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## FACIAL PLASTIC AND RECONSTRUCTIVE SURGERY

VOLUME 2

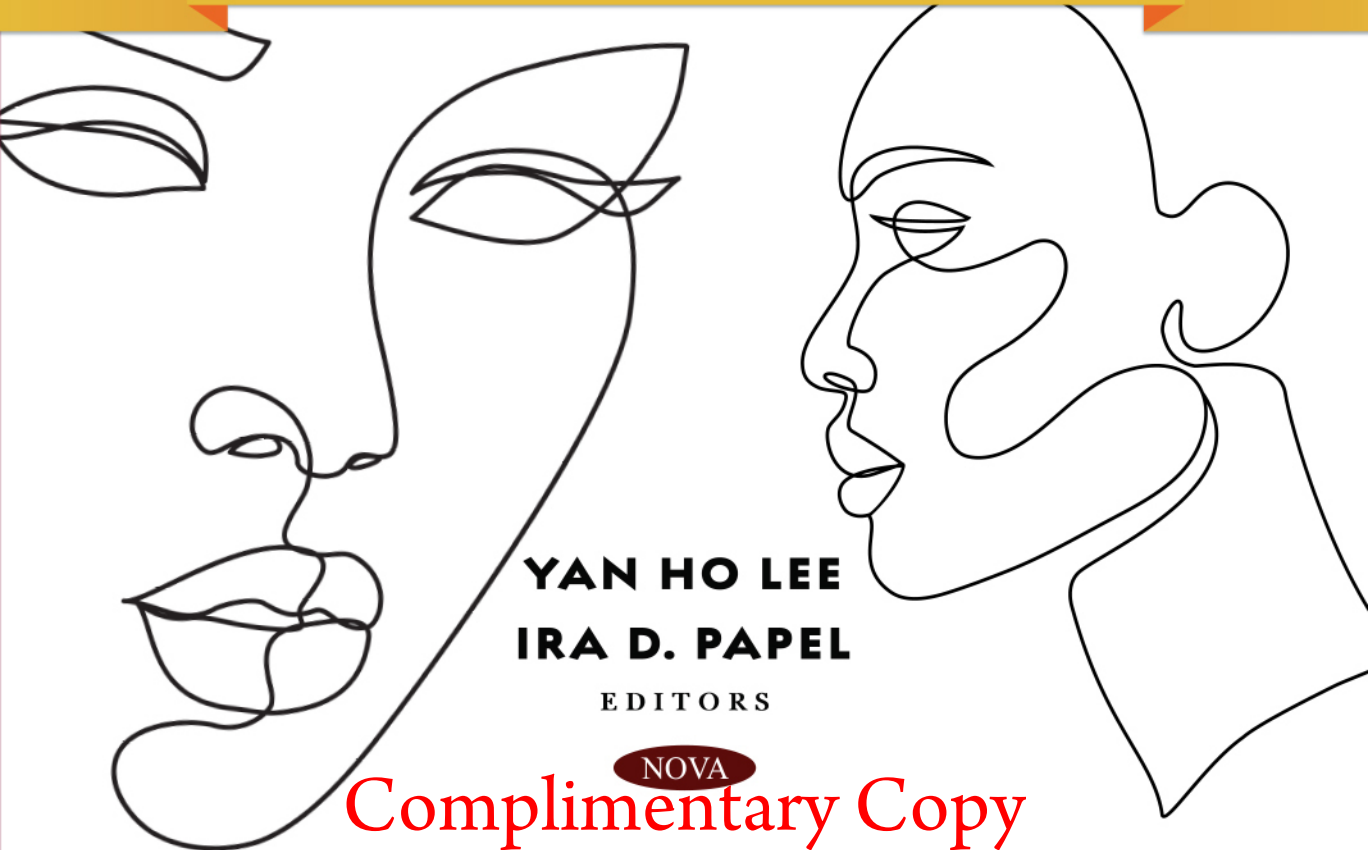
RHINOPLASTY, COSMETIC SURGERY, GENDER AFFIRMATION  
AND NON-SURGICAL FACIAL REJUVENATION

KJ LEE ESSENTIAL MEDICINE SERIES

**YAN HO LEE**  
**IRA D. PAPEL**  
EDITORS

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*To my husband Jonathan Y Lee for your unwavering support in life. Somehow you always know when I need you to help me solve an issue and when I need you to just listen to my grievances.*

*To my daughter Evie SY Lee who brightens up my day no matter what.*

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YHL

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Ira D. Papel, M.D.

