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RESEARCH ARTICLE

A STUDY TO EVALUATE EFFICACY AND SAFETY OF Q SWITCHED ND:YAG LASER IN AMATEUR AND PROFESSIONAL TATTOO REMOVAL

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Abstract

Introduction: Tattooing has gain popularity since ancient time and has become increasingly popular, particularly among young people. Advances in Laser and Light based technology have revolutionized tattoo removal, using various wavelength to target various tattoo color pigments and lesser complications. The Q-switched Nd:YAG laser is considered the standard device of choice for laser tattoo removal.

Aims: To evaluate the efficacy and safety of Q switched ND YAG laser in amateur and professional tattoo removal.

Materials and Methods: This was a prospective, interventional single centre study carried out in dermatology outpatient department of a tertiary care teaching hospital in western India. Total 44 patients over the period of 18 months with red, green, blue or black colour tattoo according to inclusion and exclusion criteria were enrolled.

Results: Most common age group in our study was 21-30 years (61.4%). Amateur tattoo 34 (77.3%) were much more than professional tattoo 10 (22.7%). Blue-black tattoo (93.2%) was more common than red-green (6.8%) colour tattoo. Most common reason for tattoo removal was found to be Army/ Police recruitment in 31 (70.5%) patients. In amateur tattoo at end of 10th session 93.34% had excellent to clear response while in professional tattoo it was only 20%.

Conclusion: Amateur tattoos generally require six or more sessions and professional tattoos may need ten or more sessions.

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Introduction:-

Tattooing has gain popularity since ancient time and has been practiced for at least two thousand years.^[1] From the ancient Egyptian, Greek, and Roman cultures to the modern society we have today, skin markings have been used to enhance beauty, demonstrate uniqueness, signify belonging, and sometimes to identify, shame, or punish.^[2] They fall into three broad categories: purely decorative, symbolic and pictorial.^[3] Much effort has been exerted in tattooing practice to make it more beautiful, brighter, colorful and permanent; whereas scientist and doctors are searching for a very promising way of removing or concealing the same. As tattoos are in trend with more and more youngsters acquiring it, similarly there is increasing number of people who are seeking for removal.^[2] Historically, the undesired tattoos removal was done by destructive techniques such as dermabrasion, salabrasion, chemical destruction, cryosurgery, electro-surgery and surgical excision.^[4,5,6] This methods are associated with incomplete

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removal, scarring and dyspigmentation. Advances in Laser and Light based technology have revolutionized tattoo removal, using various wavelength to target various tattoo color pigments and lesser complications. The Q-switched neodymium-doped yttrium aluminum garnet (Nd:YAG) (QSNY) laser is considered the standard device of choice for laser tattoo removal.^[7] This study was conducted to evaluate the efficacy and associated side effects of tattoo removal by Q switched ND:YAG Laser.

Aim and Objectives:-

To evaluate the efficacy and safety of Q switched ND YAG laser in tattoo removal. Along with this to assess side effects profile of Q switched ND: YAG laser in tattoo removal.

Materials and Method:-

This was a Prospective and Interventional single centre study carried out in dermatology outpatient department at tertiary care centre of western India. Total 44 patients with amateur or professional tattoo were enrolled over the period of 18 months.

All the subjects with professional or amateur tattoo of red, green, blue and black colour on different parts of their body and willing to give written informed consent were included in study. Exclusion criteria were patients with keloidal tendency, bleeding disorders, local infections, pregnancy/lactation, tanning tendency and patients with unrealistic expectations.

After obtaining an informed written consent, a questionnaire (including patient's skin type, reason for tattooing and tattoo removal etc.) was given to each patient to be filled. All the patients who satisfy the inclusion and exclusion criteria had been recruited and subjects with black/blue and red/green tattoo have been separated. Topical anaesthesia containing EMLA was applied under occlusion 1 h prior to session. Proper eye protection was given to the patient, as well as the treating doctor. After detailed history and thorough clinical examination of tattoo patients, we have used 1064/532nm Q switched ND YAG laser. We divided the patients into two groups. Group A patients with Black and blue tattoo, we used the 1064nm wavelength, 5Hz repetition rate and 3mm spot size whereas Group B patients with Red/ Green tattoo, we used 532 nm wavelength, 5Hz repetition rate and 2mm spot size. All tattoos have been treated with 9J/Cm² energy. Immediately after the procedure subjects have been given ice packs to reduce pain, erythema and oedema. Post procedure care consists of local antibiotics and sunscreen lotion. Treatment sessions have been planned at every 6 weeks interval till the clearing of tattoos. Photographs of each lesion were taken at baseline and before each treatment session. At each visit patient has been evaluated for percentage of clearing based on grading (Table-1) and side effects if any has been noted down. Analysis of the collected data was done at the end of study.

Table 1:- Grading of Improvement.

