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Original Research Article

Efficacy of long pulse neodymium-doped yttrium aluminium garnet 1064 laser permanent hair reduction treatment in skin types V and VI Nigerian patients

Ehiaghe L. Anaba[1]*, Babawale Arabambi[2]

[1]Department of Medicine, Lagos State University College of Medicine/Lagos State University Teaching Hospital, Lagos, Nigeria
[2]Calgary Stroke Program, University of Calgary, Calgary, Alberta, Canada

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***Correspondence:**
Dr. Ehiaghe L. Anaba,
E-mail: ehianaba@yahoo.com

ABSTRACT

Background: There are no studies examining the use, safety, efficacy, effective fluence and pulse duration of Laser hair reduction in Nigerians. This study aimed to document the safety, efficacy, effective fluence and pulse duration, and the number of Laser sessions to achieve permanent hair reduction.
Methods: A retrospective review of Laser hair removal in 87 FitzPatrick skin type V and VI patients from January 2017 to August 2021 using the neodymium-doped yttrium aluminium garnet (Nd:Yag). The fluence (Joules/cm^3), pulse duration (msecs), Laser site and interval between Laser sessions were documented. Data was summarized using frequencies and percentage proportion. Comparison of pulse duration, fluence, and the number of sessions between different body sites was tested using analysis of variance.
Results: A total of 354 laser sessions were performed in 87 patients made up of 80 females and 7 males; mean age of 35.8±9.24 years. The face was the most frequently treated site (67.5% of the sessions). The mean number of laser sessions, pulse duration and fluence were 4.07±4.22, 19.38±1.48 (msec) and 18.22±1.29 (J/cm^3) respectively. An average of 6 sessions was required to achieve permanent hair reduction: the face required a significantly lower number of sessions, p=0.043.
Conclusions: The long pulse Nd:Yag 1064 laser is an effective and safe Laser for hair removal in skin types V and VI. The effective, safe pulse duration and fluence are 16 to 22 msec and 15 to 20 J/cm^2 respectively. The face requires fewer number of Laser sessions.

Keywords: Laser, Hair removal, Safety, Fitzpatrick, Skin type

INTRODUCTION

Unwanted hair has several causes and has been associated with a poor quality of life.[1] There are several procedures deployed in the removal of unwanted hair.[2] These procedures have included the use of Laser devices for some decades now.[3-5] Many Laser devices are deemed safe for Laser hair removal depending on their wavelength and pulse duration.[3,6,7] Lasers have a variable efficacy and safety depending amongst several factors on the skin type.[8-11] The laser devices documented and approved for hair removal include the Diode (800 nm), Ruby (694 nm), Alexandrite (755 nm), IPL (515 to 1200 nm) and neodymium-doped yttrium aluminium garnet (Nd:Yag

1064 nm) with a wavelength of 700-1000 nm.[6,10,12-14] In individuals with FitzPatrick skin types VI, V and VI, the Nd:Yag Laser is reported to be the safest and most effective Laser device for hair removal due to its long wavelenght.[3,6,9,15]

The Nd:Yag Laser results in between 10-40%, 25 to 85% and 75 to 97% hair reduction after1, 3 and 6 sessions respectively of Laser hair removal.[3,5,7,10-13,16] Also, Nd:Yag Laser is not associated with scarring.[12] The end point of Laser hair removal are; decreased hair density in the treated hair area, decreased hair shaft thickness, decreased hair density, decrease in hair colour, decreased terminal versus vellus hair ratio and a hair growth cycle longer than that natural to the hair.[5,7,16,17] Most of the studies on the efficacy of Laser hair removal have been conducted outside of Africa including Nigeria. It is widely known that, the recommended Laser parameters by the Laser manufacturers are unsafe with attendant side effects of burning and pigmentary changes.[18] This has led to studies on the safe, effective fluence and pulse duration of Laser devices in different skin types.[4,7,10,11,13]

Laser hair removal is a new practice in Nigeria. There are no studies on its use, efficacy and safety in Nigerians; neither are there studies on the safe and effective fluence, pulse duration and number of sessions needed to achieve permanent hair reduction. The study aimed to determine the effective fluence and pulse duration for Laser Hair removal in Fitzpatrick's skin types V and VI Nigerians. We also aimed to determine how many sessions are required to achieve permanent hair reduction, Laser interval greater than or equal to 3 months (typical anagen period of hairs on most body sites).[5,7]

