Esthetic and cosmetic dermatology

Uwe Wollina*, Alberto Goldman†, Uwe Berger‡ & Mohammed Badawy Abdel-Naser§

*Department of Dermatology and Allergology, Hospital Dresden-Friedrichstadt, Dresden, Germany, †Clinica Goldman of Plastic Surgery, Porto Alegre, RS, Brazil, ‡Kieferchirurgische Gemeinschaftspraxis, Chemnitz, Germany, §Department of Dermatology and Venereology, Ain Shams University Hospital, Cairo, Egypt

ABSTRACT: The field of esthetic and cosmetic dermatology has gained remarkable interest all over the world. The major advantage of recent years is the high scientific levels of the most significant new developments in techniques and pharmacotherapy and other nonsurgical approaches. The present paper reviews selected fields of interest under this view. Sexual hormones are involved in the aging process of men and women. Skin function, in particular the epidermal barrier, is affected by a loss of endocrine activity. Hormone replacement therapy has only recently been introduced in treatment of aging males. This is an area of gender-medicine in dermatology with a strong well-aging attempt. Botulinum toxin therapy for hyperfunctional lines has become not only well-established but evidence-based medicine on its highest level. Recent advantages were gained in objective evaluation and monitoring the effect. Digital imaging techniques with various facets have been introduced to assess the achievements of treatment in the most objective way. This may become an example for other techniques as peeling, laser therapy, or radiofrequency in esthetic and cosmetic dermatology. Botulinum toxin has become a valuable tool for brow lifts. Details of the technique are discussed. Cellulite is a strongly female gender-related condition. During the past decades numerous treatments had been recommended but only recently a more critical scientific approach led to improvements in therapy of this common and disfiguring condition. Three major approaches are developed: (a) skin loosing with techniques such as subcision, (b) skin tightening with radiofrequency and other approaches, and (c) improving circulation in blood and lymphatic microvasculature using both physical treatments and pharmacotherapy. The last two chapters are devoted to body sculpturing by lipotransfer and lipolysis. Lipotransfer for facial or body sculpturing has a history of about 100 years. Nevertheless, recently the role of adult stem cells in adipose tissue has gained much interest. By optimizing the harvesting, storage, and transplantation of adipose tissue, remarkable long-standing results have been obtained. Here the present authors will focus on midface contouring, where lipotransfer competes with dermal fillers. Lipolysis is another effective tool in body sculpturing. The present authors will focus on recent advances in laser-assisted lipolysis for delicate body sculpturing in the submental region but also for gynecomastia abdominal region, flanks, and hips. In conclusion, esthetic and cosmetic dermatology has become a scientific-based subspeciality of dermatology with evidence-based treatments and a great variety of high-tech approaches to provide more effective, more selective, and safer therapeutic options.

KEYWORDS: adult stem cells, aging males, botulinum toxin, cellulite, hormone replacement, laser-assisted lipolysis, lipotransfer

Address correspondence and reprint requests to: Uwe Wollina, MD, Department of Dermatology and Allergology, Hospital Dresden-Friedrichstadt, Academic Teaching Hospital of the Technical University of Dresden, Friedrichstrasse 41, 01067 Dresden, Germany, or email: wollina-uw@khdf.de.
Esthetic and cosmetic dermatology (ECD) has gained a broad interest as never before in all parts of the world. Sometimes the critics of such development complain that dermatology as a medical discipline might shrink to an unimportant niche of academic beauticians. Albeit, there is always a risk of misleading developments, of false and wrong reality shows that ECD indeed has matured to a scientific discipline with strong connections to basic and applied sciences and an attempt of preventive medicine in a much broader sense than traditionally anticipated. In the following chapter the present authors will discuss selected new developments on ECD.

**Androgens and aging**

Although aging is an inevitable biologic process that can be linked to a variety of pathologies like degenerative disorders, cancer, and skin diseases, aging itself is a physiologic process and not a disease.

Several attempts have been made to ensure the physiologic nature of well aging and prevent the negative impact on health and quality of life. The detection of endocrine-senescence has raised the hope that hormone replacement might be a way to slow down the aging process and support well-being. This part of ECD has a direct link to geriatric medicine and prevention of cancer.

