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The Development of Microwave Applications in Medical Field

Running Title: Microwave Application Advance

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ABSTRACT

Through this analysis, we conclude that there is no fixed limit to the radiation threat, but that the risk begins at any stage. High frequency electromagnetic waves have detrimental effects, in particular, on the body and sensitive cells. One of the susceptible organs affected by radiation is the reproductive system, though it does not contain a high percentage of blood. This plays an important role in reducing the heat generated by the cumulative microwave effect. Most studies have agreed that these radiation communication systems have an effective effect on red and white blood cells due to the heme's cellular structure, which is influenced by magnetic and electrical fields, creating a change in the cellular composition and composition. Thus, a shift in cell function clinically visible symptoms of photo damage are fine lines and rhytides. Traditionally, for nonsurgical facial rejuvenation, truncated and non-truncated lasers were used, in addition to that its cumulative side effects and its heroes time are in the work. Initially used to target photo damage, radio frequency represents an idea of radiation surgery technology. It is different from lasers such as current of an electric is used as well as a light source. It is widely used for treating slouch of skin, deflations, skin tags and freckles, and dimple in dermatology. This work aims to show the different kinds of radiofrequency tools and their application. Assessing the effectiveness of these tools is based on facts. This paper discusses the latest RF function, applications, clinical advance. Application guide for various RF applications. The findings were positive with multiple clinical tools of radio waves, although more trials were non-randomized, non-comparative trials using local methods of assessment. Most non- truncated radio waves are a healthy, suggest method that produces moderate results for skin rejuvenation and cellulite therapy. Radio wave is act as replace from surgery.

Keywords: microwave, SAR, radiofrequency, Power density, electromagnetic radiation.

INTRODUCTION

Electric and magnetic fields were included in electromagnetic waves. Waves such as mechanical waves which need environment to travel through vacuum and do not need motion of charges (Wolfgang and Garry, 2011). We are not often aware of their attendance, in spite of radiofrequency enter in atmosphere as a light that enables to see with our eyes the world around us; infrared waves from the earth's surface reheat the atmosphere. Like light waves, the phenomena such as reflection, polarization, absorption, diffraction and scattering influence radio frequency. Radio waves transmit in different forms at various frequencies (Coles, 2010; Thide, 2004). Any of the electricity is going to be absorbed at the surface of the body in the tissues (Coles, 2010; Lucien 1987). Owing to the presence of an electric field, induced water molecules in the body will begin to rotate the energy is transformed into heat by friction. If the radio frequency amplitude is very high, therefore heating can theoretically detrimental. The specific absorption rate (SAR), is achieved to compute the value of radio frequency at the biological cell that is absorbed. SAR is represented in unit watts divided on kilograms (W / kg). There is a certain biological effect of cell phone radiation. Even if the modifications are minimal, they still exist (Jihan, 2010). Electromagnetic waves generate a cell function imbalance. It is understood from magneto-hydrodynamics that electrical currents are produced in the fluid when a stationary, transverse magnetic field is applied externally to a moving electrically conducting fluid. In this way, an electrical current has been generated and the applied current exposure to electromagnetic waves contributes to an imbalance in the circulatory system, a rise in blood flow, a disturbance in blood pressure (Braune *et al*., 1998; Scharffetter-Kochanek *et al*., 1998) and a reduction in hemoglobin (Karel *et al*., 1971). The magnetic field creates a body force (Lorentz force) that appears to slow blood movement (Sud and Sekhon, 1989)

The deposition of connect fibrils in the inner layer and mid- inner layer is the hallmark of photo damaged skin, a mechanism known as solar elastosis (Atiyeh and Dibo, 2009).This mechanism is followed by a decrease in collagen synthesis and architectural changes in the collagen fiber network by raising the abyss and decreased structure of network, the first arrangement of layer grid collagen movement into without discrimination and charged (El-Domyati *et al*., 2010: Wolfgang and Garry, 2011). Fine lines and rhytides in clinical words.

These alterations are characterized by skin laxity, dyschromia, and Telangiecia aging has historically been treated with surgery such as rhytidectomy, blepharoplasty, and brow lifts, but minimally invasive procedures have gained popularity by growing requires of ills suffers surgery of cosmetic charged (El-Domyati *et al*., 2010).

The appeal behind these procedures for non-operative antiaging means less invade and need less stopping. Conventionally, drag and non-drag laser tools were employed to promote slouch of skin but the idea of innovations have been arisen that employ energy sources without laser and light Anti-aging, like radio frequency as well as centered above sound. In spite of technologies have won prominence to repair facial and jawline slouch of skin (Sukal and Geronemus, 2008).

They have yet to assess their comparative clinical efficacy. By inducing epidermal damage and subsequent wound creation in the dermis, ablative laser resurfacing acts (Atiyeh and Dibo, 2009). Non-drag lasers have also been produced to overcome on the drawbacks of drag rejuvenation of the skin.

Diffracted, absorbed or dispersed of lasers have drawback, resulting in the penetration of optimum energy. Radio waves are a modern nondrug method that organizes by using an electric current for skin rejuvenation and also light. Radio wave can be conceded r as a best replacement to laser as well as light-based ablative and non-ablative repair. In the dermis, radiofrequency tools lead to central thermal risk (El-Domyati and El-Ammawi, 2011) Epidermis is maintained by this concentrated energy and is connected by less multiples, risk effects and faster time of repair (Bassichis and Dayan, 2004). Some modes of radiofrequency connecting were produced like divider, without polar, and two polar. The purpose of paper to indicate many kinds of radiofrequency as applications in clinical of cosmetic and to determine the tools effectiveness depend on facts (Biesman and Pope, 2007).

Evolution Basics of Radiofrequency

Radiofrequency energy contain multi medical employs, they vary from severity of intersection to subtraction of the internal viscera (Alster and Lupton, 2007). First formulated for electrocautery in the 1920s, but is now most commonly used for non-ablative skin rejuvenation in dermatology. The U.S. In 2002 the first radiofrequency tool for face concavity reducing was applied with the Food and Drug Administration (FDA) (Braune *et al*., 1998). This tool considered as a unipolar radiofrequency tool and was later included. In 2006 agreement was obtained for the repair is somewhat far from the complexion (Fisher *et al*., 2005). Several radiofrequency instruments were produced.

