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Study Using Alexandrite Laser Wavelength 755nm for Hair Removal

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Abstract

When skin is exposed to a light source, the energy may be reflected due to the different refraction coefficients between the corneal epithelium and air. In the case when the energy leaks into the skin, it can result in epidermal damage. All of which reduce the effectiveness of therapy. In this paper, the researcher has assessed how well cooling sapphire handpieces worked to lessen damage and discomfort to the epidermis while enhancing the results of laser hair removal treatments. Throughout such procedure, the follicular epithelium is harmed by the laser light that is being absorbed by melanin in hair shaft. The efficiency of using LightSheerTM laser for hair removal was evaluated in clinical research. Unwanted body hair removal is one of the most common requests in the surgical and dermatological professions. The employment of lasers to produce a more lasting decrease continues to advance. Although the usage of lasers has increased, there are still few standards to handle laser hair removal. In particular, one needs to comprehend how hair grows and the way that the lasers target hair follicle. Post- and pre-laser suggestions to patients and the intervals between treatment sessions vary significantly amongst practitioners. Based on published research, guidelines have been developed for the exposure to laser treatments prior to and afterward, along with suggestions for waxing, shaving, plucking, along with other hair removal techniques.

Keywords: Laser; Hair removal; Alexandrite; wavelength 755nm

دراسة استخدام ليزر Alexandrite بطول موجي *755nm* في ازالة الشعر

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الخلاصة

عندما يتعرض الجلد لمصدر الضوء، قد تنعكس الطاقة بسبب اختلاف معاملات الانكسار بين الضوء المسلط على البشرة ، وفي حالة تسرب الطاقة إلى الجلد، يمكن أن يؤدي ذلك إلى تلف البشرة. وهذا يقلل من فعالية العلاج خلال هذا الاجراء تضرر البشرة بسبب ضوء الليزر الذي يمتص الميلانين في بوصلة الشعر . يعتبر إزالة شعر الجسم من أكثر الطلبات شيوعاً في المهن الجراحية والجلدية. يستمر استخدام الليزر لإنتاج انخفاض أكثر استدامة في التقدم بفضل التكنولوجيا على الرغم من زيادة استخدام الليزر، إلا أنه لا تزال هناك معايير قليلة لطريقة التعامل مع إزالة الشعر بالليزر. وعلى وجه الخصوص، يحتاج المرء إلى فهم كيفية نمو الشعر والطريقة التي يستهدف بها الليزر بصيلات الشعر. تختلف ارشادات ما بعد وما قبل الليزر للمرضى والفترات الفاصلة بين جلسات العلاج بشكل كبير بين المختصين بناءً على الأبحاث المنشورة، تم وضع إرشادات للتعرض لعلاج الليزر قبل وبعد ذلك، اضافة إلى جانب الارشادات لإزالة الشعر بالشمع والحلاقة والنتف بالإضافة إلى استخدام تقنيات إزالة الشعر الأخرى.

1. Introduction

The most effective treatments for removing unwanted hair are thought to be laser devices [1]. By concentrating on melanin, the particular chromosphere, such devices aim to harm bulge stem cell as well as dermal papilla of hair follicle. Following some laser sessions, photo-epilation using alexandrite laser systems has proven to be an effective approach for the hair removal [2-4]. However, there are still a few shortcomings in laser hair removal that can be

