International Journal of Research
e-ISSN: 2348-6848 & p-ISSN 2348-795X Vol-5, Special Issue-9
International Seminar on Changing Trends in Historiography: A Global Perspective
Held on 2nd February 2018 organized by **The Post Graduate Department of History. Dev Samaj College for Women, Ferozepur City, Punjab, India**

Advent and Historicity of Laser in Aesthetic Industry

Simarpreet Kaur

Assistant Professor, Dev Samaj College for Women, Ferozepur, Punjab, India.

Abstract

Emergence of Lasers has proven effective in the field of science and technology. It has generated an entirely new range of systems with promising success in a broad diversity of application areas. Beauty as being the prime concern nowadays, the advent of lasers has given a new turn to aesthetic industry. Evolution of laser proceeded as Ruby laser, Semiconductor laser, Solid state laser, CO_2 laser, Argon Ion laser, Dye laser, Silicon laser etc. Lasers are used for a range of beauty treatments like Rosacea, acne, hirsutism, wrinkles, melasma, hyperpigmentation, scars, haemangioma etc. FDA approved technology, Laser has become the foremost choice of clients as it has ability to treat various skin and hair related problems by varying the wavelength. This paper describes the advancements in laser from the foundation to current development.

Keywords- Laser, advent, history, dermatology

I. Introduction

Light Amplification by Stimulated Emission of Radiation is abbreviated as LASER. The conceptual idea of Stimulated emission generated by Einstein dates back to 1917 and in 1939 a framework was generated to amplify radiations using Stimulated emission. In 1950, first device was developed on the basis of Einstein's foresight, called MASER (Microwave Amplification by Stimulated Emission of Radiation). On the basis of concept behind MASER, the first laser, Ruby laser having wavelength 694 nm, was generated in 1960 by Maiman.[1,2] After Ruby laser the invention progressed as Q-Switched Ruby laser, Semiconductor laser, CO_2 laser, Nd:YAG, Argon Ion, Metal Vapor, Dye laser and so on. In 1963, Laser stepped into the field of dermatology as Ruby laser for the treatment of a range of dermal disorders.[3,4,5] The application of Ruby laser was followed by two ablative lasers- CO_2 and Argon Ion laser. CO_2 laser having wavelength 10,600 nm was implemented for tissue vaporization but it resulted in scarring and pigmentary alterations due to high energy of laser.[6,7] Argon Ion laser was implemented for Vascular lesions having (488-514.5) nm wavelength but it resulted in scarring.[8,9] The problem of thermal injury was solved by the origination of concept of Photothermolysis in 1980. The objective of Photothermolysis was to target the specific chromophore while leaving the surrounding tissue intact. Different wavelengths penetrate the skin to varying levels, attacks the specific chromophore (water, haemoglobin or melanin) and damages it. A laser can generate radiation in Ultra-violet, Visible range or Infrared range and the wavelength of light depends upon the cavity material which is one of the main component of Laser system. Lasers are approved by Food and Drug Administration (FDA) for beauty Treatments.[10]

II. Lasers for Vascular Lesions

Lasers used for the treatment of Vascular lesions generate a wavelength which targets oxy-haemoglobin and leave adjoining tissues unattended. Wavelengths falling in the range of (400-600) nm band work best for Vascular lesions, which include Argon Ion (418-514) nm, Nd:YAG (532 nm), Pulsed Dye (585-600) nm, Copper Vapor (578 nm) etc.[11] Table 1 shows various lasers for treatment of Vascular lesions.

Vascular Lesions include Vascular birthmarks, telangiectasia, leg veins, Cherry Angiomas, Haemangioma, Port-Wine Stains etc. Laser treatment for Vascular lesions was first developed in 1963 which included Argon Ion and Nd:YAG Laser. Argon Ion laser was expected to be useful for Vascular lesions but it resulted in unexpected Scarring and Pigmentation changes due to high thermal effect.[12,13,14,15,16] But till 1980s it was accepted as no other treatment was found to be effective. A new concept of Photothermolysis along with Pulsed Dye Laser gave a turning point to Laser treatments in 1980s. The goal of Photothermolysis is to target selective tissue with particular wavelength. Advent of Copper vapor laser added to the success of laser Vascular treatments. In 1992, it was found that copper vapor laser provides much better results with minimal side-effects as compared to Argon Ion laser.[14] In 1993, Copper vapor laser was compared with Pulsed Dye laser and found to be better in context of post-treatment Pigmentation changes.[17] Copper vapor laser was implemented for the treatment of various Vascular and Pigmented lesions and found to be very effective as compared to other laser treatments.[18] Nd:YAG laser actually emits radiation of 1064 nm which targets Melanin in the skin, but with the implementation of frequency–doubling concept it can generate 532 nm wavelength which targets haemoglobin. 532 nm wavelength turned up to be very effective as it is absorbed very efficiently by haemoglobin.[19]

III. Lasers for Pigmented Lesions

Pigment target lasers are confined to melanin and pigmented tattoo ink in cuticle and derma layers of skin and help to eradicate them in successive number of sittings. Pigmented lesions include lentigines, freckles, melasma, age spots, sun spots, leukoderma, tattoos etc. The laser wavelengths that help to reduce pigmented lesions are Pulsed dye (510 nm), Ruby laser (694 nm), Alexandrite (755 nm), Nd:YAG (1064 nm) as shown in Table 2.

