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Case Series

Dermatology Section

Forehead Bindi Tattoo Removal using the R20 Technique with Low-fluence Q-switched Nd: YAG Laser: A Case Series

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ABSTRACT

A bindi tattoo on the forehead is a cultural practice among Indian women, particularly in rural areas. Some individuals may choose to remove a bindi tattoo for personal reasons, such as a change in style, appearance, or a shift in their identity. The Q-switched Nd: YAG (QSNY) laser is considered a good standard device of choice for laser tattoo removal. However, despite undergoing multiple treatment sessions, the effectiveness is often found to be limited. In the present case series, six patients with a bindi tattoo on the forehead were treated using the R20 method with a low-fluence Q-switched Nd: YAG Laser, resulting in complete clearance of the tattoo in five patients with no adverse effects. This method facilitates quicker, less painful, and complication-free tattoo removal.

Keywords: Efficacy, Laser tattoo removal, Q-switched laser, Tattooing

INTRODUCTION

The term "tattooing" is derived from "tattau," a Tahitian word that essentially translates to "to mark." It refers to the process of implanting permanent pigment granules in the skin [1]. It has been practiced for thousands of years across various cultures, serving as a symbol of identity, status, religion, or personal expression. The process of tattooing involves using needles to puncture the skin and deposit pigment. Once implanted, the ink particles are phagocytosed by resident dermal fibroblasts, where they permanently remain in the superficial dermis [2]. There are different types of tattoos, including accidental, permanent, temporary, professional, amateur, cosmetic, medical, and invisible tattoos [3]. There are various techniques for removing undesired tattoos, including dermabrasion, salabrasion, chemical destruction, cryosurgery, electrosurgery, and surgical excision [3]. Still, these can lead to incomplete removal with bad scarring and dyspigmentation. Q-switched laser treatment remains the gold standard for tattoo removal [4]. Although these laser systems are highly effective and safe for removing tattoos, they have certain limitations, including the need for multiple sessions, incomplete removal, and treatment-related side effects [5]. To overcome these limitations, attempts have been made to modify the technique or use multiple lasers to obtain the best outcomes and reduce potential side effects. One such technique is the R20 method of tattoo removal, which is based on the principle of repeated exposure to laser light in a single session [5].

CASE SERIES

The present case series consists of six females with bindi tattoos on their foreheads, aged between 21 and 56 years, as given in [Table/Fig-1]. The duration of the tattoo ranged from 5 to 35 years. All patients had amateur tattoos, which were monochromatic (green-blue in colour). All the patients were assessed using the Kirby Desai scale [6] to estimate tattoo-removal treatments required by laser, as given in [Table/Fig-2]. After thorough counselling, a written informed consent was obtained from each patient. Standard clinical photographs were taken before the treatment session. Topical anaesthesia was not used. Only preprocedural cooling with an icepack was done. Treatment was performed using a 1064 nm QSNY laser with a spot size of 5 mm, a fluence of 500 mJ, a repetition rate of 2 Hz, and a pulse width of 5 nanoseconds. The R20 protocol was employed in this case. An initial laser pass was delivered until immediate, pronounced whitening of the tattooed skin was observed. After a 20-minute waiting period, a second pass was administered using the same laser settings. In total, three identical passes were performed, each separated by a 20-minute interval. Following the procedure, ice compresses were applied to minimise heat-induced discomfort and inflammation. No further laser sessions were conducted thereafter.

Patients were followed up after 1 and 6 months. Post-treatment photographs were taken at 6 months. Patients were evaluated by two independent dermatologists based on the available records. Improvement was graded on scale ranging for 0-5 as follows: Grade 0: no improvement, Grade 1: 1-25% clearing of ink, Grade 2: 26-50% clearing, Grade 3: 51-75% clearing, Grade 4: 76-90% improvement, and Grade 5: more than 90% to complete clearing of ink [4]. Also, any adverse effects were recorded. The results and adverse effects of the R20 method in all the patients are given in [Table/Fig-1]. Out of the six patients, five showed more than 90% complete clearing of ink (grade 5), as indicated in [Table/Fig-3-7]. Only one patient showed grade 4 improvement, as shown in [Table/Fig-8]. Regarding adverse effects, only one patient had post-inflammatory hyperpigmentation, as shown in [Table/Fig-6].

