CORRECTIVE DERMATOLOGY TODAY

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SUMMARY – The field of corrective dermatology has gained remarkable development in the past two decades. New heights in techniques and the growing interest in rejuvenation procedures have resulted in an increase in the number of corrective procedures all over the world. Here we present the most frequently performed corrective procedures in dermatology today: lasers, intense pulsed light, fillers, botulinum toxin, chemical peeling, radiofrequency, and dermabrasion. Currently, the most preferable procedures are those with early visible results, short 'down-time' and minimal risk of unwanted effects. Therefore, ablative resurfacing has been mostly replaced by nonablative and fractional resurfacing, while fillers and botulinum toxin have been ever more employed. The best cosmetic results can be achieved with combination of different corrective procedures.

Key words: *corrective dermatology, lasers, fillers, botulinum toxin, chemical peeling*

Introduction

For decades now, we are witnessing a great increase in the number of individuals who visit dermatologists hoping to reverse the signs of aging. The acquisition of new scientific concepts has been paralleled by novel scientific developments resulting in new therapeutic methods in corrective dermatology. A variety of anti-aging products and medical interventions have been developed to improve the individual's appearance. During the 1997-2007 period, the American Society for Aesthetic Plastic Surgery (ASAPS) has noticed a 448% increase in corrective procedures, including a 747% increase in non-surgical and 98% increase in surgical procedures.

Dermabrasion

Dermabrasion was one of the first therapeutic procedures in corrective dermatology. The skin is abraded to papillary layer of the dermis by use of a metal, diamond or ruby grinder. After the procedure, remodeling of collagen fibers in the dermis has been noticed by histologic examinations.

Dermabrasion was introduced by Kromayer, and later developed by Schreus[1]. The procedure is usually performed to remove scars or reduce wrinkles. Dermabrasion may be performed under general or local anesthesia, and the depth of abrasion depends on the indication. Postoperatively, healing usually occurs within seven to ten days. Patients are instructed to avoid sunlight for three to six months after the procedure, and to use sunscreen on a regular basis when outdoors. The possible complications include bacterial and viral infections, milia, scars and pigmentation irregularities[2].

Chemical Peeling

Chemical peeling is a method by which concentrated chemicals are applied to the skin to peel off the dermis and epidermis. This results in regeneration of the dermis and epidermis with synthesis of new collagenous and elastic fibers in the dermis. Chemical peeling is performed to remove acne and/or acne scars,

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hyperpigmentation and signs of skin aging. According to the depth of peeling, chemical peel can be superficial, medium depth and deep, depending on the chemical used, its concentration, and length of skin exposure[3]. Superficial peel implies epidermal peel to the dermoepidermal junction, mostly by use of alpha-hydroxy acids, Jessner's solution and trichloroacetic acid 10%-20%. The objective of treatment is to achieve keratolytic effect with fibroblast stimulation, thus improving the skin texture, and reducing the number of comedones and hyperpigmentation[4]. Medium depth peel results in necrosis of the epidermis and part of or entire papillary layer of the dermis. The procedure is usually performed by use of tricholoroacetic acid at a concentration of 35%. The indications for medium depth peel include wrinkles, hyperpigmentation, shallow scars and signs of solar skin degeneration. Deep peel is used to remove deep scars. This procedure results in necrosis of the epidermis and the entire papillary dermis, also involving the upper part of reticular dermis. Deep peel is a demanding procedure that can only be carried out by experienced therapists using high concentrations of tricholoroacetic acid 35% or phenol solution (Baker-Gordon formula)[3,5].

Good patient selection is essential in obtaining clinical results. It is important to evaluate patient's expectations and to have the patient's written consent for the procedure. Ideal patient for chemical peeling is a fair complexion person with Fitzpatrick skin types I-II, while skin types IV-V are considered relative contraindications for this procedure. The most common complications are pigmentary anomalies. Milia, telangiectasias, prolonged erythema, infection, skin atrophy, texture changes and scars are among other possible complications. Postoperatively, proper skin care and photoprotection are essential[3,6].

