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Comparative Evaluation OFQ Switched Nd YAG alone vs Combination of Q Switched Nd YAG and CO2 Laser IN Tattoo Removal

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Abstract: ***Introduction: The demand for effective and safe methods of tattoo removal has prompted extensive research and development in dermatological treatments. Laser technology has become the preferred choice for tattoo removal due to its non - invasive, precise, and relatively safe nature. Hence in the present study we aimed to compare the efficacy of Q switched Nd YAG alone vs Q witched Nd YAG and CO2 laser combination for tattoo removal. Methods: Eighty patients with tattoo will be divided into two groups - Group A were treated with only with Q switched QS Nd: YAG laser for tattoo removal and Group B were treated with single pass of Co2 laser followed by Q switched QS Nd: YAG laser with the same settings as group one. All the patients were assessed for improvement in tatoo clearance based on a rating scale and side effects were also observed. Results: In Group A, Majority of patients (60%) showed 26 - 50% clearance of tattoos with QS Nd: YAG laser after 4 number of sessions while in Group B, Majority of patients (65%) showed 51 - 75% % clearance of tattoos with QS Nd: YAG laser after 4 number of sessions. In Group A, Most common immediate reaction was erythema (n=30) followed by pain (60%). while in group B, the most common immediate reaction was pain (70%) followed by erythema (65%). Conclusion: In conclusion, Q - switched Nd and CO2 laser followed by Q - switched Nd can expedite tattoo removal while minimizing adverse effects, offering a promising solution for those seeking efficient and safe tattoo removal treatments.***

Keywords: QS Nd: YAG, laser, CO2 ablation, tattoo

1. Introduction

A tattoo is a character or pattern created by edging in color in the skin. Firstly a artistic and ritualistic practice, tattooing has evolved into a extensively embraced form of particular expression across different demographics. The fashionability of skin - piercing body art has surged in recent times. (1) Despite its fashionability, a significant number of individualities seek tattoo junking due to colorful reasons similar as remorse, changes in particular identity, professional considerations, or the desire to replace old tattoos with new designs.

The variety of tattoo junking styles still in use moment highlights their limited effectiveness in achieving satisfactory ornamental results. ways like surgical excision, dermabrasion, cold therapy, infrared coagulation, and CO2 ray ablation cause non - specific skin destruction and affect in mild to severe disfiguring. still, the arrival of spotlights that offer picky erasing of tattoo patches with minimum damage to the girding skin has made scar - free tattoo junking possible. (1, 2) This is achieved through picky photothermolysis, where a short, energy rich palpitation at a specific wavelength is soaked up by the choosen structure, causing rapid - fire thermal shattering of tattoo patches before conterminous areas are affected. Spotlights suitable for treating carbon black tattoos include the Q - switched ruby ray (694 nm), the Q - switched Nd: YAG ray (1064, 532 nm), and the Q - switched alexandrite ray (750 nm) (2)

The demand for effective and safe methods of tattoo removal has prompted extensive research and development in dermatological treatments. Laser technology has become the preferred choice for tattoo removal due to its non - invasive, precise, and relatively safe nature. (3)

Among the range of laser systems available, the quality switched Neodymium - doped Yttrium Aluminum Garnet (QS Nd: YAG) laser is highly regarded for its versatility and effectiveness in treating various tattoo colors and skin types. Specifically, the Q - switched QS Nd: YAG laser excels in targeting and fragmenting tattoo pigment particles, which are subsequently eliminated by the body's immune system. However, achieving complete removal typically necessitates multiple treatment sessions, rendering the process both time - consuming and expensive. (4)

In the hunt to enhance the efficacity and effectiveness of

tattoo junking, combining different ray modalities has gained attention. One promising approach is using the Q - switched Nd: YAG ray in confluence with the CO2 ray. The CO2 ray, known for its ablative parcels, can help in breaking down tattoo color more effectively when used with the Q - switched Nd: YAG laser. This combined approach theoretically maximizes the dislocation of essay patches, easing hastily and more thorough junking with potentially smaller sessions. The present study aimed to conduct a comparative assessment of efficacy of the Q - switched Nd: YAG laser alone versus the combination of Q - switched Nd: YAG and fractional CO2 spotlights in tattoo junking. (5, 6)

2. Material and Method

The present hospital based Prospective study enrolled 80 adult patients with clinically diagnosed tattoo of either gender who come to the outdoor and indoor patient department (OPD/IPD) of Department of Dermatology, Muzaffarnagar Medical College were considered for the study.

Patients with the history of keloid / Hypertrophic scar tendency, pregnant and lactating women., history of bleeding or coagulation disorder, concurrent active skin disease at tattoo site, allergic to tattoo ink and presence of tattoo granuloma were excluded.