When a charged particle pass during a closed biological cell then a current is produced (Scharffetter-Kochanek *et al*., 1998). Production power was determined by using new formula (Sukal and Geronemus, 2008). In the frequency range from 3 kHz to 300 MHz, RF devices generate electric current using electromagnetic radiation but both tissue diffraction and chromophore absorption do not affect the energy that radiofrequency yield, not matching light of laser. These devices can therefore be used on any form of skin (El-Domyati *et al.,* 2011). When the electric current was applied to the organic or biological cell, it encounters obstruction which is a continuous yield of the biological cell form, often referred to as obstructive and result heat therefore electric current produced in biological cell is converted to thermal energy (Alster and Lupton, 2007). Amount of power outcome depends on the electric current value and the blocking of the biological cell targeted raise of blocking biological cell, like fat closed to skin, produce increase in energy and thermal impact (Alexiades-Armenakas *et al*., 2008; Elsaie, 2009). Light of laser obey absorbed, diffracted and distributed, outcompeting in lower power quantities arriving the target.

Measurement of Radiofrequency Power

The measurement power was required to calculate the density of microwave radiation power level. Measuring the power density of radio waves in units with Watt / m2. In the microwave frequencies used in telecommunications, this tool showed the exposure rate of radiofrequency instead of calculating the density of power emitted from some industry source as the television, computer screen and video display units (VDU), as well as energy towers. Power meter have also measured the sound waves strength connect by high level of frequency in positive or negative value of dB units (Cornet, 2012). This instrument has another feature, such as measuring electric field strength in E (V / m) units, where E, V, m represents electric field, volt meter respectively. when the device of power is positioned near to the source of the electric field. dilation, including Wi-Fi and blue tooth power cell phone. The power density microwave radiation chance with change the exposure time and also lead to change of cell depth penetration as proportional relation Fig. (1) (Cornet, 2012).

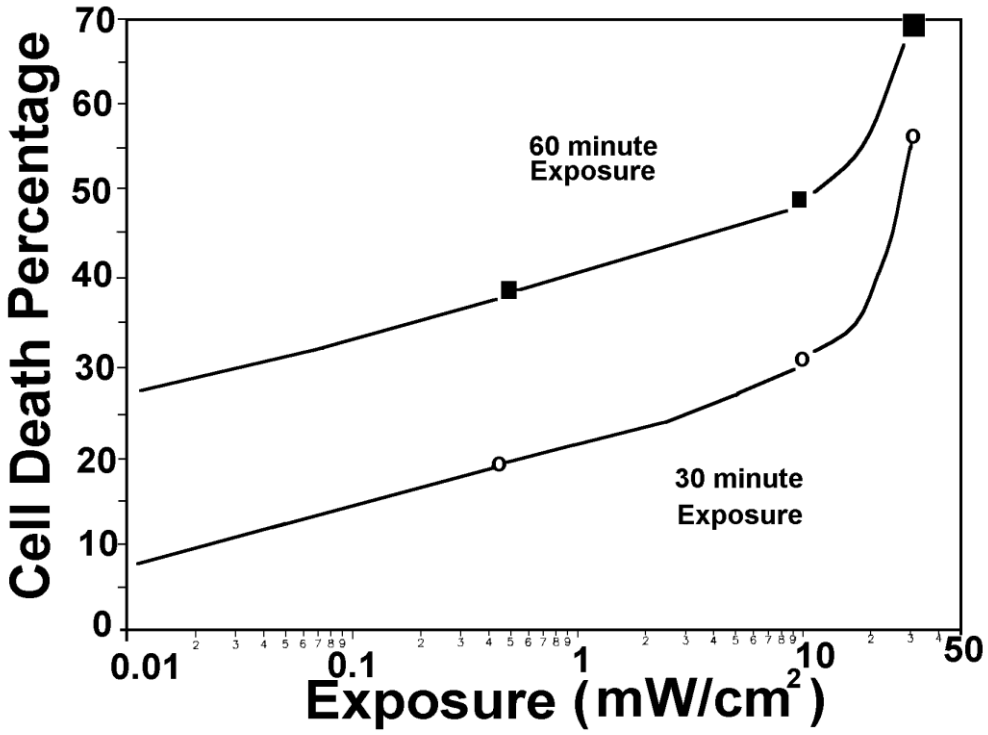

Fig. 1: Relationship between penetration of cell depth and power density with (mW/cm^2)
(Al-(Dulamey *et al*., 2018)

Instead of drawing a figure that shows the relation between power density and cell depth penetration strength producing electromagnetic radiation waves. The detector has other uses as a form of radiation contamination. Microwave radiation emitted from other setting, and detect the radiation impact from microwave ovens. The ability of waves to penetrate the biological cell increased with decrease the frequency of wave because of the current generated during the wave passing through the cell, but the increase with frequency gradually lead to induced currents in the cell and these currents represent resistance to reduce the effect of radio waves in the cell and prevent pass its Fig. (2) shown the relationship between penetration cell depth and frequency in Hertz (Elsaie, 2009; Cornet, 2012).

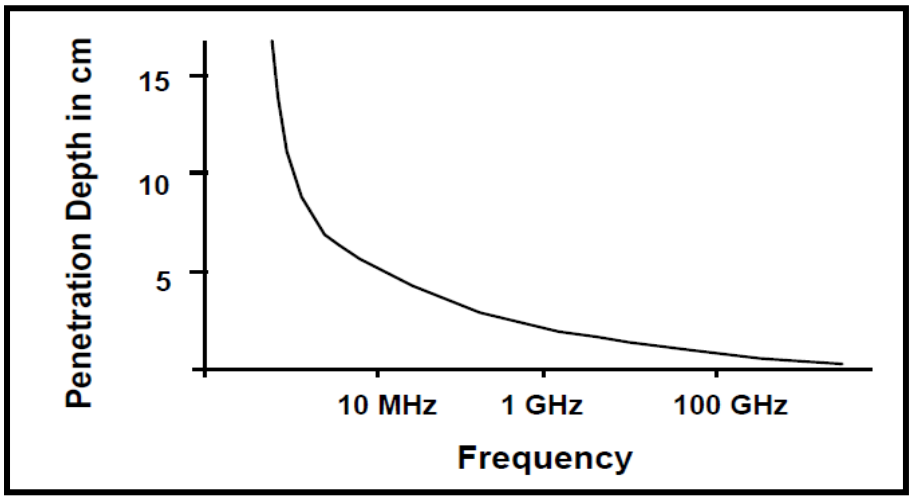

Fig. 2: Relationship between penetration of cell depth and frequency
(Al-Dulamey *et al*., 2015)