Lasers

Nowadays, corrective dermatology is almost inconceivable without the use of laser, one of the recent methods of treatment that has been rapidly and continuously developing over the past few decades. The term laser is an acronym for "light amplification by the stimulated emission of radiation". Laser light has unique properties that account for its therapeutic activity: monochromaticity (the emitted light is of a single, discrete wavelength), coherence (laser light travels in phase with respect to both time and space) and collimation (emission of a narrow, intense beam of light in parallel fashion). Thus, laser light can be focused into small spot sizes allowing for precise tissue destruction[7].

The first laser was developed by Maiman in 1959, using monochromatic 694 nm ruby light. In 1963, dermatologist Dr Leon Goldman initiated ruby laser treatment for a variety of cutaneous pathologies. Later, advances in laser technology have progressed rapidly, resulting in development of new laser systems with better therapeutic results and low risk of adverse effects[8]. Cutaneous laser surgery was revolutionized in 1983, when Anderson and Parish proposed the theory of selective photothermolysis. According to this theory, controlled destruction of target lesion with minimal damage to the adjacent tissues can be achieved under following conditions: first, the emitted wavelength must be absorbed preferentially by the intended target tissue or chromophore (molecules with unique absorption spectra, which are responsible for imparting color to substances); second, the energies produced by laser systems should be high enough to inflict thermal damage to the target; and third, the time of tissue exposure to the laser must be shorter than thermal relaxation time (defined as the time required for the target site to cool to one half to its peak temperature immediately after laser irradiation). Based on these principles, laser parameters can be tailored to effect destruction of the tissue confined to microscopic site of selective light absorption in the skin, such as blood cells and pigmented cells, with minimal collateral thermal damage[9].

Vascular lesions that are most frequently observed on aged skin include telangiectasias, cherry angiomas and venous lakes. The most commonly used lasers in treating these lesions include KTP (532 nm), Nd:YAG (532 and 1064 nm) and pulsed-dye laser (585-595 nm)[10].

Solar lentigines are the most common hypermelanotic lesions of photoaged skin. They occur from age 30 onwards as benign hyperpigmented lesions on chronically sun-exposed areas of the face, back of the hands and extensor surfaces of the forearms. To obtain selective photothermolysis of melanin, solar lentigines must be treated with laser light having a wavelength appropriate to absorption characteristics of melanin.

A variety of different laser systems that emit wavelengths of 500-1100 nm may be used to remove melanin from the skin: the Q-switched ruby (694 nm), Q-switched alexandrite (755 nm) and Nd:YAG laser (532 and 1064 nm)[11].

Cutaneous laser resurfacing represents the major advance in the treatment of severely pohotodamaged facial skin, photoinduced facial rhytides, dyschromias, and atrophic scars. Ablative laser resurfacing was introduced in the 1980s with continuous-wave CO_2 lasers, but their use was limited because of delayed healing and scarring. High-energy, pulsed, and scanned CO_2 and Er:YAG lasers have been in widespread use since the mid-1990s for ablative resurfacing. The Er:YAG laser has a higher absorption coefficient in water-containing tissue; because 90% of the epidermis is composed of water, most of the energy of the erbium laser is superficially absorbed. The Er:YAG laser yields photomechanical tissue effect, whereas photothermal tissue reaction is primarily effected by CO_2 treatment. However, the prolonged recovery time and a significant risk of postoperative hyper- and hypopigmentations, scars and other complications prompted to development of nonablative and fractional resurfacing. Nonablative laser systems produce stimulation of collagen production and remodeling while preserving epidermis. This results in little or no healing time and less patient discomfort. The most commonly used lasers for nonablative resurfacing include pulsed dye laser (585-595 nm), Nd:YAG (1064 nm, 1320 nm), diode (1450 nm) and Er:glass (1540 nm) laser. Fractional resurfacing thermally ablates microscopic columns of epidermal and dermal tissue in regularly spaced arrays over a fraction of skin surface. Each column is approximately 70-150 microns in width and 400-700 microns in depth. Intervening areas of normal skin are left untouched, which rapidly repopulate the ablated columns of the skin. This concept increases efficacy as compared to nonablative resurfacing but with faster recovery as compared to ablative resurfacing. For these reasons, fractional skin resurfacing is nowadays the most popular method of laser rejuvenation[12,13].

