

## USE OF LASER IN TREATMENT OF PREMALIGNANT SKIN CONDITIONS

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### ABSTRACT

There are various treatment procedures that are used the laser beam in the medical applications especially in the treatment of skin diseases. Some of them are utilized for cosmetic surgery, inflammatory tissue and some for premalignant skin conditions. According to the laser generation systems, there are several types of laser which are used in the medical application such as CO<sub>2</sub>, Er:YAG and the rest laser types. Almost, all of them are succeed in these applications and distinguished results are achieved. The aim of this study is to investigate the feasibility of using laser beam for treatment of the premalignant skin conditions within three types of laser have been used: CO<sub>2</sub> laser, Er:YAG and Semiconductor laser (Diode laser). Different types of premalignant skin conditions such as Keratoacanthoma, Dysplastic nevus, Marjolin's ulcer and Xeroderma pigmentosum have been treated in this paper by those laser types.

**Keywords:** Premalignant skin conditions, Laser types, CO<sub>2</sub> laser, Er: YAG laser, Laser therapy.

### INTRODUCTION

Human skin diseases look alike and are frequent diseases to everyone. Moreover, they may transfer from person to person especially if they are not controlled early and have a wide range of causes and they are divided into temporal, permanent and internal disease. In general, skin diseases are untreated will grow and give rise to a death. But if detected early it would have a chance for healing even the skin cancer. Various skin issues that are started from small red lumps on the skin to wide speared rashes are named the skin conditions. There are different causes for skin conditions such as viruses, allergens, immune system problems and genetic factors. Skin conditions have general signs such as rash, redness, colors, growths, itching etc. /Sometimes, they start with the same signs. Detection and diagnosis of skin conditions can be by visual inspection, biopsy and pathological examinations. In general, the most common of skin conditions (Frazier et al., 2016) can be separated into:

- Inflammatory conditions such as dermatitis, acne, eczema and psoriasis.
- Benign tumors such as moles, warts and skin tags.
- Skin infections such as ringworm and nail fungus.
- Premalignant conditions such as actinic keratosis, dysplastic nevus and Xeroderma pigmentosum.
- Malignant conditions such as melanoma, squamous cell skin cancer and basal cell skin cancer.

There are several therapeutic methods are applied for skin conditions (Slimani, 2014, Lee, 2010) treatment such as:

- Topical treatment: involves the external application for different types of drugs such as creams, powders, lotions.
- Systemic treatment: is used to treat skin condition by injections and oral drugs.
- Laser treatment: includes several lasers types such as carbon dioxide, Er: YAG.
- Physical treatment: contains cryosurgery, infrared irradiation (IR), ultraviolet (UV).
- Surgical treatment: is done either by conventional surgery or through laser equipment.

In dermatology, cutaneous neoplasms can be classified into benign, (Tsuchimoto, 2015) premalignant, or malignant. This classification depends on the initial cell predominantly affected by pathologic change and the cell's position in the skin such as epidermis, dermis, etc. Premalignant can be defined as pertaining to tissue that is not yet malignant but is poised to become malignant (Thiele, 2004). There are several forms from premalignant skin conditions which may appear at different body sites. Some of them are listed as the following:

- Leukoplakia. • Erythroplakia • Actinic keratosis.
- Keratoacanthoma. • Congenital nevi. • Dysplastic nevus. • Xeroderma pigmentosum. • Hutchinson's freckle. • Marjolin's ulcer.

In recent years, lasers have been utilized to treat a large variety of skin conditions such as inflammatory, tumors and cosmetic dermatology. Therefore, some of the scientific studies, proposed met-