In this chapter the present authors will focus on the aging male. The aging process associated with secondary hypogonadism is known as andropause. It is characterized by multiple clinical symptoms including osteoporosis, loss of muscle strength, loss of reproductive function and hypogonadism, thyroid dysfunction, fat accumulation, disturbance of sleep, and tendency to the development of cancer and infections. From the ECD point of view, alterations in body hair and skin are of interest.

During fetal life testosterone retards epidermal barrier function, but data on adult or aging skin are missing (1). Androgen receptors (AR) are strongly expressed in skin by sebocytes, eccrine, and apocrine sweat glands (2). In eccrine and apocrine sweat glands luminal cells of the secretory portion are variably AR reactive (3). In male mice gonadectomy leads to a diminution of the AR expression by sebaceous glands (4).

Androgen receptors are expressed by the secretory epithelium of axillary apocrine glands in correlation to their secretory activity (5). In patients with nonautoimmune dry eyes with Meibomian gland dysfunction, the level of bioavailable testosterone is significantly reduced (6).

Typical cutaneous signs of andropause are loss of hairs in ear and nose, a decrease in body hair, and thinning of skin (7). In particular the light-protected skin becomes thinner with age, and sebum production decreases which may lead to irritability and assteatotic eczema (8). Interestingly, human keratinocytes obtained from aged people show an enhanced androgen sensitivity (1). Melanocytes express AR and 5-alpha-reductase type 1, which explains the diminished pigmentation of penis and scrotal skin in hypogonadal males. Sun exposition causes less tanning but pale skin of hypogonadal men is also caused by reduced blood circulation and erythropoiesis (9).

Testosterone replacement therapy is an opportunity to normalize physiological functions after careful evaluation of the potential risks and benefits. The major domains of health risks are prostate, cardiovascular system, erythropoiesis, and lipid profile. Whereas breast cancer, polycythemia, and untreated sleep apnea are absolute contraindications, coronary artery disease in men seems to be associated with low testosterone (10). The longstanding concern that testosterone replacement therapy may increase the risk of prostate cancer has come under new scrutiny. New evidence suggests that TRT has little, if any, negative impact on the prostate, even in men with a history of prostate cancer (11). In a few studies men who underwent radical prostatectomy have been treated with testosterone replacement without any biochemical recurrences (12).

In studies including men above the age of 50, testosterone replacement has led to an increase in lean body mass (1–3 kg), decrease in fat mass (0–2%), increase in muscular strength and bone mineral density, decline of total cholesterol and normalization of sexual dysfunction, improvement of cognitive function, and mood disturbances (13–18; Table 1). The impact on skin aging, however, has not been studied systematically yet. Patients on testosterone replacement need a regular follow-up with urological investigation and serum PSA (19).

**Botulinum toxin A**

Botulinum toxin A (BTXA) has come of age in ECD. It has been proved to be an effective and safe treatment for hyperfunctional facial lines. The best evidence has been obtained for the upper face, i.e., glabellar and frown lines and
crow's feet. Randomized, placebo-controlled, prospective multicentre trial have been conducted for Botox/Botox Cosmetic/Vistabel/Vistabex (Allergan Inc., Irvine, CA), Dysport/Reloxin (Ipsen Ltd., Maidenhead/Berkshire, UK), and Xeomin (Merz Pharma, Frankfurt/Main, Germany) (20). Concerning new developments the present authors will focus on objective assessment of BTXA effects, BTXA brow lift, and combinations with other approaches in facial ECD.

Although the effect of chemodenervation by BTXA on hyperfunctional lines is obvious, recent developments gained for objective assessment. Heckmann and Schön-Hupka (2001) used standardized photography combined with digital image analysis in 30 patients with glabelar or frontal lines. Serial photographs with digital overlay technique were able to demonstrate that BTXA injections decreased upward brow mobility by 71% at 12 weeks after treatment. Frowning was decreased by 57% and the brow-to-brow distance in repose decreased by 13% (21).

Skin texture, however, is a three-dimensional quality. In a prospective open trial a silicon replica technique was used to evaluate the effect of BTXA on glabelar folds. The replicas were further analyzed for roughness, anisotropy, microsulcus number, and width by scanning electron microscopy. During a follow-up period of 6 months, significant improvement was noted for the number furrows, the average width of furrows, and the directionality index of skin lines as well as the average of skin roughness (22).

