Aucun article ou résumé dans cette revue ne peut être reproduit sous forme d'imprimé, photocopie, microfilm ou par tout autre procédé sans l'autorisation expresse des auteurs et de l'éditeur. Editions Phlébologiques Françaises
No article or abstract in this journal may be reproduced in the form of print, photocopy, microfilm or any other means without the express permission of authors and the editor. Editions Phlébologiques Françaises



*Phlébologie 2009, 62, 2. p. 15-18*

# Impact de la longueur d'onde du laser sur les résultats des traitements endoveineux des varices

# *Impact of laser wavelenght on results of endovenous varicose veins procedures*

Kaspar S., MD, PhD

## *Résumé*

**Objectif :** En général, les lasers diode (810-1470nm) et Nd:YAG(1064 et 1320nm) sont utilisés pour la thérapie endoveineuse par laser. Cette étude compare les effets secondaires et les résultats thérapeutiques du laser diode 980nm et du laser Nd:YAG 1320nm.

**Matériels et Méthodes :** Soixante membres inférieurs furent traités par laser diode 980nm avec retrait manuel et 60 autres membres par laser Nd:YAG 1320nm avec retrait automatisé. Les interventions sur la veine grande saphène (VGS) furent réalisées sous anesthésie locale tumescente (ALT) en mode continu selon le protocole habituel. Les données démographiques, les volumes de ALT et les paramètres de base des lasers étaient comparables dans les deux groupes.

Les résultats furent évalués au 5e jour après l'intervention (J5), à 1 mois, 6 mois et 1 an. A J5 tous les patients complétèrent un questionnaire succinct sur la douleur et une échelle visuelle analogue de 10cm (EVA) pour l'évaluation de la douleur postopératoire. La consommation d'analgésiques fut aussi notée. Un médecin évalua la taille des contusions ou hématomes, de l'induration et de phlébite superficielle à l'aide d'une EVA de 10cm à J5. Au cours des visites suivantes furent évalués la qualité de vie (CIVIQ-2) et, éventuellement, tout congé maladie ainsi que le score clinique CEAP et la qualité de l'oblitération saphène par duplex.

**Résultats :** Des différences statistiquement significatives furent notées. En ce qui concerne la douleur immédiate postopératoire, évaluée par le patient à l'aide d'une EVA de 10cm, entre le groupe diode (médiane [extrêmes interquartiles] : 2,15 [1,1-4,2]) et le groupe Nd:YAG (1,4 [0,4-2,2]) (p=0,003). De même pour l'effet sur les activités journalières habituelles classées de 1(les meilleures) à 5(les pires) (p=0,03) entre le groupe diode (2,5 [2-3]) et le groupe Nd:YAG (2,0 [2-3]).

## *Summary*

***Aim:*** *Diode (810-1470nm) and Nd:YAG (1064 and 1320nm) lasers are usually used for endovenous laser therapy. The purpose of present study is the comparison between 980 nm diode laser and 1320 nm Nd:YAG laser in terms of side effects and therapeutic results.*

***Materials and Methods:*** *Sixty limbs were operated on with diode 980nm laser with manual pull-back and in another 60 limbs Nd:YAG laser 1320 nm with automated pull-back was used. Endovenous laser procedures of the great saphenous veins (GSV) were performed under tumescent local anesthesia (TLA)in continuous mode according to usual protocol.*

*Demographic data, TLA volumes and basic laser parameters were comparable in both cohorts. Results of the therapy were evaluated 5 days after procedure (D5), after 1 month, 6 months and 1 year.*

*At D5 all patients completed short pain related questionnaire and 10-cm visual analogue scale (VAS) to evaluate post-procedural pain.*

*The eventual consumption of analgetics were also recorded.*

*Physician evaluated the size of bruising or hematoma, induration and superficial phlebitis using 10-cm VAS at D5, too.*

*Next visits consisted of evaluation of the actual QoL (CIVIQ-2 questionnaire) and eventual sick leave by the patient and clinical CEAP score and the quality of saphenous occlusion using duplex ultrasound by physician.*

