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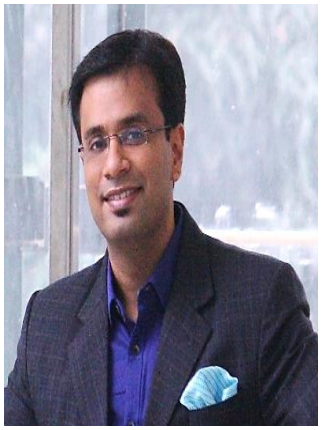

Energy based devices and their use in facial plastic surgery

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Introduction

In the current scenario, Facial Plastic Surgery is one of the fastest growing branches in medicine. Improvements in the safety and the efficacy for energy-based treatment devices have contributed to this growth. With these wide variety of options, the modern facial plastic & cosmetic surgery has reached another level, as these non-surgical techniques require significantly less downtime and have much lesser side effects.

Three broad categories of technology are leading energy-based rejuvenation technology today: Lasers, Light therapy, and Non-laser based thermal tightening devices. Laser light therapy has continued to diversify with the use of ablative and non-ablative resurfacing technologies, fractionated lasers, and their combined use. Light therapy has developed for use in combination with other technologies or as stand alone treatment options. Finally, thermally based non-laser skin tightening devices, such as radiofrequency (RF) and intense focused ultrasonography (HIFU), are evolving technologies, that have changed rapidly over the past 5 years.

Lasers

The market for nonsurgical, energy-based facial rejuvenation techniques has increased exponentially, since lasers were first used for skin rejuvenation in 1983. Advances in this area have led to a wide range of products that require the modern facial plastic surgeon to have a large repertoire of knowledge. LASER (an acronym: Light Amplification by Stimulated Emission of Radiation) is emission of a radiation which is stimulated, and light amplifies it further. Fractional photothermolysis (FP) has revolutionized the use of lasers for resurfacing. Much variation exists with different machines and techniques, and newer indications are being evolved almost daily. Different Laser systems are available:

Laser Resurfacing

The laser-resurfacing industry has produced a multitude of devices employing ablative, non-ablative and fractional technologies. The three approaches largely differ in their method of thermal damage, degrees of efficacy, downtime and side effect profiles against each other. **Ablative Laser**, though more effective, usually has higher incidences of side effects like hyperpigmentation, especially in darker skin types, compared to Non-ablative technologies. Recently fractional laser technology is gaining wide popularity because of its favorable side effect profile, reduced recovery time and significant clinical outcome. **Fractional laser** technology represents a major advantage over the previous conventional ablative methods (fully ablative CO2 and erbium: YAG lasers). They have the advantages of predictability in the depth of tissue ablation and thermal denaturation and have lesser downtime.

CO_2 Laser

Five decades after the introduction of carbon dioxide ($C0_2$) laser, since 1963, it still continues to be the gold standard in ablative lasers. Being a high powered laser, CO_2 laser has significant advantage over the conventional surgical procedure. It is widely used in facial plastic surgery to improve the appearance of scars and to remove benign growths. There are two modes in CO_2 lasers; continuous and pulsed. Water in the tissue is the chromophore and it selectively absorbs the CO_2 laser (infrared laser with 10,600 nm).

The main indications of this laser includes skin resurfacing for acne scars, traumatic scars, periorbital and perioral wrinkles, skin rejuvenation, seborrheic keratosis, deep penetrating nevus, variety of warts, moles, skin tags, skin cancers. We use this laser commonly post every surgery, to improve the healing of the surgical scars and to remove other scars as well.

Certain precautions should be taken while undergoing the procedure like correct patient selection, as Fitzpatrick's skin type 4 and type 5 skin (darker skin) are very prone for hyperpigmentation. History of keloids formation, isotretinoin use in past 4-6 months, derma-abrasion etc should be asked for.

Erbium: YAG Laser

To overcome the problems associated with CO_2 laser, such as post-inflammatory hyperpigmentation, delayed healing etc. Erbium: Yag laser was introduced. The 2,940 nm wave length emitted by it is absorbed 12-18 times more efficiently by superficial (water containing) tissues. The main indications include rhytides, superficial pigmentation scars, xanthelesma, moles, syringomas etc. The fractional versions of the above lasers namely CO2 and the Erbium YAG have revolutionized the use of these lasers in Asian skin types and are now regularly used for various indications with a much lesser incidence of side effects.

Lasers Fortatoo Removal

Laser tattoo removal was first used in the late 1960s following the creation of the first laser, but removal often led to suboptimal results due to significant surrounding tissue destruction and scarring. It was not until the description of the theory of selective photothermolysis in the 1980s that exogenous tattoo pigment could be selectively targeted as a chromophore at specific wavelengths. Due to the small size of the tattoo particles, rapid pulses of high heat at very short pulse durations in the nanosecond to picosecond range are required to prevent cooling of the particles. The thermal relaxation time of tattoo particles is thought to be less than ten nanoseconds. Lasers with Q-switched technology are capable of producing light pulses of short duration, but with a peak power that is much higher than is achievable with continuous wave output. More recently, lasers of even shorter pulse duration called picosecond lasers, have been developed, potentially offering better targeting of chromophores with less damage to surrounding tissue.

