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Synopsis of Laser Assisted Hair Removal Systems

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ABSTRACT

Conventional treatment options for hypertrichosis and hirsutism are tedious and time consuming. Laser hair removal offers an efficient way to permanently reduce excessive hair growth. Hair is damaged using the principle of selective photothermolysis with wavelengths of light well absorbed by follicular melanin and pulse durations that selectively thermally damage the target without damaging surrounding tissue. Patients with dark hair and light skin are ideal candidates. Multiple treatments (3 to 6) that are performed every 6–8 weeks are necessary to achieve hair growth reduction. As the field develops, a better sense of the effectiveness of laser hair removal will evolve and reasonable expectations will be determined.

KEY WORDS: *chromophore, hirsutism, hypertrichosis, photothermolysis*

Hypertrichosis and Hirsutism

Hypertrichosis is defined as increased hair at any body site regardless of gender. Hirsutism is the presence of excessive hair at androgen dependent sites. Waxing, shaving, tweezing, chemical depilatories and electrolysis are traditional methods to eliminate unwanted hair. However, with the exception of electrolysis, these treatments are temporary. Laser hair removal offers an alternative method to permanently reduce excessive hair growth.

Methodology of Laser Hair Removal

Most laser treatment for hair removal is based on the principle of selective photothermolysis[1], which states that by choosing the appropriate wavelength, pulse duration, and fluence, thermal injury can be confined to the target chromophore. The chromophore of pigmented hair follicles is melanin, which is located primarily in the hair shaft and in the bulge[2]. Whether damage to either one or both of these two sites is sufficient to produce permanent hair removal remains unknown.

While early studies suggest that anagen hair is the most susceptible to damage by laser pulses, recent data confirms that hairs in all portions of the cycle may be targeted[3]. During the early anagen phase, the bulb and the bulge are in close proximity to each other and are located high within the dermis. Red and infrared laser light can easily penetrate and damage these structures altering hair growth. Each treatment reduces hairs by approximately 20%. As well, hairs become less dark and coarse[4]. The result of successive treatments is the miniaturization of terminal hairs into vellus hairs.

Treatment Guidelines

To obtain optimal results, the fluence must be tailored to the patient's skin type. Scarring and pigmentary alteration may be seen with inappropriately high fluences and poor patient selection, and whitening, epidermal disruption and blistering are tissue responses that indicate inappropriately high fluences. Because these findings can be immediate or delayed, it is important to carefully observe the treated areas for at least five minutes before proceeding with a full treatment.

The ideal patient for laser hair removal is light skinned with black coarse hair. Blonde, gray and white hairs do not respond to

treatment. Dark skinned individuals, and especially tanned patients are at high risk for pigmentary alterations. Cooling devices, either spray or contact, are helpful for protecting the epidermis, but may not be sufficient to protect tanned or darker skinned patients. Patients with a tan should delay treatment until the tan fades. Darker skinned patients are best treated with long pulsed wavelength lasers such as the diode (800 nm) or the new long pulsed Nd:YAG lasers (1064 nm).

A history should be obtained to search for any underlying medical or preventable cause for excessive hair growth, e.g., tumor or

