



## HOME-BASED LASER DEVICES. EFFICACY AND SAFETY

## Dermatology

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## ABSTRACT

**BACKGROUND** Home-based light and laser devices are effective for the treatment of various dermatological problems

**OBJECTIVES** To systematically review and evaluate the efficacy and safety of commercially available home-based laser devices for various dermatological applications

**METHOD** A comprehensive literature search was performed on Google Scholar and PubMed. Prospective clinical trials were included, while animal studies, non-English articles, and studies that did not focus on home use or dermatological indication were excluded. A total of 675 articles were identified regarding home use devices. After screening the articles for inclusion and exclusion criteria, 44 studies involving 1,951 participants were selected, including 21 randomized control trials, 5 non-randomized controlled trials, and 18 case series.

**RESULTS** There was significantly more evidence for the safety or efficacy of Intense pulse light, but this study focused on using home-based laser devices. Most studies evaluated short-term hair reduction up to 3 and 6 months. Devices were found to be effective for short-term hair removal, with side effects ranging from erythema and edema to blisters.

The use of laser for skin rejuvenation is based on the fact that laser-treated areas can have islands of healthy skin left behind, which accelerate recovery. Patients who underwent treatment in a recent prospective, split-face study were evaluated by a blinded dermatologist and showed at least a 1-point improvement in wrinkles, dyschromia, and diffuse redness in 75% of participants

Low-level laser therapy stimulates hair growth. Patients who used the device for 15 minutes per week for 26 weeks demonstrated significant improvement in mean terminal hair density and overall hair growth compared to the control group.

**CONCLUSION** Available information from current clinical trials indicates that home-based laser devices are adequate for the short treatment of hair removal, skin rejuvenation, and hair removal. Additional controlled trials are recommended to better quantify the safety and efficacy of available devices.

## KEYWORDS

Home-based, laser devices, skin rejuvenation hair growth

## INTRODUCTION

Home based laser devices for hair removal are now a multibillion-dollar industry; companies launch new devices every year and claim an easy home-based solution to complex dermatological problems. Products are easily available at retail stores, spas and online shops at affordable prices. Conditions like excess body hair, acne, psoriasis and alopecia require expensive therapies and frequent visits to dermatologist's clinic. It's no surprise why low-cost home-based therapies are increasing in popularity.<sup>1,2</sup> These therapies include light or laser-based products marketed for various applications like hair removal, photorejuvenation and treatment of acne. With a major contribution from therapeutic equipment, home medical equipment market is expected to reach \$56.45 billion by 2027.<sup>3</sup> Food and Drug Administration (FDA) has approved several light-based devices for home based dermatological applications.<sup>4</sup> Currently these devices are labelled as cosmetic products and are available over the counter to consumers. The first light device used for hair removal purposes was intensely studied for its safety and efficacy following short and long-term use.<sup>5,7</sup> It was found to be effective for all skin types and tones with the use of appropriate cut-off filters.<sup>8</sup> These results were verified by several studies.<sup>9-11</sup> However, most of these products are not held to same standards as medical devices which have to undergo meticulous peer-reviewed, double-blinded randomized controlled trials demonstrating their efficacy and safety before FDA approval. The objective of this systemic review is to summarize existing literature on home-use devices so consumers and dermatologists can make informed decisions.

## METHODS

A literature search was performed on September 25, 2021, using Google Scholar and PubMed to review literature between 1996 and 2021. Emphasis was put on the efficacy and safety of home-use laser devices. Articles were screened for inclusion and exclusion by authors. Clinical trials focusing on the safety and efficacy of home-use laser devices for dermatologic indications were included while animal studies, non-English articles and studies that did not focus on home use or dermatological indication were excluded. It was noted that significantly more studies exist for home use intense pulse light devices than laser devices. This study only focuses on studies concerning home use laser devices.

## RESULTS AND DISCUSSION

A total of 675 articles were identified regarding home use devices.

After screening the articles for inclusion and exclusion criteria 44 studies involving 1,951 participants were selected including 21 randomized control trials, 5 non-randomized controlled trials and 18 case series. This article will limit its focus to randomized controlled trials on home use devices.