Electro smog power meter (Al-Dulamey *et al*., 2015; Cornet, 2012) the relationship between microwave frequency and tissue penetration depth decreases as frequency increases, as shown in

Figs. (2 and 3). The relationship between the frequency of the microwave and tissue penetration depth. Thermal and non-thermal effect of microwave: The thermal effect of EM radiation is referred to as the exposure of tissues to EM radiation with absorbing energy and increasing temperature as $1^{o}C$ degrees. thermal therapy. The frequency-proportional effects of EM radiation. The basic absorption rate used to assess the radiation's thermal effect, also called power density (PD), is SAR. There are many other significant physical exposure parameters that are called non-thermal (NT) effects. Most of the thermal or non-thermal biological effects of radiofrequency studies have been conducted with different cellular functions, including gene expression (Ivaschuk *et al*.,1997) and mutation (Koyama *et al*., 2007) protein deposition (George *et al*., 2008) biochemical cell systems (Shazmanet *et al*., 2007) cell wall (Kim *et al*., 2008) cell morphology (Shamis *et al*., 2011) and proliferation of cells (French *et al*., 1997; Velizarov *et al*., 1999). It has long been established that microwave radiation causes a rapid temperature increase due to intermolecular friction (Goldblith,1966; Chipley, 1980).

Fig. 3: measurement power density of radio waves
(Jihan, 2010)

The Evolution of Single-pole Radiofrequency Action

By single electrode connecting with the outer skin and serving as the original surface, monopolar systems deliver current (Alster and Lupton, 2007). The impact of skin pulling was depended on the volumetric heating idea (Sukal and Geronemus, 2008). The skin-contacting electrode provides the skin with an electrical current. By applying a cooling spray to the epidermis, a reverse thermal gradient is formed, supports it from the device's impact of heating (Abraham and Ross, 2005). The surface also heated volumetrically as well as uniformly and skin fat. As a result of this heating, partial collagen denaturation happens, which leads to collagen contraction and thickening (Elsaie, 2009; Ivaschuk *et al*., 1997). Due to the denaturation of the fibril, several collagen case deflations can produce at once (Abraham and Ross, 2005). Stiffen the injury wound recovering response induces nucleogenesis as well as skin deflation, further tightening follows

(Alster and Lupton, 2007; Elsaie, 2009; Abraham and Ross, 2005). Fibrous septa dependent on collagen separating fat cells under the skin. It is also concentrated heating, resulting in necrosis doubled of collagen and cell under the skin contraction (Alster and Lupton, 2007; Abraham and Ross, 2005).

Advantage and Disadvantage of Devise Applications

Three key components consist of some monopolar RF devices: a protector, portable, and a unit of cryogen. A cryogen cooling system is not used by others. The protector produces continuously replacing electric intensity, successively, up to million cases per second (Biesman and Pope, 2007; Sukal and Geronemus, 2008; Elsaie, 2009). The system of cooling as well as electrode supports the ailments with three case of cooling natural, less and more than natural are included in the handheld tip, which differs in size (Fisher *et al*., 2005; Elsaie, 2009). Sensors test temperate continuous and strain. Resistance is met by the electrode, and heat is generated. In a method called capacitive coupling, the electrode is built to distribute energy evenly through the skin surface (Bassichis *et al*., 2004). This produces a more temperature zone regulated close to 3-6 mm depths (Sukal and Geronemus, 2008, Fisher *et al*., 2005; Elsaie, 2009). The size and geometry of the recovery intensity promote depth of heating (Elsaie, 2009). The outer shell was heated with system usually between 65 - 75 ° C, and the collagen temperature material is heated at the tip denatures (Sukal and Geronemus, 2008). Again, the epidermis is covered by the cooling apparatus, holding the epidermal temperature between 35-45 ° C.55 ° C.

In order to treat periorbital wrinkles, the Food and Drug Administration initially identify single polar radiofrequency tools (Fisher *et al*., 2005; Elsaie, 2009). They were employed to repair stretching the front of the face, lips, retirement of the nasolabia, fetish limits, chin, and neck. Effective soft treatment to extreme balloon fallen, and fallen splatter was fixed in addition to rhytide reduction (Elsaie, 2009). The nettings, huge structure and linked atoms effects of radiofrequency were examined.

Two specimens of people visceral skin shell were repaired with power f close to 95 - 18 joule, colleagues tested radiofrequency effects visible spectrum and neutral charge microscopy of perforated wipes achieved at once and more than to eight weeks after repair evaluated the treatment effect. Gentle near the blood vessels and semi- experimental fudge was noticed at once after surgery. Electron microscopy showed collagen fibrils with greater therapy from zero to eight weeks then processing.

Compared to the outer layers of the epidermis, the measured pretreatment diameter (shortening of collagen fibers) is more than five millimeters deep in the epidermis. As assessed using Northern blot analysis, and also correlated at raising in collagen term (19, 36).

At baseline, at repair was completed as well as next three months of processing, cheat prick of the external complexion was completed Histological observations included an increase in the thickness of the epidermis, rise in the layer depth, and stimulating of the grid ridge detected after completion of treatment and three months after processing. Also, lower outer shell of skin, appear more indicated three months coming, following treatment. Finally, substantially more collagen was found after Care, and even more after 3 months of therapy (El-Domyati *et al*., 2011).

For different applications, the activity of single polar frequency was studied. In an invisible, repeated clinical testes sites, circumferential contracture and outer shell material appeared activity of single polar radiofrequency method in eighty-six ills. Mono repair from 52to 220 joule on the side palace and top position of the face was received by subjects. Three blind doctors measured the effectiveness of treatment using with calibration images worked from two – six months, the Fitzpatrick Wrinkle Classification System (FWCS) with calibration limits from four to six-month images by target methodology, eyebrow raise was also measured. Eighty-three percent of patients progressed on the FWCS with only one spot as well as fifteen percent of topics registered periorbital satisfaction.

Reduction of wrinkles in approximately 62 per cent of patients, brow lifts of at least 0.5 mm were recorded. An objective and subjective reduction of per orbital wrinkles and improvements in brow position has been concluded by the authors of this report.

