skin is still in the proper conditions using that procedure. This is not the case in most applications, where it takes time to prepare and apply the serum to the treated layers of the skin. The importance of applying the serum immediately is because the treated skin might have certain time availability to apply the serum to get the best effect out of this treatment. For example, the micro hole, generated into the skin surface to facilitate deep penetration of the serum, has a limited life time before starts to narrowing and closing. The limited life time, in this case, is different from type of skin to another; based on the elasticity and other skin properties and conditions. Many systems and devices have been developed and are now in use by skin care professionals. Each one of them is capable of the application of one of the known treatment techniques. They are

bulky, expensive, and mainly used in doctors or professional offices. Also, because these devices are only preparing the skin conditions for the serum/cream application, the timing factor in the application of the serum is very critical. Therefore, if the serum is not applied right after the completion of the procedure, the treatment will not be done as planned. In addition, in most facial skin conditions, more than one procedure is needed, based on each skin conditions. This requires the use of another one of those bulky machines/systems.

Because of these limitations, a novel approach/technique has been developed to maximize the skin treatment results. This is done, in a new design of the skin treatment system, by providing the serum continuously and simultaneously in parallel during the application of any of the mechanical, laser, or microwave procedures, or other procedures [5,6]. Also, the new system design in a way to combine all the required component to conduct all those major procedures, one after the other, with a one simple handheld system. This developed handheld system can be used at home without the need for professional help. During the development of this novel system, a lot of testing procedures were conducted, and on a large number of patients at different ages and genders. All achieved results were very encourage. In this letter, a brief presentation and discussion on the system design and application is presented.

Methods and Results

Because of the limitations explained before on the effectiveness of the serums applied to the skin after the completion of the mechanical, laser, or other skin treatment procedure, a new system design was created to provide the serum continuously and simultaneously in parallel during the application of mechanical, optical, or microwave treatment procedure. Prototypes were manufacture and extensively tested to maximize the designs application for skin treatment. This

was followed by manufacturing a large number of systems, which were in direct testing with a broad spectrum of patients, from different ages and/or genders. The design of the developed new system is based on combining all the required components (parts or devices) in a smart way for proper application of all procedures, with the same reasonable size system. The system should be light enough to be carried by one hand for skin treatment at home. This required the use of an On-Off coupling technique for the major parts, to change form one procedure to the other, instead of having all of the components integrated within the handheld system. The system major components/parts are four, as explained next.

Part A

Which interacts directly with the skin surface, and is equipped with the proper tools to provide the mechanical, laser, or MW/RF treatments. For an example; a small disk has one of the surface equipped with diamond-tipped wands for dermabrasion treatment. In another design, the disk has an area prepared to embed a roller, equipped with a large number of micro needles, as shown in Figure 1. Also, the disk can be equipped with miniature narrow band light emitting diodes or laser diodes, and so on. All these disks are designed in a way that they have engraved channels to facilitate the movement of the serum or cleanser fluids from the back surface side of the disk to the front one, and to collect waste/cleanser fluids and dead skin from the surface to the back side of the disk, see Figure 1 [5]. For sure, the disk designed for laser treatment, to MW/RF has some differences from the mechanical treatment disks, as explained and disclosed in reference 6 [6]. All these disks are designed in a way to clip on-off the main body of the system. Wherein, the front of the main body is prepared with a special coupling unit to be connected with any of the proper disk, for the application of that disk procedure.

