e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(3); 1448-1455

Original Research Article

# Efficacy and Safety of Nd: YAG Laser in Tattoo Removal: An Interventional Study

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**Received: 29-01-2023 / Revised: 24-02-2023 / Accepted: 23-03-2023**

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**Conflict of interest: Nil**

**Abstract**

**Background:** Tattoos are intentionally made on skin by an artist or cosmetologist which may be temporary or permanent. Most of them are permanent. Because of various reasons patient intends for tattoo removal, in that situation various procedures like dermabrasion, cryo-surgery, excision are available but with limited satisfaction. Newer techniques like lasers such as Q-switched lasers are now being tried.

**Objective:** Present study was done to know the efficacy and safety of neodymium-doped yttrium aluminium garnet (Nd: YAG) laser in eliminating tattoos.

**Materials and Methods:** Present study was done at a tertiary care teaching institute in the Department of DVL at MNR Medical College, Sangareddy, Telangana from January 2021 to June 2022. 50 patients were included as per the eligibility criteria. Age, gender, the motive for tattoo removal, wavelength of Nd: YAG laser, number of sittings undergone by study patients, clearance rate and adverse effects were assessed.

**Results:** Most common age group of patients involved in study was 21 to 30 years. Males are predominant with 56% and most of the patients were managed with 1064 nm wavelength for tattoo removal. The most consistent motive for tattoo removal was to get new employment. The mean number of sittings was 7.2±1.3. There is no statistical significance in the clearance rate between amateur and professional tattoos. There is no statistical significance in the clearance rate between lasers of various wavelengths.

Adverse effects were mild and self-limiting.

**Conclusion:** Q switched Nd: YAG laser is considered a good choice for treating amateur and professional tattoos, as it enables complete removal with acceptable minor side effects.

**Keywords:** Efficacy, Interventional study, Nd: YAG Laser, Safety, Tattoo.

## Introduction

Tattoos are dyes or pigment designed by an artist or cosmetologist, which may be temporary or permanent. Most of them are permanent. Tattoos may be amateur or professional. Amateur tattoos are usually in one colour, ink in varying levels of the skin, these tattoos are made by amateurs, who are just trained and it is for rites of passage or symbol of beauty or bravery etc, whereas professional tattoos done by tattoo artist has licence to do tattoos, uses several colours, level of penetration is uniformly done at salon or tattoo parlour. [1] Tattoos are for self-attractiveness or religious or self-expression.[2] After tattooing few people change their mind because of relationship breakage or felt wrong decision when young or during intoxication mistake or career aspiration doesn't allow visible tattoos like army service and few government jobs etc. Various modalities of treatments exist using conventional methods like rubbing with salt, retattooing using flesh-coloured pigment or intradermal injection of chemical irritants or excision. [3] No such treatments give satisfactory results, so modern technique like laser light irradiation is tried, but previously limited studies were done on effectiveness and safety profile of Q switched Nd: YAG laser. [4] Laser treatment causes tattoo pigment particles to heat up and made them to break to form small particles, which are subsequentially removed by various body processes. Present study was conducted on 50 patients with tattoo removal for different reasons, by using Q switched Nd:YAG laser.

## Objective

Present study was done to know the efficacy and safety of Q switched Nd: YAG laser in treating tattoos.

## Material And Methods

Present study was a interventional study, carried out at a tertiary care center in India from January 2021 to June 2022.

**Study Design:** Interventional study

The study is interventional, as treatment was given in the form of tattoo removal using laser.

**Study Location:** This study was carried out at a tertiary care teaching institute in the Department of DVL at MNR Medical College, Sangareddy, Telangana, India.

**Duration of study:** January 2021 to June 2022

**Sample size:** 50 Patients

**Sampling procedure:** Simple random sampling

**Size of sample calculation:** As per Joymati *et al*. [13] the prevalence of tattoo among Indians was 5.5%.

At a confidence level of 85%, taking error as 5%, the base sample size was 44. So, we included 50 patients.

**Subjects & selection method:** Patients coming to the department of DVL for tattoo removal were included.

**Eligibility criteria**

**Inclusion criteria:**

1. Patients aged above 18 years.
2. Either sex.
3. Patients who provided informed consent to participate in the study.
4. Patients with blue, black, red, green, amateur and professional tattoos.

**Exclusion criteria:**

1. Pregnant and lactating women.
2. Patients with bleeding abnormalities or using anticoagulants.
3. Patients with associated photo aggravated skin disorders.