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# Foreword and Acknowledgements

As the knowledge of medicine has grown exponentially, it is necessary to have books each encompassing one subspecialty. I had the vision of creating a book for each subspecialty building from the formula and on the success of *Essential Otolaryngology-Head and Neck Surgery*, the inceptive book, which is in its 12th Edition, 50th year, and has been translated into several languages. It was cited as one of the most read texts in the field worldwide. Working with President Nadya S. Gotsiridze-Columbus, CEO of Nova Science Publishers, Inc., we developed K. J. Lee Essential Medicine Series to launch the subspecialty books. After a national search, we were fortunate to have Dr. Yan Lee and Dr. Ira Papel to be Editors of this book. We commend the scholarly contents of the chapter contributing authors. It is with great pleasure and honor for me to say they all worked very hard and have done a superb job. I thank them all and kudos to them.

Like the inceptive book, I have no doubt this book will find its way to libraries, to the reference sections of emergency rooms, urgent care centers, as well as the dorm rooms, apartments, and homes of medical students, residents, fellows, young attendings, physician assistants, nurse practitioners and others.

This book is not only a great text and reference for medical professionals, but it can also be of value for people outside the medical field to understand key concepts in order to better communicate with providers.

K. J. Lee, MD, FACS, Editor-in-Chief  
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## Acknowledgements

We would like to thank Dr. K.J. Lee for his mentorship and sponsorship. Dr. Lee has been pivotal in the training and education of otolaryngology head and neck surgeons for decades. We are honored he has entrusted us with the task of editing this book.

To the authors who contributed to this book: We are so fortunate to have colleagues from various specialties and subspecialties who are collectively experts in our field. Your experience and knowledge truly enrich the content of this book. We could not ask for contributors who are more dedicated to the field of Facial Plastic and Reconstructive Surgery.

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## Chapter 21

# Laser and Energy Treatments

**Richard W. Westreich, MD**

### Introduction

1. Skin tightening generally results from heating of the reticular dermis or fibroseptal network with adipose tissue. The methods of heating may differ, such as ultrasound or radiofrequency (RF), but the common endpoint is target temperature within the tissues.
  - a. Skin tightening can result from external heating to 42-45 degrees C
  - b. Fat liquification (lipolysis) occurs at 48-50 degrees C
  - c. Skin contraction results at levels between 60-70 degrees C [1]
  - d. Thermal injury results in growth factor release (TGF-alpha, TGF-beta, VEGF, PDGF) that stimulates collagen, elastin fiber production and angiogenesis
2. Both skin tightening and body contouring through lipolysis can be achieved with non-surgical approaches
3. Laser (Light Amplification by Stimulated Emission of Radiation)
  - a. Emits 1 wavelength of light to produce photothermolysis
  - b. Terms:
    - i. Lasing medium: substance that produces laser beam; can be gas (argon, CO<sub>2</sub>), solid (ruby crystals, Nd:YAG) or liquid (dye)
  - c. Laser parameters:
    - i. Wavelength: distance between two peaks; measured in nanometers (nm); shorter has more superficial penetration, longer has deeper penetration
    - ii. Pulse duration: speed at which energy is delivered; longer pulse means slower heating of tissues
    - iii. Spot Size: larger spot size leads to deeper penetration; smaller size leads to more energy absorbed in superficial layers
    - iv. Fluence: energy per area; measured in joules

### Patient Evaluation

1. Patient assessment and selection are critical for successful outcomes with non-invasive facial rejuvenation treatments. Patients must be counseled on:
  - a. Degree of expected change
  - b. Variable nature of results

- c. Potential future option/need to have invasive procedures if the non-invasive therapy does not yield satisfactory results
2. Patient's general health status, age, and skin quality must be taken into account
  - a. All non-invasive treatments rely on wound healing processes in order to produce tightening of skin
  - b. Patients with thin atrophic skin, older patients, or patients with a poor history of response to prior treatments should be counseled about the potential for results that are may be less than expected
3. Patients with mild to moderate skin laxity or lipodystrophy problems are generally the best candidates because non-invasive treatments have limitations in the amount of tightening that can be achieved; these parameters are age independent
4. Secondary factors, such as the presence of dyschromias, pore size, and rhytids may play a role in choice of device, depending on whether simultaneous treatment for these factors is desired
5. Counsel patients about the concept of a bell curve and that projections or assumptions about potential results are based upon average response; the less invasive the procedure, the wider the bell curve tends to be and more variability in outcomes may occur
6. In general, for most modalities, published patient satisfaction rates range from 70-98% [1-8]