hods and the recent researches discussed and improved the treatment of premalignant skin conditions by laser treatments. Some of them are used CO<sub>2</sub> laser, Er: YAG, Nd:yag and semiconductor laser. In other study (Iyer, 2004), the employed strategy combines Er: YAG laser with 5-fluorouracil for treating the skin condition that might convert into skin cancer. This condition is a keratoacanthoma (KA<sub>s</sub>). An approach to minimize the number of actinic keratosis (AK<sub>s</sub>) in faces is presented (Hantash, 2006) by obtaining optimal face resurfacing for 24 cases. In addition, in [30], the cases are treated by the ablative laser (Er: YAG and CO<sub>2</sub>). Furthermore, other data (Cantarelli, 2006) used CO<sub>2</sub> laser in order to study the effect of full-face resurfacing treatment to the actinic keratosis (AK<sub>s</sub>). On the other hand, (Abdelaal, 2006) presents a CO<sub>2</sub> laser beam with 0.8mm, 5 Watt in continuous wave mode and power density 2.5W/cm<sup>2</sup>. This beam is used for patient who suffers from erythroplakia on his lower lip. The study stated that the erythroplakia completely disappeared and there was no repetition of them was observed. In (Hatzis, 2000), the authors compared the results of different laser treatments for thirty patients suffering from congenital melanocytic nevi (CMN). They were divided into three groups. The first group were treated by Nd: YAG laser (Q-switched, 1064nm and 30 ns pulse-width). The second group were treated by using of both Nd: YAG and CO<sub>2</sub> laser (10600 nm, CW mode with duty cycle 50% with power 8-14 Watt) and third group were treated by using of both Q-switched Nd:YAG and Er: YAG laser (2940nm, 350μs pulse-width with energy fluence 10-15J/cm<sup>2</sup>). According to this study, satisfactory results had been achieved by all the types of lasers used here but with differing degree. (Kaplan, 2012) used carbon dioxide laser (CO<sub>2</sub>) for treatment another premalignant skin condition that was Marjolin's ulcer. It was the first report of the use of a carbon dioxide (CO<sub>2</sub>) laser in the treatment of Marjolin's ulcer. (Abdul Wahid, 2016) treated another premalignant skin condition that was the Xeroderma Pigmentosum (XP). The treatment likes facial peeling. The case was an adult man who has Xeroderma Pigmentosum in his face. The recommended procedure for this treatment was, using Carbon Dioxide laser with average power 10 Watt and scanning back and forth over the whole face by focused laser beam. (Yousif, 2013) studied and assessed the efficiency of treatment of skin pigmented lesions such as freckles, pigment nevus and lentigines by using Q-switched and long pulse of Nd:YAG laser. Two types of Nd: YAG laser wavelengths (1064 nm and 532 nm) were used in this study. In

this paper, Different types of premalignant skin conditions were treated by different laser types. Those lasers can be classified into ablative laser (Er: YAG and CO<sub>2</sub> lasers) and low-level laser (semiconductor laser).

## METHODOLOGY

The data of this study were collected from a private clinic of Dr. Kadhum Shabaa, Al-Sadr Teaching Hospital-Consultant of cosmetic burns, Kufa University Faculty of Medicine-Laser Therapy Unit. Four patients with different sessions have been treated for eight months. Three laser types were used by different devices:

- MORE-XCL scanning device (CO<sub>2</sub> laser) was manufactured by BIOSEN MEDICAL CO., LTD. South Korea.
- Matisse device (Er: YAG laser) was manufactured by Quanta-system S.p.A. Italy.
- PowerTwin 21device (semiconductor laser) was manufactured by MKW Laser system GmbH in Germany. Details of patients have been documented for each one including the name, age, address, medical history for patient and family as well as the examination, diagnosis and type of treatment. The outcomes have been evaluated by using image before and after treatment for each patient.

## RESULTS

The first case was of a 30-year-old male who was suffering from Keratoacanthomas (KA) in his nose. KA was cut by a 10600 nm CO<sub>2</sub> laser applying from MORE-XCL scanning device. The number of treatment sessions was three with three-week intervals. Figure 1 shows the nose before the treatment and after removing the KA while figure 2 shows the case after the aesthetic surgery.



**Figure 1:** KA of the nose in a 30 years old man before the treatment (A), after the treatment (B).



**Figure 2:** Nose after the aesthetic surgery.

The second case was for a male who has 35 years old. The case was the xeroderma pigmentosum (XP) in his face and neck. XP was transmitted from his father to him by heredity. XP in this case was treated by pulsed Er:YAG laser. Laser beam was applied by the extra handpiece tool of the Matisse device. It was used to provide pulsed laser with wavelength 2940nm, 0.4ms pulse width with 1 Hz of the repetition rate and the fluence was 10 J/cm<sup>2</sup>. Figure 3 shows the XP before and after the treatment.