Three-dimensional profilometry with optical triangulation and digital image processing is another attempt to objective assessment. With this technique there is no need to produce replicas, but measurements are performed directly on the patient's skin surface. In a study with 24 patients treated with BTXA for forehead lines a significant improvement of skin profiles was seen over 8 months. The three-dimensional analysis is more complex but comes closer to the clinical approach than a two-dimensional effort (23).

In contrast to the former techniques, which depend on static images, the complex automated facial image analysis (AFIA) uses computer vision to quantitatively measure facial motion. Facial features are manually marked in the initial image and then automatically tracked across the image sequence. In a pilot study, eight patients with ocular or oral synkinesis obtained BTXA. AFIA was

<table>
<thead>
<tr>
<th>Table 1. Testosterone replacement therapy in aging males</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study</strong></td>
</tr>
<tr>
<td>Tenover 1992</td>
</tr>
<tr>
<td>Sih et al. 1997</td>
</tr>
<tr>
<td>Snyder et al. 1999</td>
</tr>
<tr>
<td>Kenny et al. 2002</td>
</tr>
<tr>
<td>Dean et al. 2004</td>
</tr>
<tr>
<td>Wang et al. 2004</td>
</tr>
</tbody>
</table>
performed before and after the injections. In each patient, 35 facial points were marked on the digital images. AFIA provides information about movement from the entire digitized sequence of facial expression including the speed of motion, acceleration, direction of motion, and displacement (24).

The brow contour shows gender differences. The peak of the female brow may be as far as the lateral canthus, whereas the brow arcs are above the orbital rim. In men the brow rests along the orbital rim. The brow position is affected by the frontalis muscle, which is the only elevator, and the depressors, i.e., corrugator supercili, procerus, depressor supercili, and orbicularis oculi muscles. Alteration of brow position by BTXA may be optimally used in a younger patient who desires a brow lift but does not want surgery (25).

The present authors can differentiate a medial brow lift and a lateral brow lift.

The medial brow lift can be achieved by a similar injection technique as for frown lines. The usual dosage is about 20 U Botox or Xeomin or 5 U Dysport. To achieve an optimal result, injections into corrugator supercili should be below or at the level of the brow and to avoid injections into the frontalis fibres. The procerus muscle is treated by an injection just above the radix and 2 cm above. The depressor supercili muscle is targeted by a single injection just inferior and lateral to the medial head of the brow. Exact injection technique and concentrated solution are necessary to avoid diffusion of BTXA (25). Overdosing will result in an unesthetic surprised look (26).

The lateral brow is depressed by the orbicularis oculi muscle. If the parts of the muscle just beneath the lateral brow are treated with BTXA, the lateral brow can be lifted. Usually, half of the dosage used for medial brow lift is enough. The injections should start at the high point and go laterally immediately inferior to the brow. To further mobilize the lateral brow, the upper part of crow’s feet need another injection lateral to the orbital rim. The injection is just superficial intradermal using 10 U Botox. Ahn et al. reported on lateral brow lifts in 22 patients. They used 16–20 U Botox injected in the superolateral part of the orbicularis oculi muscle, which produced an average of 4.8 mm elevation in the height of the lateral brow and 1 mm at the mid-pupil level (27,28).

Brow contouring is possible by weakening the medial and lateral brow depressors, resulting in some elevation. The most significant adverse effect of BTXA injections in that area is lid ptosis with an incidence of up to 1%. This effect is temporary, lasting about 2–3 weeks. It can be treated by apraclonidine eye drops that contract Mueller’s muscle to raise the lid about 1 mm (29).

Brow ptosis occurs after overdosing BTXA. Ectropium or diplopia are much less common possible adverse effects. Bruising is more common for crow’s feet (29). Compared with surgical procedures, chemodenervation is less adequate for the aging face (30).

Botulinum toxin A can be used in conjunction with other ECD procedures to ensure an optimum in facial rejuvenation. Yamauchi et al. combined peri orbital laser resurfacing with BTXA. First, the skin surface should be smoothened by BTXA, afterwards laser pulses can be placed more evenly as the patient is unable to wrinkle the skin during the procedure (31). Other combinations for the facial rejuvenation include chemical peels to improve superficial texture and remove pigmentation, intense pulsed light (IPL) or radiofrequency for tightening the skin (32–34).