4. Patients with herpes, staphylococcal infections, unstable vitiligo, psoriasis.
5. Patients with tattoo granuloma, keloids.
6. Patients with incomplete data.

## Methodology

After including patients as per the eligibility criteria, data collection was done. A complete clinical history was obtained. Thorough physical examination, vital signs, systemic examination and local examination was done. Post procedure ice packs were given to control pain, redness and swelling. Post procedure local antibiotics prescribed to prevent secondary infections. For every 4 weeks interval, sessions were carried out.

The data was subjected to statistical analysis and then a conclusion was drawn.

## Parameters assessed:

- Age
- Gender
- Motive for tattoo removal
- Colour of tattoo
- Type of tattoo
- Wavelength of laser used
- No of sittings
- Clearance of tattoo at 1st, 3rd and 6th month (Poor/Fair/good/excellent/clear) noted as

Clear: More than 95% of clearance
Excellent: 76 to 95% of clearance
Good: 51 to 75% of clearance
Fair: 25 to 50% of clearance
Poor: Less than 25% of clearance

- Side effects- pigmentary changes, rashes etc

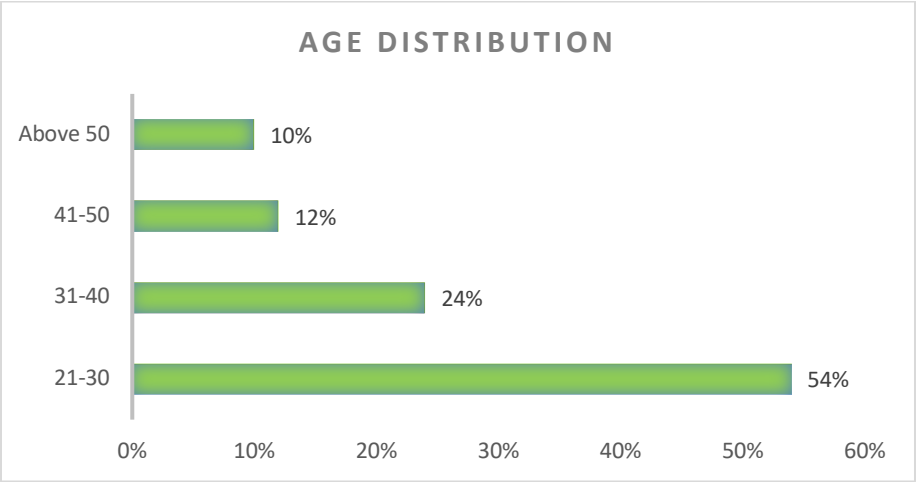
## Statistical Analysis

Analysis of data was carried out using Epi info software version 7.2.5. Results were noted as percentages and mean with standard deviation. Results were presented in tabular forms and graphs in pie and bar diagrams. Chi square test was performed to compare two groups. P value below 0.05 is considered significant.

## Results

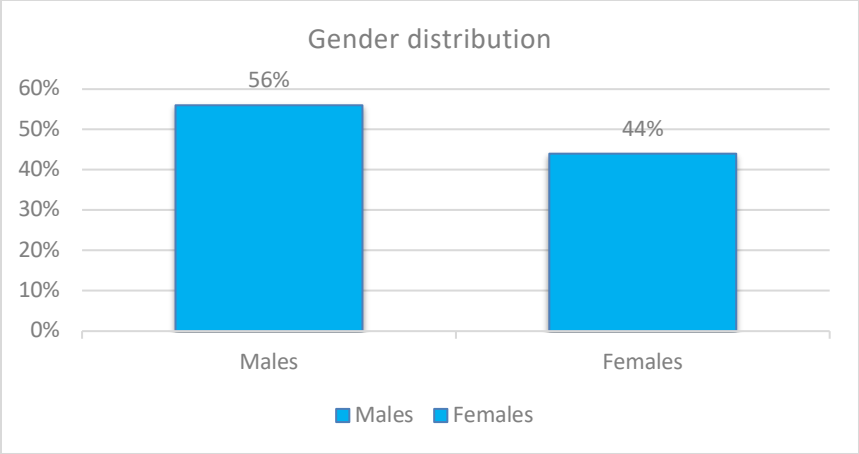
The present study included 50 patients with tattoos.

**Age:** Most common age group affected in the study were 21 to 30 years, followed by 31 to 40 years and the mean age of study was 23.4±2.1 years.