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fixed. Despite being efficient, laser treatment can cause discomfort and side effects, particularly in the case of treating dark or tanned skin [5-8]. These side effects include transient erythema, hypo- and hyperpigmentation, perifollicular edema, crusting, and vesicles. The radiation from the laser damages melanin cells, absorbs and destroys the follicles of the hair, and slows or stops growth of the new hair in the radiation-exposed area [9][10]. Prior to beginning the laser treatment, a pre-session with the doctor is required. During this time, the dermatologist will decide with the patient on the regions that will be treated, taking into account the patient's preferences as well as colour, type, and thickness of their hair and skin. The effects of skin colour and type on laser hair removal. Laser hair removal has been considered a better option, which does less damage to hair and skin, and results in longer hair and lighter-toned skin.[10][11] With regard to hair removal, there are a number of lasers that use light therapy and are effective for various skin tones. These include alexandrite lasers (755nm) for lighter skin tones, ruby laser (694nm) for the fair skin tones, diode lasers (800-810nm) for all skin tones, and Nd: YAG (1064nm) for the darker tones. With a 755nm wavelength, alexandrite laser is very good at removing thinner and lighter hair. In terms of laser hair removal for those with prototype I–III, the laser is regarded as "gold standard." The melanin chromosphere in Alexandrite Laser Hair Removal 755nm provides more potent energy absorption, which makes it perfect for a broad variety of hair colours and types—especially thin and light-colored hair. Ideal for skin types I–III is 755 nm. An Alexandrite Laser is specified as a kind of laser which produces high-energy light by passing through alexandrite crystal. A light beam 755 nm long is created as light travels through alexandrite crystal. Professional Alexandrite Laser Hair Removal 755nm has been considered perfect for a wide variety of hair kinds and colours, notably thin and light-colored hair, because it provides the melanin chromosphere with more potent energy absorption. Targeting the bulge of hair follicle, 755nm wavelength has a more superficial penetration and works particularly well for superficially entrenched hair in places like the eyebrows and upper lip.

2. Hair

Mammal bodies develop hair, which is a protein growth made up of a few non-living cells, as well as a few substances which are typically toxic and damaging to the body. These substances are ejected from mammals in the form of hair. [12] In most cases, infants have simple brows and hair that cover their eyes and heads. After puberty, hair begins to grow on human body in areas besides the head, like armpits, pubis, and leg. The amount of the hormone androgen determines whether males develop chest hair, facial hair, or beards. The majority of human body has hair, including the head, and it is highly prized. Facial hair is another thing, and women and men have different tastes in it. Hair plays a vital function in daily life and undergoes continuous change as a person develops. The follicle and hair shaft, which are the two main parts of hair and are produced from the epidermal layers of skin, are depicted in Figure 1 (A). The follicle represents the main component that is involved in the creation of hair. The hair shaft is composed of cells from the bark and epidermis. The hair follicle passes through several continuous growth and rest phases, which together make up the hair growth cycle [12] [13].

Figure -1 (A) Anatomy of hair structure, (B) Alexandrite laser hair removal, (C) Relation skin type and hair type.

3. Type of Hair

1-Normal hair: which is in between dry and oily hair, therefore, it neither clearly demonstrates dryness nor considerable fat; in other words, it is neither greasy nor dry.

2-Oily hair: The hair is what looks greasy or rapidly goes out of fashion.

3-Dry hair: After being washed, the hair is what begins to dry out and lose its shine.

4-Mixed hair: It is the most challenging hair type and requires careful maintenance since it's dry at the bottom and greasy on top, with lack of the fat at the ends and excess fat closer to scalp. Two forms of melanin, pheomelanin and eumelanin, cause the pigmentation of hair follicles, which is what gives hair its color. Hair color will often be darker if there is more melanin present. The hair color is lighter and (Eumelanin) is present if it is less normal. An individual's hair color might change with time as a result of changes in melanin levels, and hair follicles on the same individual may have more than one hue.

4. Hair Removal Mechanism by Using Laser

Laser hair removal techniques aim for treating hair growth and stop it from growing back in body places where the patient doesn't want the hair to grow, to cure the excess hair, or for cosmetic reasons. [14] Laser hair removal could help minimize the amount of unwanted hair. Among the most often treated locations are the upper lip, chin, armpits, and legs. You may get rid of unwanted hair in almost any region, save for the area around the eyes or eyelids. Skin with tattoos shouldn't be handled very roughly. Skin type and hair color have an impact on how well laser hair removal works. The fundamental idea is that hair pigment needs to absorb light, not skin pigments. Lasers must only damage hair follicles; they shouldn't cause damage to skin. It has been found that having black hair and light skin that contrast with each other produces the best effects. Yet, those with darker skin tones currently have the option of laser hair removal due to the technological breakthroughs in the field. In the case when there is little difference in the color of hair and skin, there is a greater risk of skin harm. Because gray, red, white, and blond hair hues don't absorb light well, laser hair removal is less efficient on these types of hair. Research is still ongoing on laser treatment options for light-colored hair [15]. Laser beams cause damage to melanin cells, absorbing and dissolving hair follicles while also

delaying or preventing the growth of new hair in the exposed area. Although it's not often precise, the term "permanent hair removal" is frequently utilized to characterize a laser hair removal procedure. There is no guarantee that hair will not grow back after the procedure.