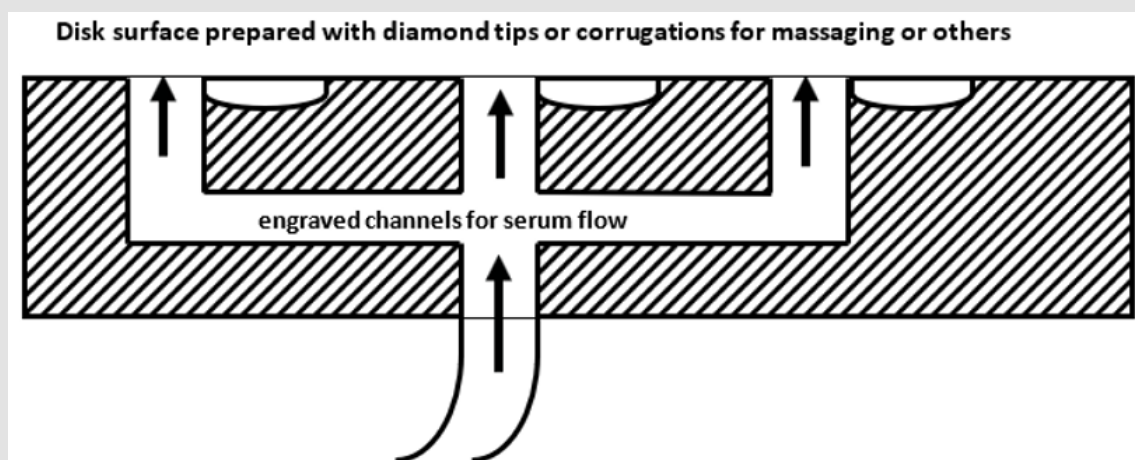


Figure 1: A schematic sketch of an on-off disk, as Part A, in the hand-held system.

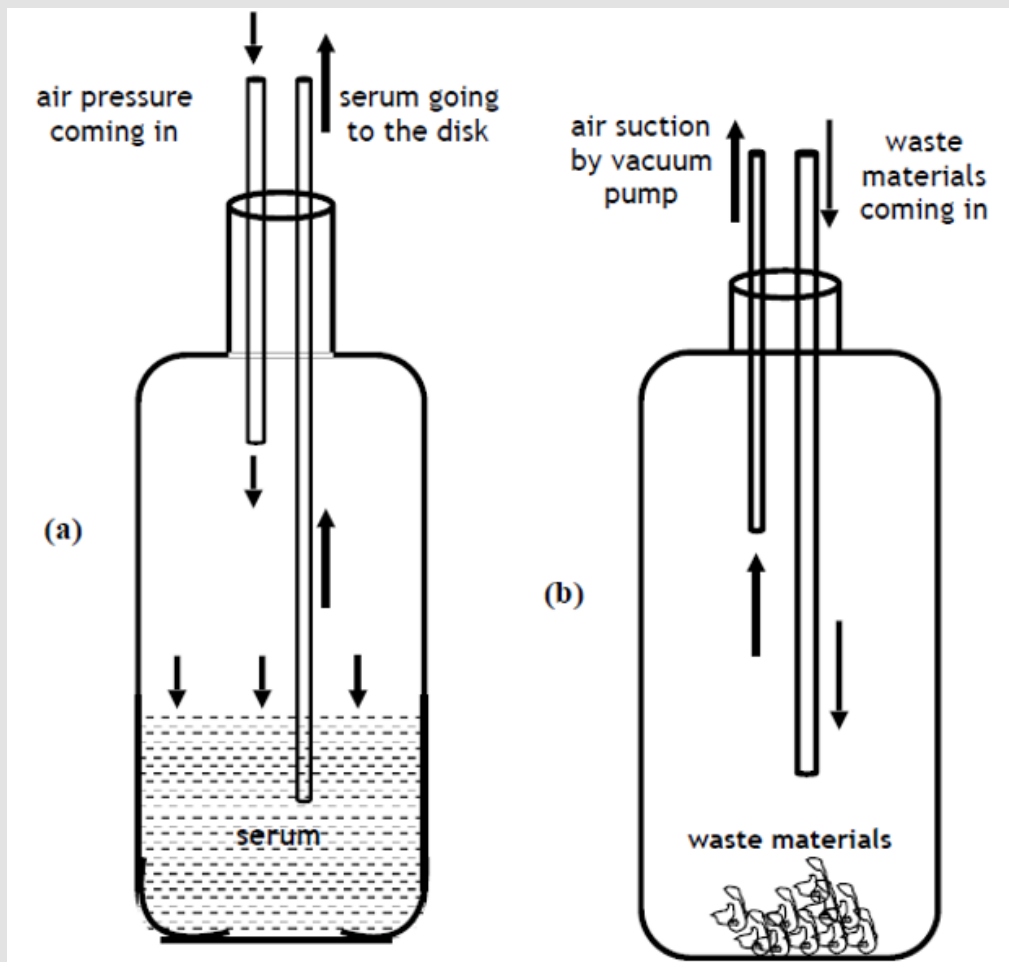


Figure 2:

- a) A schematic diagram showing a serum container.
- b) And the waste container.