The combination of fillers with BTXA is another interesting option. Wrinkling in the aging face is a complex phenomenon involving muscles, laxity, and loss of subcutaneous tissue volume. The rejuvenation with fillers combined with BTXA affects both volume loss and muscular hyperactivity. BTXA is administered about 1 week before filler injections or at the same setting. Preferred indications include resting glabelar folds, brow height adjustment, horizontal forehead lines, nasojugal folds, and resetting facial contours in the zygomatic and the perioral region. Commonly used dermal fillers are based on collagen and hyaluronic acid. Such fillers are biodegradable. The injection of these fillers is deep dermal or deep subdermal (as for resetting the zygomatic region). For the latter indication, polylactic acid would be another option. It has been shown that not only the immediate results are promising but also the effect seems to be longer lasting than with BTXA or fillers alone (35,36). In a prospective three-arm study with 65 patients treated for glabellar frown lines, the combination of BTXA with a collagen filler showed a significant better improvement after 1 month and significantly better maintenance at 3 months that monotherapy with either filler or BTXA (37). Intradermal microinjections (1 U of either Dysport or Botox) and hyaluronic acid gel (Restylane Vital) can be combined for facial rejuvenation even in the more difficult to treat areas as the periorbital area (38).

Epinephrine 1 : 100,000 is capable to enhance the effect of BTXA by 30–45% compared to BTXA.
alone for crow’s feet as shown by a pilot trial involving 14 patients (39). It is supposed that epinephrine increases the effective dosage by minimizing dilution by blood circulation.

Although the effect of BTXA is temporary, a regular long-term treatment from the mid-20s is capable to prevent the development of imprinted facial lines at rest and the crow’s feet as well. Such a slow-down of the facial aging process was nicely shown by a comparison in identical twins for a period of 13 years (40).

**Cellulite (gynoid lipodystrophy)**

Cellulite is a physiologic gender-linked condition clinically characterized by an orange-peel aspect of skin surface, later on mixed with irregular dimpling and lumpy-bumpy cobbles. Predominant localization is on thighs and buttocks.

This condition is a result of adipose tissue protrusions to the dermis, enlargement of fat lobules and alterations of the network of connective tissue strands that connect the dermis to deeper tissue layers (41). Proteoglycan deposits can also be found (42).

High-resolution in vivo magnetic resonance demonstrated that cellulite grading was corresponding to diffuse pattern of extrusion of adipose tissue into dermis, to the percentile of adipose versus connective tissue in a given volume of hypodermis, and the percentile of hypodermic invaginations inside the dermis (43). The interaction of estrogens with matrix metalloproteinase might be a clue to better understanding the biochemistry of this condition (44).

Although cellulite is for sure no disease, many women seek treatment for improvement. There are many different treatments described in the literature that are frustrating. Usually the more treatments are described the less effective they are. Although various treatments have been shown to be ineffective or even harmful (45), recent developments provide some hope.

Smalls et al. (2006) investigated whether controlled weight loss would improve cellulite. The results were mixed. There was improvement in those with higher initial body mass index and significant weight loss, but in others the condition worsened. Weight loss is a good starting point in obese women but alone it is not enough. Even for the combination of diet and regular exercise there is no scientific data proving its efficacy (46).

Topical use of anticellulite cream has not often been well documented. However, recent investigations with herbal cream containing caffeine, black pepper seed extract, sweet orange peel, ginger root extract, green tea extract, cinnamon bark extract, and Capsicum annum resin in 40 women provided evidence of clinical improvement during a 4-week course (47). Because all women also used neoprene shorts, it remains unclear whether the herbals would be as effective when used alone. How would the cream work? The authors suggested stimulation of microvascular blood flow and lymphatic flow as well as lipolysis.

Topical caffeine solution twice daily for 30 days decreased thigh and hip circumferences. Despite the clinical effects in this investigation, topical caffeine had no significant impact on parameters of microcirculation (48). What about coffee drinking? No such study is available.

Topical retinol during a 6-month period of treatment partially increased skin elasticity and decreased viscosity. There were objective effects in the lab but in clinical use irregularities and lumpy-bumpy appearance of skin did not improve (49).

Mesotherapy is a widely used albeit not scientifically approved method with multiple injections to deliver various ingredients into the skin. In vitro isoproterenol, aminophylline, yohimbine, and melilotos stimulate lipolysis alone, and lipolysis is further enhanced by combining lipolytic stimulators in mesotherapy solutions. Lidocaine is antilipolytic in vitro (50). For in vivo use, there are safety concerns related to the substances injected. Evidence-based medicine is missing for mesotherapy in cellulite (51).