Enrolled patients were randomized into two groups using simple random sampling technique. Group A underwent treatment with QS Nd: YAG laser, while group B received a combination therapy of QS Nd: YAG and fractional ablative CO2 laser.

3. Procedure

Prior to laser therapy, topical EMLA cream (a combination of 2.5% lidocaine and 2.5% prilocaine) was applied and covered for 45 minutes to provide anesthesia. The treatment area was sterilized with alcohol just before laser application, and both the patient and treating physician wore protective goggles.

Group A underwent treatment with QS Nd: YAG laser, while group B received a combination therapy of QS Nd: YAG and fractional ablative CO2 laser. A single pass of CO2 laser was performed, followed by QS Nd: YAG laser using the same parameters as group A. Laser sessions were scheduled every 4 weeks for 6 - 8 treatments. Patients were discharged home immediately after the procedure and advised to use photoprotection methods such as protective clothing and broad - spectrum sunscreens. They were also instructed on local wound care with topical antibiotics. Patients were informed about the possibility of erythema and edema persisting for several hours to days and were instructed to promptly report any signs of crusting or pigmentation.

Evaluation of Response:
For each patient, a baseline photograph of the tattoo was taken in a fixed position at a fixed distance from the same camera at the beginning of treatment. Similar photographs of the tattoo site were taken with the same camera and settings on the 1st, 3rd, and last sitting and 1 month thereafter. Three independent blinded physicians noted the percentage of improvement on the basis of visual analogue scale and grading system for tattoo ink lightening. Visual Analogue Scale was calculated based on the assessment of the patient, whereas tattoo ink lightening was calculated by evaluating the response in serial digital photographs. Side effects (if any) were recorded in the preset proforma.

Response
Response was assessed on the percentage of decrease in tattoo pigmentation achieved based on subjective assessment scale of 1 - 4: 1: 1–25% mild improvement; 2: 26–50% moderate improvement; 3: 51 - 75% good improvement; 4: 76 - 100% excellent improvement.

4. Results

The demographics of the patients were highlighted in Table 1. Majority of the patients were in the age group of 21 - 30 years (47.5%).77.5% of the studied patients were male and 22.5% were females. Most common site involved forearm (45%) followed by hands (28.7%). While the most common flitzptrick skin type was Type III (72.5%) (table 1)

Table 1: Demographic characteristics of the patients

Age Groups	Frequency (n=80)	Percentage
10 - 20 years	14	17.5%
21 - 30 years	38	47.5%
31 - 40 years	16	20%
41 - 50 years	11	13.7%
51 - 60 years	1	1.25%
Gender		
Male	62	77.5%
Female	18	22.5%
Site Involvement		
Head	1	1.25%
Neck	2	2.5%
Arm	12	15%
Forearm	36	45%
Hand	23	28.7%
Torso	4	5%
Back	1	1.25%
Thigh	1	1.25%
Flitzpatrick Skin Type		
II	3	3.75%
III	58	72.5%
IV	9	11.25%

The Most common tatoo color observed was black (78.75%) followed by blue (11.25%), red (6.25%) and yellow (3.75%).

Side Effects
In Group A, most common immediate reaction was erythema (n=30) followed by pain (60%). while in group B, the most common immediate reaction was pain (70%) followed by erythema (65%). Table 2

Table 2: Comparative side effects in both the groups

Side Effects	Group A QS Nd: YAG Laser	Group B Combined QS Nd: YAG and Fractional Co2 Laser
Erythema	30 (75%)	26 (65%)
Edema	1 (2.5%)	1 (2.5%)
Pain	24 (60%)	28 (70%)
Blisters	0 (0%)	-
Crusting	0 (0%)	6 (15%)
PIH	2 (5%)	4 (10%)
Post inflammatory hypopigmentation	2 (5%)	-
Secondary Infection	-	**1 1 (2.5%)**
Scarring	1 (2.5%)	2 (5%)

Comparative improvement of tattoo clearance

In Group A, Majority of patients (60%) showed 26 - 50% clearance of tattoos with QS Nd: YAG laser after 4 number of sessions while in Group B, Majority of patients (65%) showed 51 - 75% % clearance of tattoos with QS Nd: YAG laser after 4 number of sessions. (table 3) Figure 1 and Figure 2.