5. Laser Technique

The alexandrite laser system utilized in this work (Motus AX, DEKA, Calenzano, Italy) achieves a 755nm wavelength with fluence range between 6J/cm2 and 8J/cm2, frequency up to 10Hz, and spot size of 20mm in diameter. The appropriate fluence for the procedure was chosen based on the clinical features of a patient (hair and skin types). Prior to the treatment, there was no anesthetic cream utilized. With alexandrite laser, a special handpiece (Moveo, TM) with integrated cooling system was utilized. Following applying clear oil or gel, Moveo handpiece is moved over skin repeatedly in a series of continuous linear or circular motions, with the goal of covering a single region. The patient experienced discomfort due to the hair's vital components being slowly heated by repeated passes over small sections. A particular alert from the device indicated when an acceptable therapeutic dose had been achieved in the area of 10 x 10 cm. A moisturizer for skin recovery has been used following each session. Patients have been encouraged to apply sunblock the days after treatment in a case when the area was exposed to the sun despite the strong recommendation to avoid it. It is the most widely used equipment in the area, one of the optimal laser kinds for hair removal in clinics, efficient and somewhat safe. It can be utilized in order to remove facial hair, and people with dark skin tones are recommended to use it. Alexandrite laser represents the most widely used method for laser hair removal. Despite the fact that more recent machines include built-in cooling device to enhance patient comfort in figure (1) (B). Alexandrite laser runs at a lesser wave-length of 755nm [16] in table (1) explain Technical Parameters laser 755nm.

Table 1- Technical Parameters

Wavelength	755mm
Spot Size	6~18 mm (Adjustable)
Monitor	10 inches Digital Real Colour LCD
Function	HR (hair removal), VR (vein removal), SR (skin rejuvenation).
Max Energy Density (Fluencies)	212J/cm² (755nm@6.0mm diameter)
Function	40~60J(755nm)
Laser Fiber	Made by Japan
Pulse Frequency	0.50-2.0Hz
Pilot Beam	635 nm diode 3mw
Pulse Duration	5-100ms
Machine Measure	500 mm(W)x1100mm(L)x1150mm(H)
Weight	120kg
Power Supply	3000 watts

6. Alexandrite Hair Removal Laser

It is a very good laser type for the hair removal in the clinics, the most popular device in this area, fairly safe, and effective. It could be utilized for eliminating facial hair, and those with brown and dark skin are advised to use it. The most often utilized laser hair removal system is Alexandrite laser. Despite the fact that more recent machines include built-in cooling device to enhance patient comfort. Operating at a lesser wavelength of 755 nm, the Alexandrite laser [17].

7. Parameter of Alexandrite Laser

In order to achieve optimal outcomes for any possible combination of hair type and skin tone, several laser wavelengths must be used. Because we provide all three laser systems including IPL, we are able to benefit from every technology's advantage without being constrained by its drawbacks. A highly competent laser operator who can safely adjust the next laser parameters is needed for expert hair removal.

- Pulse Width (shutter speed)
- Spot size (measured typically in mm)
- Wavelength (colour of light)
- Fluence (power)

Making the right choice guarantees that hair follicle is destroyed as effectively as possible without causing any harm to the surrounding skin.

7.1 Laser Wavelength (Colour of light)

Choosing the right laser wavelength is crucial because it allows for the following:

- the safe handling of every type of skin. Darker skin types react better to Nd Yag 1064nm laser, whereas types of lighter skin respond better to Alexandrite 755nm laser in figure(1) (C) . Moderate skin types benefit greatly from the diode 810nm laser.
- Treatment of hair follicles at different depths with effectiveness. A few hair follicles are superficial (like those over the upper lip), whereas others are much deeper (like those in bikini). This is because the root of a hair follicle could be found anywhere from 2 to 7mm below skin's surface. For best outcomes, the operator must be able to target all of the follicles at various depths, which calls for the use of numerous laser wavelengths.
- The method used for treating hair of various colours. A laser like Alexandrite 755nm laser that has a strong attraction to melanin is necessary for the effective treatment of light-colored, fine hair. Darker, thicker hair will react more favourably to diode 810nm or Nd Yag 1064nm lasers.