Fourteen low redness of the skin rates and injury rate with 0.36 percent of number two-degree lgnition were included in the side effects. Plurality ills ranged their ache as poor to improved (Fitzpatrick *et al*., 2003). Single polar method employed on improvement of the face third highest face, as indicated by the height of the hair above the eye, was also evaluated by Bassichis and colleagues. Rising the center, side upper face and time sites, single pass repair of twenty-four ills was given. Pretreatment, as well as follow-up photos were received from one to three months and then processing, lifting the top hair above the eye was assessed. Completing the power ratio supplied without seem influence the ratio of lifting the top hair above eye; in eighty –seven and a half percent of ills, care necessity in calculatedly organized lifted the top hair above face close to half milometer or higher, with incremental change over time; in many patients, brow arrangement was noticed as well as sixty –four ills percent without configure beauty treatment.

Advantage showed **t**here were no complications identified, but pain as a potential complication was not included. With a monopolar RF system (ThermaCool). Ten patients were administered on one side of their face by a monopolar pass, deforesting in impact between ninety-seven to one hundred thirty –four Joule per cm^2 (Nahm *et al*., 2004). By measuring photographic images from one to three months and then processing, improvements in lifting the top hair above eye site were assessed. Most ills lifting the top hair above eye rising was noticed in three significant mean rising of 4.33 millimeter in the center of top face then 2.42 millimeter in the side lifting the top hair above the face also elevate of 1.89 millimeter in the scale of the eyelid deflate happened during the months. No adverse effects have been reported, like comforting, insensible, or spots with new paper (Coles, 2020) six persons at weak to improvement shrinkage were treated with a monopolar RF system for 3 months (six meeting at period of two week). Many Preliminary preparations of one hundred and fifty joule were achieved upper the vacancy face then, three to six penetrates of two hundred joules were worked in the processing regions concerned. Normal images at baseline and 3 and 6 months were used to test the results. At the end of treatment, all six volunteers demonstrated substantial improvement in skin tightening and wrinkles in the periorbital and forehead regions, with continuing improvement 3 months after treatment. Skin tightening has increased from 35% to 40%. Up to 70 percent to 75 percent at the completion of recovery 3 months after treatment. Processing with three months, we notice the appearing of a contraction in the face increased between fortify- forty –five percent to ninety –ninety-five percent. These findings were connected by rising in the collagen building of collagen and a reduce in the finding of elastin amino acid. In one volunteer, transient erythematic and hyper pigmentation formed. Periorbital rhytides were also handled with 4 MHz single polar radiofrequency method. Contents were tested from one to six months coming radiofrequency method processing. Points average level was employed number nine then, cosmetically and due to electron microscopic investigation, calculably is related developments were noted (Javate *et al*., 2011).

ThermaCool scheme to treat 24 patients with neck slouch was used with Jacobsen *et al*., nose constriction, moving statues steps, and bottom face (Jacobsen *et al*., 2003) Every ill gave from one - three monthly hilling involving of two methods on the upper face, three on the sides of face and residual for neck. By analyzing photos, there are two physicians increased results from one to two months during the processing of the twenty –four ills appeared significant development at one month after hilling, which was more indicated after three months of processing. After the operation, most ills experienced discomfort. There were higher outcomes for patients receiving multiple therapies and passes. Patients of thirty were repaired by single polar radiofrequency Alster and Tanzi (Alster and Tanzi ,2004) reported similar findings with the with improvement in moderate cheek laxity and nasolabial folds. Ills fifty-six percent had discomfort, about the operation. In order to determine ratio and average of side impacts (Weiss *et al*., 2006). More than six hundred ills have

been hilling for mild laxity. Using a 1-, 1.5-, or 3-cm^2 tip, patients were treated with various fluid transfers of 74 to 130 J / cm^2. Both self-limited erythematic and edema were the most common side effects. Nearly 90 % of ills had passed redness of the skin that resulted between five to twenty minutes, on the other hand redness of the skin was limited with 5 percent.

Non-polar Radiofrequency

Non-polar RF is distinct from monopolar RF in that it does not supply the skin with an electrical current. Instead, to cause rotational oscillations in water molecules and eventually generate heat, electromagnetic wave was employed with energy at 40 MHz. This heat is dissipated into the tissues then it can arrive thickness of 15-to-20-millimeter Fig. (4). Deeply penetrating method was employed to process conditions resulted by fibrous barrier overruns in dermis, Cellulite explicitly. Activity of a single polar instrument was assessed by Goldberg and colleagues (Kenneth *et al*., 2016) in 30 patients with upper thigh grade III or IV cellulite. At intervals of 2 weeks, patients underwent six procedures. 6 months after admission only 27 ills from 30 case were processed with clinical progress decrease with 2.45 centimeter around the leg. There were minor side impacts recorded. Histology make sure to change the skin was achieved. Authors indicate that initial skin tightening effect can be explained by radiofrequency impact deflation from outer shell of skin to gathering scarf on the other hand, long-term impact is due to skin infection (Del Pino *et al*., 2006) recorded a twenty-case percent deflation from sixty-eight percent of ills at fifteen days during hilling from outer shell of skin to gathering scarf. Using an Accent RF System (unipolar RF device). Six months after treatment (Goldberg *et al*., 2008) without note any impact, suggesting that it may have been a temporary reaction. Similarly, untidy, invisible, separate system, restricted research of ten people with degree from second to third recorded positive experimental outcomes evident so measurable cellulite enhancement three months at all time of processing at a single polar radiofrequency instrument (Alexiades-Armenakas *et al*., 2008; Kenneth *et al*., 2018).

Fig. 4: non-polar Radiofrequency device
(Alexiades-Armenakas *et al*., 2008).

Polar radiofrequencies in the biological domain

The configuration is a chef differential from double polar to single polar radiofrequency. There is one active electrode mounted on the skin and a grounding electrode on the monopolar RF units. The bipolar configuration consists of two active electrodes mounted over the intended treatment area, a small displacement. Between two electrodes, the passing current penetration depth. The

depth of penetration is a weakness of this configuration (Elsaie, 2009). High penetration of the transmitted current is achieved by the monopolar device then, its main disadvantage connected with ache (Elsaie, 2009, Montesi *et al*., 2007). Double polar arrangement it cannot be penetrated, then offers controlling power delivery as well as weaker soreness (ACGIH, 2016). Double polar radiofrequency method also paired depending on the light experiential, known as photoelectric bonding about half of the distance between the two electrodes (Elsaie, 2009). The Principal (ELOS) (Atiyeh and Dibo, 2009; Alster and Lupton, 2007). On the other hand, second method employed for the double polar instrument needs emptying to optimize monitor electric current passage is partial desire inferred from thermal and electrical representation Fig. (5).