METHODS

This study is a retrospective chart review of eighty-seven (87) patients who underwent Laser hair removal at a private dermatology practice between 1st of January 2017 and 31st of August 2021 (The GastroDerm Clinic, Lekki Phase1, Lagos, Nigeria). The study was conducted over four weeks from September to October 2021.The managers of the clinic granted permission for the study as the clinic did not have an ethical review board. Case records of all the patients who had Laser hair removal at the clinic were retrieved and the relevant data were extracted. No case was excluded from the review as the cases had complete documentation. The data extracted included; age, gender, number of Laser sessions, anatomical area treated, pulse duration and fluence. In addition, in 21 patients who were consistent with their Laser schedules, the number of sessions that resulted in ≥3 months Laser appointment interval was noted (permanent hair reduction). In this study, a Laser interval ≥3 months (typical anagen period of most hairs) was defined as the point of permanent hair reduction. Furthermore, a test of significance was conducted to assess if the site treated affects the number of sessions required for permanent hair reduction. The patients were encouraged to shave their hair 24-48 hours before each session and those who did not were shaved at the clinic. The Laser used in all patients was the Quanta system Nd:Yag Laser 1064 manufactured in Italy. Spot size 8/10 with a repetition rate of 2 was used in all participants. The treated area was pre-cooled for 2 minutes with concurrent cooling during and for 1 minute after the session. In each patient prior to initial treatment, a test dose was done to determine the maximum fluence and pulse duration tolerated based on pain threshold, and erythema without burning. Following which the most comfortable pulse duration and fluence for the patient were deployed in the treatment.

Each patient had an initial interval of 4 weeks between sessions and this interval was increased depending on the patient's response. Also the fluence and pulse duration were increased by 1-2 Joules/cm^2 and 1-2msec at subsequent Laser visits depending on tolerability, safety and absence of side effects from the previous session. All the patients were instructed to stop waxing, threading, plucking and electrolysis once they commenced Laser treatment. The primary end points were a reduction in the number of times each patient shaved between Laser sessions and the Laser session at which a 3-month interval was given. Follicular erythema and oedema are the usual end points of Laser treatment. Follicular erythema is however only readily visualized in skin type V and not in most skin type VI individuals. So, we used follicular oedema which is readily visualized in both skin types as immediate end points of each Laser session. Written informed consent was obtained from all the patients. The data was recorded in an excel sheet and analyzed with SPSS version 23. Data were summarized using frequencies and percentage proportion for categorical variables and mean with standard deviation for numerical variables. Skewed data were represented using median and interquartile range (IQR). Comparison of pulse duration, fluence, and the number of sessions between different body sites was tested using analysis of variance. A p-value of less than 0.05 was considered as a statistically significant difference or association.

RESULTS

A total of 354 laser sessions were conducted within the study period in 87 patients. The population was made up of 80 (92%) females and 7 males (8%). Their mean age was 35.8±9.24 years (range of 15-73 years). Patients aged <20 years accounted for 4%, 21-30 years for 18%, 31-40 years for 43%, 41-50 years for 3% and 2% were >60 years. In total, 634 sites were treated. Majority of the patients (51/87;58.6%) had multiple sites treated at each session. In those who had only one site treated per session, this was the chin in 24.1%, side locks and chin in 15%, armpit in 1.1% and Brazilian (pubic area and the adjourning inner thigh) in 1.1%. Four patients progressed from side locks only to side locks and chin, (Table 1). The reason for Laser hair removal was strictly cosmetic in 93.1%, polycystic ovary disease in 4.6% and pseudofolliculitis barbae in

2.3%. The face was the most frequently treated site, accounting for 67.5% of the sessions (Figure 1, Table 2).

Table 1: Frequency of laser sessions.

Site	N	%
Chin/Side locks	149	23.5
Chin only	143	22.6
Moustache	116	18.3
Armpit	66	10.4
Brazilian	50	7.9
Chest	20	3.2
leg	26	4.1
Arm	16	2.5
Side locks	12	1.9
Abdomen	9	1.4
The whole face	9	1.4
Knuckles	8	1.2
Nape	7	1.1
Bikini	3	0.5

Table 2: Frequency of anatomical sites treated.