In a pilot study, 12 women were treated twice weekly with a radiofrequency (RF)-light-based device for eight to nine treatments. The device called VelaSmooth™ (Syneron Medical Ltd, Yokneam, Israel) delivers bipolar RF, infrared light, and a pulsatile vacuum suction through a handheld applicator that is pressed directly against the skin. Each treatment lasted 30–45 minutes with an infrared light and RF power of 20 W and a negative, vacuum pressure of 200 millibars. Stimulation of lymphatic and blood flow and strengthening of the fibrous network by heating are possible ways of action. In this study and two others with the same device, 90–100% of patients noted an improvement of cellulite lasting for months (52–54).

A single-center study compared VelaSmooth™ with another combined approach, i.e., low-energy diode laser, contact cooling, suction, and massage (TriActive™; Cynosure, Chelmsford, MA) (55). Twenty women were treated twice a week for 6 weeks with a randomization of TriActive on one site and
VelaSmooth on the other site. Both methods showed an equal efficacy. In a pilot study combining application of a retinyl-based cream with IPL for a 12-week course in 20 patients IPL improved cellulite. The effect was not better with combination than with IPL alone (56). However, the cream may create some other beneficial effects. The major point is, IPL can stimulate collagen synthesis and make the dermis denser. A denser dermis, on the other site, makes fat less likely to herniated.

Recently, a controlled, double-blinded study has been conducted in nine women with grade II–III thigh cellulite to evaluate the efficacy and safety of a phosphatidylcholine-based, cosmetic anticellulite gel combined with a light-emitting diode (LED) array at the wavelengths of red (660 nm) and near-infrared (950 nm). The female volunteers were randomly treated twice daily with an active gel on one thigh and a placebo gel on the control thigh for 3 months for a total of 24 treatments. At the end of 3 months, eight of nine thighs treated with the phosphatidylcholine-based, anticellulite gel and LED treatments were downgraded to a lower cellulite grade by clinical examination, digital photography, and pinch test assessment. Digital ultrasound at the dermal-subcutaneous interface demonstrated not only a statistically significant reduction of immediate hypodermal depth, but also less echo-like intrusions into the dermal layer. Three of six biopsies from thighs treated for 3 months with the active gel and LED treatments demonstrated less intrusion of subcutaneous fat into the papillary and reticular dermis than in placebo- and LED-treated thighs. Patients experienced minimal and transient side effects that included pruritus, erythema, and swelling. Fifteen months after treatment, five responsive thighs reverted back to their original cellulite grading, indicating a need for maintenance treatment (57).

There are also surgical procedures available. A minimal invasive procedure has been developed by Hexsel and Mazzuco (58). They used local anesthesia, inserted a notched catheter into the subcutaneous tissue, and moved it manually parallel to the surface in a repetitive manner. By breaking the connective tissue adhesions of the dermis, the skin surface appearance is smoothened. In a retrospective trial, 232 women showed improvement of surface depressions and reported a high degree of satisfaction. There is little downtime after the procedure because of bruising, pain and hemosiderosis (58).

Liposculpture in tumescence anesthesia is a safe and standardized method to reduce subcutaneous fat tissue – so far, so good. However, the fibrous attachments tethering the dermis to subcutaneous layers will not be affected. Therefore, liposculpture is not a method to treat cellulite (59). Whether it might be a method to prevent cellulite has yet not been investigated systematically. The recent developments in laser lipolysis and laser-assisted liposuction allow treating body areas of flaccidity and irregularities (60–63).

Histologic investigations demonstrated high efficacy in adipocyte destruction and heat coagulation of collagen fibres and blood microvessels (64). By reorganization of the collagen network the procedure leads to skin tightening that seems to have a beneficial effect on cellulite (61) but has yet not been studied systematically.

**Lipotransfer for midface contouring**

The white adipose tissue of the subcutaneous layer results from differentiation of mesenchymal cells into pre-adipocytes and mature adipocytes. Genome-wide expression profiles of preadipocytes from abdominal subcutaneous, mesenteric, and omental fat deposits are distinct (65). Autologous fat is not immunogenic, easy to harvest and implant, and surprisingly long lasting (66).

