Current Standards in Light-Based Hair Reduction
Edward Zimmerman, MD

The following potential conflict of interest relationships are germane to my presentation.

Speakers Bureau: Alma Laser.

Why Provide Hair Removal?
• One of the most popular (top 5) non-surgical cosmetic procedures in the United States
• Since 2003, the number of women seeking hair removal exceeded the number of men nearly 4:1
• Has become the second most requested nonsurgical cosmetic procedure by men in the United States
**Market for Hair Removal**

- In 2005, more than 12 million laser hair removal treatments were performed, generating over $2.7 billion
- More than 133 million waxing treatments were performed, generating over $4 billion
- By 2010, laser hair removal treatments are expected to grow to $3.5 billion in revenue

**Laser Hair Removal Popularity**

- ASAPS 2009 Procedural Statistics list laser hair removal as the third most popular nonsurgical cosmetic procedure
- ASAPS 2009 list laser hair removal as the second most popular nonsurgical cosmetic treatment for men and the third most popular nonsurgical cosmetic treatment for women

**Hair Removal Revenue Potential**

<table>
<thead>
<tr>
<th>Monthly Business Mix</th>
<th>Treatments per Month</th>
<th>Gross Income per Month</th>
<th>Treatments per Week</th>
<th>Treatment per Day</th>
<th>Treatment Time per Day (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Lip</td>
<td>11</td>
<td>$1600.00</td>
<td>2.75</td>
<td>0.65</td>
<td>5.50</td>
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<tr>
<td>Legs</td>
<td>8</td>
<td>$2800.00</td>
<td>2</td>
<td>0.4</td>
<td>12.00</td>
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<tr>
<td>Bikini</td>
<td>7</td>
<td>$2100.00</td>
<td>1.75</td>
<td>0.35</td>
<td>5.25</td>
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<tr>
<td>Back</td>
<td>6</td>
<td>$3600.00</td>
<td>1.5</td>
<td>0.3</td>
<td>10.50</td>
</tr>
<tr>
<td>Vascular</td>
<td>12</td>
<td>$3800.00</td>
<td>3</td>
<td>0.6</td>
<td>15.00</td>
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<tr>
<td><strong>Monthly Totals</strong></td>
<td><strong>44</strong></td>
<td><strong>$14,598.00</strong></td>
<td><strong>11</strong></td>
<td><strong>2.2</strong></td>
<td><strong>48.25 min/day</strong></td>
</tr>
<tr>
<td><strong>Monthly Gross</strong></td>
<td></td>
<td><strong>$15,948.00</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Annual Gross</strong></td>
<td></td>
<td><strong>$185,388.00</strong></td>
<td></td>
<td></td>
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</tbody>
</table>
### Methods of Hair Removal

- Shaving
- Waxing
- Tweezing
- Depilatory Cream
- Vaniqa Cream
- Electrolysis
- Laser/ IPL
- ELOS

### Successful Hair Practice

- Requires time and financial commitment
- Patients must receive excellent clinical outcomes
- Treatments must be time efficient, safe, and comfortable

### Successful Hair Reduction

- Laser hair reduction is a process that occurs over a full calendar year
**Successful Hair Reduction**

As in all other aesthetic procedures, successful hair reduction treatments require:
- Educating patients to expect realistic outcomes
- Educating staff to achieve excellent reproducible results

**Anatomy of Human Hair**

Hair is composed of keratinous fibers that grow from epithelial follicles over the surface of the skin.

- Hair shaft
- Hair bulb
- Sebaceous gland
- Eccrine gland
Two Major Types of Hair

- **Terminal**
  - Long, thick, and pigmented with melanin
  - Found on underarms, genital areas, eyebrows, scalp, arms, chest, face, and back
- **Vellus**
  - Short, small in diameter, non-pigmented
  - Found on areas such as the forehead

Hair Regeneration

- **Papilla**
  - Deep in the dermis
    - 3-7 mm from the skin surface
- **“Bulge”**
  - Near the attachment point of the Arrector Pili
    - 1.5 mm below the epidermis

Phases of Hair Growth

- Hair can be damaged during the active growth phase
Three Phases of Hair Growth

Anagen
- Active hair growth
- Bulb and papilla develop and cells multiply
- Hair contains an abundance of melanin
- Only stage that hair is susceptible to treatment by laser/IPL

Catagen Phase
- A short (three week) stage of regression
- Cell division stops and lower portion of the follicle begins to be reabsorbed by the surrounding cells

Telogen

Hair Growth Cycles
Hair Growth Cycles

Telogen Phase

- Hair falls out in preparation for development of new hair
- Dormant stage - no growth