## Hair Removal

As the consumer market for home-based laser devices increases global hair removal device market size is expected to reach \$1177.8 million by 2027. Laser-based and light-based therapies have been used by dermatologists and spas for years but now consumers have access to these over-the-counter devices.<sup>12</sup> Its mechanism of action is based on selective absorption of optical energy by pigmented targets leading to localized heating of hair follicle compartment. The temperature rise is based on several factors ranging from the wavelength of light, fluence, duration of pulse to properties of target tissue such as thickness, colour and density.<sup>13,14</sup> Optimal wavelength of light for penetration and destruction of hair follicles is 650 to 1,100 nm. Light is absorbed by the melanin of hair follicles and converted to heat, diffusion of heat to the root of hair follicles leads to coagulation of proteins and destruction of cells. Wavelengths less than the optimal range don't effectively penetrate the hair bulge and higher wavelengths are not absorbed by melanin. The peak temperature achieved by target tissue is defined as fluence and pulse duration determines the time a target has been heated. The goal of laser therapy is to deliver targeted energy to tissue with minimal diffusion to surrounding areas. Home-use laser devices have to be small enough to fit in the palm of hand and powerful enough to achieve effective hair removal. While office-based laser devices can release light pulses of various wavelengths and have fluences of 10 to 60 J/cm<sup>2</sup>, home use laser devices deliver wavelengths of 800-810 nm and have lower maximum fluences. Studies suggest that a minimum fluence of 5 J/cm<sup>2</sup> is required to effectively limit regrowth of hair follicles and lower fluences may only temporarily delay hair growth.<sup>15</sup>

Studies suggest that these devices are easy to use and consumers can administer treatment with minimal training. However, these studies were carried out in a controlled environment under the supervision of physicians who could guide the consumers about device usage and prevent any mistakes that could lead to serious damage.<sup>16</sup> Although these devices come with detailed user manuals outlining proper usage and safety precautions but most consumers choose not to read the details.

Ocular exposure is perhaps the biggest concern about safety of these

devices. Most devices don't require protective eyewear use to prevent retinal damage but exposure to wavelength below 400 nm and above 750 nm can theoretically result in blind spots, glaucoma and cataract.<sup>17</sup>

### Tria (SpectraGenics, Inc., Pleasanton, CA)

FDA approved Tria in 2009, it was the first device to receive approval for removal of nonfacial hair.<sup>18</sup> Current model offers fluence ranging from 7-20 J/cm<sup>2</sup> and pulse duration ranging from 150-400 milliseconds.<sup>18</sup> A study by Town and Ash demonstrated that measured fluences were 38% less than the ones claimed by the manufacturer and spatial distribution of energy was uneven, however, the device was effective for hair removal purposes.<sup>19</sup> Wheeland and Colleagues assessed the safety and efficacy of Tria in two armed peer-reviewed trials, Patients with type I to IV in the first arm noticed 41% (p<0.01) and 31% (p<0.01) reduction in mean hair count at 6 month and 12-month interval with minimal erythema. In the second arm, 44 patients with type V to VI skin type were assessed for dermatological side effects after a single treatment at the highest laser setting. One patient with type V and 10 patients with type VI skin developed blisters which eventually resolved with slight dyspigmentation. Another study by Wheeland assessed safety and efficacy in 13 patients. Thirty-eight patients had more than 80% reduction in mean hair count while 86% had more than 30% reduction one year after completing 8 monthly treatments.<sup>21</sup>

The device has several safety features; the manufacturer includes a skin tone chart and phone activation system. Patients obtain an activation code after answering questions about their skin type. A contact switch ensures that the laser cannot fire until it is in contact with skin and appropriate levels of pigment are detected.