Proper patient selection for laser resurfacing is essential for obtaining successful procedure. Patients should be evaluated for their skin type according to the Fitzpatrick system; lower skin types (I-II) are at a low risk to develop postinflammatory hyperpigmentation, whereas skin types IV-VI more often develop dyschromia. Patients with a personal history of previous cosmetic surgery may be predisposed to more fibrotic skin, while previous blepharoplasty increases the risk of ectropion. Postoperative scarring usually develops in patients with impaired wound healing from an underlying collagen vascular disease, immunodeficiency, or history of isotretinoin use within the past year. Special attention must be focused on patients with a history of labial herpes, bacterial or yeast infections, as medical prophylaxis is necessary in such cases. The presence of hyperelastic skin can lead to increased scaring, and the presence of hypertrophic or keloidal scars should be given consideration. Absolute contraindications for laser resurfacing include isotretinoin use within 1 year of the procedure, concurrent bacterial or viral infection and ectropion. Patients with unrealistic expectations should be discouraged. Relative contraindications for laser resurfacing include a history of dyschromias, ongoing UV exposure, hyperelastic or keloidal skin, history of radiation therapy, collagen vascular disease and prior cosmetic surgery (chemical peels, dermabrasion, laser surgery, and blepharoplasty). In order to minimize the risk of postinflammatory hyperpigmentation, sun avoidance is recommended during 2 to 3 months postoperatively, and the use of broad-spectrum sunscreens is obligatory[12,13].

Intense Pulsed Light (IPL)

Intense pulsed light technology was developed in the early 1990s, initially for vascular lesions, then hair removal and pigment lesions, and today it is one of the standard procedures for photorejuvenation. Intense pulsed light emits the spectrum of wavelengths (550-1200nm), therefore targeting both melanin and hemoglobin, resulting in global improvement of dyspigmentation and vascularity. Intense pulsed light is able to induce remodeling of collagen and elastic fiber, without epidermal damage. The main advantage of this method is short recovery time and minimal risk of unwanted effects[14].

Radiofrequency

Radiofrequency is one of nonablative methods of rejuvenation, using devices that produce electrical energy that heats the dermis at relatively low tempera-

tures. The result is collagen shrinkage and skin tightening. New technologies combine radiofrequency and infrared laser or IPL, with better therapeutic results. The effects are visible after several treatment sessions. The main advantages include minimal postoperative erythema that resolves within few hours and lack of significant risk of side effects[15].

Skin Implants (Fillers)

Skin implants or fillers are various substances injected into the skin to fill in the wrinkles, atrophic scars and skin defects, and for face remodeling (lips, zygomatic region, chin and nose enlargement). Skin implants are classified according to the process of degradation (biodegradable or non-biodegradable), origin (natural or synthetic), organic or inorganic character, and duration of effect (short-term, long-term or permanent). Biodegradable implants include collagen (human, autologous, animal, stabilized 'cross linked' collagen), hyaluronic acid (animal, 'non-animal', stabilized-'cross linked', non-stabilized) and hyaluronic acid in combination with other materials (dextran, lactic acid), and lactic acid (L-polylactic acid). Non-biodegradable fillers include polymethylmethacrylate (PMMA), acrylate hydrogels, microspheres (60-90 microns) containing hyaluronic acid and zirconium, polyacrylamides, alkylamides, methylsiloxanes, hydroxyapatite, and polytetrafluorethylene. An ideal implant should be safe and of optimal duration, simple to apply with minimal discomfort, hypoallergenic and isovolemically degradable; upon treatment, the face should have natural appearance, and the price of treatment should be acceptable. After all, the ideal effect means stimulation of own fibroblasts for the synthesis of own collagen. Unfortunately, none of the agents available meets all the conditions mentioned above[16].