***Results:*** *Statistically significant difference in immediate postoperative pain (p=0.003) evaluated by patient using 10-cm VAS was found: in diode group (median [inter-quartile range]: 2.15 [1.1-4.2]) compared to Nd:YAG group (1.4 [0.4-2.2]) and influence on usual daily activities graded 1(best) to 5 (worst) (p=0.03): in diode group (2.5 [2 -3 ]) compared to Nd:YAG group (2.0 [2-3]).*

*Flebocentrum, Liznerova 737, 50009 Hradec Kralove, Czech Republic - email: kaspar@flebocentrum.cz*
*Accepté le 26 mars 2009.*

Aucun article ou résumé dans cette revue ne peut être reproduit sous forme d'imprimé, photocopie, microfilm ou par tout autre procédé sans l'autorisation expresse des auteurs et de l'éditeur. Editions Phlébologiques Françaises
No article or abstract in this journal may be reproduced in the form of print, photocopy, microfilm or any other means without the express permission of authors and the editor. Editions Phlébologiques Françaises



L'évaluation par un médecin, à l'aide d'une EVA de 10cm, démontra une différence statistiquement significative dans la taille des contusions ou hématomes (p<0,001) entre le groupe diode (3,8 [3-5]) et le groupe Nd:YAG (1,35 [0,4-2,5]) et dans le degré d'induration (p=0,04) entre le groupe diode (0,4 [0-1]) et le groupe Nd:YAG (0 [0-0,6]). Aucune différence ne fut notée pour la qualité de vie, le score clinique CEAP et le pourcentage d'oblitération saphène.

**Conclusion :** L'efficacité du diode 980nm et du Nd:YAG 1320nm est similaire dans le court et moyen terme. Le Nd:YAG 1320nm offre l'avantage de causer moins de douleurs postopératoires et de contusions.

***Mots clés :*** *longueur d'onde du laser, laser diode, laser Nd:YAG, qualité de vie, oblitération saphène.*

*Evaluation by physician using 10-cm VAS found statistically significant difference in grade of bruising or hematoma (p<0.001): in diode group (3.8 [3-5]) compared to Nd:YAG group (1.35 [0.4-2.5]) and in induration (p=0.04): in diode group (0.4 [0-1]) compared to Nd:YAG group (0 [0-0.6]). There were no differences in quality of life, clinical CEAP score and percentage of saphenous occlusion.*

***Conclusions:*** *Efficacy of diode 980nm and Nd:YAG 1320nm lasers is comparable in short and mid-term horizon. The advantage of Nd:YAG 1320nm device consists in the least immediate postprocedural discomfort and bruising.*

**Keywords :** laser wavelength, diode laser, Nd:YAG lasers, quality of life, saphenous occlusion.

## Introduction

• Diode lasers using wavelength of 810, 940, 980 and 1470nm and neodymium:yttrium-aluminium-garnet lasers (Nd:YAG) emitting 1064 or 1320nm are most frequently used for endovenous laser therapy of varicose veins. These lasers can also be classified as hemoglobin-specific (810, 940 and 980 nm) and water-specific (1320 and 1470nm). Multiple clinical studies have documented excellent vein ablation results with hemoglobin-specific lasers but patients treated with these wavelenghts frequently show postreatment pain and bruising in the thight (1,2).

• Perforation of the venous wall caused by conventional wavelengths boiling blood and by uncontrolled manual pull-back of the laser fiber during ablation may be responsible for the increase in these symptoms which are associated with a longer recovery time and delayed return to normal activities (3,4).

The 1320nm water-specific laser was developed to directly targer the interstitial water in the vein wall thus minimizing perforations (5).

• *The purpose of present study is the comparison between 980 nm diode laser and 1320 nm Nd:YAG laser in terms of side effects and therapeutic results.*

## Materials and Methods

Endovenous laser procedures of the great saphenous veins (GSV) were performed under tumescent local anesthesia (TLA) in continuous mode according to usual protocol (6).

