Original Article

Refractory Port Wine Stains (PWS): Long Pulsed Alexandrite Laser as an Option

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Abstract:

Introduction: Port wine stains (PWS) are congenital vascular malformations. Pulsed dye laser (PDL) is the treatment of choice till now, although many lesions do not respond completely. One of possible options is long pulsed alexandrite laser. Some literatures confirmed its efficacy. The aim of the present study is to determine the efficacy of this laser as an option in treating refractory PWS in Iranian patients.

Methods: Patients with refractory PWS lesions that did not respond to at least six PDL sessions were included if they had no history of Isotretinoin consumption in past year, history of keloid or hypertrophic scar formation, active infection in laser site and if they were not pregnant. All patients signed an informed consent. Alexandrite laser with fluences from 36-40J/Cm^2, 12 mm spot size, 3 ms pulse duration and dynamic cooling device tuned to 50/50 ms was used in three successive sessions to treat lesions. All patients photographed before each session and after 8 weeks from the last sessions. Then, pictures were rated by two blinded dermatologist rater to determine degree of response based of visual analog scaling from score 1(below 25% response) to score 4 (more than 75% response).

Results: A total of 20 patients comprised of 12 males and 8 females with mean age of 23 years were included. 35% (7 patients) had score of 1, 35% (7 patients) had score of 2, 25% (5 patients) had score of 3 while one patient (5%) reached score 4. No serious side effect was observed. There was no significant relationship with age, gender and size of lesions and response rate.

Conclusion: It seems that considering a conservative approach, long pulsed alexandrite laser may be an effective option in treating refractory PWS lesions. Although future studies with higher sample size using higher fluences are required to confirm these results.

Keywords: hypersensitivity; Nd:YAG laser; graphite.

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Introduction

Port wine stains (PWS) are congenital vascular malformations that are amenable to treatment with different laser modalities. Incidence varies from 0.3 to 0.5 in newborns and common sites are head and neck(1-3). These lesions usually begin in infancy as thin macular lesions and then, especially on head and neck, progress to thicker and darker vascular lesions due to vessel ectasia and decreased sympathetic innervations(1,2). Till now, gold standard of PWS treatment was Pulsed dye laser (PDL) in 585, 595 wavelengths, which have high absorption coefficient in hemoglobin and oxy-hemoglobin(4-8). Between 570 to 595 nm, selective blood vessel damage to structures located in the superficial vascular plexus up to a depth

of 2 mm has been shown. According to this fact, pink and flat PWS's of children and young adults respond much better than dark hypertrophied lesions of older subjects (4-8). Why PDL fails to clear PWS is complex and multifactorial. Variable parameters, including vessel diameter, endothelial wall thickness, vessel depth, flow rates and presence of oxy-hemoglobin or carbo-hemoglobin with deferent ratios significantly alter the responsiveness of PWS to PDL treatment (4-8). This explains why a simple constant PDL setup such as 585nm wavelength and 0.45 ms pulse duration does not produce optimal results in all PWS lesions(4-8). The main mechanism by which the PDL selectively destroys the ectatic capillaries in PWS is by selective photothermolysis, in which light converted to heat inside the capillary results in irreversible damage to the capillary vessel wall (9,10). Complete vessel destruction is necessary to ensure that the capillary does not re-canalize or regenerate; hence, purpuric setup is preferred in treatment of PWS (9, 10). Some vessels in PWS may be deeper that 2mm, the maximum penetrance of PDL laser. Penetration of 755nm Alexandrite laser and Nd-Yag laser may be 50% to 75% more than PDL (1,10,11), and this explains how these lasers may be effective in resolution of non-responding PWS. According to lower absorption of these wavelengths by hemoglobin than PDL, higher fluences are required to achieve sufficient clinical response (1,10,11) and this high fluence limits therapeutic window to a narrow band, where higher fluences will cause deep dermal scarring(1,10-13) and depression of cutaneous surface. The long pulsed Alexandrite laser (755nm) with its preferential targeting of carbo-hemoglobin(1,10-13) has an advantage that predominantly targets venous vessels of the PWS and has less destructive effect on deep arterial dermal plexus. Although the long pulsed alexandrite laser penetrates deeply into the skin and have the capacity to produce deep dermal thermal damage, the lower probability of destructing deep dermal arteries, significantly decreases the risk of scarring. The aim of the present study was to determine the efficacy of long pulsed alexandrite laser in treating refractory PWS non responding to conventional PDL treatment.