## Management

1. Types of laser and light therapies and applications (Table 21.1)
2. Current Modalities for skin tightening include:
  - a. Radiofrequency- monopolar, and bipolar, fractionated
    - i. Bipolar applicators technically limit deeper thermal spread and avoid injury to surrounding studies; monopolar systems may produce deeper energy treatments, which can help if fat reduction is primary desire from treatment [2]
    - ii. Surface heating
      - Surface heating with monopolar or bipolar RF above 42 degrees C can result in skin tightening
      - Multiple treatments (5-6) generally recommended for optimal clinical effectiveness
      - Treatments can be done as often as weekly
    - iii. Microneedling with RF – essentially a mechanical heat fractionation [3]
      - Electrodes can penetrate to reticular or papillary dermis and provide RF heat sufficient to cause skin tightening and limited lipolysis
      - Some devices can penetrate into subcutaneous fat depending on area being treated and dermal thickness of region

- Multiple treatments (3-5) typically recommended at 4-6 weeks apart
- iv. Subdermal heating, also known as Radiofrequency Assisted Lipolysis (RFAL)

**Table 21.1.** Types of Laser and Light treatments

Laser/Light	Wavelength	Description
CO <sub>2</sub>	10,600nm	-Ablative or non-ablative; can be fractionated -Used to treat scars, warts, rhytides
Erbium: Yttrium aluminum garnet (Er:YAG)	2940nm	-Ablative or non-ablative; can be fractionated -Infrared beam -Promotes collagen remodeling -Used for scars, resurfacing, treating rhytides, skin laxity, benign skin lesions
Potassium Titanyl Phosphate (KTP)	532nm	-Non-ablative -Penetrates red pigment/hemoglobin -Effective for blood vessels, acne, rosacea, ecchymosis, benign pigmented skin lesions
Pulsed Dye Laser (PDL)	585-595nm	-Non-ablative -Penetrates red pigment/hemoglobin -Treats hyperpigmentation -Effective for blood vessels, acne, rosacea, ecchymosis, benign pigmented lesions -Used for tattoo removal (red)
Ruby	694nm	-Used for tattoo removal (black, blue/green)
Alexandrite	755nm	-Penetrates red pigments -Can target blood vessels -Used for tattoo removal (black, blue/green) -Used for hair removal -Q-switch mode delivers high-intensity short pulses of energy
Diode	810nm	-Used for hair removal
Neodymium:yttrium aluminum garnet (Nd:YAG)	1064nm	-Infrared wavelength -Reaches deeper level -Used for spider veins, varicose veins, vascular malformations, brown-pigmented skin lesions -Used for removal of tattoos (black, yellow, orange, red) -Used for hair removal
Intense pulsed light (IPL)	520-1100nm	-Uses light source (technically not laser) -Targets hemoglobin and melanin -Penetrates red and brown pigments for brown/red skin lesions -Can treat acne, rosacea, vascular lesions, hyperpigmentation -Used for hair removal
Light-emitting Diode (LED) Light Therapy		-Can have red, blue, yellow, or near-infrared light -Treats hyperpigmentation, rhytides, acne
Phototherapy		-UVB light helps to treat psoriasis, vitiligo

- Classified as minimally invasive
- Subdermal electrodes passed underneath skin surface and controlled heating up to 70 degrees C can be done with or without liposuction [4]
- Both monopolar and bipolar options exist depending on system being used
- Studies have shown almost 30% more skin tightening than with liposuction alone
- As a stand-alone procedure, studies estimate 20-36.4% skin surface reduction [1]
- Treatment effects have been described as 37% of a surgical facelift