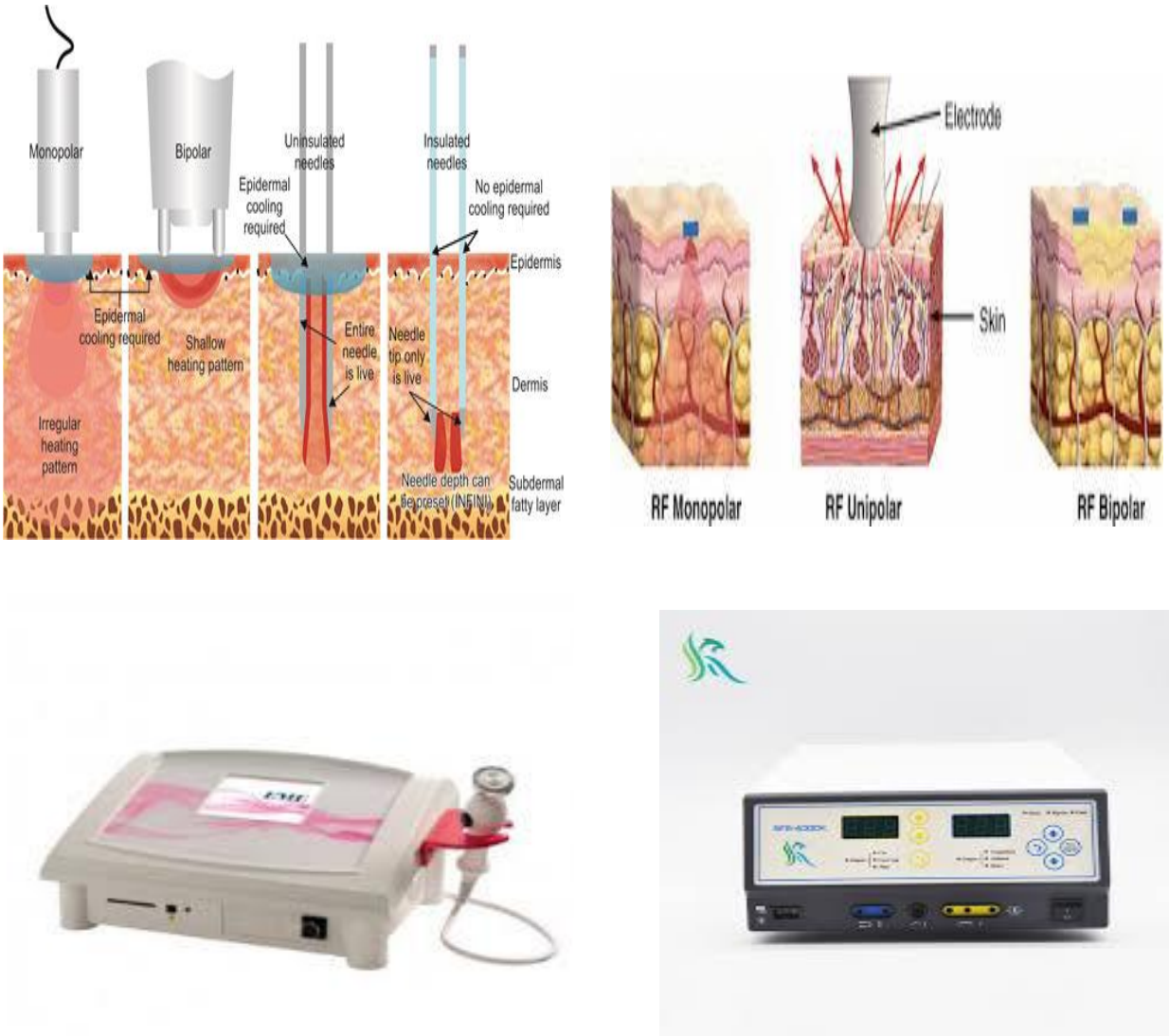

Fig. 5: mono and bipolar radiofrequency devices
(Elsaie, 2009)

Work System

For simple bipolar RF devices, the mechanism of action is identical to single polar radiofrequency tools. It passes from the biological cell then encounters collision with molecular in the skin, the electric current produces heat. Wrinkling of the outer layer of the skin, resistance to redness of the skin, and preventive pollution in the outer shell are triggered by this heat. Light accumulating effects and employed tools depend on radiofrequency by ELOS framework. Light power is worked by photothermolysis to make initial heat in the target cell, which impairs cell

immunity. Impairs cell immunity makes the cell highly sensitive to the radiofrequency spectrum therefore the transition is targeted (Atiyeh and Dibo, 2009; Elsaie, 2009). Thus, in order to achieve the desired effect with less side effects, lower energy levels of radiofrequency and visible light spectrum are required (Elsaie, 2009). The optical component often targets fibroblasts, blood vessels, and dyschromias (Al-Dulamey *et al*., 2015). In conjunction with bipolar RF, where this system employs an evacuation method. Evacuation is achieved for folding the layer of tissue arrives specified depth a while ago that permits for the nearest integration by power of radiofrequency and breaking into great depth compare with typical single polar and double polar methods. Value of hilling biological cell is determined to found in the evacuation case between the electrodes, then this method led to find lest power scale employed to obtain the energy density necessary to penetrate and impact the tissue selected, resulting in higher effectiveness, less discomfort, and lower side impact.

Therapy program

The skin texture and cellulite have all shown some change in all patients. While the mean circumference decrease was 0.8 inches, decreases of more than 2 inches were seen by some patients. Oxygen fragmentation from oxyhemoglobin and transition to adipose tissue increase by radiofrequency and infrared power, Fat cell aggregation disturbance and tightening the nodes of nerve fibers increased by the physical method are thought to happen in the mechanism (Sadick and Mulholland, 2004). Most patients had cellulite visual improvement of less than 50 percent, and 31 percent of patients experienced bruising (Khan *et al*., 2010). The results of vole value of twenty ills received eight weeks repairing were also analyzed by Tanzi and Alster, the overall experimental progress was observed in patients. Average value of leg circumference decreases with distance near one centimeter well as rate experimental enhancement of 50 percent (Alster and Tanzie, 2005).