Because it allows the operator to target hairs of varying sizes, choosing the proper pulse width is crucial.

- Short pulse widths, typically between 5 and 10ms, are necessary for fine hairs

due to the fact that they heat up rapidly, yet can't maintain the heat in figure(2) (A) .

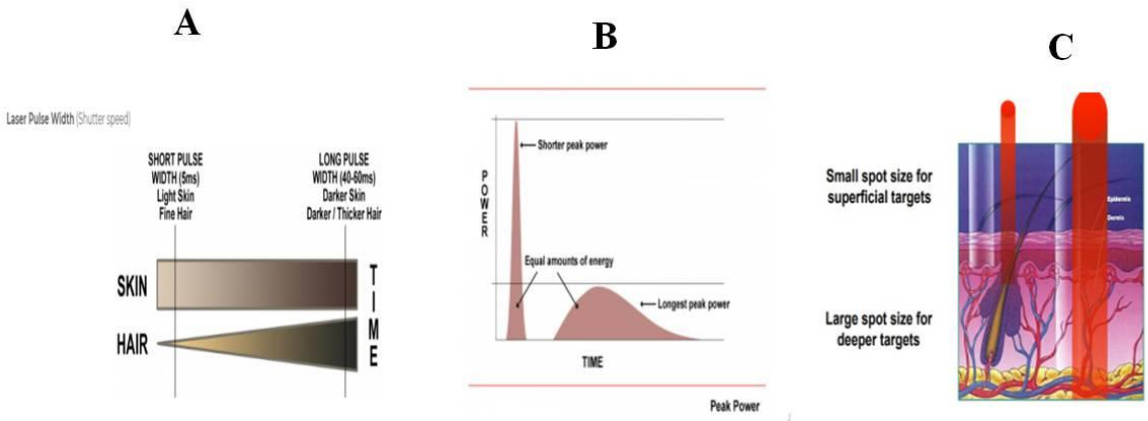

Figure -2 (A) laser pulse width, (B) Spot size and Depth of optical penetration, (C) Relation between power and peak power .

Since thicker hairs heat up more slowly, they need significantly longer pulse widths, often between 40 and 60 ms. Frequently, as a laser hair removal treatment goes on, the follicles shrink and the hair gets finer, necessitating a decrease in pulse width to guarantee treatment effectiveness.

7.2 Laser Spot Size

Larger spot sizes work best for deeper targets, while the smaller spot sizes work best for the treatment of smaller superficial hair follicles in fig.2(C) . The deeper the penetration of laser, the larger the spot size. Also, bigger spot sizes make it possible for the operator to comfortably and quickly treat bigger body parts. Therefore, a broad range of spot sizes yields better results.

7.3 Laser Power (Fluence)

The better the result, the stronger the laser. A temporary loss of hair lasting one to three months could be caused by any low-powered, inexpensive laser device. High-quality lasers which could provide the significant power required for heating the hair follicle to 65 to 70 degrees Celsius are necessary for the permanent reduction of hair in order to guarantee irreparable damage to the hair. The next forms of energy must be able to be delivered by Gold Standard hair removal lasers.

- High peak power short pulse lengths allow energy to be focused on smaller hair follicles.
- Larger hair follicles can be gradually heated by longer pulse times with lower peak powers in figure (2) (B).

A proficient laser operator can attain significantly better outcomes by utilizing high-quality lasers with adjustable wavelengths, variable spot sizes, variable pulse durations, and variable fluence. To remove hair, most clinics in UK use IPL (Intense Pulsed Light), regardless of the patient's skin tone, follicle depth, or hair thickness. This is sometimes mislabelled "laser hair removal" (IPL device is a light source, not a laser), and it's promoted as the best way to remove hair. IPL is typically significantly less effective compared to a laser at a given task, as demonstrated by clinical research.

8. Benefit of Laser Hair Removal

In spite of being more expensive than other conventional treatments, laser hair removal has numerous advantages over them. Those advantages include [18] [19].

1. Effectiveness: laser is a very effective hair removal technique, and its results last for very long time.
2. Speed: based upon the area that is under treatment, laser permanently removes the hair rather fast.
3. Simple pain: the skin is treated with aesthetic cream prior to starting the treatment since it could result in feeling uncomfortable. Hair removal with a laser is less unpleasant than hair removal with thread or wax, by simply stinging with every one of the laser pulses.
4. Skin Smoothing: laser hair removal leads to softening and enhancement of the beauty of skin, and it’s safe to use on sensitive places like the eyes or mouth.