In 1960s, Goldman studied the effect of ruby laser (694 nm) on human skin and afterwards, Nd:YAG and Alexandrite were designed in 1964. The concept of Q-switching, giant pulse formation, was originated in 1962. But nothing came out to be fruitful before the invention of photothermolysis. 694 nm wavelength is absorbed by melanin so well that it must be used carefully on darker skin tone as it may lead to skin burn. It works best for fairer skin. Epidermal pigment related problem can be treated with lower wavelengths i.e Pulsed dye laser (510 nm) and Dermal problems can be treated with higher wavelengths which penetrate deeper into skin i.e Ruby laser (694 nm), Alexandrite (755 nm), Nd:YAG (1064 nm). Q-Swiched or Giant pulse technology best works for tattoo lightening.[20,21,22] Orange, Yellow and red pigments are attacked by lower wavelength i.e 510 nm and higher wavelengths work for darker pigments.[23]

IV. Lasers for Hair Reduction

Eradication of undesirable body hair is getting more and more popular since ancient times, the conventional methods for removing undesirable hair include shaving, plucking, waxing, threading and chemical methods. But these are temporary and tiresome ways.[24,25] Among the permanent methods, Electrolysis is the older technique but its results depend upon efficiency technician and several cases of scarring and pigmentation changes have also been reported.[26] Laser, being the most successful and permanent method, targets melanin in the hair follicles and destroys it. Wavelengths lying in the range of (600-1200) nm prove to be effective in hair reduction which include Ruby laser (694 nm), Alexandrite (755 nm), Diode laser (810 nm), Nd:YAG (1064 nm), as shown in Table 3.

Although the laser treatment was initiated many years back, Food and Drug Administration approved it in 1995 and the first one was Nd:YAG, which proved to be very effective for dark skin as it penetrates deeper into dermis and has least chances of pigmentation changes.[27] In 2000s, Ruby, Diode and Alexandrite also got approved, among these Ruby is used for fairer skin tone since melanin absorbs it effectively and there are chances for darker skin to get burn. Diode laser is effective for dark as well as fair skin tone.[28]

V. Laser Skin Resurfacing

Skin Resurfacing treatments stepped into market in mid 1990s and are very much prevalent since then, which includes reduction of deep rhytides, atrophic scars, acne scars, skin tags, warts, birthmarks, moles, fine lines, stretch marks, hypertrophic scars etc. They work by attacking water in the skin and includes two types of processes: Ablative and Non- Ablative.

Ablative treatment includes removal of top most layer of skin followed by dressing for approximately two weeks whereas, Non-Ablative treatment works on lower layers of skin and does not need dressing but it is less effective than Ablative treatment. CO_2 laser (10,600 nm) and Er:YAG (2940 nm) laser are ablative in nature,[29] whereas Nd:YAG (1064 nm, 1320 nm), diode (1450 nm) and Er:glass (1540 nm)lasers are Non-Ablative in nature [30,31] as shown in Table 4.

Conclusion

No doubt, lasers entered the field of beauty almost four decades back, but it has gained popularity in the past few years only. Advances in the laser technology has replaced historical beauty rituals for various skin deformities. It provides miraculous results for a range of beauty enhancing treatments like hair reduction, Skin Resurfacing (Ablative and Non-Ablative), Various skin treatments i.e Vascular lesions, Pigmented lesions. Previously, the treatment used to be very painful and resulted in post treatment Scarring, Pigmentary Alterations due to over exposure to strong thermic radiations. The advent of concept of photothermolysis and Q-switching has worked wonders in context of patient satisfaction and efficacy of results. Constant exploration in the field of lasers is expected to provide much better results in future.