An effective, minimally invasive procedure usually used to treat facet-linked back or neck pain is conventional radiofrequency ablation (RFA) Fig. (6). Treatment also tends to be a viable therapeutic choice to relieve OA.2 chronic knee. C-RFA is a variant of the conventional procedure, whereby clinicians use an implanted electrode to cool the affected area, offering the advantage of creating a greater lesion size than the standard technique. Four patients were carefully chosen in the current study after they had a positive genetic nerve block (>80 percent reduction in pain). The patients were exposed to C-RFA on the knee's superior lateral, superior medial, and inferior medial gene nerves. At 1, 3, and 6-month follow-up, patient accounts of pain relief, functional outcomes, analgesic treatment, opioid use and progression to TKA were assessed.

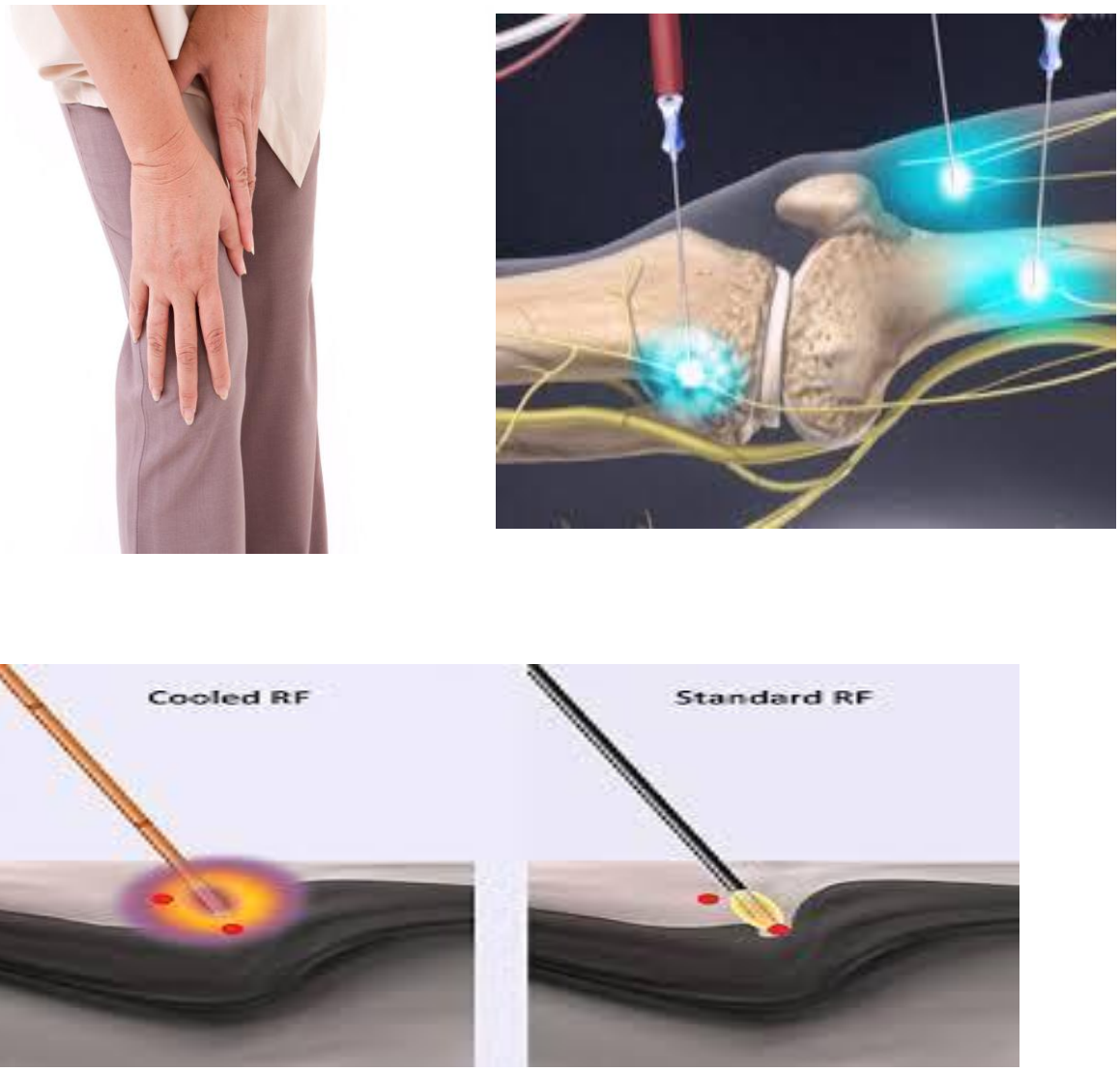

Fig. 6: Cooled radiofrequency ablation device (C-RFA)
(Reddy *et al*., 2016)

Good outcomes were obtained by the patient selection process and C-RFA protocol, with patients showing a >90% reduction in pain after the operation, which was sustained until 6 months of follow-up. One patient (aged 65, BMI 41, baseline MQS3/MEq 32.1/64) recorded a full reduction in pain of 100 percent for a total of 6 months following the C-RFA (unilateral) procedure (Reddy *et al*., 2016). With walking and squat transfers, the same patient experienced initial improvements, relieving the need for a cane. Important functional changes following the C-RFA procedure were also documented by other patients, including better sitting transfers, extended standing and ambulation, and stair climbing. According to Rajiv Reddy, MD, of the Rehabilitation Institute of Chicago, Illinois, none of the patients had surgery following C-RFA treatment, which may indicate that successful joint denervation may negate the need for further surgical intervention by substantially relieving pain and improving functional capacity. While we would be reluctant to claim unambiguously that the C-RFA rejected the need for TKA [since at least (Choi *et al*., 2011) patient was a weak surgical candidate and was unlikely to be offered surgery], we think it is fair to infer that the pain relief provided by the procedure at least deferred the need for these patients to undergo surgery,' Dr. Reddy told Practical Pain Management. Lesioning of the radiofrequency nerve is considered a reasonably healthy operation. Indeed, none of the patients reported any detrimental effects in the study. Clinicians may however, want to be careful when using C-RFA therapy, as there may be a chance, however rare, of developing third-degree skin burns at the

electrode site in patients. Although there is 1 third-degree burn case report with C-RFA, it has not been clearly shown in the literature whether conventional RFA and C-RFA are similar in terms of adverse events and protection. This adverse event can occur as a blanching of the skin around the introducer needle, resulting in serious, localized pain that will take months to heal. Clinicians may want to exercise caution with thin patients, particularly when working between the lesion target and the dermis with anatomical regions containing minimal subcutaneous tissue (Walega and Roussis, 2014).