- Primary cause of tightening is thermal injury to fibroseptal network in fatty layer
  - Single treatment is effective in most cases
  - Can be combined with microneedling RF for enhanced tightening effects [3]
  - If 20% reduction is assumed, then for a typical jawline (5 inches long), 1 inch per side reduction is expected, or a total of 2 inches for a bilateral treatment
- b. Ultrasonic devices [5]
- i. Diffuse ultrasound is used to map the depth of skin layers targeted for treatment
  - ii. Focused ultrasound is then used for treatment, which can be adjusted to various depths and energies
  - iii. Heat is caused by vibration of molecules within tissue
  - iv. Single treatment often suggested
  - v. Pain can be a limiting factor for patient acceptance
  - vi. Results variable but can be significant in a subset of patients; some studies report greater than 70% subjective patient satisfaction
- c. Laser devices
- i. Resurfacing effects, pigment reduction, and fat reduction can be achieved with laser treatments [6] (Tables 21.1 and 21.2)
  - ii. Generally, most non-ablative lasers do not result in predictable skin tightening, although it can occur, especially with laser assisted liposuction
  - iii. Ablative
    - CO<sub>2</sub>: invisible infrared band of 10,600nm
    - Erbium (Er:YAG): wavelength of 2940nm
  - iv. Fractionated
    - Most laser types can be fractionated. Most common are CO<sub>2</sub> and erbium [7]
    - Concept is to create mini zones of injury, while leaving skin intact in between
    - Having smaller zones of injury results in faster healing times
    - Even though treatment is not ablative, after several treatments, skin will be fully resurfaced
- d. Laser assisted lipectomy
- i. Non-invasive
    - 1060nm diode laser
    - 635 nm laser
  - ii. Invasive
    - Laser liposuction cannulas
    - Laser assisted lipectomy can add an additional 7-10% of tightening above liposuction alone [8]

### 3. Cryolipolysis

- a. While primarily used for fat reduction, skin tightening can occur after treatment, but is not a predictable outcome from cooling. [4]
  - b. 2 to 12 30-minute treatments 6-8 weeks apart
  - c. Paradoxical adipose hyperplasia has recently been reported as a unique complication of procedure and will likely be the focus of future investigations
4. Magnetic Resonance Contouring or High Intensity Focused Electromagnetic (HIFEM) treatments
    - a. While mechanism involves rapid muscle contractions, some studies have demonstrated a reduction of adipose tissue and/or skin tightening
    - b. 4 to 6 30-minute sessions over 2-3 weeks
    - c. Maintenance treatment every 3-6 months

**Table 21.2.** Comparison of Treatment Types for Skin Tightening and Fat Reduction

Treatment Type	Skin Tightening	Fat Reduction	Typical Number of Treatments
Radiofrequency - surface	+	+	5-6
RF- Needle	++	++	3-5
RF-Subdermal	+++	++	1
Ultrasound	++	++	1
Laser - ablative	+	-	1
Laser - nonablative	-	+	3-4
Laser assisted liposuction	++	++	1
Electromagnetic (HIFEM)	+	+	5-6
Cryolipolysis	-	++	variable

## Complications

1. Limited complications exist with all of these treatments but typically are the result of heat:
  - a. Burns
  - b. Pigmentation changes
  - c. Nerve injury (sensory or motor)
  - d. Nodules and contour irregularities

**Summary Points**

1. A myriad of treatment options exist for facial rejuvenation that can be specific for skin tightening, adipose reduction, or resurfacing
2. A variety of non-surgical treatments are available for redness, pigmentation concerns and hair reduction
3. Patient factors and physician factors may determine the choice of modality
4. Some modalities are capable of producing more than 1 clinical result



## Patient Case

Patient with loss of neckline due to excess adipose tissue.



**Figure 21.1.** Case Figure.

Q1: What is the primary treatment modality that should be used in this patient?

A1: Suction assisted Lipectomy

Q2: What alternative treatments may be considered in a patient with this concern?

A2: non-surgical fat reduction techniques, such as cryolipolysis, radiofrequency, ultrasound, or mesotherapy (injection). If the patient desires an enhanced result, consider laser assisted lipectomy or RFAL to enhance skin tightening.

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Q3: What should be part of your counseling for this patient prior to any laser/energy treatments?

A3: Patient expectations: degree of expected change, variable nature of results, potential future option/need to have invasive procedures if the non-invasive therapy does not yield satisfactory results

Counsel patients about the concept of a bell curve and that projections or assumptions about potential results are based upon average response; the less invasive the procedure, the wider the bell curve tends to be and more variability in outcomes may occur.

For most modalities, published patient satisfaction rates range from 70-98% [1-8]

Potential complications include: burns, pigmentation changes, nerve injury (sensory or motor), nodules and contour irregularities

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