The use of different types of laser in hair removal

Essay

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List of abbreviations

- **ASNs**: Androgen-secreting neoplasms
- **BMP:** The Bone morphogenetic protein
- **CO2:** The carbon dioxide
- **DCD:** Dynamic cooling device
- **DHEA**: Dehydroepiandrosterone
- **DHT**: Dihydrotestosterone
- **DOPA:** Dihydroxyphenylalanine
- **DP:** Dermal papilla
- **EGF:** Epidermal Growth Factor
- **EMR:** Electromagnetic radiation
- **Er:YAG:** Erybuim: Yttrium-Aluminium-Garnet
- **FDA:** Food and drug adminstration
- **FGF5:** Fibroblast Growth Factor 5
- **Ga:As:** Gallium: Arsenide
- **GnRH:** Gonadotrophine releasing hormone
- **HAIRAN**: The hyperandrogenic-insulin-resistant-Acanthosis Nigricans
- **Hb:** Hemoglobin
- **HbO_2:** Oxyhemoglobin
- **HE:** Hematoxin and eosin
- **HS:** Hair shaft
- **IH**: Idiopathic hirsutism
- **IPL:** Intense pulsed light
- **IRS:** Inner root sheath
- **LASER:** Light amplification by stimulated emission of radiation
- **LPIR**: The Long Pulsed Infrared
- **Ms:** Millisecond
- **NCAH**: Non classic adrenal hyperplasia
- **Nd**: **YAG:** Neodymium:Yttrium-Aluminium-Garnet
- **OD**: Optical dimension
- **ORS:** Outer root sheath
- **PAM**: Peptidylglycine ∝-amidating monooxygenase

- **PCOS:** The polycystic ovarian syndrome
- **Q-switched:** Quality switched
- **SGK3:** Serum and glucocorticoid responsive kainase 3
- **TDT:** Thermal damage time
- **TGFß:** Transforming Growth Factor ß
- **TRT:** Thermal relaxation time
- **UV**: Ultraviolet
- **W:** Watts
- **Wnts:** Wingless integration site factor

Introduction

The use of different types of laser in hair removal

Introduction:

Hirsutism is defined as the presence in women of terminal hair in male like pattern, and affects between 5%-10% of women surveyed .The presence of Hirsutism is generally a sign of underling disorder principally androgen excess. While hormonal therapy is generally successful in stopping further progression of the disorder, it has only modest effects in reversing the hair growth process ***(Sanchez et al., 2002).***

Shaving, waxing and electrical epilation have been widely used as means of removing unwanted hair , but each of those methods is unsatisfactory due to disadvantages regarding their effects and the techniques involved. Laser epilation has spread in the last few years and is highly valued since it is an easy, minimally invasive, painless and extremely effective technique to remove hair ***(Kato et al., 2004).***

Laser hair removal is accomplished through follicular unit structure destruction. The ability to remove hair without damaging the surrounding skin is based on selective photothermolysis: the theory that at a particular wavelength, pulse duration and fluence, thermal injury is confined to the target, containing a light absorbing molecule called a chromophore ***(Wanner, 2005).***

Several hair removal systems have been shown to be effective in this setting as Ruby laser (694nm), Alexandrite laser (755nm), Diode laser (800nm) and the Neodymium:Yttrium-Aluminium-Garnet (ND:YAG) laser

(1064nm) with or without the application of carbon suspension. The parameters used with each laser vary considerably ***(Liew, 2002).***

There is still an increasing demand for safer and more efficient hair removal technique. The latest effective choice in the treatment of hair removal is noncoherent intense pulsed light (IPL) (590 to 1200nm) which is both efficient and safe for hair removal ***(Bedewi, 2004).***

Intense pulsed light (IPL) works on the principle of selective absorption of energy by components of the hair follicle. The target chromophore is melanin in the hair bulb and outer root sheath zones of the hair follicle, while the competing chromophores are any other melanin-containing component of the skin and other light- absorbing components such as hemoglobin in blood vessels (Bedewi, 2004). These properties allow for great variability in selecting individual treatment parameters and adapting to different types of skin types and indications ***(Raulin, 2003).***

Adverse effects reported after laser-assisted hair removal includes erythema and perifollicular edema, which are common, and crusting and vesiculation of treatment site, hypopigmentation and hyperpigmentation (depending on skin color and other factors). Most complications are generally temporary ***(Liew, 2002)***

Aim Of the essay:

The aim of this essay is to review the different types of laser used in hair removal and find out best treatment parameters.