Device	Wave-length	Pulse Duration	Spot Size (mm)	Cooling Device	Scanner	Comments
Q-switched Nd:YAG:						
• *SoftLight* (ThermoLase Corp, USA)	1064 nm	10–20 ns	7–10	No	No	• ± carbon particles makes no difference in efficacy; temporary reduction; can be used on pigmented skin
• + carbon solution						• lower fluences (2–3 J/cm^2, 7 mm spot size) and carbon particles applied to wax-epilated skin
• - carbon solution						• higher fluences can be used
Long-Pulsed Ruby:						
• *EpiLaser* (Palomar Medical Technologies, USA)	694 nm	3 ms	7–10	Cold sapphire tip	No	• Permanent reduction
• *EpiPulse* (ESC Sharplan, Israel)	694 nm	1.2 ms	4–6	Gel	No	• Permanent reduction; dual mode: Q switched and long pulse
Long-Pulsed Alexandrite:						
• *GentleLASE* (Candela, USA)	755 nm	3 ms	7–15	DCD	No	• Permanent reduction; Dynamic cooling device (DCD) requires cryogen
• *EpiTouch Alex* (ESC Sharplan, Israel)	755 nm	2–40 ms	5–10	Gel	Yes	• Permanent reduction, fast
• *Apogee-40* (Cynosure, USA)	755 nm	5–40 ms	7–12	Cooling tip	No	• Permanent reduction, variable split pulse duration, multiple pulses
Diode laser:						
• *LightSheer* (Coherent Medical, USA)	800 nm	5–30 ms	9 x 9	Cold sapphire tip	No	• Small size, speed, efficiency; can treat pigmented skin safely
Long-Pulsed Nd:YAG:						These lasers produce:
• *CoolGlide* (Altus Medical, USA)	1064 nm	10–100 ms	9 x 9	Contact	No	• Minimal epidermal injury
• *Orion* (Laserscope, USA)	1064 nm	1–50 ms	1–4	Contact	No	• Can treat darker skinned individuals
• *VascuLight* (ESC Sharplan, Israel)	1064 nm	2–16 ms	1–6	Contact	No	• Reportedly may be able to treat blonde hair
Flashlamp:						
• *EpiLight* (ESC Sharplan, Israel)	Variable: 550–1200 nm	Variable	8 x 33 or 10 x 45	Contact	No	• Multiple pulses • Short term reduction • Experience needed because of wide range treatment parameters

Table 1. Laser Hair Removal Systems

Drug Treatments For Skin Disease Introduced in 1999

Drug Class	Generic/Trade/ Company Names	Indication	Approving Regulatory Agency
Anti-acne Agents	**Roxithromycin** *Rulid* Hoechst Marion Roussel	• For treatment of severe acne	Japanese Pharmaceutical and Medical Safety Bureau
Antibacterial Agents	**Clindamycin Phosphate** *Cleocin* 2% Cream Pharmacia and Upjohn	• An additional indication for the treatment of bacterial vaginosis	US FDA
	Gatifloxacin *Tequin* Bristol Myers Squibb	• For the treatment of uncomplicated skin and skin structure infections	US FDA
	Moxifloxacin Hydrochloride *Avelox* Tablets Bayer	• For the treatment of uncomplicated skin and skin structure infections	US FDA Germany
	Mupirocin *Bactroban* 2% Ointment SmithKline Beecham	• An additional indication for use with pediatric patients	US FDA
	Quinupristin/Dalfopristin *Synercid IV* Rhone-Poulene Rorer	• For treatment of infections associated with vancomycin resistant *Enterococcus faecium* bacteremia • For treatment of skin structure infections caused by methicillin susceptible *Staphylococcus aureus* or *Streptococcus pyogenes*	US FDA
Antifungal Agents	**Ciclopirox** *Penlac* Nail Laquer 8% Hoechst Marion Roussel	• For treatment of fingernail and toenail fungus	US FDA
	Itraconazole Injection *Sporanox* IV injection Janssen	• For treatment of blastomycosis, histoplasmosis and aspergillosis in immunocompromised and non-immunocompromised patients	US FDA
	Terbinafine Hydrochloride *Lamisil* 1% Cream Novartis	• OTC for tinea pedis, tinea cruris and tinea corporis	US FDA
Antipsoriatic Agents	**Calcipotriene** *Dovonex* Ointment 0.005% Westwood Squibb	• For treatment of plaque psoriasis in adults	US FDA
Antiviral Agents	**Famciclovir** *Famvir* SmithKline Beecham	• An additional indication for the treatment of recurrent herpes simplex infections (genital herpes and cold sores) in HIV infected patients	HPB – Ottawa
	Imiquimod *Aldara* Cream 3M Pharmaceuticals	• For treatment of external genital and perianal warts • For treatment of condyloma acuminata in adults	HPB – Ottawa
	Varicella Vaccine *Varivax* Merck Frosst	• For use in children aged 1 year and older	HPB – Ottawa
Atopic Dermatitis	**Fluticasone Propionate** *Cutivate* Cream 0.005% Glaxo Wellcome	• For infants 3 months of age and older with corticosteroid responsive dermatoses	HPB – Ottawa US FDA
	Betamethasone Valerate Foam *Luxiq* 0.12% Connetics Corporation	• For relief of the inflammatory and pruritic manifestations of corticosteroid-responsive dermatoses of the scalp	US FDA
	Fluocinolone Acetonide 0.01% *Derma-Smoothe/FS* Hill Dermaceuticals	• For the treatment of moderate to severe stable atopic dermatitis in patients 6 years of age and older	US FDA
Atrophic Vaginitis	**17-Beta-Estradiol** *Vagifem* Novo Nordisk	• For treatment of atrophic vaginitis	US FDA
Diabetic Ulcers	**Becaplermin** *Regranex* Gel 0.1% Johnson & Johnson/McNeil (Europe) Janssen-Ortho (US)	• For treatment of full thickness neuropathic chronic diabetic ulcers (Europe) • An additional indication for the treatment of full-thickness, lower extremity diabetic ulcers (US)	European Commission (CPMP) US FDA