**Figure 3:** XP of the face in a 35 years old man before the treatment (A), after the treatment (B).

The third case was for a 65 years old man who has Marjolin's ulcer in his right leg. The treatment was by low level laser therapy (LLLT) which was applied by PowerTwin 21 device (diode laser). The wavelength of the laser beam was 785nm with total power of 1050mW. The case was treated at three weekly intervals until maximum improvement. Each treatment session was 15 minutes. Figure 4 shows the Marjolin's ulcer before and after the treatment.



**Figure 4:** Marjolin's ulcer of the leg in a 65 years old man before the treatment (A), after the treatment (B).

The fourth case was for a male who has 49 years old. He had dysplastic nevus under his left eye. It also treated by ablative laser (CO<sub>2</sub> laser). A 10600 nm wavelength emitted as continuous beam by MORE-XEL scanning device. The treatment was repeated four times with four weeks intervals. Figure 5 represents the face before and after treatment.



**Figure 5:** Dysplastic nevus in a 49 years old man before the treatment (A), after the treatment (B).

**DISCUSSION**

A laser beam can be focused on a very small area as a spot on the tissue. Consequently, part of laser beam energy is absorbed by the tissue and

transformed into heat. As the local temperature is increased, different changes occur, and thermal effects appear on the skin. These effects are depended not only on the temperature but also on the exposure time (Song, 2017). In fact, the absorption of laser lights in the tissue is the usual desirable effect and it is the beneficial aim for laser therapy. The absorbed energy depends on the wavelength of laser beam. In human body, there are several of light absorbers which are called chromophores (Azadgoli, 2016, Gandikota et al., 2017). Each one of them can absorb specific wavelength as in Table 1. Furthermore, CO<sub>2</sub> laser and Er: YAG laser have higher water absorption compared to other lasers. Because of that, most of the absorbed energy vanishes during the treatment due to the vaporization process. That is the reason why the treatments by those lasers have less heat transfer to surrounding area and deeper cells. That means, the therapy by laser does not have side effects and without long-standing implication on the skin as in figures 1B and 5B.

**Table 1:** Different types of absorbers and its wavelengths (Silfvast, 2004)

Wavelength (nm)	Chromophores	Position in human body
350-514	Melanin	Skin, Hair, Moles
	Hemoglobin	Blood
630-980	Melanin	Skin, Hair, Moles
	Water	All tissue
694	Melanin,	Skin, Hair, Moles
	Hemoglobin	Blood
1064	Melanin	Skin, Hair, Moles
	Proteins	Scatter in different organs
10600	Water	All tissue
2940	Water	All tissue

Thus, several lasers have been used in this study to treat different types of premalignant skin conditions. These lasers include ablative lasers and cold laser. The ablative lasers were carbon dioxide laser (10600nm) and Er: YAG (2940 nm) while the cold laser was diode laser (785 nm). Water can be accumulated in some cases of premalignant skin conditions as in Dysplastic nevus, Xeroderma pigmentosum and Actinic keratosis therefore, the ablative lasers are good option to treat these skin disorders because of their ability to vaporize the water and ablate the entire lesions. CO<sub>2</sub> laser and Er: YAG laser were used to treat the second and fourth case in this study, respectively. In addition, laser beam can be focused on small area as a spot because it is coherent and monochromatic. That is exactly why the laser equipment is useful to get a light with much higher power density than other light sources. Owing to these properties, CO<sub>2</sub> laser

can be used as scalpel or excision tool for removing the damaging tissue as in the first case and figure 1. Another laser type was used in this study which was low level laser (LLL). This type is widely used in medical applications, especially in skin disorders. Low level lasers are suitable for several skin issues, such as reduction of inflammation, stimulation of healing, reduction of cell death and skin rejuvenation (Workplace,1993, Mohseen, 2017). Marjolin's ulcer was treated by this type (diode laser, 785nm). This premalignant skin condition grows from poorly healing wounds and these wounds have a chance to spread through surrounding area and other body organs. Therefore, it should be treated in the early stages. From the nature of this disorder, the skin will be wet and blister as in figure 4A. By using low level laser therapy with three treatment sessions, the skin became dry and the blisters are fewer as in figure 4B.

### Conclusion

Ablative laser and non-ablative laser can be used to treat different types of premalignant skin conditions. Use of laser in treatment of premalignant skin conditions does not cause any damage to the neighbor area and deeper cells. In premalignant skin conditions, laser therapy is faster than conventional methods. In comparison to the scalpel surgery, laser therapy decreased tissue distortion, minimized bleeding, shorter recovery period and minimal scarring.

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