Site	N	%
Face	428	67.5
Upper limb	90	14.2
Brazilian	50	7.9
Lower limb	26	4.1
Chest	20	3.2
Abdomen	9	1.4
Nape	7	1.1
Bikini	4	0.6

Figure 1: Side burn and underchin hairs before laser treatment.

The number of laser sessions varied from 1 to 20 with a mean of 4.07±4.22 and a median of 2; (IQR 1 to 6). Details of pulse range, fluence and the number of sessions done to achieve a 3-month appointment interval in 21 patients who were consistent with their laser sessions are depicted in (Table 3). Out of the 21 consistent patients, 3 patients were yet to achieve the 3-months interval. One of the patients had 9 sessions of chin-only Laser, a maximum pulse duration of 22 msecs and a maximum fluence of 20 J/cm^3. The second patient had 5 sessions of Brazilian area Laser, a maximum pulse duration of 20 msecs and a maximum fluence of 18 J/cm^3.

Figure 2: Side burn and underchin hairs after laser treatment.

Figure 3: Side burn before laser treatment.

Figure 4: Side burn after laser treatment.

The third patient had 4 sessions of Brazilian area Laser, a maximum pulse duration of 19 msecs and a maximum fluence of 17 J/cm^3.

Table 3: Summary of laser parameters.

Variable	Range	Mean±SD	Median; IQR
Pulse duration at initiation (msecs)	15 to 20	16.98±1.17	17; 16 to 17
Pulse duration at last visit (msecs)	16 to 22	19.38±1.48	20; 18 to 21
Fluence at initiation (J/cm^3)	13 to 21	15.74±1.26	16; 15 to 16
Fluence at last visit (J/cm^3)	15 to 20	18.22±1.29	18; 17 to 19
Number of sessions before 3 months interval	2 to 10	5.65±2.81	6; 5 to 7.75

Table 4: Comparison of laser parameters and number of laser sessions between different laser treatment areas.

Parameters	Site (Mean±SD)					
	Chin	Chin/Side	Brazilian	Armpit	F value	P value
Initial pulse duration	16.95 (1.09)	17.16(1.32)	17.33(1.12)	17.67(1.16)	1.202	0.313
Last pulse duration	19.60 (1.54)	19.56 (1.46)	20.00 (0.89)	19.5 (1.20)	0.177	0.912
Initial fluence	15.73 (1.30)	15.89 (1.27)	16.00 (0.71)	16.17 (0.84)	0.469	0.705
Last fluence	18.32 (1.38)	18.39 (1.34)	18.33 (1.21)	18.5 (1.20)	0.038	0.990
Number of sessions	3.87 (4.18)	4.95 (4.92)	7.33 (6.40)	7.92 (5.76)	2.812	0.043

We compared pulse duration, fluence and the number sessions before a 3-month treatment interval in the four most frequently treated areas. There was a statistically significant difference in the number of sessions required to achieve a 3-month treatment interval with the face requiring fewer sessions (Table 4). In all the patients pain during the laser session was reported. Two patients (2.3%) had superficial burns despite using a low fluence (12 and 14) and pulse width (14 and16) and there was complete recovery after 3 weeks. All the patients reported a marked reduction in hair growth with shaving 0-1 time between sessions.

Figure 5: Before laser treatment.

DISCUSSION

Several treatments including the use of Lasers are deployed in the management of unwanted hair.[2] The practice of permanent Laser hair reduction (PLHR) with the aid of various Laser devices has been the practice for several years now. The effective Lasers deployed in PLHR have a long wavelength, and can penetrate to the bulb of the hair with minimal epidermal melanin absorption.[4,7] These Lasers use a high fluence, a long pulse duration longer than the thermal relaxation time of the treated hairs.[3,4] Manufacturer recommended pulse duration and fluence are not without safety issues as burns and pigmentary changes have been reported.[18] Lower Laser settings have been found to be effective in dark skin types and this is reported to result in fewer side effects.[6,18]

Figure 6: Underchin hairs after laser treatment.