Part B

A number of small containers used to store different types of serums or the cleanser/cleaning fluid. Each type of serum is prepared to be applied to the skin during the application of the specific mechanical or optical skin treatment procedure. Each one of the containers has two tubes, to connect the inside of the container to outside medium, see Figure 2a. One to pass a high pressured air to inside the container to push the serum out from the other tube. The air continues to push the serum in the tube until it reaches the disk, and continue into the disk to cover the other surface area. Also, these serum containers are connected to the other side of the main body of the system, one at a time. This is done in a simple clip on-off way. Each is connected only when the matching Part A is connected to the front of the main body of the system.

Part C

A small container, as the waste container, which is used to collect dead skin and cleanser fluids after cleaning the skin surface. It has two tubes, to connect the inside of the container to outside. One of the tube is used to pass a strong suction air, coming from the mini vacuum pump, to create enough vacuum inside the container, see Figure 2b. This will result in sucking dead skin and waste/dirty fluids from the skin surface, and through the engraved channels into the disk to the tube connected to the waste container. This container is connected to main body only when the cleaning fluids container is connect and the dermabrasion disk is connected to the front of the main body. This process is designed to perfectly clean the skin surface, and will follow immediately with the application of the proper serum after the removal of the dead skin and waste materials, while the front dermabrasion is still connected, and in use.

Part D

The energy sources and control electronics, valves, and switches are all within the main body of the system. The main body of the system/device has one pressure mini pump, and another vacuum mini pump. The pumps are used to provide the high pressured air for serum movement to the disk, and to the skin surface, and to provide

air vacuum in the waste container for continuous sucking of waste materials from the disk/skin interface to inside the waste container. For sure, the mini pumps have the required power supply, whatever batteries or connected to the main source/supply. Also, there is an integrated mini chip to control the time and for the on-off of the pumps, as well as several valves and switches to control all fluids as well as waste materials (Figure 3).