This essay will include:
1- Introduction.
2- Aim of the easy.
3- Summary and conclusion.
4- References.
5- Arabic Summary.

Review of literature

The hair follicle

Embryology of the hair follicle: *(Fig 1)*

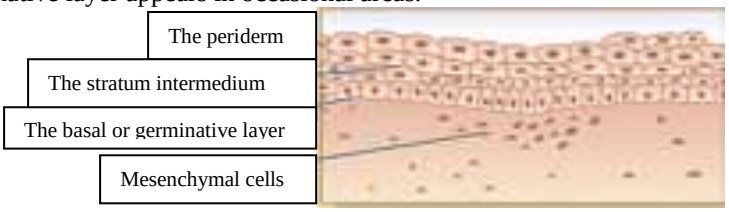
The earliest development of the hair rudiments occurs at about 9 weeks in the regions of the eyebrow, upper lip and chin ***(Friedmann and Holden, 2004).*** No further neogenesis occurs after birth ***(Hashimoto, 1970).***

Each follicle is formed by an interaction between dermal and epidermal components ***(Ebling, 1987).*** The first sign of a hair follicle is a crowding of nuclei in the basal layer of the epidermis, the so-called primitive hair germ or pregerm stage. The pregerm passes rapidly into the hair-germ stage, the basal cells become high, the nuclei become elongated and the structure starts to grow downward into the dermis. At the same time, mesenchymal cells and fibroblasts increase in number to form the rudiment of the hair papilla beneath the hair germ. At this stage it is known as the hair peg ***(Fuchs et al., 2001).***

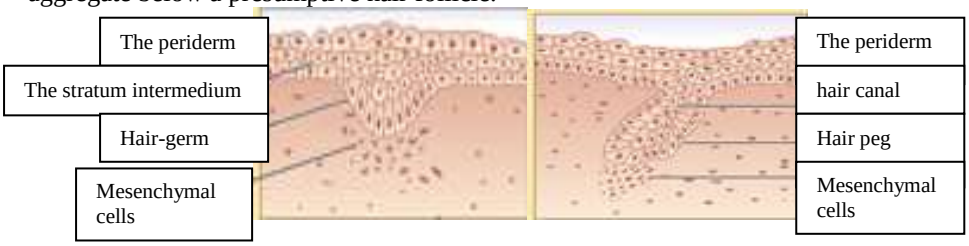
As the germ develops, it grows obliquely downwards, and the advancing extremity becomes bulbous, gradually enveloping the mesodermal papilla. At this bulbous hair-peg stage, two epithelial swellings appear on the posterior wall of the follicle. The lower one is the bulge to which the errector muscle becomes attached, and the upper is the rudiment of the sebaceous gland. In many follicles, a third bud later appears above the sebaceous gland; this is the rudiment of the apocrine gland ***(Altman and Brivanlou, 2001).***

As the skin grows, these first germs become separated, and new rudiments develop between them when a critical distance, dependent on the region of the body, has been reached. Secondary germs develop in relation to primary germs, so that the hair follicles are in groups of three**.** There is no large-scale destruction of follicles during postnatal development, only a decrease in actual density as the body surface increases; nor do any new follicles develop in adult skin ***(Altman and Brivanlou, 2001).***

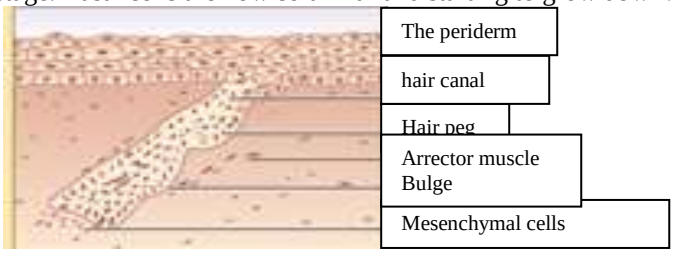
Development of epidermis, hair follicle and associated structures. (Section of skin of embryo at about 4 weeks). The periderm is clearly seen, and a basal or germinative layer appears in occasional areas.