REFERENCES

1. Einstein A. Zur quantentheorie der strahlung. Phys. Z..1917;18:121-8.
2. Maiman TH. Stimulated optical radiation in ruby, Nature, 1960; 187:493-4.
3. Goldman L, Blaney DJ, Kindel Jr DJ, Franke EK. Effect of the laser beam on the skin: preliminary report. Univ. of Cincinnati; 1963 Jan 1.
4. Goldman L, Blaney DJ, Kindel DJ, Richfield D, Franke EK. Pathology of the effect of the laser beam on the skin. Nature. 1963 Mar 2;197(4870):912-4.
5. Goldman L, Rockwell RJ, Meyer R, et al. Investigative studies with the laser in the treatment of basal cell epitheliomas. South Med. J.,1968;61:7.
6. Haina D, Landthaler M, Braun-Falco O, et al. Comparison of the maximum coagulation depth in human skin for different types of medical lasers. Lasers Surg. Med.,1987;7:355-62.
7. Lanzafame RJ, Naim JO, Rogers DW, et al. Comparisons of continuous-wave, chop wave, and superpulsed laser wounds. Lasers Surg. Med.,1988;8:119-24.
8. Noe JM, Barsky SH, Geer DE, et al. Port wine stains and the response of argon laser therapy: successful treatment and the predictive role of color, age, and biopsy. Plast. Reconstr. Surg., 1980;65:130-9.
9. Apfelberg DB, Maser MR, Lash H, et al. Progress report on the extended clinical use of the argon laser for cutaneous lesions. Lasers Surg. Med., 1980;1:71-83.
10. Anderson RR and Parrish JA. Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science, 1983;220(4596):524-7.
11. Dover JS and Arndt KA. New approaches to the treatment of vas-cular lesions. Lasers Surg. Med., 2000;26:158-63.
12. Apfelberg DB, Maser MR, Lash H, Rivers J. The argon laser for cutaneous lesions. JAMA 1981;245:2073.
13. Arndt KA. Argon laser therapy of small cutaneous vascular lesions. Arch. Dermatol., 1982;118(4):220-4
14. Neumann RA, Knobler RM, Leonhartsberger H, et al. Comparative histochemistry of port-wine stains after copper vapor laser (578) nm and argon laser treatment. J. Invest. Dermatol.,1992,99(2):160-7.
15. Geronemus RG. Argon laser for the treatment of cutaneous lesions. Clin. Dermatol.,1995;13(1):55-8.
16. Dixon JA, Huether S, Rotering R. Hypertrophic scarring in argon laser treatment of portwine stains. Plast. Reconstr. Surg., 1984;73(5):771-9
17. Waner M, Dinehart SM, Wilson MB, et al. A comparison of copper vapor and the flashlamp-pumped pulsed dye lasers in treatment of facial telangiectasia. J DermatolSurgOncol., 1993; 19:992-8.
18. Dinehart SM, Warner M, Flock S. The copper vapor laser for treatment of cutaneous vascular and pigmented lesions. J. Dermatol. Surg. Oncol.,1993;19(4): 370-5.
19. Goldberg DJ and Meine JG. A comparison of four frequency-doubled Nd:YAG (532 nm) laser systems for treatment of facial telangiectasias. Dermatol. Surg., 1999; 25(6):463-7.
20. Kilmer SL. Laser eradication of pigmented lesion and tattoos. Dermatol. Clin. ,2002 ;20(1):37-53.
21. Aster TS and Lupton JR. Laser therapy for cutaneous hyperpigmentation and pigmented lesions. Dermatol. Ther.,2001;14:46-54.
22. Hodersdal M, Bech-Thomsen N, Wulf HC. Skin reflectance-guided laser selections for treatment of decorative tattoos. Arch. Dermatol.,1996;132(4):403-7.
23. Tanzi EL, Lupton JR, Alster TS. Lasers in dermatology: Four decades of progress. J. Am. Acad. Dermatol.,2003;49:1-31.
24. Marchell NL and Alster TS. Evaluation of temporary and permanent hair removal methods. J AesthCosmetDermatol. Surg., 1999;1: 3-12.
25. Olsen EA. Methods of hair removal. J. Am. Acad. Dermatol. 1999; 40:143-55.

26. Richards RN and Meharg GA. Electrolysis: observations from 13 years and 140,000 hours of experience. J. Am. Acad. Dermatol.,1995;33(4):662-6.
27. Nanni CA and Alster TS. A practical review of laser-assisted hair removal using the Q-switched Nd:YAG, long-pulsed ruby, and long-pulsed alexandrite lasers. Dermatol Surg.1998;24(12):1399-405.
28. Rogachefsky AS, Silapunt S, Goldberg DJ. Evaluation of a new super-long-pulsed 810 nm diode laser for the removal of unwanted hair: the concept of thermal damage time. Dermatol surg.2002;28(5):410-4.
29. Alster TS and Lupton JR. Treatment of Complications of laser skin resurfacing. Arch FacialPlast Surg.2000;2(4):279-84.
30. Bjerring P, Clement M, Heickendorff L, et al. Selective non-ablative wrinkle reduction by laser. J. Cutan. Laser Ther.,2000;2(1):9-15.
31. Menaker GM, Wrone DA, Williams RM, et al. Treatment of facial rhytids with a nonablative laser: a clinical and histologic study. Dermatol. Surg.,1999;25(6):440-4.

Table 1: Lasers for Vascular Lesions

Type of Laser	Wavelength
Argon Ion	(418-514) nm
Nd:YAG (frequency doubled)	532 nm
Copper Vapor	578 nm
Pulsed Dye	(585-600) nm

Table 2: Lasers for Pigmented Lesions

Type of Laser	Wavelength
Pulsed dye	510 nm
Ruby	694 nm
Alexandrite	755 nm
Nd:YAG	1064 nm

Table 3: Lasers for Hair Reduction

Type of Laser	Wavelength
Ruby	694 nm
Alexandrite	755 nm
Diode	810 nm
Nd:YAG	1064 nm

Table 4: Lasers for Skin Resurfacing

Type of Laser	Wavelength
Ablative: CO_2	10,600 nm
Er:YAG	2940 nm
Non-Ablative: Nd:YAG	1064 nm, 1320 nm
Doide	1450 nm
Er:Glass	1540 nm