**Graph 1: The age distribution of patients**

**Gender:** Predominant gender were males (56%).




**Graph 2: The gender distribution of patients**

**Motive for tattoo removal:** The most common motive for tattoo removal was to get new employment.

**Table 1: Reasons for tattoo removal**

| Reasons | No of patients | % of patients |
|---|---|---|
| Change in job | 10 | 20% |
| New employment | 19 | 38% |
| Family members pressure | 14 | 28% |
| Police or army recruitment | 7 | 14% |

**Colour of tattoo:** Most frequently patients had blue-black tattoos (62%). 38% had red-green tattoos.

**Type of tattoo:** Most often patients had amateur tattoos (54%). 46% had professional tattoos.

**Wavelength of laser used:** 1064nm was the wavelength used for 58% of the patients. 532 nm is the wavelength used for 42% of patients.

**Number of sittings:** Most often patients needed 7 to 9 sittings. The mean number of sittings were 7.2±1.3.

**Table 2: No of sittings undergone by study patients.**

| No of sittings | No of patients | % of patients |
|---|---|---|
| 1 to 3 | 9 | 18% |
| 4 to 6 | 18 | 36% |
| 7 to 9 | 21 | 42% |
| More than 9 | 10 | 20% |

**Clearance rate:** There is no statistical significance in the clearance rate between 532 and 1064 nm wavelength lasers by the end of 1$^{st}$, 3$^{rd}$ and 6$^{th}$ months.

**Table 3: Clearance rate at the end of 1st, 3rd and 6th months**

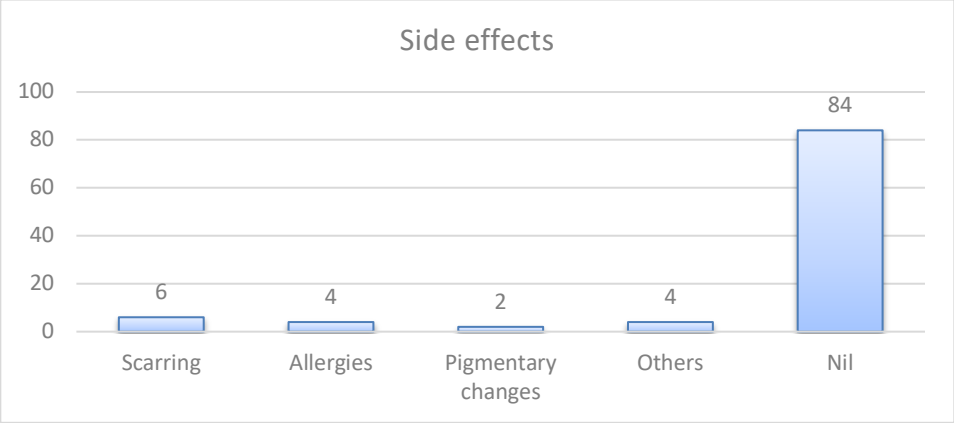
| Clearance rate | No of patients who received 532 nm wavelength of laser | No of patients (1064 nm) | P value |
|---|---|---|---|
| Clear | 1 | 2 | 0.716 Chi square value=2.1 |
| Excellent | 8 | 10 | |
| Good | 6 | 6 | |
| Fair | 2 | 7 | |
| Poor | 4 | 4 | |

**Clearance rate:** There is no statistical significance in the clearance rate of professional and amateur tattoos by the end of 1st, 3rd and 6th months.

**Table 4: Clearance rate at the end of 1st, 3rd and 6th months**

| Clearance rate | No of patients (Amateur tattoo) | No of patients (Professional tattoo) | P value |
|---|---|---|---|
| Clear | 2 | 1 | 0.35 Chi-square value=4.37 |
| Excellent | 9 | 9 | |
| Good | 4 | 8 | |
| Fair | 6 | 3 | |
| Poor | 6 | 2 | |

**Side effects:** The most frequent adverse effect seen was scarring, which is seen among 6% of patients, in remaining 84% patients no adverse effects were noticed.