Hyaluronic acid, a biodegradable implant, is currently most widely used because of its excellent therapeutic results associated with a very low risk of side effects. Therapeutic effect lasts for three months to two years in case of biodegradable implants, whereas non-biodegradable implants may last for years or even indefinitely. However, the application of non-biodegradable agents may be associated with the development of foreign-body granulomas, pseudocysts and abscesses[17].

Botulinum Toxin

In addition to popular fillers, the clients show increasing interest in the use of botulinum toxin to correct facial expression lines (around the eyes, between the eyebrows and forehead). Botulinum toxin is a potent neurotoxin produced by the bacterium *Clostridium botulinum*, which causes temporary paralysis of striated muscles. The main precondition for therapeutic success is proper training and experience of the physician, who should have profound knowledge of the treated area anatomy, be sure in choosing correct indication and agent dosage, and using appropriate injection technique[18]. Therapeutic result in terms of wrinkle reduction can be observed within a week of the injection and lasts for several (4-12) months; the interval between two procedures should be at least three months. Contraindications for this procedure include known hypersensitivity to any substance of the product injected, systemic muscle disease (e.g., myasthenia gravis), concomitant use of aminoglycoside antibiotics and spectinomycin, infection at the site of injection, blood coagulation diseases, pregnancy and lactation. Adverse affects are rare and include paralysis of the adjacent muscles, e.g., m. levator palpebrae, resulting in ptosis of upper eyelid, which usually resolves in few weeks[19].

Current Trends: Combination of Different Corrective Procedures

Recently, combinations of the methods listed above have been ever more employed to obtain the best aesthetic results. For example, botulinum toxin and fillers are commonly combined with chemical peeling, lasers and IPL.

Conclusion

Nowadays, the most popular corrective procedures are those with early visible results, minimal down-time after the procedure, with minimal risk of unwanted effects and complications (nonablative and fractional resurfacing instead of ablative, fillers, botulinum toxin, chemical peeling). Proper choice of high quality treatments is the responsibility of dermatologist specialized in the field of corrective dermatology, especially in the light of the great number of new therapeutic options offered by fast technological

advancement. Unfortunately, these demanding corrective treatments are ever more frequently performed at non-medical institutions and by incompetent persons. Properly trained and experienced physician is fully aware of the crucial role of appropriate assessment of the patient and his/her expectations. He will explain to him/her the corrective procedure, the potential risks and the expected outcome. A predictable lack of patient compliance with proper skin care after the treatment and unrealistic expectations are considered absolute contraindications for any corrective treatment.

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Sažetak

KOREKTIVNA DERMATOLOGIJA DANAS

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U posljednja dva desetljeća zabilježen je znatan razvoj u području korektivne dermatologije. Nova vrhunska postignuća u tehnikama i sve veće zanimanje za postupke podmlađivanja doveli su porasta broja korektivnih zahvata širom svijeta. U radu se prikazuju korektivni postupci koji se danas najčešće primjenjuju u dermatologiji, a to su laseri, intenzivno pulsno svjetlo, fileri, botulinski toksin, kemijski piling, radiofrekvencija i dermabrazija. Danas se prednost daje onim zahvatima kod kojih se razultati najbrže vide, koji imaju kratko vrijeme zastoja i minimalan rizik od neželjenih učinaka. Stoga je ablativno "presvlačenje" (resurfacing) uglavnom zamijenjeno neablativnim i frakcijskim "presvlačenjem", dok se fileri i botulinski toksin rabe sve više. Najbolji kozmetski rezultati postižu se kombinacijom različitih korektivnih postupaka.

Ključne riječi: *korektivna dermatologija, laseri, fileri, botulinski toksin, kemijski piling*