Drug Class	Generic/Trade/ Company Names	Indication	Approving Regulatory Agency
HIV and AIDS	**Abacavir Sulfate** *Ziagen* Glaxo Wellcome	• A nucleoside analogue reverse transcriptase inhibitor for the treatment of HIV and AIDS	HPB – Ottawa
Male Pattern Hair Loss	**Minoxidil 2% Topical Solution** Taisho	• Recommended for OTC use	Japanese Pharmaceutical and Medical Safety Bureau
	Finasteride *Propecia* 1mg Tablets Merck Sharp & Dohme	• An additional indication of male-pattern hair loss	UK MCA
Oncologic Agents	**Aldesleukin** *Proleukin* Chiron	• An additional indication for treatment of malignant metastatic melanoma	HPB – Ottawa
	Alitretinoin *Panretin* Gel 0.1% Ligand Pharmaceutical	• For topical treatment of cutaneous lesions in patients with AIDS related Kaposi's Sarcoma	US FDA HPB – Ottawa
	Allovectin-7 Vical	• For treatment of invasive and metastatic melanoma	US FDA (orphan drug status)
	Bexarotene *Targretin* 75mg Capsules Ligand Pharmaceuticals	• For treatment of cutaneous manifestations of cutaneous T-cell lymphoma (CTCL) in patients who are refractory to one or more prior systemic treatments for CTCL	US FDA
	Denileukin Diftitox *Ontak* Ligand Pharmaceuticals	• For the treatment of CTCL	US FDA (accelerated approval)
	G-3139 Vical	• For the treatment of advanced malignant melanoma	US FDA (fast-track designation)
	Interferon Alpha-2a *Roferon-A* Hoffmann-La Roche	• For the adjuvant treatment of malignant melanoma patients who are at risk for relapse following resection	European Commission (CPMP)
	Melanoma Lysate *Melacine Therapeutic Vaccine* Schering-Plough	• For the treatment of late stage (IV) melanoma	HPB – Ottawa
	Methoxsalen *Uvadex* Therakos	• For palliative treatment of the skin manifestations of CTCL that are unresponsive to other forms of therapy	US FDA
Osteoporosis	**Alendronate** *Fosamax* Merck	• For treatment of glucocorticoid induced osteoporosis in patients receiving glucocorticoids in a daily dosage equivalent to $\geq$ 7.5mg prednisone and who have low bone mineral density	US FDA
Pediculocides	**Malathion** *Ovide* 0.5% Lotion Medicis Pharmaceutical	• For treatment of head lice and their ova	US FDA
	Pyrethrins/Piperonyl Butoxide *Rid* Aerosol Foam Mousse Pfizer	• For treatment of head lice	US FDA
Photodynamic Therapy	**Aminolevulinic Acid** *Levulan* Photodynamic Therapy DUSA Pharmaceuticals	• For treatment of actinic keratoses of the face and scalp	US FDA
Topical Anesthetics	**Lidocaine 5%** *Lidoderm* Patch Endo Pharmaceuticals	• For treatment of postherpetic neuralgia	US FDA
	Lidocaine/Prilocaine *EMLA* Cream Astra	• An additional indication for use in pediatric patients	US FDA
Vaginal Atrophy	**Estradiol** *Estradiol Transdermal System* Wyeth Ayerst Laboratories	• For the treatment of vulvar and vaginal atrophy	US FDA