5.Rarity of negative effects: Laser hair removal seldom results in any temporary side effects. Permanent hair removal technology -the optimal absorption wave-length of the melanin 755nm.
6-Professional Cryogen-based Dynamic Cooling System – More comfortable compared to typical skin contact cooling, this method removes hair with maximum strength.
7- High speed, big spots – comprehensive enhancements brings new surprises.
8- Higher Laser Power.
9-Lighter Handpiece.
10-755nm: best suited for skin types I-III.
11-Skin Rejuvenation.
12- Super Long-Life Span.

9. Principles of Laser Hair Removal

Since Goldman et al.[20] first reported ruby laser harm to pigmented hair follicles in the year 1963, laser depilation has offered a different, clinically superior method of permanent hair removal. A number of factors, primarily related to laser light itself, as well as the properties of skin and hair follicles, vary and impact the effectiveness of such treatment. "selective photothermolysis," a physical mechanism originally indicated by Anderson et al., provides the basis for laser hair removal. [21] This method is characterized by laser energy being preferentially absorbed by hair follicle, as opposed to any other potential target on skin's surface. The target "chromosphere" is the "melanin" that the hair follicle contains.[22] The target is destroyed by the heat energy of laser through both physical and chemical effects. The bulb, infundibulum, and isthmus are the 3 separate components of a hair follicle, which is located in skin's dermis. Melanocytes are found in the bulb and bulge of the hair follicle, which are approximately 4mm below the surface of the skin. Skin layer containing the bulb and bulge should be the focus of laser energy in order to remove hair. Through adjusting the laser's spot size and wavelength, this is accomplished. Longer wavelengths are less absorbed through melanin yet enter the dermis more deeply. Laser light penetrates deeper the larger the spot size. The hair follicle's growth cycle is another significant component influencing the outcome. Three phases in a whole cycle: anagen, catagen, and telogen. The anagen, or the phase of the active growth, is when the hair is most vulnerable to the laser light. [23,24] Since follicles in different parts of the body are in various growth stages, the length of cycle varies depending on the area of the body. As a result, many laser sessions are typically required. Hair removal is presently accomplished using a range of laser wavelengths, from short 695 nm ruby laser to the long 1064 nm Nd: YAG laser. [25] Longer wave-lengths are too near to the rates at which melanin and oxyhemoglobin absorb light to be completely efficient, while shorter wave-lengths are useless for accomplishing the intended long-term hair removal. Alexandrite laser is a perfect option because of its wavelength of 755 nm, which puts it almost in the centre of the spectrum. The quantity of photons that reach the target determines the laser light's energy, which is expressed in joules (J). A laser's power is expressed in watts and is determined by the total amount of energy it delivers over time. The energy applied to a unit area is referred to as fluence (J/cm2). The diameter regarding laser beam determines the spot's size; larger spots enable the delivery of more potent fluence in dermis. (26] The surrounding tissue should be protected while laser energy destroys the follicle of the hair for laser treatments to be considered safe. The application of thermal relaxation time (TRT) principle accomplishes this. This term describes the amount of time the target cools. Selective thermal damage occurs in a case when energy is delivered for a longer period of time than the

target's TRT, yet for a shorter period of time than the TRT of hair follicle. This prevents the target from cooling, which damages the hair follicle. (26,27) Hair follicle takes between 40 and 100 ms to cool, even though the epidermis' TRT was measured at 3 ms. Apart from this principle, skin could be treated with cooling equipment. These devices allow the operator to safely provide more energy while also protecting the skin from any thermal injury and reducing patient suffering.

10. Treatment by Laser

Ten samples were taken from patients who used lasers to remove facial hair. Use modelling Comparisons were made before using the laser and after using the laser. The area after using the laser beam was free of hair and smoother, and it took longer for the hair to appear compared to using thread or wax instead of the laser. It was found that Laser is the best treatment or technology for the purpose of getting rid of excess hair. The period of its appearance is long compared to using traditional methods.