Radiofrequency Ablation Effective for Small Kidney Cancers

Radiofrequency ablation (RFA) is widely used to treat tumors that are not prone to liver, lung, and other surgical procedures. The treatment requires the use of a tiny probe inserted into the cancer site. Via CT or MRI scans, the doctor directs the probe so that the procedure can be contained at the cancer site, minimizing the effects on surrounding tissue. Radio waves flow to the cancer site via the probe, thereby killing the cells. Typically, RFA requires local anesthesia and affects only the cancer site without causing the rest of the body to have side effects Fig. (7) (Farrell *et al*., 2020). RFA is currently used to treat kidney tumors that are small or unable to undergo surgery in individuals that are readily available.

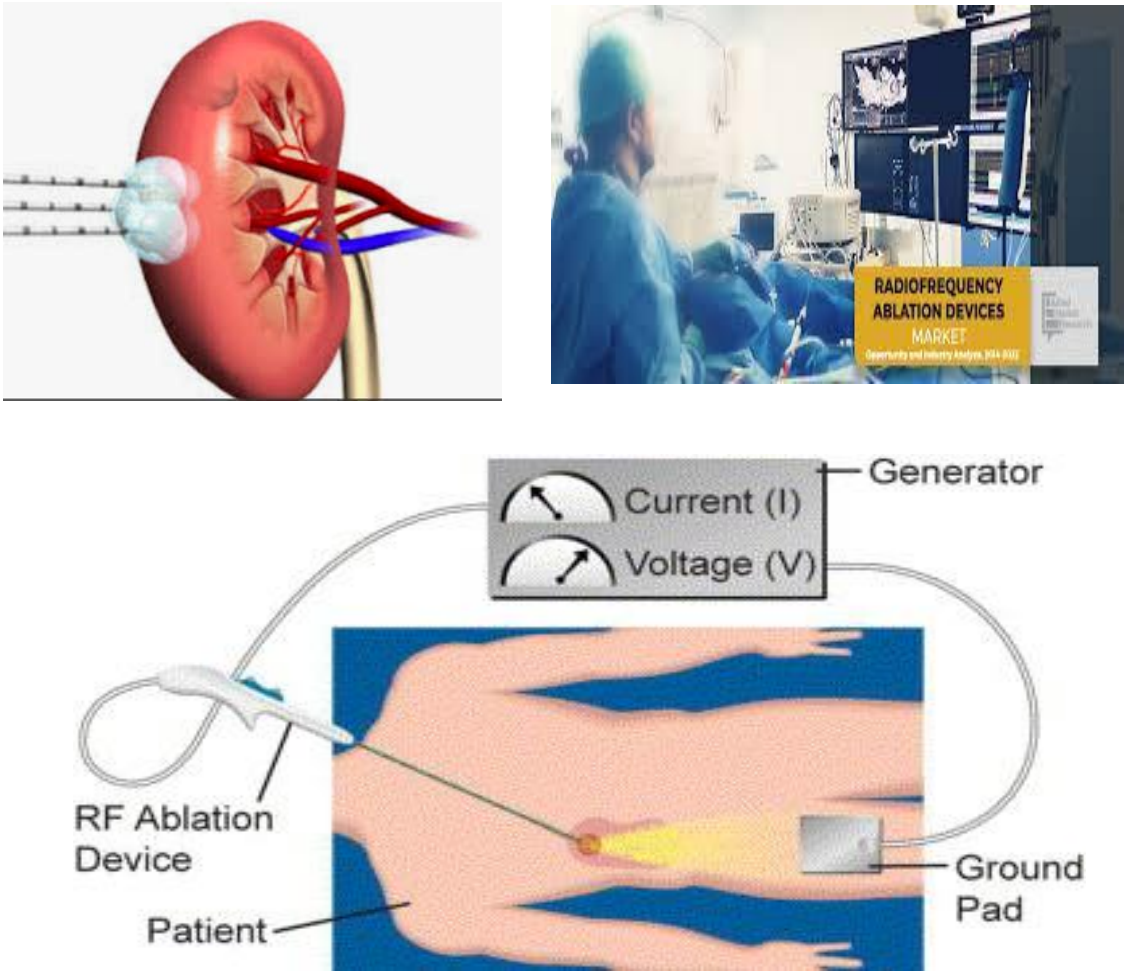

Fig.7: Radiofrequency ablation (RFA) for kidney
(Farrell *et al*., 2020)

Radiofrequency Ablation as an Efficient Alternative to Renal Cell Cancer Surgery

In 2003, doctors from the Mayo Clinic confirmed that RFA in patients with renal cell cancer who were not suitable for surgery could provide an important alternative therapy to surgery 32

patients with a total of 51 renal tumors were included in this small study. 98 percent of cancers have been absolutely killed following RFA (Matsumoto *et al*., 2020). Overall, the medication was tolerated quite well. In order to treat the primary lesion, doctors announced the findings of 124 patients with small renal growths (median tumor size 2.8 cm) treated with RFA (Karam *et al*., 2010).

The local recurrence-free survivals of one and three years were 99.0 percent and 94.6 percent respectively. There were eight RCC deaths, but all of these individuals at the time of RFA treatment had metastatic disease. Patients diagnosed with renal tumors were treated with either CT or laparoscopy-guided RFA in another study. At 6 weeks, and again at 3 and 6 months, each patient received repeated imaging scans. From that point on, scans were continued every 6 months. The 91 patients enrolled in the study had a tumor size of 2.4 cm on average. Among these participants, 98 percent of the tumors were eliminated (107 out of 109 treated tumors, with more than one tumor in some patients). The remaining two tumors retreated and were killed successfully afterwards. Sixty patients, most of whom were diagnosed with renal cell cancer at least 1 year before RFA (Varkarakis *et al*., 2005; Bristow *et al*., 2017)

Radiofrequency Ablation of Liver Tumors

Radiofrequency ablation, also referred to as RFA, is a cancer therapy that is minimally invasive. It is an image-guided technique which heats cancer cells and destroys them Fig. (8).