drug. Individuals with a history of hypertrophic scarring or keloids should be treated with caution. Those who have been treated with isotretinoin should wait at least one year before undergoing laser treatment. Patients should not pluck or wax 2-4 weeks prior to treatment. Bleaching hair does not interfere with treatment because the intracutaneous portion of the darkly pigmented hair is not affected. A bleaching cream can be applied to the area six weeks before treatment for patients with skin types III and higher to prevent pigmentary alteration.

Topical anesthesia may be used to prevent discomfort, but local infiltration is rarely necessary.

After the procedure, ice packs may be needed to reduce edema and pain. A mild potency topical corticosteroid is usually applied for two to three days posttreatment to reduce perifollicular edema and erythema. Sun avoidance is a must. Patients should be told that they might experience some shedding of the treated hair within the first few weeks of treatment and this should not be confused with regrowth. Loss of freckles in the treated area is possible.

Infection is rarely seen except when there is epidermal damage. Although herpetic outbreaks are uncommon, patients at the highest risk can be protected with antivirals.

Specific Laser Systems

The low energy Q-switched Nd:YAG laser (*SoftLight* by ThermoLase) used in conjunction with a carbon-containing topical solution produces only temporary hair loss. High energy, short pulsed Q switched Nd:YAG lasers produce some permanent hair growth reduction, but are not as effective as the long pulsed laser systems. However, they can be used safely on darker skinned individuals.

The *EpiLaser* and *EpiPulse* by Palomar Medical Technologies and ESC Sharplan, respectively, are long-pulsed ruby lasers (694 nm) with pulse durations in the millisecond domain. The long pulsed ruby lasers produce permanent hair loss after 1-2 years of treatment, which histologically correlates with miniaturization of the hair bulb and papillae[5]. Pigmentary side-effects are most common at this wavelength because it is so well absorbed by melanin.

Long pulsed alexandrite lasers (755 nm) produce less pigmentary side-effects, and while long-term studies have yet to be completed, results suggest that hair removal is as effective as the ruby lasers.

Diode lasers (800 nm) produce long-term hair reduction similar to the ruby lasers with less pigmentary side-effects. Because of the longer pulse duration, it is more effective for coarse hair, but slightly less effective for fine hair. The intense pulsed light source (*EpiLight* by ESC Sharplan) delivers an incoherent broad spectrum of light that can be used with filters to narrow the range wavelengths emitted at pulse durations of 2.5-7 ms. The broad wavelengths of this device are theoretically more effective for a variety of hair colors in both light and dark skin types[4].

Conclusions

Laser hair removal is a safe and relatively effective therapeutic option for patients who desire permanent reduction of hair growth. Early studies suggest permanence, but only time will tell how truly effective these devices are. The aim of technical advances in the future include permanent loss of hairs of all color, and safety of use on all skin types after just one treatment.

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Guidelines Set for Online Prescription Purchase

Guidelines for purchasing prescription medicines using online pharmacies have been set by the US Pharmacopeia (USP). They are intended to help patients protect themselves against purchasing drugs that are either harmful or of poor quality. According to the USP, consumers can ensure safety by:

- establishing whether the online pharmacy requires a valid prescription
- verifying whether it is licensed to operate a pharmacy and deliver medications in the area where the patient lives

An online pharmacy's license status can be found by looking for the Verified Internet Pharmacy Practice Site (VIPPS) seal on the Pharmacy's web page. VIPPS is a voluntary certification program that identifies and monitors properly licensed and inspected sites. It is run by the National Association of Boards of Pharmacy.