• Our study population consisted of 99 patients in whom 120 procedures were performed. Sixty limbs were operated on with diode laser - wavelength of 980 nm with manual pull-back ( BIOLITEC, Ceramoptec Bonn, Germany) and in another 60 limbs Nd:YAG laser 1320 nm with automated pull-back (CTEV, CoolTouch, Roseville, USA) was used. In 21 patients, boths limbs were operated on – one with diode and another one with Nd:YAG laser. All procedures were completed with hook phlebectomy.

There were no statistically significant differences regarding demographic data in both cohorts (gender, age, body mass index, clinical CEAP classification before procedure and diameter of GSV). All patients completed quality of life (QoL) questionnaire ( CIVIQ-2) dedicated to chronic venous disease before procedure. For the assessment of QoL, the Global Index Score (GIS) ranging from 0 (worst quality of life) to 100 (best QoL) served as a standard scale. There were no differences in both groups as to QoL.

• Technical parameters of laser procedure differed in terms of total laser energy (p=0.001), lenght of the treated vein (p<0.001) and total laser time (p<0.001), but there were no difference in the basic parameters of linear endovenous energy density (LEED) in Joules per centimeter (p=0.62), pull-back speed of laser fiber in millimeters per second (p=0.83) and power of laser generator in Watts (p=0.12) – (**Table 1**). TLA volumes were comparable in both groups.

• The results of the therapy were evaluated 5 days after procedure (D5), after 1 month and after 6 to 8 months. At D5 all patients completed short pain related questionnaire (Table 2) and 10-cm visual analogue scale (VAS) to evaluate post-procedural pain.

• The eventual consumption of analgetics were also recorded. Physician evaluated the size of bruising or hematoma, induration and superficial phlebitis using 10-cm VAS at D5, too. Next visits consisted of evaluation of the actual QoL (CIVIQ-2 questionnaire) and eventual sick leave by the patient and clinical CEAP score and the quality of saphenous occlusion using duplex ultrasound by physician.

Aucun article ou résumé dans cette revue ne peut être reproduit sous forme d'imprimé, photocopie, microfilm ou par tout autre procédé sans l'autorisation expresse des auteurs et de l'éditeur. Editions Phlébologiques Françaises
No article or abstract in this journal may be reproduced in the form of print, photocopy, microfilm or any other means without the express permission of authors and the editor. Editions Phlébologiques Françaises



| | p | Nd:YAG 1320 nm | | | Diode 980 nm | | |
|---|---|---|---|---|---|---|---|
| | | Median | Minimum | Maximum | Median | Minimum | Maximum |
| Total energy(J) | 0.001 | 3655,20 | 2045,92 | 6311,93 | 3024,50 | 1031,00 | 5148,00 |
| Length of GSV (cm) | <0.001 | 35,50 | 23,00 | 48,00 | 29,00 | 10,00 | 49,00 |
| LEED (J/cm) | 0.62 | 103,04 | 81,93 | 197,25 | 102,37 | 78,02 | 160,48 |
| Total time (s) | <0.001 | 439,50 | 247,00 | 742,00 | 377,00 | 130,00 | 560,00 |
| Pull-back (mm/s) | 0.83 | 0,81 | 0,43 | 0,98 | 0,80 | 0,58 | 1,18 |
| Power (W) | 0.12 | 8,00 | 8,00 | 10,00 | 8,00 | 7,00 | 10,00 |

*TABLE 1: Technical parameters of laser procedure.*

| | |
|---|---|
| 1. | To what extent did you experienced any limitations at work ar in any other daily activities? |
| 2. | Did you have any sleep-related difficulties regarding your operation? |
| 3. | To what extent did you feel somewhat limited in remaining in a standing position? |

*TABLE 2 : Questions related to pain.*

### Ethics

Institutional review board approval was obtained for this study.

### Statistical analysis

Descriptive measures were used for analysis. Results are expressed in terms of median values with inter-quartile ranges. To compare the demographic data, laser parameters, clinical CEAP, QoL, post-operative pain, bruising, induration and phlebitis in both cohorts

(980 vs.1320nm), non-parametric Mann-Whitney U-test was used. Kaplan-Meier life table method was used to evaluate the occlusion of GSV.

P value of .05 was considered significant.

All analyses were performed using software Excel (Microsoft, Redmond, USA) and Statistica (version 8.0, StatSoft, Tulsa, USA).