Grade	Description	Percentage of clearing
5	Clear	More than 95
4	Excellent	76-95
3	Good	51-75
2	Fair	25-50
1	Poor	Less than 25

Results:-

In our study, total 44 patients were enrolled; 32 (72.7%) were male and 12(27.3%) were female. All patients with tattoo above 18 years to 50 years of age were included in this study, most common age group was 21-30 years (n=27,61.4%) followed by 31-40 years (n=12, 27.3%) and 11.3% (n=5) in 41-50 years. Male: Female ratio was 1:0.37. We observed that highest number of participants had Fitzpatrick skin type IV in 29 patients (65.9%) followed by type III in 08 patients (18.2%), and type V in 07 patients (15.9%) among 44 participants.

Most common type of tattoo was Amateur tattoo in 34 patients (77.3%) while professional was seen in 10 patients (22.7%). 41(93.2%) study participants had blue-black and rest 03(6.8%) had Red -green.

Majority of the participants 22 (50.0%) had tattoo on forearm, followed by tattoo on arm in 10 (22.7%) participants; 2.3% (n=1) on forehead was least common. (Table -2)

Table 2:- Site of Tattoo.

Site of Tattoo	Number of Patients (n-44)	Percentage (%)
Forearm	22	50.0
Arm	10	22.7
Back	06	13.6
Hand	03	6.8
Leg	02	4.6
Forehead	01	2.3

Reason for tattooing among study participants shows the most common reason for tattooing was style statement in 29 patients (65.9%) followed by partner influence (n=07, 15.9%). Others were Peer pressure and Religious practise in 04 patients (9.1%) in each.

As shown in Table 3, More than two third patients (n=31, 70.5%) wanted to remove their tattoo due to recruitment in army/police services. Strict discipline in these services must be a reason for people pursuing to remove the tattoo. Other reasons for tattoo removal were self realization in 06 (13.6%) patients followed by family pressure in 04 (9.1%) and in 03 (6.8%) patients the reason was change of partner.

Table 3:- Reason for Tattoo Removal.

Reason for tattoo removal	No. of patients	Percentage (%)
Army/ Police recruitment	31	70.5
Self realization	06	13.6
Family pressure	04	9.1
Change of partner	03	6.8

In our study, 41 (93.2%) patients who had blue black tattoos were treated with 1064 nm wavelength whereas 532nm wavelength was used in 03 (6.8%) patients of Red- Green tattoo. Fluence used for tattoo removal was 9 J/ Cm² in all patients.

The efficacy of Fluence 9 J/cm² of ND: YAG laser in amateur tattoo removal at different sessions. Response was graded as poor, fair, good, excellent and clear based on percentage reduction in pigmentation. At the end of 2nd session 82.35% (n=28) had poor response and 17.65% (n=06) had fair response. After 6th session, 26 patients (76.47%) had good response and excellent response was noted in 03 (8.82%) while clearance of tattoo was seen in 01 (2.94%) patient. 02(6.66%) patients had good response while excellent and clear response was seen in 24 (80.00%) and 04 (13.34%) patients respectively.

Table 4:- Efficacy of Fluence 9J/cm² in amateur tattoo at the end of different session.

At the end of session	Grading of response	No of patients	Percentage (%)
2 nd	Poor (Grade 1, <25%)	(n=34) 28	82.35
	Fair (Grade 2, 25-50%)	06	17.65
	Good (Grade 3, 51-75%)	00	00.00
	Excellent (Grade 4, 76-95%)	00	00.00
	Clear (Grade 5, >95%)	00	00.00
6 th	Poor (Grade 1, <25%)	(n=34) 00	00.00
	Fair (Grade 2, 25-50%)	04	11.76
	Good (Grade 3, 51-75%)	26	76.47
	Excellent (Grade 4, 76-95%)	03	08.82
	Clear (Grade 5, >95%)	01	02.94
	Poor (Grade 1, <25%)	(n=30) 00	00.00

10 th	Fair (Grade 2, 25-50%)	00	00.00
	Good (Grade 3, 51-75%)	02	06.66
	Excellent (Grade 4, 76-95%)	24	80.00
	Clear (Grade 5, >95%)	04	13.34



(Image- 1)

(Image – 2)

Note: Image -1 (Professional tattoo at baseline and 10th sitting)

Image -2 (Amateur tattoo at baseline and 6th sitting)

As shown in below table-5 the efficacy of 9 J/cm² in professional tattoo removal at the end of second session only 01 (10%) patient had fair response, rest 09 (90%) had poor response. At the end of 6th session 50% (n=05) had fair response; whereas at the end of 10th session, 06 (60%) patients had good to excellent response.

Table 5:- Efficacy of Fluence 9J/cm² in Professional tattoo at the end of different session.