**Graph 3: Side effects seen among study patients.**

## Discussion

Tattoos are dyes or ink applied on skin surface for memorial or spiritual or religious grounds. Now a days to improve attractiveness, most of individuals are having tattoos on their bodies. They consider it as self-expression. Sometimes after getting a tattoo, it may not be liked or may be objectional from family or it may be objectional to find a new job especially in defence sectors and some government of India jobs.[5] In this view to search for tattoo removal technique, various modalities to remove tattoo exist, but it will not only damage tattoo but also surrounding skin. In order to prevent this, newer modalities like laser especially Nd:YAG laser is being used. The Q switched Nd: YAG laser works on the principle of selective photothermolysis, it is considered best for cosmetic reasons because of less damage to surrounding skin of

tattoo.[4] The present study is conducted on 50 patients who are willing to participate in study for tattoo removal. Most of the patients were aged 21 to 30 years. 56% of the patients were males. Most of our study patients were exposed to 1064 nm wavelength for tattoo removal. The most frequent reason for tattoo take away was to get new employment. The mean number of sittings were 7.2±1.3. There is no statical significance in the clearance rate between amateur and professional tattoo. There is no statistical significance in the clearance between lasers of various wavelengths in our study.

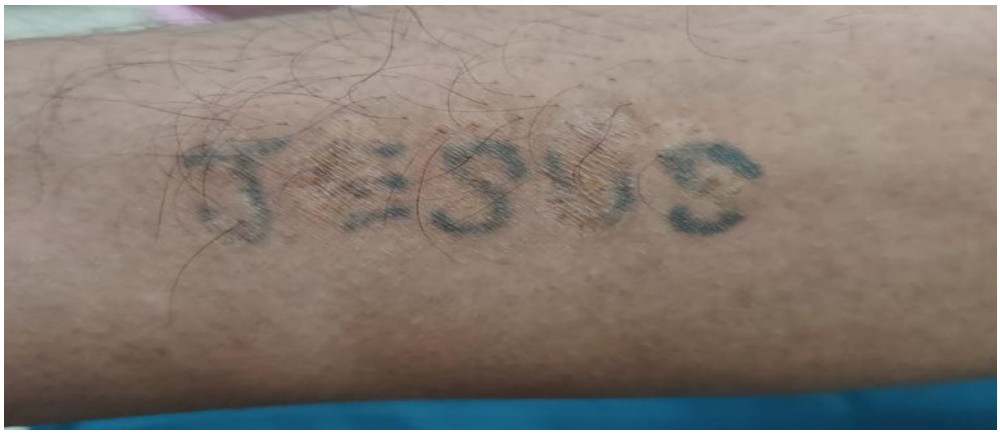


**Figure A: Clinical Images; Subject 1: Tattoo on forearm- before laser treatment.**

**Figure B: Subject 1; Tattoo on forearm- after laser treatment.**

**Figure A: Subject 2; Tattoo on forearm- before laser treatment.**

**Figure B: Subject 2; Tattoo on forearm- after laser treatment.**

In the present study, mean age of patients was 23.4 year, which was correlated with study of Majid *et al* [6], who reported mean age as 27 years in their studies done on efficacy of Q switched Nd: YAG laser. Present study has male preponderance, which was similar to the studies of Bencini *et al*.[7]

Amateur tattoo was most commonly seen in our study. Jones A *et al*.[8] Kilmer *et al*. [9] and Werner *et al*.[10] also reported that amateur tattoo as a common entity in their studies.

Most often the patients had blue-black tattoo in our study, which could be due to their size or ability to absorb more wavelengths of light. In the study of Ali Mahmood *et al* [11], it was found that black and blue colour tattoo got removed completely with faint shadow. Red colour tattoo was removed completely. There was no response for green colour tattoo.

The most often adverse effect seen was scarring, seen among 6% of patients. Remaining 84% patients had no adverse effects. Side effects seen were erythema and mild in the study of Giovanni *et al*. [12]

In the study of Padhiar *et al*.n [5] 74% faced pain. Pinpoint bleeding was seen in 11.2% of subjects. 2.2% of patients had burns and blisters. 19.1% showed delayed reactions.

1064 nm wavelength was used for 58% of our study participants. Kim YJ *et al* [13] used 1064nm Nd: YAG laser and Gorsic M [14] used 532nm Nd: YAG laser.

In view of above observations Q switch Nd:YAG laser is effective and safe for tattoo removal for both amateur and professional tattoos.

## Limitations of this study

1. Small sample size
2. Site of tattoo was not assessed.
3. Level of satisfaction of patients was not assessed after treatment.

## Conclusion

Q switched Nd:YAG laser is considered a good choice for treating amateur and professional tattoos, as it enables complete removal with acceptable minor side effects. We recommend a personalized treatment as per the reliable preoperative assessment which considers both patient and tattoo characteristics.

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