The type of laser and wavelength chosen for removal largely depends on the patient's tattoo color and skin type. Q-switched (QS) lasers such as the QS Ruby, QS Nd: YAG, and QS Alexandrite until recently were the most effective devices for tattoo removal. However, picosecond lasers have quickly become the mainstay of treatment due to their superior efficacy and decreased treatment durations. Now there are picosecond 532-nm, 694-nm, 755-nm, and 1064-nm devices available to target a wide array of tattoo pigments. Patients with Fitzpatrick IV-VI (darker) skin types should be treated cautiously due to increased risk for hypopigmentation following treatment. Lasers that penetrate deeper into the dermis, such as the Nd: YAG 1064-nm laser, are associated with a decreased risk of epidermal damage and hypopigmentation in this patient population. Some chromophores for various laser wavelengths include: 532 nm - red, orange, yellow, brown. 694 nm - black, blue, green.755 nm - black, blue, green.1064 nm - black, blue. Colors that respond best to laser removal are black, brown, dark blue, and green, while the most difficult colors to remove are red, orange, yellow, and light blue. Also these lasers have widely been used for pigmentary disorders like Nevus of Ota, followed by solar lentigines, post-inflammatory hyperpigmentation, melisma, congenital nevus, café au lit macule, dermal melanocytosis, Nevus of Ito, and Becker's nevus.

Laser Hair Reduction

Today, laser hair removal (LHR) is the most commonly requested cosmetic procedure in the world. The ideal candidates for LHR are fair skinned with dark terminal hair; however, LHR can today be successfully performed in all skin types. Knowledge of hair follicle anatomy and physiology, proper patient selection and preoperative preparation, principles of laser safety, familiarity with the various laser/light devices, and a thorough understanding of laser-tissue interactions are vital to optimizing treatment efficacy while minimizing complications and side effects.

Principle: The epidermis contains melanin and thus does absorb light irradiation. The hair contains high concentrations of melanin. It is the difference in the thermal elevation in the epidermis versus the thermal elevation in the hair bulb that makes for selectivity of treatment.

Intense Pulsed Light

Intense pulsed light was first described for the treatment of rhytides, fine hair removal and photo damaged skin in 2000. Because of their safety profile and lack of down time, they are often used in combination with other lasers to enhance rejuvenation.

Cryolipolysis

Noninvasive procedures for fat reduction are becoming increasingly popular. The demand for cosmetic procedures targeting subcutaneous adipose tissue (SAT) has rapidly increased, with good results. Cryolipolysis has proven to effectively and safely reduce the subcutaneous fat deposits. In cryolipolysis, the adipose tissue is exposed to a temperature of 10°C for 50 minutes or more, using vacuum applicators. Cryolipolysis is a noninvasive procedure that reduces localized adipose tissue safely and effectively; targeted cold temperatures trigger apoptosis of the adipocytes without affecting the surrounding tissue and this has been cleared by the USFDA as a safe treatment option to reduce subcutaneous fat noninvasively for areas like abdomen, flanks, thighs, and more recently, for the submental area. In submental fat reduction, it has shown excellent results, where one-two sittings are required at the most, with an interval of a month.

High Intensity Focused Ultrasound (HIFU)

In 2009, a device delivering intense ultrasound energy or HIFU (Ulthera; Ultera Inc., Mesa, AZ) received US Food and Drug Administration clearance for use in a noninvasive brow lift and neck lift. Since then, HIFU has been the representative noninvasive

method for skin rejuvenation. Various HIFU models have been introduced and are commonly being used. This technique induces spatially defined heating and coagulation (TCP) within preselected depths using different transducers (HPs, cartridges) and initiates a wound healing process that stimulates new tissue formation and collagen remodeling. As a result, the skin is tightened, and the skin of the face and body are visibly lifted.

Radio Frequency

Radiofrequency works by using the natural electrical resistance of the tissues to convert that energy into thermal energy. Both monopolar and bipolar forms of this technology are available. It is frequently used to treat skin laxity, rhytides, acne vulgaris, scarring and cellulite. Results show modest improvement in skin tightening of face and neck. Improvement in dyschromias, skin texture etc. also has been shown to occur very well.

Radio frequency like Venus Freeze is an FDA-approved, non-invasive treatment for cellulite and loose skin on the face, neck, and body. Usually six sessions are recommended for the face/neck and eight to 10 for the body. Venus Freeze provides an extremely comfortable, non-surgical solution that harnesses the power of radio frequency technology to boost collagen production by heating the deeper layer of tissue under the skin. This treatment works to smoothen out fine lines and wrinkles, tighten sagging skin, and restore a refreshed, younger-looking appearance. Venus Freeze™ works by using a combination of Multi-Polar Radio Frequency and Pulsed Electro Magnetic Fields. The two technologies work in unison to safely and comfortably heat the tissue under the surface of skin, which encourages the body to produce more collagen and elastin fibers. This process results in firmer, smoother skin that looks noticeably more youthful on the surface.

In summary, the improvements in safety and efficacy for energy-based treatment devices have greatly expanded the patient base. Today, we can achieve non-surgically, with almost zero risk and morbidity, what almost certainly needed surgery a few years ago! With a wide variety of options, the modern facial plastic surgeon can now have a frank discussion with the patient regarding non-surgical techniques, leading to greater predictability of results & increased patient satisfaction.