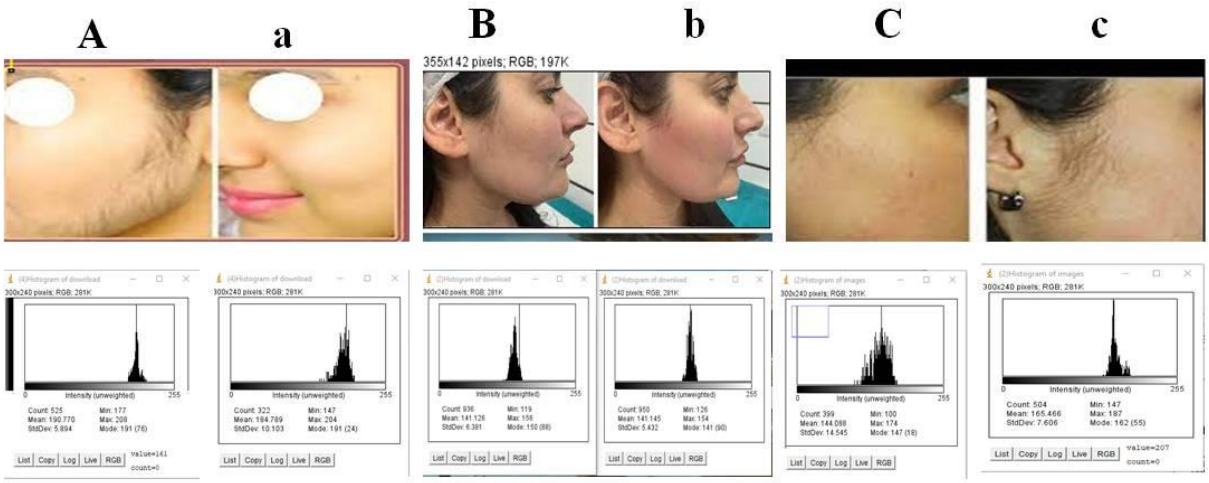

Figure -3 The patient that treated (A) before useing laser and (a) after laser, (B) The patient that treated before use laser and (b) after laser, (c) The patient that treated before use laser and (C) after laser.

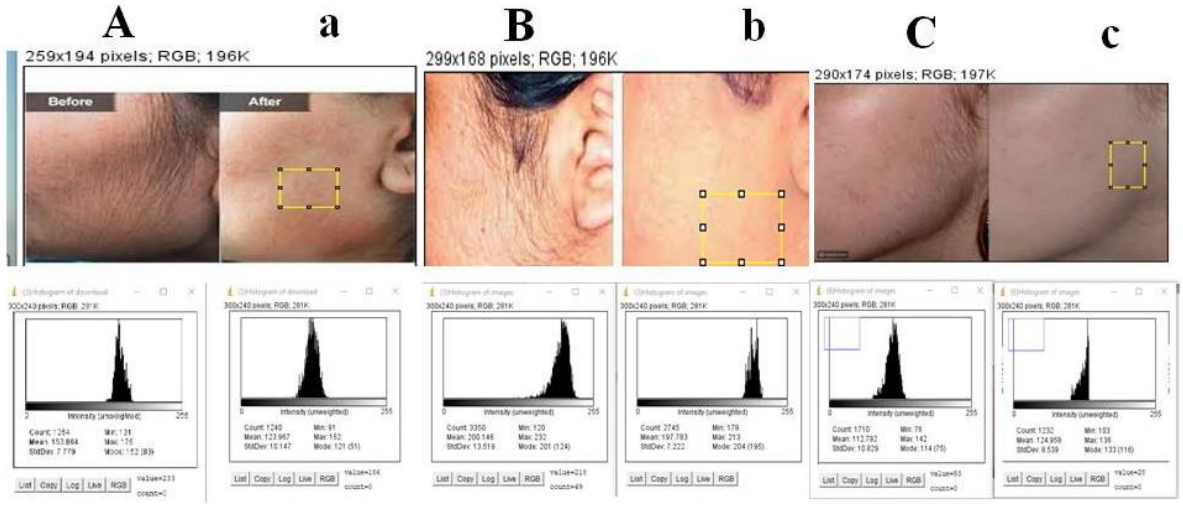

Figure -4 The patient that treated (a) after use laser and (A) before laser, (B) The patient that treated before use laser and (b) after laser, (C) The patient that treated before use laser and (c) after laser