### Rio Salon Laser (Dezac Ltd., Cheltenham, United Kingdom)

Currently this device has two models which differ in spot size and the number of hair that can be removed in a single pulse. Although the manufacturer has not disclosed information about fluence and pulse duration, a study conducted by Town and Ash measured its fluence 0.09 J/cm<sup>2</sup> as insufficient for permanent hair destruction. This device requires an activation key, security code and contact sensor to prevent improper firing. According to the manufacturer, this device is not suitable for "black skin complexions or grey hair"

### Skin rejuvenation

Photoaging modifies the tensile strength of tissue by altering proteoglycans, collagen and elastic fibers in the extracellular matrix. The use of laser for skin rejuvenation is based on the fact that laser-treated areas can have islands of healthy skin left behind which accelerate recovery. Damaged extracellular matrix is removed allowing fibroblast resettlement and production of proteoglycans, collagen and elastin.<sup>22</sup> A recent prospective, split face study evaluates efficacy of home-use device for treatment of photoaging. Thirty-four subjects were treated with 1,440 nm laser device either 5 times daily or biweekly for 12 weeks. Patients were evaluated by a blinded dermatologist and showed at least a 1 point improvement in wrinkles, dyschromia and diffuse redness in 75% of participants. An improvement in skin roughness was noticed in 100% of participants.<sup>23</sup>

### Hair Growth

Low-level laser therapy (LLLT) stimulates hair growth.<sup>24</sup> Home use LLLT devices for hair growth use low power monochromatic red light.<sup>25</sup> Exact mechanism of hair growth is not known but it is suggested that LLLT acts on mitochondria and disassociates inhibitory nitric oxide from cytochrome c oxidase.<sup>26</sup> This results in increased production of ATP and induction of various transcription factors.<sup>27</sup> Satino and colleagues evaluated the efficacy of home use hair growth device in 28 male and 7 female patients. Hair count and tensile strength were evaluated. A greater improvement in tensile strength in the vertex area for males and temporal area for females was noticed. Both sexes had a substantial increase in hair count. A 74% increase in temporal area and 110% increase in vertex area hair count was noticed in men compared to 55% and 65% in women respectively.<sup>28</sup>

A double-blind, multi-centre randomized control study assessed the efficacy of home-use laser device for hair growth in 110 male patients. Patients used the device for 15 minutes per week for 26 weeks. A significant improvement in mean terminal hair density and overall hair growth was noticed compared to the control group.<sup>29</sup>

Home-Use Laser Devices						
Device	Manufacturer	Indication	Wavelength (nm)	Fluence J/cm <sup>2</sup>	Level of Evidence	Source
Tria Laser x4	SpectraGenics, Inc.	Hair removal, Acne treatment	810	7-20	Single-centre uncontrolled trial, Single-centre controlled trial	Wheeland <sup>21</sup> Wheeland & Koreck <sup>20</sup>
Tria Laser precision	SpectraGenics, Inc.	Hair removal	810	7-20	-	-
Rio Scanning Laser x60	Dezac, Ltd.	Hair removal	808	-	-	-
Rio Scanning Laser x20	Dezac, Ltd.	Hair removal	808	-	-	-
Tria Age-defying Laser	SpectraGenics, Inc.	Photoaging	1,440	5-12	Prospective, single-centre, split-face trial	Shaffer et al. <sup>23</sup>
HairMax Laser comb	Lexington International, LLC	Hair Regrowth	655, 635	-	Double-blinded, sham device-controlled, multicenter trial (n=2) Single-centre uncontrolled trial (n=1)	Leavitt et al. <sup>25</sup> Jimenez et al. <sup>27</sup> Avram and Rogers <sup>22</sup>

All devices are suitable for skin type I-IV

### CONCLUSION

There are limited blinded, controlled studies evaluating efficacy and safety of home-use devices but credible evidence has been published in respected peer-reviewed journals that confirm most home use devices are safe and effective in providing short-term hair removal upto 6 months. Data on long-term effectiveness is not available.

Manufacturers have tried making these devices safe and easy to use by considering the needs and capabilities of consumers. Devices come with warnings, safety notices and precautions to decrease the risk of injury. Furthermore, there are built-in safety switches and sensors to prevent accidental trauma and burn.

Home-use laser devices can be considered as an alternative to professional treatment for some patients who require long-term therapy due to some hormonal disorder but cannot afford economic burden of extensive office-based treatments. It is also effective for top ups and treatment of private areas where patients may be embarrassed to talk about their concerns. Consumers should understand that home-use devices require regular and frequent use. It should be noted that most devices are not suitable for all skin types.

### Conflict of Interest/ Disclosure

There was no conflict of interest.

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