Richards - Merhag

<table>
<thead>
<tr>
<th>Location</th>
<th>Telogen (%)</th>
<th>Anagen (%)</th>
<th>Density/cm²</th>
<th>Follicle Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp</td>
<td>85</td>
<td>15</td>
<td>350</td>
<td>2-3.5 mm</td>
</tr>
<tr>
<td>Eyebrow</td>
<td>90</td>
<td>10</td>
<td>350</td>
<td>2-2.5 mm</td>
</tr>
<tr>
<td>Ear</td>
<td>85</td>
<td>15</td>
<td>350</td>
<td>2-3.5 mm</td>
</tr>
<tr>
<td>Cheeks</td>
<td>30-50</td>
<td>50-70</td>
<td>350</td>
<td>2-4 mm</td>
</tr>
<tr>
<td>Beard</td>
<td>20</td>
<td>70</td>
<td>500</td>
<td>2-4 mm</td>
</tr>
<tr>
<td>Upper lip</td>
<td>35-65</td>
<td>65</td>
<td>500</td>
<td>1-2.5 mm</td>
</tr>
<tr>
<td>Axillae</td>
<td>70</td>
<td>30</td>
<td>65</td>
<td>2-4 mm</td>
</tr>
<tr>
<td>Trunk</td>
<td>NA</td>
<td>NA</td>
<td>70</td>
<td>2-4.5 mm</td>
</tr>
<tr>
<td>Bikini</td>
<td>60</td>
<td>40</td>
<td>70</td>
<td>3.5-5 mm</td>
</tr>
<tr>
<td>Arm</td>
<td>70</td>
<td>30</td>
<td>80</td>
<td>2-4.5 mm</td>
</tr>
<tr>
<td>Leg</td>
<td>70</td>
<td>30</td>
<td>60</td>
<td>2.5-4 mm</td>
</tr>
<tr>
<td>Breast</td>
<td>70</td>
<td>30</td>
<td>65</td>
<td>3-4.5 mm</td>
</tr>
</tbody>
</table>

Laser treatment has been shown to interrupt these cycles

When Should Hair be Treated?

- Treat during Anagen phase.
- Number of treatments predicted by Richards-Merhag chart
- Example:
  - 20% of typical leg hair is in Anagen phase
  - at least 5 treatments to get maximum hair reduction
- Repeat: every 6 to 8 weeks
**Variables of Hair Growth**

- Male vs. Female
- Hormonal Changes
  - Pregnancy, Menopause, etc.
  - Certain endocrine disorders and hormonal diseases or syndromes
    - PCOS, Cushing’s Disease, etc.
- Certain medications
  - BCP’s, HRT, etc.
- Age
- Diet or exercise

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**Laser Absorption vs. Wavelength**

![Graph showing absorption vs. wavelength](image)

- Melanin absorption coefficient of the hair shaft and bulb is roughly two to six times that of the epidermis

Fitzpatrick’s Classification

- I: very white, always burns
- II: white, usually burns
- III: white to olive, sometimes burns
- IV: brown, rarely burns
- V: dark brown, very rarely burns
- VI: black, never burns

Laser Hair Reduction
Lasers & Devices

Ruby: 694 nm

- Appropriate for skin types I-III
  - Dark to light brown hair
  - Fine to coarse in diameter
  - Hair counts reduced by approximately 30% after single treatment
  - Hair counts reduced by approximately 60% after 3-4 treatments
Ruby Devices

- Palomar E2000
- Sharplan Epitouch Ruby
- Aesclepiion-Meditec Ruby Star
- Wavelight Sinon

Alexandrite: 755 nm

- Appropriate for skin types I-IV
  - Dark to light brown hair
  - Fine and coarse in diameter
  - 45-56% reduction in hair growth in lip, leg, back at 6 months after one treatment with variable pulse alexandrite laser

Alexandrite Devices

- Cynosure Apogee
- Candela Gentlelase
- Sharplan Epitouch ALEX
- Light Age Epicare
Diode: 800/940 nm

- Appropriate for skin types I-IV
  - Dark to light brown hair
  - Coarse in diameter
  - Long term results suggest that diode laser is very effective for removal of dark terminal hair

Diode Devices

- Alma Soprano
- Lumenis LightSheer Duet
- Palomar SLP1000
- Aesclepion-Meditec MedioStar

Nd:YAG: 1064 nm

- Appropriate for skin types I-VI
  - Dark to medium brown hair
  - Coarse to medium in diameter
  - Long term results suggest Nd:YAG effective for removal of dark hair safely in all skin types
  - Long term results suggest that Nd:YAG effective for treatment of pseudofolliculitis barbae in darker skin types
Nd:YAG Devices

- Aerolase LightPod Neo XT
- Cutera CoolGlide
- Laserscope Lyra
- Candela Gentle YAG
- Cynosure Acclaim
- DEKA PhotoSilk Plus
- Sciton Profile
- Lumenis Vasculite

Intense Pulsed Light

- Appropriate for skin types I-IV
  - Dark to light brown hair
  - Coarse to medium in diameter
  - Long term results suggest IPL effective for hair reduction

Intense Pulsed Devices

- Lumenis Quantum
- Cynosure Photolight
- Palomar Estelux
- Radiancy Spa Touch
- Derma Med USA Quadra Q4
- Sciton BBL
Hair Removal Lasers & Devices

- Intense Pulsed Light + Nd:YAG
  - Lumenis Vasculite Elite
  - Palomar Starlux
- ELOS Technology
  - Syneron Aurora DS