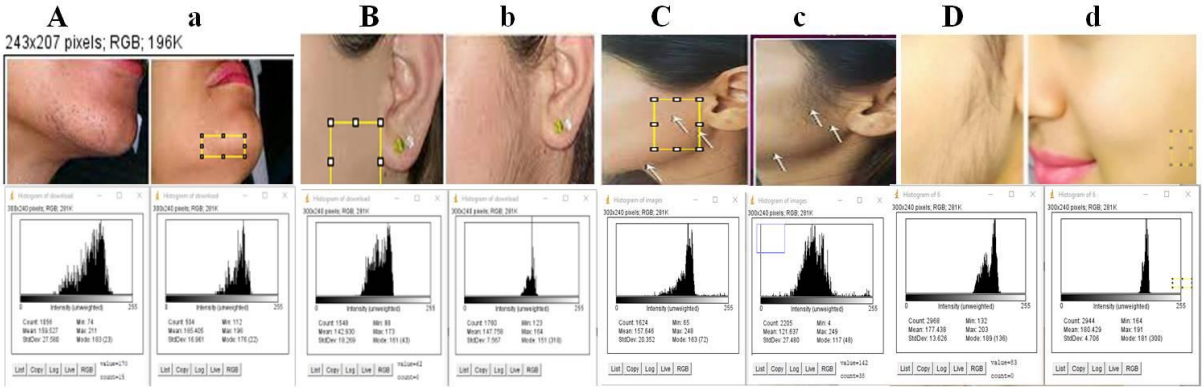

Figure -5 The patient that treated (a) after use laser and (A) before laser, (b) The patient that treated after use laser and (B) before laser, (C) The patient that treated after use laser and (c) before laser , (d) The patient that treated before laser and (D) after use laser .

11. Discussion

For eliminating undesired extra hair, a focused light beam called a laser is utilized in the medical treatment known as laser hair removal. The pigment (melanin) in hair absorbs the light that is emitted by the laser throughout laser hair removal. Heat from the light radiation damages the skin's tubular vesicles, or hair follicles, which are in charge of creating hair. Hair development is inhibited or delayed by this damage. Laser hair removal does not typically lead to permanent hair removal, even while it efficiently slows hair growth for prolonged periods of time. The first laser hair removal process requires multiple treatments, and it might need maintenance treatments. Although it could work well on all skin types, laser hair removal is most effective on those with light skin and dark hair. When we researched resources on the topic of laser hair removal, we found that our series had the highest reported number of studied patients and the highest reported number of applied sessions. We instead chose to present our actual application experience and method in this paper because the action mechanism, chemical and physical impacts of laser energy, along with the statistical findings of the hair follicle removal, had already been published [28–30]. The results of treating pseudo folliculitis barbae in individuals with coiled hair with laser hair removal were quite encouraging. We wish to underline that laser therapy represents the most effective treatment and must be the selected type of the therapy, despite the fact that multiple other treatment modalities, including different shaving equipment, electrolysis, and surgery frequently are advised for such patients [31,32].

12. Conclusions

Reduction of undesired hair is the aim of laser hair removal. The effectiveness of laser hair removal is affected by hair colour and skin type. The fundamental idea is that light is absorbed by hair pigment, not by skin pigment. It is intended that laser rays will just injure hair follicles and not the skin. Consequently, the best effects are obtained when hair and skin colours

contrast, such as dark hair and light skin. Although there is less difference between the colour of the skin and hair, there is still hope for darker skin tones to advance in laser technology. Red, grey, white, and blonde hair types that do not absorb light efficiently are less successful candidates for laser hair removal. On the other hand, laser therapy solutions for light-coloured hair are still being developed. There are many different kinds of lasers available, yet there are limitations when it comes to selecting the best one for ethnic skin. Lasers have been used to remove hair or to stop hair growth in parts of the body where it is not wanted. It's important to select the right laser for the skin type. It is necessary to determine the type of laser to be used, the pulse's length, and the skin type of patient before the beginning laser therapy. Treatments with long-pulse alexandrite laser hair removal are successful in meeting patients' expectations for long-lasting hair loss. In comparison to other methods, this method is quicker and more comfortable for the patient. We advise doctors to thoroughly educate patients and adhere to the recommended course of action in order to achieve the optimal results.

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