Lipotransfer, also called lipo-filling, fat transfer, or lipoinjection, is an old technique developed in the 19th century (67). It is a commonly performed procedure in particular for midface contouring, but other indications developed as well (68–70).

Recently the technique has been studied systematically concerning the mode of fat harvest, preparation, storage, and use in facial contouring. It was shown that lipotransfer covers not only mature adipocytes but adipose-derived stromal cells (ASC) and preadipocytes (71). Excisional harvest is better than blunt or needle harvest (72). Fine needles seem to gain better fat cell viability than liposuction cannulas (73). In our hands 18 G needles have been found to be most convenient, as thinner needles may cause disruption of fat cells.

Anesthesia of the donor site is considered as a negative factor for fat cell survival although the various techniques do not seem to have a significant influence on adipocyte transfer. Vasoconstriction before fat extraction supports the maintenance of adipocyte viability (74). Local anesthetics, however, show a significant influence on viability of preadipocytes (75).

Cryopreservation of fat cells without cryoprotective agent causes an almost complete
depletion of metabolic activity as measured by glycerol-3-phosphate-dehydrogenase. Up to 54% of baseline metabolic activity can be preserved by adding cryoprotective agents (76). The addition of 10 μM coenzyme Q10 to adipocytes reduces stress-induced apoptosis (77). The recovering of viable adipocytes from cryopreserved samples can be further improved by controlled freezing compared to direct freezing at –20°C (78).

Transplantation of adipose tissue provides an excellent long-term soft tissue augmentation (FIGS. 1 and 2). It has been observed that transplanted adipose tissue also improves surrounding tissues into which the fat is placed (79). In an experimental study, it was shown that fat transfer enriched with ASC provides better results than aspirated fat alone. ASC differentiated into vascular endothelial cells thereby contributing to neoangiogenesis (80).

Pre-adipocytes are an interesting source for adipose tissue regeneration and lipofilling. Some factors have been identified that enhance the adipogenic conversion of pre-adipocytes. Fibrin matrix and basic fibroblast growth factor are effective in that way. In addition, basic fibroblast growth factor enhances neovascularization in the newly formed adipose tissue (81). It was demonstrated that freeze-thawed preadipocytes constantly show typical adipocytic functions in terms of lipid content, leptin secretion, adipogenic gene expression, and viability. After transplantation they form adipose tissue similar to those developed from fresh differentiated adipocytes. In addition, CD34-positive endothelial cells were identified in the implants contributing to improved blood supply (82).

In recent time, adult stem cell transfer by lipofilling has been debated. Mesenchymal stem cells (MSC) are nonhaematopoietic stem cells residing in bone marrow but adipose tissue as well. MSC are characterized by expression of a wide range of surface markers but lack of markers typical of hematopoietic or endothelial lineages including CD14, CD34, and CD45 (83,84).

In vitro MCS can differentiate into adipocytes when treated with a cocktail containing dexamethasone, isobutyl methylxanthine, and indomethacin. Changes in the bone morphogenetic protein receptor are intrinsic factors for the commitment into adipogenic or osteoblastic cell lines (84). A denatured collagen type I matrix preserves MCS adipogenic potential during ex vivo expansion (85).

MCS have been identified in white adipose tissue named adipose tissue-derived stem cells (ADSC). They share most cell surface markers with MCS. The two exceptions to the rule are CD49d expressed by ADSC only and CD106 expressed by MCS only. ADSC when grown in culture express several adipocytic genes including lipoprotein lipase, leptin, and peroxisome-proliferator activated receptor – 2 (86).

Adipose tissue-derived stem cells can be grown in vitro using a gelatine sponge as scaffold. After transplantation on severe combined immunodeficient mice, ADSC turns into mature adipose tissue within 4 weeks (87). Encapsulation of MSC in poly (ethylene glycol) diacrylate hydrogel retains defined shape and dimensions after in vivo implantation (88). Other potential scaffolds for engineered tissue include poly(lactic-coglycolic acid) (89), porous collagenous microbeads (90), and fibrin (91).

Laser-assisted liposuction

Liposuction is the most popular esthetic procedure performed is cosmetic surgery. Despite the evident progress related to the development of new resources such as the use of tumescent solution, ultrasound, and power-assisted liposuction, the major concern in relation to this procedure is the amount of the aspirated volume, its repercussion in hemodynamic aspect, the surgical trauma, and quality of the recovery period.