Methods

Patients having PWS lesions were included if they had PWS lesion that did not respond at least to six PDL sessions (refractory PWS). The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki, and informed consent was obtained from all patients before enrollment. Also, local ethics committee has confirmed commencement of the study. We included all matching patients visiting Razi hospital laser clinic through 2011 and 2012 if they were interested. Patients were excluded if they were pregnant, had history of isotretinoin use in the last year, history of keloid formation or hypertrophic scarring, active infection in site of lesion, marked sun tanning in past six month and if they were known case of sturge-weber syndrome.

All patients were treated with 755nm long pulse alexandrite laser (GentleLase, Candella Corporation, Wayland, USA), with 3ms pulse duration, 12mm spot size and fluence of 36-40J/cm^2 with DCD 50/50 according to test spot results. Fluence started with 36J and after 10 minutes if deep fade purpura did not develop, increased by two joules, to produce that outcome, which considered as optimum treatment endpoint. To prevent from blistering and dermal scarring, pulse stacking was avoided.

All patients were treated in three sessions, without local anesthesia and tolerated treatment without major complains. Lesions photographed before and after every session by the same photographer in identical light and background situations. Canon Powershot SX 210 was used to take pictures. 8 weeks after the end of the three treatment sessions, lesions were photographed again and all photos were evaluated by two independent and blinded dermatologists (Assistant professors, Tehran university of medical sciences, Razi hospital) in order to determine the degree of resolution of the lesions, without knowledge of pre or post op. pictures.

To assess patients responses, visual analogue scaling has used. Lower than 25% resolution was considered as no response (score 1), from 25% to 50% clearance was considered as partial response (score 2), 50-75% clearance was regarded as good response (score 3) and more than 75% resolution was considered as excellent response (score 4). Then paired t-test was used to analyze recorded data and comparing scores while $P<0.05$ was considered as significant.

Results

20 patients with refractory and hypertrophic PWS were enrolled. Mean age of patients was 23 years (from 16 to 40 years, ± 18.3) including 12 male (60%) and 8 female (40%). Three patients had hypertrophic

PWS lesions, while 17 had flat refractory PWS. Mean diameter of lesions was 4.1 cm ranging from 3 to 30 cm. Table 1 shows demographic state of patients.

Patients were treated with long pulsed alexandrite laser with these parameters: fluence 36-40J/Cm^2, DCD 50/50, spot size 3mm, and 3ms pulse duration. All patients noted visible deep dark purpura without ulceration or blistering after treatment which lasted for two to three weeks. From those three patients having hypertrophic PWS, one had poor response (score 1), one had partial response (score 2) and one had excellent response (score 4). From patients with flat refractory PWS, six patients (30%) had no response, six patients (30%) had partial response (30%) and five patients (40%) had good response. (Table 2)

Data analysis according to age, gender and size of lesions showed no significant relationship between these variables and response to treatment (P>0.05).

Figures 1-3 show treatment results in three patients.

Table 1. Demographic properties of patients

	Gender		Type of PWS	
	Male	Female	Flat	Hypertrophic
Patients number	12 (60%)	8 (40%)	17 (85%)	3 (15%)

Table 2. Response of different PWS types to treatment

	Score 1	Score 2	Score 3	Score 4	Total
Hypertrophic PWS	1	1	0	1	3
Refractory flat PWS	6	6	5	0	17
Total	7 (35%)	7 (35%)	5 (25%)	1 (5%)	20

Discussion

PWS lesions, especially on the face, have negative effect on self-esteem and social legitimacy of patients. Hence, many persons having these lesions call for help to treat them. Long pulsed dye Laser (PDL) till now, is the treatment of choice for these lesions(1), although some lesions does not respond well to the