## Results

In both cohorts, no statistically significant difference was observed in terms of sleep-related difficulties (p=0.89) and prolonged standing position (p=0.34). The degree of phlebitis of GSV (p=0.32) and eventual pain killer medication (p=0.98) was also the same in both groups. No diferences in clinical CEAP classification (p=0.60) and eventual non-occlusion or early re-opening of GSV according to Kaplan-Meier analysis (log-rank test: p=0.95) were observed within 12 months after procedure. Sick leave (p=0.25) and GIS of QoL (p=0.22) were comparable in both groups.

- On the other hand, there was statistically significant difference in immediate postoperative pain (p=0.003) evaluated by patient using 10-cm VAS: in diode group (median [inter-quartile range]: 2.15[1.1-4.2]) compared to Nd:YAG group (1.4[0.4-2.2])-**(Figure 1)** and influence on usual daily activities graded 1(best) to 5 (worst) (p=0.03): in diode group (2.5 [2 -3 ]) compared to Nd:YAG group ( 2.0 [2-3])-**(Figure 2)**.
- Evaluation by physician using 10-cm VAS found statistically significant difference in grade of bruising or hematoma (p<0.001): in diode group (3.8 [3-5]) compared to Nd:YAG group (1.35 [0.4-2.5])-**(Figure 3)** and induration (p=0.04): in diode group (0.4 [0-1]) compared to Nd:YAG group (0 [0-0.6])-**(Figure 4)**.

In patients with both limbs operated (n=21), 6 prefered diode, 12 Nd:YAG procedure and 3 reported no difference.

## Discussion

- *The amount of applied energy is very important during endovenous laser therapy*. Undertreatment can result in a clinically unsatisfactory outcome, and excessive overtreatment leads to adjacent tissue destruction without additional shrinkage of the targeted tissue.
- *To establish the optimal parameters, it is necessary to determine the response of venous tissue to different thermal insults over different time periods*. Not only the total amount of energy per centimeter of vein length can influence the final result but also the energy deposition pattern. «Slow» heating using the lower or medium power (8 to 12 W, optimally 10 W) with slow pull-back speed of 0.2 to 2 mm/sec causes the best shrinkage with minimum complications because perforations are more frequent at higher power settings (7).
- **Kabnick** compared 810nm and 980nm diode lasers in a randomized and single-blinded study. Ecchymosis and superficial phlebitis was more often present when 810nm laser was used (8).

Aucun article ou résumé dans cette revue ne peut être reproduit sous forme d'imprimé, photocopie, microfilm ou par tout autre procédé sans l'autorisation expresse des auteurs et de l'éditeur. Editions Phlébologiques Françaises
No article or abstract in this journal may be reproduced in the form of print, photocopy, microfilm or any other means without the express permission of authors and the editor. Editions Phlébologiques Françaises