At the end of session	Grading of response	No of patients	Percentage (%)
2 nd	Poor (Grade 1, <25%)	(n=10) 09	90.00
	Fair (Grade 2, 25-50%)	01	10.00
	Good (Grade 3, 51-75%)	00	00.00
	Excellent (Grade 4, 76-95%)	00	00.00
	Clear (Grade 5, >95%)	00	00.00
6 th	Poor (Grade 1, <25%)	(n=10) 04	40.00
	Fair (Grade 2, 25-50%)	05	50.00
	Good (Grade 3, 51-75%)	01	10.00
	Excellent (Grade 4, 76-95%)	00	00.00
	Clear (Grade 5, >95%)	00	00.00
10 th	Poor (Grade 1, <25%)	(n=10) 01	10.00
	Fair (Grade 2, 25-50%)	03	30.00
	Good (Grade 3, 51-75%)	04	40.00
	Excellent (Grade 4, 76-95%)	02	20.00
	Clear (Grade 5, >95%)	00	00.00

In our study compared to 34 patients of amateur tattoo 03 had clearance of tattoo, whereas in 10 patients of professional tattoo none had clear response. This difference is due to higher density of ink in professional tattoo and being deeper with in skin compared to amateur tattoo's ink being less in volume and superficial. Black pigments are the easiest to remove due to their relative small size, lack of metallic elements, and ability to absorb every

wavelength of light. Red pigments are also considered easily removable in comparison to other colours, such as green and yellow based on their composition as well. ^[8,9]

Discussion:-

The Q Switched Nd:YAG Laser system was developed by Geusic **et al.** in 1964. It operates with two wavelengths (532 and 1064 nm). 532 nm is highly absorbed by melanin and red and green colour pigments, whereas 1064 nm is a longer wavelength which is poorly absorbed by melanin but well-absorbed by blue-black tattoo ink. The depth of penetration ranges from 3 to 6 mm in human skin. ^[10,11]

In present study, most common age group was 21-30 years with 61.4% (n=27) which was similar to study conducted by Padhiar B **et al.** ^[12] Mean age of participants was 25.9 years; which was quite comparable with the similar study done by Padhiar B ^[12], Asilian A **et al.** ^[13], SG Parasramani **et al.** ^[14] where mean age was 25.3, 26.3 and 25.2 years respectively. Contrasting result was found in study done by Bencini PL **et al.** ^[15].

In our study, 72.7% were male and 27.3% were female which was comparable to study conducted by Padhiar B **et al.** ^[12] (79.8% male and 20.2% female) and Thakur BK **et al.** ^[16] (84% male and 16% female). Male to female ratio was 1:0.37. Male preponderance in this study was comparable with the study done by Padhiar B ^[12], Bencini PL **et al.** ^[15] and Thakur BK ^[16].

Study observed that highest number of participants had Fitzpatrick skin type IV 29(65.9%) followed by skin type III (18.2%) and skin type V (15.9%) whereas in study of Padhiar B **et al.** ^[12] 86.5% had skin type 4 and 7.9% and 5.6% in type III and V respectively.

Most common type of tattoo among study participants was Amateur tattoo 34 (77.3%) while professional was seen in 10(22.7%). This findings were comparable study done by Padhiar B **et al.** ^[12] Jones A **et al.** ^[17], Ferguson **et al.** ^[18] and Werner **et al.** ^[19]; and quite opposite to the study done by Kirby W **et al.** ^[20].

Reason for tattooing among study participants shows the most common reason was style statement in 29 (65.9%) followed by partner influence (n=07, 15.9%). Others were Peer pressure and Religious practise in 04 (9.1%) patients in each. This is comparable with study done by Padhiar B **et al.** ^[12], in which Fashion was the most common reason in 69.7%. Recruitment in army or police was main reason in 70.5% patients for removing their tattoo, similar reason was found in 83.3% patient in study of Padhiar B **et al.** ^[12].

In present study all participants (amateur and professional) were treated with Fluence of 9J/cm² for tattoo removal. In amateur tattoo major improvement was seen in the form of good response (76.47%) and excellent to clear response (11.76%) after 6th sitting; whereas excellent to clear response was noted in 93.34% patients at the end of 10th sitting. This result was incompatible with study done by Padhiar B **et al.** ^[12] where 91.0% patients of amateur tattoos had clear to excellent response at the end of 6th sitting. In our study 10 patients of professional tattoo required more number of sessions compared to amateur. At the end of 6th session in professional tattoo, none had excellent to clear response but at the end of 10th session it was seen in 02 patients; which is contradictory to the study done by Padhiar B **et al.** ^[12] where none had achieved excellent to clear response even after 10th session.

In present study, 34 (77.27%) experienced mild to moderate pain immediately after session followed by erythema and edema in 28 (63.63%). Painful blisters as an early reaction was observed in 02 (4.54%) patients. Hypo/Hyperpigmentation (Delayed adverse reaction) seen in 13.63% and 9.09% respectively. This findings were related to study conducted by Padhiar B **et al.** ^[12], however lesser adverse effects were noted in study done by Ferguson **et al.** ^[18], Werner **et al.** ^[19] and Kirby W **et al.** ^[20].

Conclusion:-

Although Q Switched Nd:Yag lasers remain the gold standard for tattoo removal, the appropriate device and technique does not always guarantee successful results. This laser is the safest for use in patients with darker complexion with minimal adverse reactions. Amateur tattoos generally require six or more treatments and professional tattoos may need ten or more sessions. As this study was conducted for short duration and on limited sample size so further studies of long duration is required to calculate sessions necessary for professional tattoo removal.

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