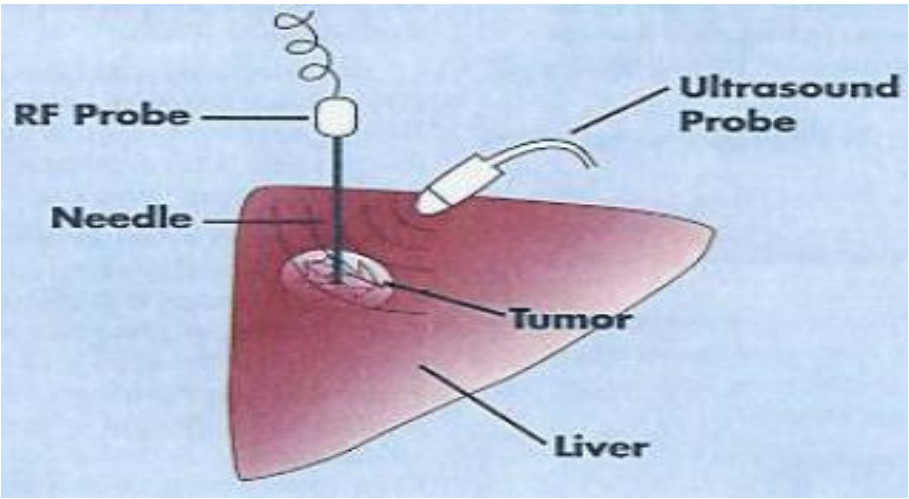

Fig. 8: Radiofrequency ablation (RFA) for liver
(Ajay Upadhyay, 2019)

Imaging methods such as ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) are used in radio frequency ablation to help direct a needle electrode through a cancerous tumor. Then the electrode is passed through high-frequency electrical currents, producing heat that kills the abnormal cells (Ajay Upadhyay, 2019).

DISCUSSION AND CONCLUSIONS

In the field of dermatology, non-ablative RF devices have wide applications. Using this technical to treat skin sagging, deflation, scarring and valol, as well as cellulite. Overall findings have been positive, although many studies are non-randomized, non-comparative studies using subjective means of assessment. Often statistically important, and overall patient satisfaction. Several studies have been employed quantitative assessment progress. These devices have a milder side-effect profile than those of intrusive and ablative modalities, including intermittent redness of the skin, outer shell, and ills uncomfortable. Safe prospect efficient method obtained for skin

enhancement and repairing of cellulite is non-ablative RF. It produces moderate outcomes that can determine instead of surgery. Lower rate side impacts is main approach upper removal addition to surgical therapy. After care, and with less stopping required remain as to optimal parameters of treatment, specifically the energy levels and the number of passes to be used for maximum performance. To understand the subject of tools in order to use in different clinical applications, more controlled randomized comparative clinical trials are required. In addition, using, protection and efficacy have not been developed for monopolar, bipolar and fractional RF devices.

Both monopolar and bipolar RF ablation are safe and effective in treating chronic atrial fibrillation patients during open cardiac surgery, but bipolar RF ablation is more convenient in practice. The bipolar clamping device produces narrower lesions which are more likely to be transmural and lead to electrical isolation of ablated tissue than those produced by the unipolar device. However, both devices failed to consistently produce transmural lesions using the epicardial beating heart technique studied, particularly in thicker tissues. High output pacing within the ablated tissue partially predicts lesion transmurally and be a guide to the need for further ablation. However, endocardial ablation or transmural bipolar ablation are likely to remain the techniques of choice for linear radiofrequency ablation in the atria until improved techniques are developed.

In order to delineate the effects of C-RFA versus conventional RFA, a large randomized comparative prospective trial would be completely beneficial especially in the appropriate patient selection, diagnostic blocks, C-RFA technique, efficacy of the procedures, as well as adverse events reported.' Dr. Reddy told Realistic Pain Management that this is something we will be interested in doing in the future. A structured screening and procedure protocol for selecting patients eligible to undergo genetic nerve C-RFA is defined in the current report. In order to effectively manage pain and improve functional results in this patient group, further study may also be needed to explain the optimal number of genicular branches to be ablated. There is also a query as to whether the ideal modality for image guidance in the procedure is fluoroscopy or ultrasound, the authors concluded.

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تطور تطبيقات الموجات الدقيقة في المجال الطبي

الملخص

من خلال هذه المراجعة، نستنتج انه لا يوجد حد ثابت للخطر الاشعاعي فالخطر يبدا في اي مرحلة. الموجات الكهرومغناطيسية عالية التردد لها تاثيرات ضارة بشكل خاص غلى الجسم والخلايا الحساسة. يعد الجهاز التناسلي أحد الاعضاء الحساسة للإشعاع على الرغم من انه لا يحتوي نسبة عالية من الدم. يلعب هذا دور مهم في تقليل الحرارة الناتجة من تأثير المايكرويف التراكمي. اتفقت معظم الدراسات على ان انظمة الاتصال الاشعاعي هذه لها تأثير فعال على خلايا الدم الحمراء والبيضاء بسبب التركيب الخاوي للهيم، والذي يتاثر بالمجالات المغناطيسية والكهربائية، مما يؤدي الى حدوث تغييرات في التركيب الخلوي والتوكين. وهكذا فان التحول في وظيفة الخلية المعرضة مرئيا عند التعرض للموجات الدقيقة. طبيعيا من اجل تجديد شباب الوجه او نضارة البشرة بشكل غير جراحي استخدم الليزر الاستئصالي وغير الاستئصالي وكانت لها اثار جانبية مقارنة مع استخدام الموجات الدقيقة لاستهداف نفس الصورة من الوجه. هي تقنية جديدة تختلف عن الليزر من حيث استخدام المجال الكهربائي بدلا من مصدر الضوء. يستخدم على نطاق واسع لعلاج ترهل الجلد، التجاعيد، جب الشباب، والتندب والسيلوليت في الامراض الجلدية. الهدف من هذه المراجعة هو تلخيص الانواع المختلفة لأجهزة التردد اللاسلكي واستخدامها وتقييم فعالية هذه الاجهزة بناء على الحقائق. اذ تناقش هذه الورقة أحدث الادبيات للموجات الدقيقة وتطبيقاتها والجدوى السريرية والتطبيق العملي.

الكلمات الدالة: الموجات الدقيقة، معدل الامتصاص النوعي، الترددات الراديوية، كثافة القدرة، الاشعة الكهرومغناطيسية.