

## Case Report

# The Advancement of Lasers in Skin Health

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## Overview

Lasers have evolved quite drastically since their roots were discovered back in 1900. Today, lasers have a prevalent place in the skincare world and are used to treat a wide variety of skin conditions. Lasers were first used in dermatology in 1963, and although the technology was groundbreaking at the time, laser treatments were still slow and painful for patients. We look at how lasers have evolved since then to make skincare treatments more effective and result in less side effects. In particular, we focus on why fractional carbon dioxide lasers have become so popular in recent years. Although lasers in skincare have developed considerably in recent history, we also explore opportunities for growth and further advancement.

Although lasers sound like a modern innovation, the origins of lasers used in skincare today go back more than 100 years. The technology has advanced drastically since lasers were first used, and today they are a popular and effective tool to treat skin conditions.

The most common uses of lasers in skincare are to reduce the appearance of wrinkles and scars (called laser resurfacing), even out skin pigmentation, tighten skin, and remove non-cancerous and malignant tissue. Lasers can also help improve the appearance of unwanted tattoos and birthmarks, as well as perform hair removal [1]. Laser treatments for skincare have become especially popular in the past 20 years due to their significant results and minimal side effects. Currently, the main reported side effects are skin-related, like redness, swelling, and itching, although there have been cases of infection as well [2].

The scientific foundation for lasers can originally be traced back to 1900, when Mark Planck discovered the relationship between energy and the frequency of radiation and realized that energy could only be emitted or absorbed in distinct amounts, called quanta. His theory then led to the creation of the first device that generated microwave radiation in 1954. In 1960, Theodore Maiman used radiation to construct the first-ever laser [3].

Lasers continued to develop and became used in almost every field, from commerce to photography to aeronautics. They were first used in dermatology in 1963 by Leon Goldman, also known as the “father of lasers in medicine,” who stated how lasers helped remove tattoos and pigmented skin elements such as black hair. In addition to examining ruby and Q-switched lasers, Goldman studied argon lasers for vascular lesions and carbon dioxide lasers for skin

lesion destruction [3]. As laser technology continued to advance, dermatologists Rox Anderson and John Parrish developed the theory of selective photo thermolysis, which states that laser energy is absorbed more by the target than its surrounding structures. “Precise aiming is unnecessary,” they wrote, “because inherent optical and thermal properties provide target selectivity” [4].

It wasn't until 1984 that the Food and Drug Administration (FDA) created their first guidelines around the use of lasers in vascular and dermatological lesions, which are now updated annually [3]. In 1988, robotic scanning mechanisms were developed that allowed laser treatments to be done more quickly and reduce patients' pain. Previously, argon lasers had been used to treat port wine stains with the “point-by-point” technique, which was slow, or the “painting technique,” which was painful and required anesthesia. The robotic system instead used a scanning mechanism to diffuse heat in the skin. In a study that followed where 123 patients were treated with the robotic hand piece over a 12-month period, no hypertrophic scars were reported [5].

The era of laser resurfacing (cited in 2014 as the most popular nonsurgical procedures for skin rejuvenation) began in the mid 1990's when carbon dioxide lasers started to be used on the skin [6]. These lasers remove thin layers of skin with minimal heat damage to surrounding areas and were considered a major advantage in skin laser therapy as they resulted in less bleeding, shorter surgery time, less risk of infection, and less post-op swelling. However, patients still suffered oozing and crusting, prolonged skin rash, infection, scarring, herpes sores, and a long recovery time [7].

Fractional carbon dioxide lasers, developed in 2004, are considered to have comparable results to traditional carbon dioxide lasers, but with minimal side effects and a recovery time of only five to seven days. “The main difference [between fractionated and non-fractionated carbon dioxide lasers] is that the non-fractionated CO<sub>2</sub> laser ablates 100% of the skin surface, whereas the fractionated CO<sub>2</sub> laser ablates only a part of the skin surface that it treats,” board-certified dermatologist Douglas Wu, M.D., wrote for Real Self. “Because a certain degree of healthy, non-ablated skin is left behind after a fractionated CO<sub>2</sub> laser treatment, the healing times are typically faster and there is generally less chance of complication” [8]. Fractional carbon dioxide lasers are also significant because they can treat the neck and chest, while traditional carbon dioxide lasers would never be used off the face [9].

The most-used lasers in dermatology today are surgical lasers, such as carbon dioxide lasers, which can treat sun damage, scars, warts, and other skin conditions. Erbium-YAG laser resurfacing is also an effective, minimally invasive technique used to treat photo aging and wrinkles. Other notable lasers today are the DYE laser and the Nd:YAG laser, which are used for spider veins, rosacea, birthmarks, and more [3].

Despite the vast improvements in dermatologic laser technology

since Goldman's initial discovery, there is still room to grow in the future. When it comes to laser hair removal, there is currently no way to remove white, red, grey, and blonde hairs. Also, darker skin types require a more limited use of lasers. "Currently, we can use longer wavelength laser devices, such as Nd:YAG lasers or infrared lasers, on darker skin types with more conservative laser settings and skin cooling before, after, and during treatment to successfully treat skin of color," said Melanie D. Palm, M.D., M.B.A., medical director of Art of Skin MD in Solana Beach, California [10].

Laser technology continues to progress—Nd:YAG lasers have recently expanded their scope to treat cellulite and fungal infections [3]. Considering how quickly lasers have advanced in skin health in the past few decades, the future of laser technology seems likely to be just as innovative as its history.

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