The use of laser in direct action in the fatty tissue was initially described by Apfelberg and colleagues in the early nineties (92). Recently, new lasers concepts have been adapted for the treatment of lipodystrophy in the body and face using a neodymium, yttrium, aluminum, garnet (Nd-YAG) laser, at a wavelength of 1064 nm. The current principles and technique of laser-assisted liposuction were initially described by Blugerman, Schavelzon, and Goldman using a pulsed 1064 nm Nd-YAG laser (Smartlipo, Deka, Italy) (93,94). Many studies showed interesting aspects related to the use of the subdermal 1064 nm Nd-YAG laser not only in the fat but also in surrounding tissues such as dermis, vessels, and sweat glands (95–98).

The main indication for laser-assisted liposuction is in the treatment of localized fat. Treatment is performed in direct contact with the fatty tissue or other targets such as sweat glands or dermis via optical fiber delivered through a 1-mm diameter cannula. When in contact with the previously infiltrated fatty tissue, the light energy produced by the laser is absorbed and converted into heat,
thereby expanding the adipocyte contents and rupturing the cell membrane. A photomechanic effect may also play a role in cellular lysis, as a result of the rapid absorption by and heating of the cell. The procedures can be performed after local tumescent subcutaneous infiltration of a Klein’s solution or a similar warm solution containing normal saline solution, epinephrine and sodium bicarbonate. Through thermal and photomechanical effects the laser action can produce cellular lysis, disrupt the thin adipocyte membrane, obliterate small blood vessels in the subcutaneous layer and fatty tissue, coagulate collagen in deep dermis, reorganize the reticular dermis and denatured sweat glands. As a consequence of these effects related to the laser, it is possible to transform a dense fatty tissue into a less dense solution, facilitating the aspiration of this material. The product of the cellular lysis is usually removed using negative pressure of around 350 mmHg to 450 mmHg in conjunction with a 2.5 mm suction cannula decreasing the trauma to the tissues. Potential complications related to the

FIG. 1. Facial atrophy in the cheek and lower lid region. (A) Before treatment, (B) 1 year after autologous lipotransfer.

FIG. 2. Lipotransfer for facial sculpturing in a 70-year-old woman. (A) Before treatment, (B) after 1 year, and (C) after 4 years with a stable result.
procedure are similar to a regular liposuction technique including asymmetry, hyper and hypo correction and infection. Burns also represent a potential complication. Histological findings suggest several positive benefits brought by the use of the Nd:YAG laser, which include skin retraction as a result of new collagen formation and a reduction in pre-operative and postoperative bleeding as well as in the population of adipocytes. The observation of a reddish color from the Helium-Neon source associated to the equipment, as a result of transillumination, makes the procedure very precise and accurate, as it allows the surgeon to identify the exact place where the tip of the 1 mm microcannula containing the optical fiber is and where the laser is working. It is a very useful characteristic mainly in special cases such as in the treatment of severe cases of cellulite, another interesting indication for this technique. The 1064 nm Nd-YAG laser due to its physical characteristics reach the oxyhemoglobin in small vessels located in the treated areas, coagulates these vessels. The collagen coagulation with a consequent neocollagenesis in the deep dermis is another important effect related to the laser which contributes to adequate skin tightening. This capacity to produce skin retraction is very important in the treatment of patients with some skin laxity, mainly in submental region, abdominal

FIG. 3. Laser-assisted lipolysis of subcutaneous adipose tissue deposits of flanks and abdomen in a 33-year-old woman. (A) Before treatment, (B) after treatment.

FIG. 4. Laser-assisted lipolysis of the buttock area. (A) Before treatment, (B) 23 months after treatment.
region, arms and thighs as well as in cellulite (99–101) (FIGS. 3–6).

Bromidrosis represents another indication for this type of laser (102). The subdermal laser-assisted axillary hyperhidrosis treatment using a 1064 nm Nd-YAG laser produces collapse of eccrine glands and resulted in significant clinical improvement (103,104).

Lipomas, gynecomastia, liposuction of flaps, herpes and oral disorders, stretch marks, scars and some minor vascular alterations represent other indications for this laser. Although the positive effects observed by many authors in many scientific publications, more studies and follow-ups are needed in order to deeply determine the characteristics and effects of the pulsed 1064 nm Nd-YAG laser and new indications.

References