DISCUSSION

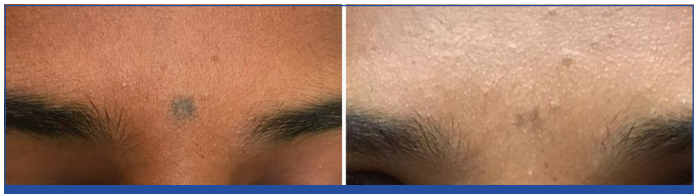
The fundamental principle in tattoo removal using QSNY laser is the concept of selective photothermolysis [7]. Although the QSNY laser is the gold standard laser for unwanted tattoo removal, there are several limitations, of which the requirement for numerous sessions over an extended period is the primary concern, where suitable whitening of the tattoo occurs in 4-6 sessions for amateur tattoos and 20 sessions for professional tattoos [8]. The Kirby-Desai scale can be used as a practical tool to assess the number of

S. No.	Age/sex	Duration of tattoo	Location	Grade of improvement	Side effects
1	21/F	7 yrs	Forehead	5	None
2	56/F	35 yrs	Forehead	5	None
3	36/F	20 yrs	Forehead	5	None
4	22/F	5 yrs	Forehead	5	Post-inflammatory hyperpigmentation
5	24/F	7 yrs	Forehead	4	None
6	54/F	28 yrs	Forehead	5	None

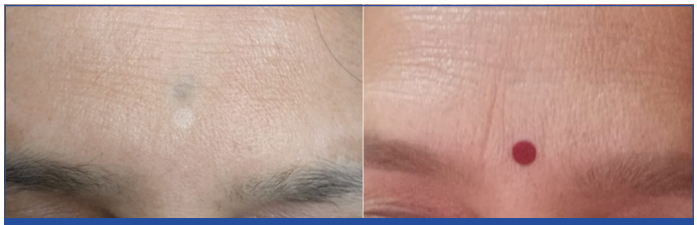
[Table/Fig-1]: Demographic profiles of patients and improvement after the R20 method.

Patient	Skin type	Location	Amount of ink	Layering	Scarring and tissue changes	Colours	Score	Required number of sittings
1	4	1	1	0	0	1	7	7
2	4	1	1	0	0	1	7	7
3	4	1	1	0	1	1	8	8
4	4	1	1	0	0	1	7	7
5	4	1	1	0	1	1	8	8
6	4	1	1	0	0	1	7	7

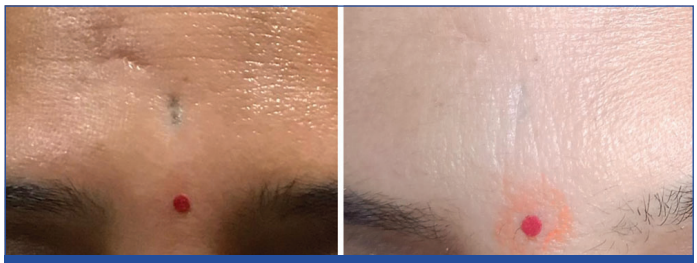
[Table/Fig-2]: Kirby Desai scale to assess tattoo-removal treatments.



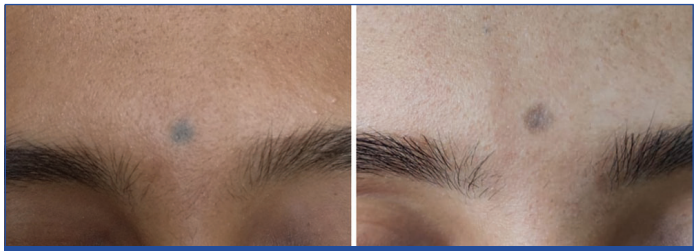
[Table/Fig-3]: Patient 1: Pre and post treatment photographs of a 21-year-old patient with grade 5 improvement.