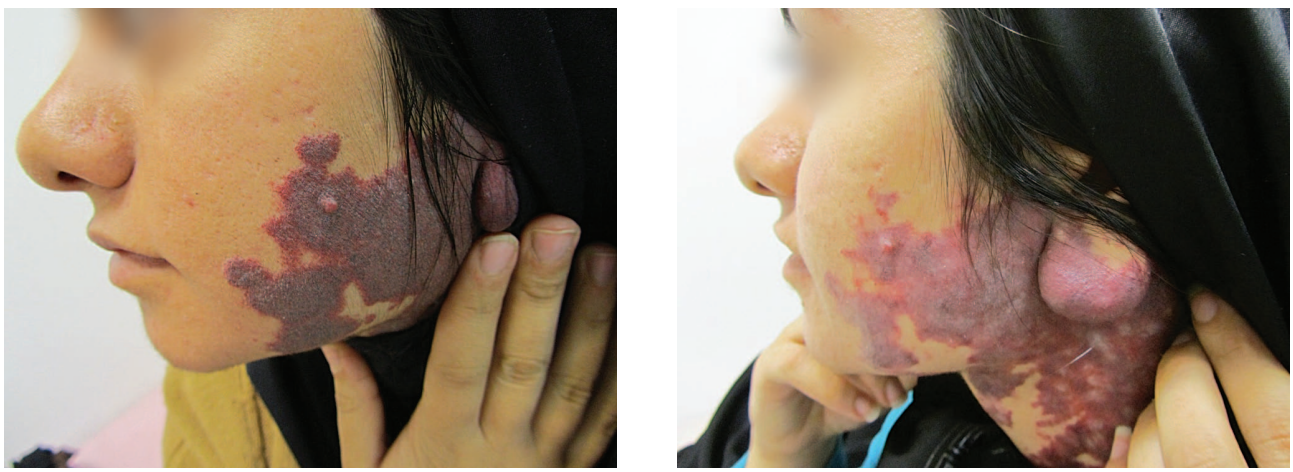

Figure 1. Left: Before treatment. **Right:** After treatment. (final three session)

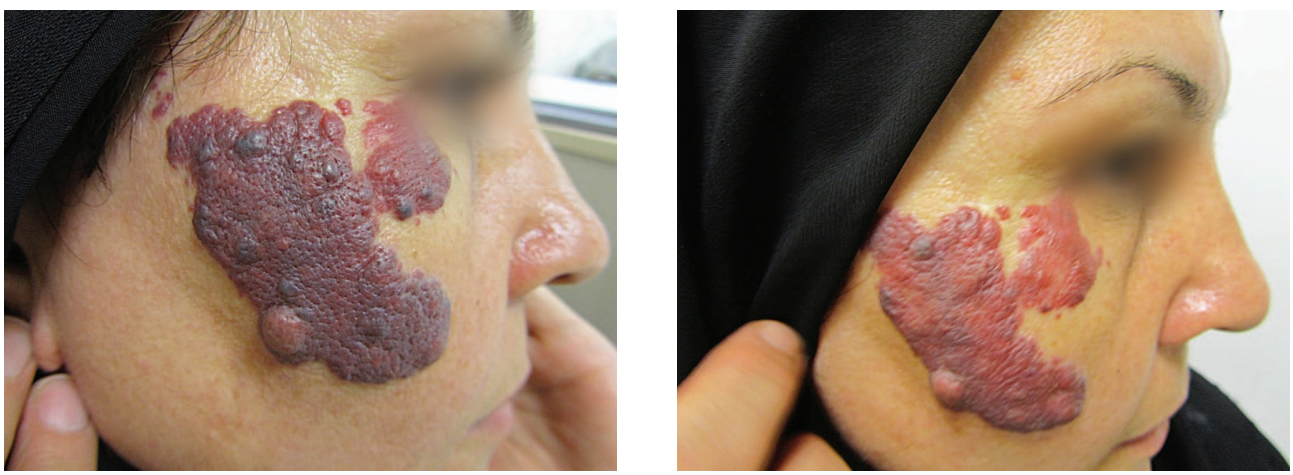

Figure 2. Left: Before treatment. **Right:** After treatment. (final three session)