Update on Drugs

Class	Name/Company	Approval Dates and Comments
Wound Care	**Tissue Engineered Collagen Matrix** *Oasis Wound Dressing* COOK's	The US FDA approved this dressing in January 2000, for the management of full-thickness skin injuries. This dressing is provided in single sheets for one-time use only.
Anticancer	**Bexarotene** *Targretin* Gel 1% Ligand	An NDA was submitted to the US FDA in December 1999, for this novel topical therapy for the treatment of cutaneous lesions in patients with stage IA, IB, or IIA cutaneous T-cell lymphoma (CTCL) who have not tolerated other therapies or who have refractory or persistent disease. The US FDA granted orphan drug designation for the treatment of patients with CTCL.
Hypertrichosis and Hirsutism	**Eflornithine Hydrochloride** *Vaniqa* Cream 15% Bristol-Myers Squibb/Gillette	An NDA was submitted to the US FDA in October 1999, to gain marketing approval for the treatment of excessive facial hair in women.
Human Skin Construct	**Biologically Active Dressing** *Composite Cultured Skin (CCS)* Ortec International	An NDA was submitted to the US FDA in November 1999, for this biomaterial and cell culture biotechnology for the treatment of epidermolysis bullosa, Stevens-Johnson Syndrome, toxic epidermal necrolysis and erythema multiforme. The company is seeking approval to market this product under a Humanitarian Device Exemption, which allows access to devices that can potentially improve patient outcomes for critical diseases or conditions that affect < 4000 people in the US a year.
Antiviral	**Famciclovir** *Famvir* Smithkline Beecham	HPB – Ottawa approved an additional indication for this drug in November 1999. It can now be used for the treatment of recurrent herpes simplex infections (genital herpes and cold sores) in HIV infected patients. It is already available for the treatment of herpes zoster, recurrent genital herpes and the suppression of recurrent genital herpes in patients who are immunocompetent.
Antibacterial Agents	**Moxifloxacin** *Avelox/Avalox* Bayer AG	The German drug regulatory authorities approved this drug in September 1999, for the treatment of uncomplicated skin and skin structure infections. It has already been approved in the US, the UK and Mexico.
Male Pattern Hair Loss	**Finasteride 1mg Tablets** *Propecia* Merck Sharp & Dohme	The UK MCA approved this drug in October 1999, for the new indication of male pattern hair loss. It is currently available in the UK for the treatment of benign prostatic hyperplasia.
	Drug News	
DRUG WARNING	HPB – Ottawa issued a drug warning in November 1999, to consumers not to use *Miralex* Cream (Miralex Healthcare Inc/Hueson Pharmaceutical) because it has been found to contain clobetasol, a prescription corticosteroid that could cause severe adverse reactions if used without medical supervision. Anyone using this product is asked to contact his or her health care provider in order to find an alternative treatment.	
Dear Doctor Letter	Teva USA has issued a Dear Doctor letter in October 1999, regarding labelling changes for Pimozide (*Orap*) used to treat Tourette's Syndrome. Labelling will now include warnings about using this drug in combination with clarithromycin and other products that inhibit the CYP 3A enzyme. This follows two sudden unexpected deaths in the past few years linked to the use of this drug at higher than recommended doses and in combination with clarithromycin.	
Mouth Wounds	Access Pharmaceuticals began a trial in October 1999, in the UK with its Amlexanox Biodgradable Disc (*OraDisc*) for the treatment of mouth wounds. This is a polymer disc that adheres to the wound site and slowly erodes, releasing the drug. Amlexanox is already being marketed in the US (*Aphthasol*) for the treatment of canker sores.	

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