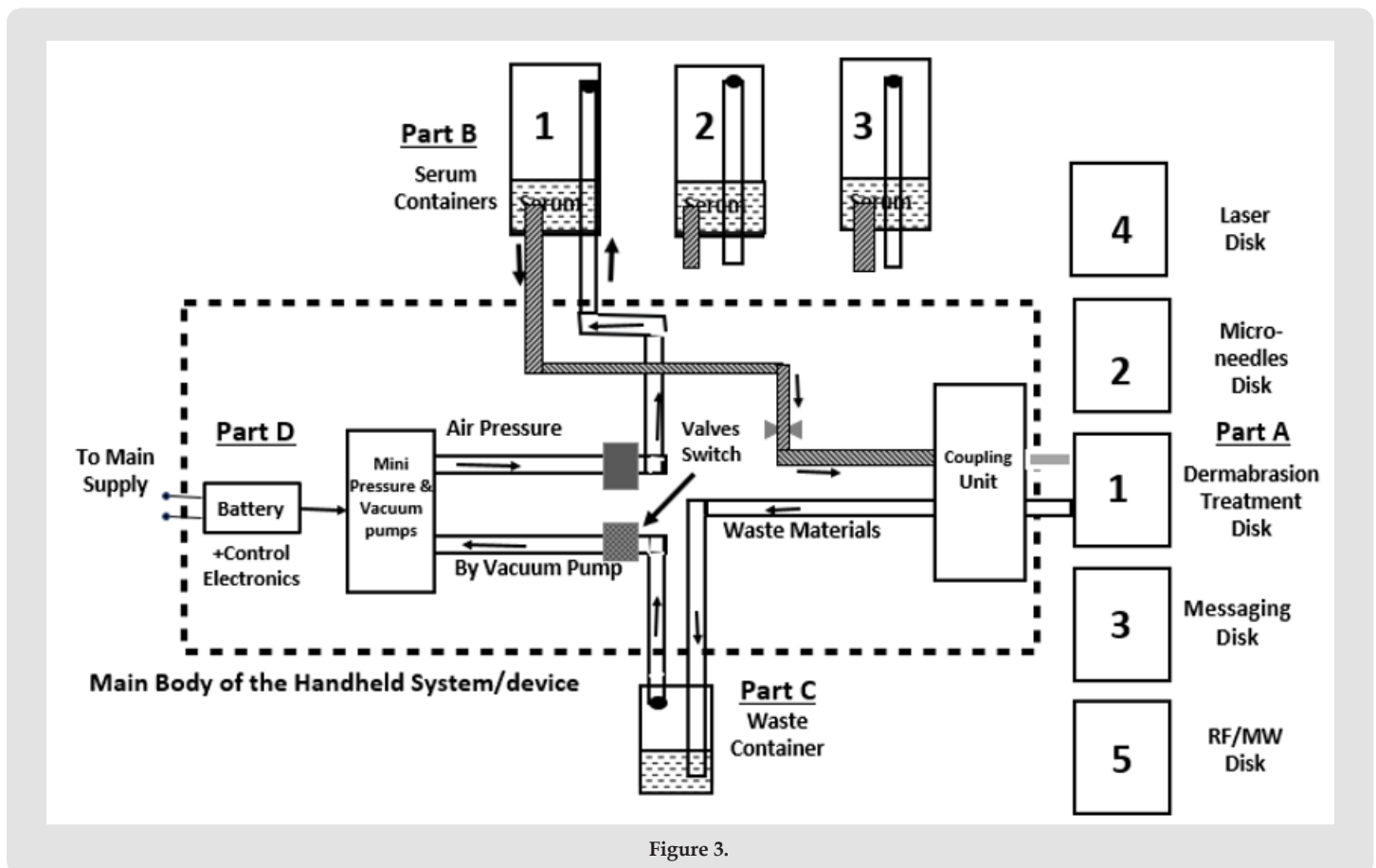


Figure 3.

Figure 3 is a schematic function diagram, showing all the main body components, including all the required internal connect tubes, to move serums from the container in use to specific disk under operation. Also, includes the connecting tubes to move waste materials to the waste container. A special coupling unit is designed for the proper fixation of any of the disks onto the main body, and is positioned in the front side of the main body. Any number of serum containers can be used, but only a single one at any time. Also, any number of disks for various procedures applications can be designed and connected to the coupling unit, but, only a single disk is connected at any time.

Discussion

The main reasons behind the development of this new skincare system are three. The first is to overcome the limitation provided by most, if not all, existing systems, where the serum is applied after some time of the completion of the mechanical or optical/microwave facial skin treatment. This can results in limited interaction, as explained before for the micro needles application. Whereon, the micro holes may not exist for a long time enough until the serum is applied. The second reason is to design the system in a simple structure and in small size. It has to be handheld, and can be used by any person at home or anywhere. Also, it is designed in a simple way, so any one can use it without any need for professionals or assistance. The third

reason is that Part A, the disk, is designed in a way that it can be connected to the main body of the system in a simple clip-on technique, as well as the required serum/waste container. In this way, the same main body of the device is used with any of the disks at any time. Wherein, when a specific disk is connected to the front of the main body, a container with the required serum is connected to the other side of the main body. As a result a patient can do multiple skincare treatment procedures with one simple/handheld system. The new system design was successfully tested on hundreds of patients, and recorded results were encouraging for real use and application. More results will be published in the near future.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2025.63.009909

Mahmoud El Sherif. Biomed J Sci & Tech Res



This work is licensed under Creative Commons Attribution 4.0 License

Submission Link: <https://biomedres.us/submit-manuscript.php>

References

1. Zahra Lotfollahi (2024) The anatomy, physiology and function of all skin layers and the impact of aging on the skin. *Wound Practice and Research* 32(1): 6-10.
2. Darius J Karimipour, Gholamreza Karimipour, Jeffrey S Orringer (2010) Microdermabrasion: an evidence-based review. *Plast Reconstr Surg* 125(1): 372-377.
3. Shim EK, Barnette D, Hughes K, Greenway HT (2001) Microdermabrasion: a clinical and histopathologic study. *Dermatol Surg* 27(6): 524-530.
4. Sharwari Jaiswal, Sugat Jawade (2024) Microneedling in Dermatology: A Comprehensive Review of Applications, Techniques, and Outcomes. *Cureus* 16(9): e70033.
5. El Sherif, et al. (2023) Patent, US 11,786,438 B2, Oct 17.
6. El Sherif, et al. (2023) Patent Application, US /0413979 A1, Dec 28.



Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles

<https://biomedres.us/>