Table 3: Comparative improvement of tattoo clearance

Improvement of tattoo clearance	Group A QS Nd: YAG Laser	Group B Combined QS Nd: YAG and Fractional Co2 Laser
Score 1 (1 - 25%)	2 (5%)	0 (0%)
Score 2 (26 - 50%)	24 (60%)	2 (5%)
Score 3 (51 - 75%)	12 (30%)	26 (65%)
Score 4 (76 - 100%)	2 (5%)	12 (30%)

Figure 1: (A) showing Black tattoo on medial aspect of hand before laser sessions and (B) showing satisfaction score 4 with 75 - 100% of clearance after 6 sessions of QS Nd: YAG laser.

A **B**

Figure 2: (A): showing Black tattoo on forearm before laser sessions and (**B)** showing satisfaction score 4 with 75 - 100% of clearance after 4 sessions of combination of QS Nd: YAG laser and Fractional Co2 laser.

5. Discussion

Tattooing has been a rising practice across the globe and subsequently there has been a growing demand for their removal due to stipulation in various corporate, military institutes and personal life decisions. The types of tattoos seen in OPD for tattoo removal could be amateur professional and sometime medical also. While amateur tattoos are easier to remove, professional tattoos pose a challenge to dermatologists. In our study we have compared tattoos removal by QS Nd: YAG laser alone vs Co2 laser and QS Nd: YAG combined over 80 patients by dividing them into two equal groups of 40 patients.

While using QS Nd: YAG laser the frequency we used is 1064 nm, pulse duration was kept constant at 10ms. Energy was kept between 2 - 6J/cm2 and spot size was kept at 3 - 6 mm according to dimensions of the tattoo. When using Co2 laser we keep energy at 3J/cm2 and repetition at 10ms. Minimum duration between sittings was 4 weeks and maximum was 8 weeks with mean duration between sittings being 5.29 weeks having standard deviation of 1.46.
Whereas minimum duration to clearance of tattoo was 10 weeks and maximum being 16 weeks with a mean of 12.73 weeks having standard deviation of 1.83.

Minimum spot size is kept at 3mm going up to 7mm with a mean of 4.74 and standard deviation of 1.12 where interquartile range is 2 and 95% confidence interval for mean lies between 4.49 - 4.99

Our study clearly shows that combined Q switched Nd: YAG and Fractional Co2 laser is an optimal choice for tattoo removal. Tattoos were removed with multiple sessions ranging from 4 - 6 treatments. The results of our study revealed that satisfaction score 4 with clearance rate of 76 - 100% of the tattoo was achieved in two patients (5%) with alone Q switched Nd: YAG laser whereas 76 - 100% clearance was seen in 12 patients (30%) with combined QS Nd: YAG laser and fractional Co2 laser. In a study conducted by Celia Luzia Peterson et al (7) in 2020, combination of QS Nd: YAG laser and Co2 laser was done in a single female patient with black tattoo on her left thigh and after ten sessions of combined lasers she had complete clearance of tattoo.30% of patients seemed satisfied with score of 3, 60% with score 2 and 5% of patients only had score 1 i. e only 1 - 25% of clearance was observed in patients treated with alone QS Nd: YAG laser sessions.

The subjective scoring for patients treated with combination of QS Nd: YAG laser and Fractional Co2 laser was 65% of satisfaction with score of 3, 5% of patients were satisfied with score of 2 and none of the patient were dissatisfied or had score 1.

The unwanted effects were mild and transient erythema, which was present in 30 (75%) patients in alone QS Nd: YAG and 26 (65%) in combined group followed by pain 28 (70%) in combination group and 24 (60%) in QS Nd: YAG alone.

Scarring was seen in 2 patients (5%) in combined fractional CO2 laser and QS Nd: YAG group whereas it was only present in 1 patient (2.5%) in group A ie QS Nd: YAG laser.

In two (5%) cases slight hypopigmentation was noted in patients treated with alone QS: Nd YAG laser. Whereas it was seen in 4 (10%) patients treated with combined QS Nd: YAG laser and fractional Co2 laser.

In one case (2.5%) in each group had localized mild edema, which usually disappeared in 3 - 4 days. Crusting was seen only in patients who were treated with combined QS Nd: YAG laser and Fractional Co2 laser which (n=6) usually went away after 6 - 7 days and after 10 - 12 days skin completely healed. More treatments were also required when multi - colored (red and yellow color) tattoos were treated.

In drawing things to a close, combination of QS Nd: YAG laser and Fractional Co2 laser showed better clearance rate with significant p value < 0.05 as compared to alone QS Nd: YAG laser which is consistent with the conclusion of a study done by Vanarase et al. In 2017 (48)

6. Conclusion

In conclusion, combining Q - switched Nd versus Fractional CO2 laser followed by Q - switched Nd can expedite tattoo removal while minimizing adverse effects, offering a promising solution for those seeking efficient and safe tattoo removal treatments.

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