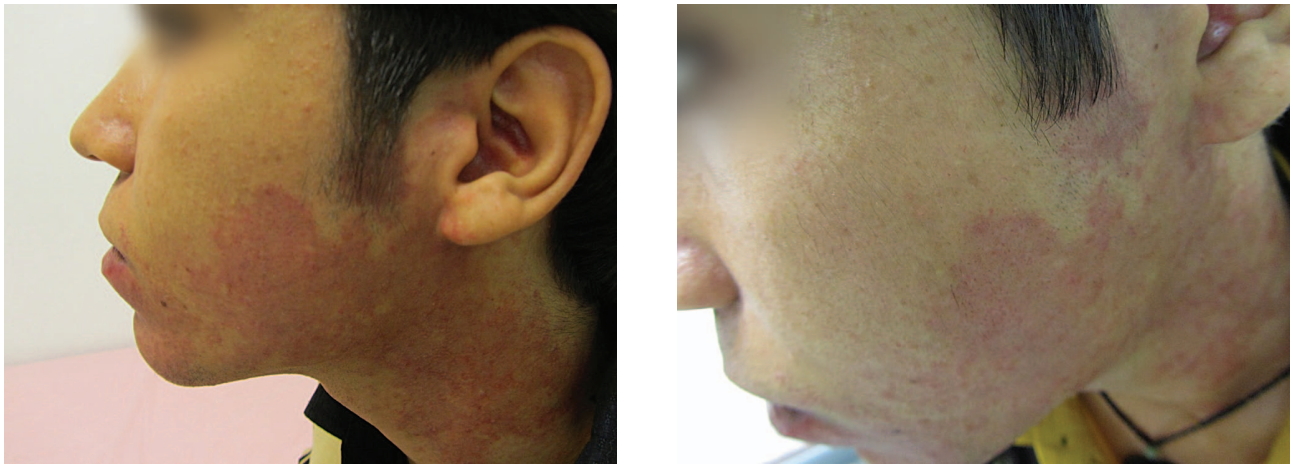

Figure 3. Left: Before treatment. **Right:** After treatment. (final three session)

treatment. In fact complete clearance cannot be achieved in many cases(4-8) and this depends on deep extension of lesions into dermis (more than 3-5mm) (4-8), heterogeneity in vessels diameter, ranging from 10 to more than 100µm(1,2,3), and production of fibrous shield due to destruction of more superficial vessels limiting penetration of PDL(1-4). Long pulsed alexandrite laser according to deeper penetration and selective absorption by deoxy-hemoglobin, has been shown to be effective in treating different type of vascular lesions, including leg telangiectasias and reticular veins; PWS and other vascular malformations (9,15,16). Long pulsed alexandrite laser may be more effective in treating bulky and mature PWS lesions, probably due to larger vessels presenting in these lesions and larger amount of deoxyhemoglobin circulating in these lesions (9,10,13,15). On the other hand, absorption of 755nm laser by epidermal melanin and higher fluence that is needed to treat vascular lesions, will cause epidermal damage, and test spots are necessary to determine suitable fluence. We used 12 mm spot size with fluences ranging from 36 to 40 joules. Other studies assessing the effect of alexandrite 755nm laser on PWS used 8 and 12 mm spot sizes with higher fluences from 40-60 joules(12,13). Our results are in agreement with previous studies although they had better results possibly due to the higher fluences they used (12,13). One of these studies(13) found that average sessions required to produce significant clinical improvement were not meaningfully different between flat and hyper trophic PWS lesions (2.8 for hypertrophic PWS and 2.5 for flat ones) although rate of excellent response was higher in hypertrophic and violaceous PWS lesions(12), possibly due to better absorption of 755nm wavelength. This matches our results, we had one excellent response among hypertrophic lesions and none among flat lesions. Our case that showed excellent response had a PWS lesion more violaceous in color and with a hypertrophic and nodular component (Figure 1). This was predictable according to deeper penetration of alexandrite laser and higher absorption by deoxyhemoglobin. As a whole, 35% of our patients had partial response while 25% had good response and 5% (one case) had excellent response. This is a bit lower than other studies(4-8,9,10,13,15). About 35% of our patients had no detectable response to treatment; this may be due to insufficient fluence used in the present study. GentleLase ™ system require optic-fiber change to use 8 and 10 mm spot sizes, and this was technically impossible for our laser center to change fiber because of lack of required optic-fiber. 40j/Cm^2 was the maximum fluence we could retrieve from 12mm spot size. If we could use 8 and 10 mm spot sizes with higher fluences, it could have been possible to achieve higher response rates. Our patients reported little side effects, considering high fluences used, including deep purpura lasting for one to two weeks and pain and tingling sensation in treated site for no more than 48 hours after laser therapy. No blistering, dyspigmentation or scarring was observed. Almost all patients said that they had less pain, crusting and other post op. complications with alexandrite laser in comparison with PDL prior sessions. All patients were followed for six months after laser therapy and no subsequent scarring or depression of skin surface was observed.