In this study, more females than males sort PLHR. It is normal to observe facial hair in males unlike in females and unwanted hair affects QOL negatively. This difference in perception between sexes accounted for the predominantly female population. Similar to our study, other studies of Laser hair removal reveal a predominantly female population.[13,16,19] Most of the population studied were aged 31 to 40 years. This is the working age group. Comments by colleagues and embarrassment at the unwanted hair could have contributed to this age group seeking treatment more than other age groups. Also, the working age group, likely has the economic power required for this treatment as payment for PLHR is usually out of pocket. The most treated site was the face followed by the armpit and upper limb; then the Brazilian area

(pubic). Our finding is similar to what has been previously documented.[13,18,19] Increasingly, a smooth and perfect face is sought in the society. Most of the patients in this study were female and facial hair is normal in males but not in females. In addition, the face is an anatomical site that is visible and readily commented on with consequent embarrassment.

Figure 7: Side burn before laser treatment.

Figure 8: Side burn after laser treatment.

Multiple Laser sessions were done in each patient just as reported in similar studies.[13,18] Lasers are said to cause a destruction, moderate fibrosis and a change in the hair cycle of the hairs in the area treated. They target the growth areas of the hairs located in bulge and bulb of the hairs by selective photothermolysis which is photochrome dependent.[7-9,11] The implication of this is that Lasers are only effective when used for dark hairs (melanin-containing).[8] Multiple Laser sessions are reported to be important in the achievement PLHR.[6,13,16,18] This need for multiple sessions is one of the drawbacks of the treatment modality as effective Laser hair reduction amongst other things is dependent on the patient's consistency of attendance.[13,16,18] The effective and safe pulse duration employed in this study was 15 to 22 msecs. A long pulse duration is usually employed in Laser hair treatment.[4,19] The pulse duration used in PLHR is generally longer than the time it takes the epidermis to cool thus focusing the heat on the hair follicle. This is referred to as the thermal relaxation time thereby ensuring the efficacy and safety of the treatment. The study's safe and effective pulse duration is in accord with that reported in other studies in which the Nd-Yag Laser was used.[18,19] The effective and safe fluence ranged from 13-21 J/cm^3. A high fluence is recommended in most studies of PLHR. This due to the anatomical location of the bulge and bulb regions of the hair which are not superficial. If the fluence is low, the superficial epidermal melanin will absorb the heat with not much left for the desired hair treatment.[4,7,19] The other studies of Laser hair removal report a high fluence as used in this study to be required for effective PLHR.[4,6,10,18,19]

Laser hair treatment is new in Nigeria and patients pay out of pocket. Consequently, not many individuals can afford the treatment and in those who engage in the treatment, inconsistency with treatment schedules is common. Only twenty-one of our patients were consistent with their treatment schedules. In these patients, an average of six treatment sessions was required to achieve a three-month appointment interval, defined as the point of permanent hair reduction.[5,7] In most areas of the body, the anagen phase of the hair cycle is about three-months. Laser hair reduction is deemed permanent when there is a decrease in number of terminal hairs for a period longer than the period of complete hair growth (anagen) at any given site.[20] In other studies a similar number of sessions were required to achieve PLHR.[1,10,18] We could not demonstrate any difference in pulse duration and fluence required to achieve a permanent reduction between the face and other sites. This may be due to the physical properties of the Laser device as a long pulse duration and a high fluence are required for PLHR in dark skin types.[3,4] Also, there is no regional difference in the location of the bulge area and hair bulbs of hair, the target area for Laser treatment. Rao et al contrary to our study found the face to require a higher fluence than extra-facial sites.[19]

The difference in study outcome could have been influenced by the number of patients available for the study; 21 only in our study. On the other hand, the face required fewer sessions compared to extra facial sites to achieve PLHR. This is contrary to study reports by other researchers where the face was found to require more sessions than other sites.[6,11,19] We cannot account for this study difference and cannot say if the response of the face is peculiar to the African skin as these other studies were not in Africans. More studies of African skin will allow a

definitive comparison. No patient had post-treatment scarring. One of the advantages of the Nd-Yag Laser is the lack of scarring following treatment.[9,12,13,] All the patients experienced transient pain during the Laser treatment. Lasers are light devices that emit heat and this can result in temporary pain or discomfort which can be mitigated by concurrent cooling. Other studies of Laser hair treatment report non-scarring temporary side-effects in consonance with our study.[9,10,12,13,17-19]

Limitations

The study was limited by being a retrospective one and the number of patients available for study.