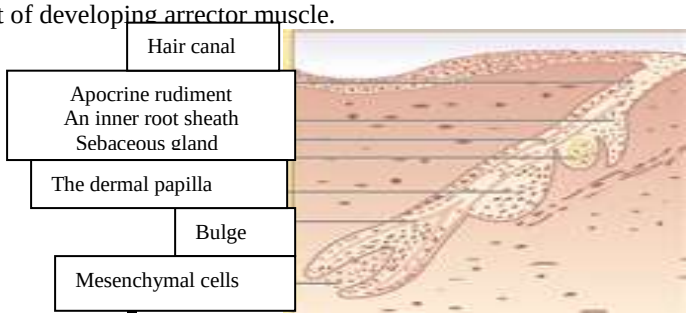
Skin at about 11 weeks. The epidermis is made up of basal cells, cuboidal in shape and cells of the stratum intermedium are beginning to appear above them. The periderm consists of a single cell layer. Mesenchyme cells are beginning to aggregate below a presumptive hair follicle.



Hair-germ stage. Basal cells are now columnar and starting to grow downwards.



Bulbous hair peg. Note solid hair canal, sebaceous gland rudiment, bulge for attachment of developing arrector muscle.



Later stage showing apocrine rudiment, sebaceous gland now partly differentiated, and bulge. The dermal papilla has been enclosed and a hair is starting to form, with an inner root sheath.

Fig 1*: The Embryology of Human Hair *(Altman and Brivanlou, 2001).

Anatomy of the hair follicle :*(fig.2)*

Hair is the keratinized product of the hair follicle, continuous with the epidermis at its upper end. The follicles are sloped in the dermis, and longer follicles extend into the subcutaneous layer. An oblique muscle, the errector pili, runs from the mid-region of the follicle wall to a point in the papillary dermis close to the dermal-epidermal junction. Above the muscle, one or more sebaceous glands, and in some regions of the body an apocrine gland also, open into the follicle ***(Narisawa et al., 1993).***

The hair follicle in vertical section is divided into two regions: The upper part consisting of the infundibulum which extends from the skin surface, to the opening of the sebaceous gland duct and the isthmus which extends from the opening of the sebaceous duct to the insertion of the errector pili muscle. And the lower part consisting of suprabulbar region below the isthmus and above the hair bulb and the hair bulb, the deepest part of the permanent portion of the follicle that persists in all phases of the hair cycle. The upper follicle is a relatively constant structure, whereas the lower follicle undergoes repeated episodes of regression and regeneration during the hair cycle ***(fig2) (Friedmann and Holden, 2004).***

The hair follicle is a tube like structure made up of three cell layers: an outer cuticle, the cortex and a variable central medulla, all of which derive from highly proliferate cells in the hair bulb at the base of the follicle. Cells in the hair bulb also give rise to the inner root sheath which surrounds the hair fiber and which disintegrates before the hair emerges from the skin. The inner root sheath is itself enclosed by the outer root sheath, which forms a continuous structure extending from the hair bulb to the epidermis then the dermal or connective tissue sheath surrounding the

follicle ***(Narisawa et al., 1993).***

The dermal papilla that invaginates the hair bulb is a mass of richly vascular connective tissue, which consists of fibroblast-like cells, collagen, blood vessels, nerves, and androgen receptors and interspersed by melanocytes. It is also continued with the fibrous sheet that envelops the entire follicle. The papilla has proven to be able to induce new hair growth in inactive germinating cells after transplantation in a variety of mammals ***(Reynolds and Jahoda, 1991).***

The hair follicles are arranged in groups of three or more follicles known as follicular units. Several follicles within a follicular unit may coalesce so that hairs emerge through a common infundibulum ***(Narisawa et al., 1993).***