In conclusion, it seems that considering conservative approach using long pulsed alexandrite laser including

test spots, this laser is an effective approach to treat refractory PWS especially those which are hypertrophic with violaceous color. Probably, future studies with higher patient's number and higher laser fluences will confirm results of the present study.

Reference

1. Yang MU, Yaroslavsky AN, Farinelli WA, Flotte TJ, Rius-Diaz F, Tsao SS, et al. Long-pulsed neodymium:yttrium-aluminum-garnet laser treatment for port-wine stains. J Am Acad Dermatol 2005;52(3 Pt 1):480-90.
2. Chapas AM, Eickhorst K, Geronemus RG. Efficacy of early treatment of facial port wine stains in newborns: a review of 49 cases. Lasers Surg Med 2007;39(7):563-8.
3. Enjolras O, Riche MC, Merland JJ. Facial port-wine stains and Sturge-Weber syndrome. Pediatrics 1985;76(1):48-51.
4. Tan OT, Morrison P, Kurban AK. 585 nm for the treatment of port-wine stains. Plast Reconstr Surg 1990;86(6):1112-7.
5. Alster TS, Wilson F. Treatment of port-wine stains with the flashlamp-pumped pulsed dye laser: extended clinical experience in children and adults. Ann Plast Surg 1994;32(5):478-84.
6. Edstrom DW, Hedblad MA, Ros AM. Flashlamp pulsed dye laser and argon-pumped dye laser in the treatment of port-wine stains: a clinical and histological comparison. Br J Dermatol 2002;146(2):285-9.
7. Scherer K, Lorenz S, Wimmershoff M, Landthaler M, Hohenleutner U. Both the flashlamp-pumped dye laser and the long-pulsed tunable dye laser can improve results in port-wine stain therapy. Br J Dermatol 2001;145(1):79-84.
8. Yamauchi PS, Soriano TT, Lask GP. Treatment of port wine stains using the pulsed-dye laser at 585 nm with the dynamic cooling device. J Cutan Laser Ther 2000;2(1):33-6.
9. Izikson L, Anderson RR. Treatment endpoints for resistant port wine stains with a 755 nm laser. J Cosmet Laser Ther 2009;11(1):52-5.
10. Garden JM. Laser removal of port wine stains: how close are we? A Commentary. Lasers Surg Med 2007;39(7):569-70.
11. Jasim ZF, Handley JM. Treatment of pulsed dye laser-resistant port wine stain birthmarks. J Am Acad Dermatol 2007;57(4):677-82.
12. Tierney EP, Hanke W. Alexandrite Laser for the Treatment of Port Wine Stains Refractory to Pulsed Dye Laser . Dermatol Surg 2011;37:1268–78 .
13. Izikson L, Nelson JS, Anderson RR. Treatment of hypertrophic and resistant port wine stains with a 755 nm laser: a case series of 20 patients. Lasers Surg Med 2009;41(6):427-32.
14. Kane KS, Smoller BR, Fitzpatrick RE, Walker NP, Dover JS. Pulsed dye laser-resistant port-wine stains. Arch Dermatol 1996;132(7):839-41.
15. Li L, Kono T, Groff WF, Chan HH, Kitazawa Y, Nozaki M. Comparison study of a long-pulse pulsed dye laser and a long-pulse pulsed alexandrite laser in the treatment of port wine stains. J Cosmet Laser Ther 2008;10(1):12-5.
16. Kauvar AN, Lou WW. Pulsed alexandrite laser for the treatment of leg telangiectasia and reticular veins. Arch Dermatol 2000;136(11):1371-5.