Laser Hair Removal Indications

- Hirsutism
- Hypertrichosis
- Cosmetic
- Folliculitis

Medical History Considerations

- Conditions causing hypertrichosis
- Local or recurrent skin infection
- History of herpes simplex or genitalis
- Keloid/hypertrophic scarring tendency
- Vitiligo
- Psoriasis
- Previous treatments
Medical History Considerations

- Recent sun, tanning bed, or sunless tanning exposure
- Onset of hair regrowth
- Tattoos
- Patient lifestyle

Contraindications

- Photosensitizing medications
- Presence of tattoo in treatment area
- Psoriasis
- Accutane
- Recent UV exposure
- Gold therapy
- Vitiligo

Pre-Treatment Instructions

- No bleaching, tweezing, waxing, depilatory creams four weeks prior to treatment
- Avoid Retin-A, AHA, or glycolic acid one week prior to treatment
- Avoid sun exposure, tanning, and self-tanning product two weeks prior to treatment
- Shave treatment area 24 hours prior
- Prophlax for herpes simplex if indicated
Clinical Endpoints

• Hairs visible burned to surface
• Odor of burnt hair
• Hairs may simply fall out
• Edema
• Erythema

Post Treatment Instructions

• Avoid harsh topical agents
• Avoid sun exposure for two weeks
• Shaving permissible between treatments
• Follow up treatment schedule six to eight weeks

Important Features of Laser Hair Removal Devices
Important Clinical Parameters

• Maximum hair count reduction per treatment
• Treats all skin types
• Minimal pain
• Designed for safe operation
• Highest speed

Important System Features

• Pulse width must be less than the thermal relaxation time (10-400ms)
• Fluence: 20 to 120 Joules/cm² - hair
• Contact cooling

Important System Features Cont.

• Beam shape: square (top hat)
• Speed: average
• Scanning devices
Pulse Width

A pulse of the optimum time duration heats both the bulb and the bulge of the follicle to a necrotic temperature ~70°C.

A longer duration pulse gives time for heat to flow laterally out of the follicle producing a lower peak temperature. If the fluence is increased additional tissue adjacent to the follicle will be damaged and pain is increased.

Pulse Stacking: A Problem With Hand Delivery of Pulses

When pulses are applied next to one another, the epidermis heated by the first pulse may still be warm when the second pulse arrives. The "double hit" or "pulse stacking" can result in blisters. The problem will vary with the amount of overlap, which is not well controlled with hand delivery. A model of this effect is shown in the next slide.

Pulse Stacking

After a pulse has deposited heat in tissue, the elevated temperature will diminish with time. If the positions of two successive pulses overlap, the temperature rise can be greater than that produced by either pulse alone and may overheat the dermal/epidermal junction.
Energy Distribution

Comparison of a 10 mm diameter Gaussian spot with a 6.4 mm diameter square (Top Hat) spot. The square distribution delivers equal energy to a larger area.

Before and After Photos

Hair Removal

Pre Tx with 1064nm module
One Month Post 1TX

Photos courtesy of Arkansas Laser Solutions, Fayetteville, AR 72703
High Hair Count Reduction

- Tx I Sept 15, 2000: 70 Joules/cm² – 20 msec
- Reduction at Sept 29, 2000: 64%
- Tx II Nov 13, 2000: 70 Joules/cm² – 20 msec
- Reduction at Nov 27, 2000: 95%
- Reduction at Apr 22, 2002: 100%

Before and After Photos

Photos Courtesy of Dr. Don Groot
Hair Removal Diode

Pseudofolliculitis Barbae Diode

After 2 elōs Hair Removal Treatments

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Laser Hair Removal
Side Effects & Complications

Hair Removal Side Effects

• Pain
  – Larger spot sizes associated with more pain
  – Pain tolerance decreases as length of treatment increases
  – Epidermal cooling very important in pain management
• Perifollicular edema and erythema
• Folliculitis
Laser Injury Occurrences

- Poor patient selection
- Inadequate understanding of light and tissue interaction
- Inadequate epidermal protection

Light Based Adverse Events

- Scarring
- Burn/blister
- Infection
- Hyperpigmentation
- Hypopigmentation

Scarring

Scarring caused by:
- Over aggressive treatment
- Inadequate cooling
- Post-procedural infection

Following treatment with Nd:YAG
**Burns/Blistering**

- Occurs in 10-15% of patients
- Due to direct thermal injury
- Lower fluences and larger spot sizes lead to greater chance of burns

![Image of burns](image1)

*Treatment using Diode laser*

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**Hypopigmentation**

- Dark skin types experience more hypopigmentation
- May be related to:
  - Melanocyte destruction
  - Suppression of melanin production
  - Melanin redistribution

![Image of hypopigmentation](image2)

*Treatment with Ruby laser*

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**Hyperpigmentation**

- Lighter skin types experience more hyperpigmentation
- May be related to:
  - Melanin stimulation
  - Delayed tanning
  - Epidermal injury
  - Photo-oxidation of existing melanin

![Image of hyperpigmentation](image3)

*Treated with Intense Pulsed Light*
Poor Laser Choice

Poor Cooling/Excess Energy