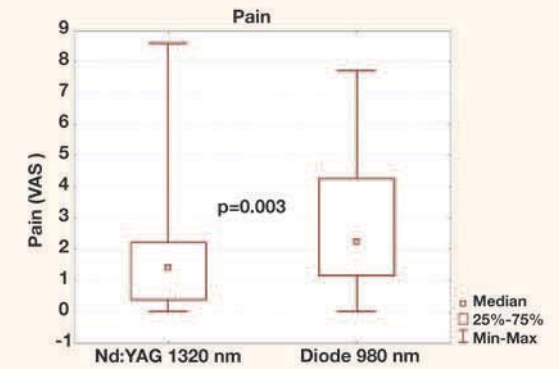



*FIGURE 1: Postoperative pain.*

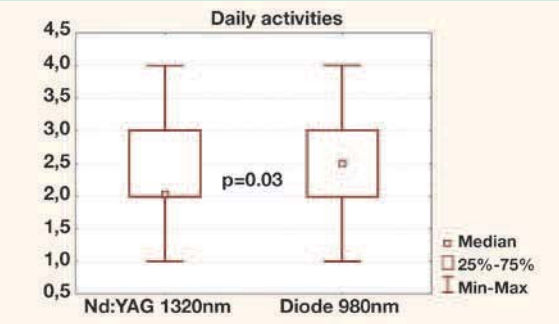



*FIGURE 2: Daily activities.*

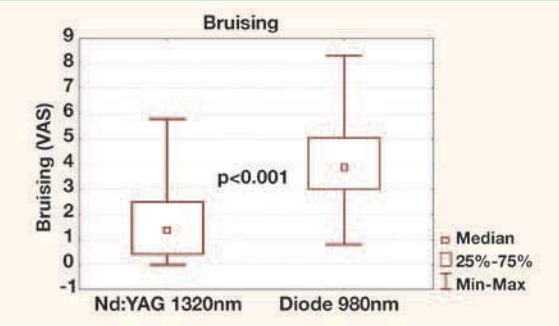



*FIGURE 3: Bruising.*

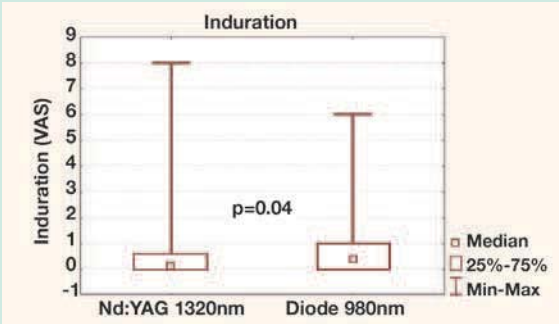



*FIGURE 4: Induration.*

• In order to minimize complications and side-effects, longer-wavelength lasers were developed.

In present study we confirmed better immediate outcome when Nd:YAG 1320nm laser was used in spite of the fact that the length of GSV was higher in these cases.

## Conclusions

Efficacy of hemoglobin-specific and water-specific lasers is comparable in short and mid-term horizon.
The advantage of Nd:YAG 1320 nm device consists in the least immediate postprocedural discomfort and bruising which can be important for majority of patients.

In surgeon´s point of view, the advantage of CTEV Nd: YAG laser is also the motorised pull-back of the fibre and build-in powermeter which can secure the exact emission of laser energy during procedure.

## References

1. Min, R.J., Khilnani, N., Zimmet, S.E. Endovenous laser treatment of saphenous vein reflux: long-term results. J Vasc Interv Radiol 2003; 14(8): 991-996.
2. Proebstle, T.M., Lehr, H.A., Kargl, A., Espinola-Klein, C., Rother, W., Bethge, S., Knop, J. Endovenous treatment of the greater saphenous vein with a 940-nm diode laser: thrombotic occlusion after endoluminal thermal damage by laser-generated steam bubbles. J Vasc Surg. 2002 Apr;35(4):729-736.
3. Proebstle, T.M., Sandhofer, M., Kargl, A., Gul, D., Rother, W., Knop, J., Lehr, H.A. Thermal damage of the inner vein wall during endovenous laser treatment: key role of energy absorption by intravascular blood. Dermatol Surg. 2002 Jul;28(7):596-600.
4. Weiss, R.A. Comparison of Endovenous Radiofrequency Versus 810nm Diode Laser Occlusion of Large Veins in an Animal Model. Dermatol Surg 2002,28:56-61.
5. Goldman, M.P., Mauricio, M., Rao, J. Intravascular 1320-nm laser closure of the great saphenous vein: a 6- to 12-month follow-up study. Dermatol Surg. 2004 Nov;30(11):1380-5.
6. Navarro, L., Min, R.J., Boné, C. Endovenous laser: a new minimally invasive method of treatment for varicose veins-preliminary observations using an 810 nm diode laser. Dermatol Surg. 2001 Feb;27(2):117-22.
7. Kaspar, S., Siller, J., Cervinkova, Z., Danek, T. Standardisation of parameters during endovenous laser therapy of truncal varicose veins--experimental ex-vivo study. Eur J Vasc Endovasc Surg. 2007 Aug;34(2):224-8.
8. Kabnick L.S. Outcome of different endovenous laser wavelengths for great saphenous vein ablation. J Vasc Surg. 2006 Jan;43(1):88-93.