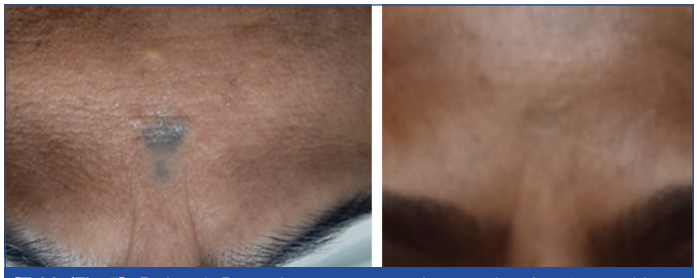
[Table/Fig-4]: Patient 2: Pre and post treatment photographs of a 56-year-old patient with grade 5 improvement.



[Table/Fig-5]: Patient 3: Pre and post treatment photographs of a 36-year-old patient with grade 5 improvement.

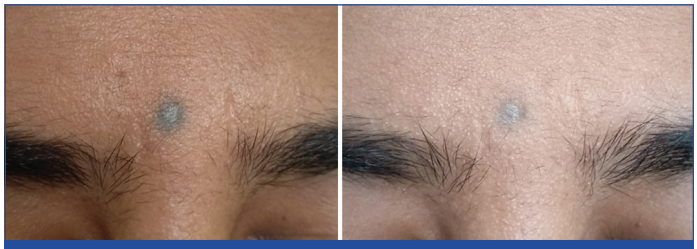


[Table/Fig-6]: Patient 4: Pre and post treatment photographs of a 22-year-old patient with grade 5 improvement with post-inflammatory hyperpigmentation.



[Table/Fig-7]: Patient 6: Pre and post treatment photographs of a 54-year-old patient with grade 5 improvement.

laser tattoo-removal sessions required, leading to a more accurate cost calculation for the patient [6]. Additionally, the effectiveness of QSNY laser for tattoo removal by the traditional method in skin type VI showed an improvement of 75%-90% at the end of four sessions in only 50% of patients, while another 50% showed a 50% improvement, as reported in a study by Jones A et al., [9]. Kossida T



[Table/Fig-8]: Patient 5: Pre and post treatment photographs of a 24-year-old patient with grade 4 improvement.

et al., described the R20 method, where optimal tattoo removal was done in a single laser session based on the process of repeated exposures [10]. In the R20 method, the laser energy is delivered using the same parameters, with a 20-minute gap between each pass in one sitting. The exact mechanism of action is not known. It was postulated that after the subsidence of frosting, delivering a laser can penetrate deeper into the dermis, targeting more dermal ink and fragmenting the ink particles into smaller pieces, thus allowing faster clearance of ink by macrophages [5]. It is assumed that the multi-pass technique opens the portal to the next pass by removing the effect of the upper skin blocking the laser wavelength. Laser bleaching occurs instantly, causing an apparent formation of a gas bubble. In the first pass, the gas bubble limits the penetration of the light laser into the deep dermis. In the second pass, after 20 minutes, the surface gas bubbles are resolved, allowing the subsequent pulse to penetrate more deeply and provide greater bleaching [11,12].

In our study, the Kirby-Desai scale was used to predict the number of sittings required for each patient, which ranged from 7 to 8 sittings. However, with the R20 method, the number of sittings was reduced to a single session. In this present case series, 83.33% patients showed more than 90% improvement. Similarly a study by Kossida T et al., in 2011 which was a comparative study where the tattoo was divided and treatment was randomised with either "conventional" method using a single laser pass or "R20" method using 4 consecutive passes separated by 20 minutes showed most (61%) of the tattoo sites cleared completely by R20 method while in contrast, none of the tattoos treated with the conventional method were removed entirely, and lightening was much less than with the R20 method [10]. Similar results were observed in a study by Abbas KF et al., where standard parameters of QSNY laser utilising the R20 method were done, in which 62% of the tattoo sites were cleared entirely with the R20 process [11]. Reddy KK et al., demonstrated comparable efficacy of the R0 method to the R20 technique, achieving similar results within an average total treatment time of about 5 minutes, and showing greater effectiveness than the single-pass approach [13]. Identical results were observed in a case report by Bunert N et al., 2014, which demonstrated the efficacy of the R20-method for the removal of tattoos by Q-switched 694-nm Ruby laser [14]. The only patient in our study who showed a grade 4 improvement in tattooing may be due to a dense or deep tattoo or scarring caused by a previous procedure.