CONCLUSION

Permanent Laser hair reduction is safe and effective in Nigerian patients. Multiple sessions are required especially in extra-facial areas. Pulse duration and fluence lower than manufacturer's recommendation should be used.

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REFERENCES

1. Alizadeh N, Ayyoubi S, Naghipour M, Hassanzadeh R, Mohtasham-Amiri Z, Zaresharifi S et al. Can Laser Treatment Improve Quality of life of Hirsute Women? Int J Women's Health. 2017;9:777-80.
2. Shapiro J, Lui H. Treatments for unwanted facial hair. Skin Ther Lett. 2005;10:1-4.
3. Gan SD, Graber EM. Laser hair removal: a review. Dermatol Surg. 2013;39:823-38.
4. Rogachefsky AS, Becker K, Weiss G, Goldberg DJ. Evaluation of a long-pulsed laser at different parameters: an analysis of both fluence and pulse duration. Dermatol Surg. 2002;28:932-5;
5. Nabi N, Bhat YJ, Dar UK, Hakeem A, Mir SA, Shah IH, et al. Comparative study of the clinico-trichoscopic response to treatment of hirsutism with long pulsed (1064 nm) laser in idiopathic hirsutism and polycystic ovarian syndrome patients. Lasers Med Sci. 2021.
6. Fayne RA, Perper M, Eber AE, Aldahan AS, Nouri K. Laser and Light Treatments for Hair Reduction in Fitzpatrick Skin Types IV-VI: A Comprehensive Review of the Literature. Am J Clin Dermatol. 2018; 19:237-52.
7. Bencini PL, Luci A, Galimberti M, Ferranti G. Long-term epilation with long-pulsed neodimium. Dermatol Surg. 1999;25:175-8.
8. Ibrahimi OA, Avram MM, Hanke CW, Kilmer SL, Anderson RR. Laser Hair Removal. Dermatol Ther. 2011;24:94-107.
9. Arsiwala SZ, Majid IM. Methods to overcome poor responses and challenges of laser hair removal in dark skin. Indian J Dermatol Venereol Leprol. 2019; 85:3-9.
10. Galadari I. Comparative evaluation of different hair removal lasers in skin types IV, V and VI. Int J Dermatol. 2003;42:68-70.
11. Alster TS, Bryan H, Williams CM. Long-pulsed Nd:YAG laser-assisted hair removal in pigmented skin: a clinical and histological evaluation. Arch Dermatol. 2001;137:885-9
12. Shrimal A, Sardar S, Roychoudhury S, Sarkar S. Long-pulsed Nd: YAG Laser and Intense Pulse Light-755 nm for Idiopathic Facial Hirsutism: A Comparative Study. J Cutan Aesthet Surg. 2017;10: 40-4.
13. Jansy R, Manickam N, Kandasamy M, Gopalan K, Revathi D. Efficacy of long pulsed Nd:YAG laser in the treatment of hirsutism. Indian J Clin Exp Dermatol. 2018;4:85-9.
14. Haedersdal M, Wulf HC. Evidence-based review of hair removal using lasers and light sources. J Eur Acad Dermatol Venereol. 2006;20:9-20.
15. Battle EF, Hobbs LM. Laser-assisted hair removal for darker skin types. Dermatol Ther. 2004;17:177-83.
16. Puri N. Comparative study of diode laser versus neodymium-yttrium aluminum: garnet laser versus intense pulsed light for the treatment of hirsutism. J Cutan Aesthet Surg. 2015;8:97-101.
17. Mohamed EE, Ahmed AM, Tawfik KM, Ibrahim SM. Trichoscopic changes in hair during treatment of hirsutism with 1064-nm neodymium:yttrium-aluminum-garnet laser. J Cosmet Dermatol. 2016;15: 31-5.
18. Mittal R, Sriram S, Sandhu K. Evaluation of Long-pulsed 1064 nm Laser-assisted Hair Removal vs Multiple Treatment Sessions and Different Hair Types in Indian Patients. J Cutan Aesthet Surg. 2008; 1:75-9.
19. Rao K, Sankar TK. Long-pulsed laser-assisted hair removal in Fitzpatrick skin types IV-VI. Lasers Med Sci. 2011;26:623-6.
20. Bhat YJ, Bashir S, Nabi N, Hassan I. Laser treatment in hirsutism: an update. Dermatol Pract Concept. 2020;10:e2020048.

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