The ideal parameters for QSNY laser tattoo removal include using high fluence for faded tattoos or those with a lower concentration of target chromophore, and low fluence for tattoos with intense pigmentation or multiple layers, along with a larger spot size and

Authors and year	Study type	N	Age	Type of skin	Fluence used	No of sessions	Result	Side effects
Kossida T et al., 2011 [10]	Original study	12	18-64 years	Not mentioned	5.5 J/cm^2	1	61% cleared completely	None
Abbas KE et al., 2021 [11]	Short report	40	15-54 years	Skin type 4	10 J/cm^2	1	90% clearance	None
Reddy KK et al., 2012 [13]	Comparative study	22	Not mentioned	Not mentioned	3 to 5 J/cm^2	1	51% - 75% clearance	None
Bunert N et al., 2014 [14]	Case report	1	54 years/ male	Not mentioned	4 J/cm^2	3 (at an interval of 4 weeks)	Stronger fading	Slight transient blistering
Zawar V et al., 2014 [15]	Case report	1	26 years	Not mentioned	450 mJ	1	Complete clearance after 4 weeks	None
Elghblawi E 2020 [16]	Case report	1	75 years/ Female	Skin type 4	4.1 J/cm^2	1	Good resolution	None
	Case series	6	21-56 yrs	Skin type 4	500 mJ	1	More than 90% clearing	None

[Table/Fig-9]: Summary of published case reports, series, and studies on the R20 method for laser tattoo removal with a review of the literature [10,11,13-16].

the shortest possible nanosecond pulse duration [7]. In general, higher laser fluence is more effective in treating tattoos. However, in our study, very good results were observed with 3 consecutive laser passes with a low fluence of 500 mj, repetition rate of 2 Hz and pulse width of 5 nanoseconds. Similarly, case reports by Zawar V et al., [15] and Elghblawi E [16] demonstrated successful outcomes with the use of low-fluence QSNY laser employing the R20 method. The fluence used for tattoo removal in the case report by Zawar V et al., was 450 mJ [15], while Elghblawi E [16] used 4.1 J/cm^2. However, we were unable to find any studies relating to the use of low fluence in the literature. The fluence is inherently dependent on laser machine settings and design, and can be adjusted by modifying pulse energy, spot size, and pulse characteristics. The laser machine used in our series had a fluence that ranged from 500 mJ to 2000 mJ; therefore, 500 mJ was specified as the lowest fluence for the patient. No adverse effects were found in any patient in our case series, except for one patient who developed post-inflammatory hyperpigmentation, similar to a study by Kossida T et al., [10]. This Post-Inflammatory Hyperpigmentation (PIH) may be attributed to the patient's tendency to get PIH or poor post-treatment care, such as inadequate use of sunscreen and photoprotection. [Table/Fig-9] [10,11,13-16] describes various studies and case reports utilising the R20 method in tattoo removal, with only 2 case reports using the R20 method with low fluence.

The results of this case series cannot be generalised because of several limitations. Even the small sample size limits the reliability of the results. Additionally, all laser parameters, including pulse duration, repetition rate, and spot size, have not been thoroughly studied and need to be standardised for optimal results. Another limitation is the shorter follow-up period.

CONCLUSION(S)

The Q-switched Nd:YAG laser, utilising R20 methods, is a promising, effective, and time-saving technique for both professional and amateur tattoo removal.

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