

Treatment of Lower Limbs Telangiectasias with Nd: Yag Laser-Prospective Study on 446 Patients

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ABSTRACT: In the last two decades Nd: YAG laser has become a standard of treatment of telangiectasias of the lower limbs in C₁EAP stage of chronic venous insufficiency. This paper shows the results of a two years study period of telangiectasias of lower limbs with Nd: YAG laser conducted in a specialised centre in this type of procedures. The study group consisted of 446 patients (21 males and 425 females) with telangiectasias (C₁EAP) on the lower limbs between January 2016-December 2017. The patients had to complete a form in which they noted the initial state on a scale from 1 to 10 but also the result of the treatment and the intensity of the pain during the laser treatment. Moreover, the doctor also evaluated the results of the treatment for each and every patient taking also into account the initial phase of the disease. We observed a significant improvement of the clinical appearance (the reduction of telangiectasias) almost in the entire study group, regardless of the gender and the age, but the intensity of the pain was higher in men and in persons under the age of 30. Based on these data we can conclude that Nd: YAG laser represents a minimally invasive therapeutic option with minor side effects and major aesthetic results and furthermore it can be combined with several other methods (microsclerotherapy, radiofrequency, complex surgery) in order to improve peripheral chronic venous insufficiency.

KEYWORDS: Telangiectasias, Nd:YAG laser, chronic venous disease

Introduction

Chronic venous insufficiency of the lower limbs is a disease that affects more than one third of the population, from which more and more people solicitating the adequate treatment [1].

There were several proposals to try to standardise the diagnosis over the time. Although there are some reluctance, currently the CEAP classification allows the most accurate evaluation of the stage's condition [2].

Telangiectasias fall into the C₁EAP clinical class and their impact on the patient is more important visually in comparison with the medical significance cause the associated characteristic symptoms (burning sensations, heaviness, pain, paresthesia of the lower limbs) are rarely seen in this early stage.

Telangiectasias of the lower limbs affect around 5% of the males and 30-40% of the women of the general population, plenty of which solicit treatment [3].

Microsclerotherapy represents the gold standard in treating these lesions but, during the last century, laser therapy has grown more and more popular along with the development of the new techniques [1,2,4].

Patients and methods

In the Department of Surgery of Medical Center Dr. Ianosi (Craiova, Romania), we included 446 patients (21 males and 425 females), with telangiectasias on the lower limbs (C₁EAP) with less than 2mm in diameter and without local phlebitis signs associated in this prospective study between January 2016 and December 2017.

The study was conducted in accordance with the World Medical Association Declaration of Helsinki (1975) and approved by the Institutional Ethics Committee of the Medical Center Dr. Ianosi (No. 614/18.12.2015).

All the patients signed an informed consent and acknowledged the risks and benefits of the procedure. We included patients over 18 years,

phototype II, III and IV according to Fitzpatrick scale [5].

The exclusions criteria for this procedure were the following: signs of infection or inflammation of the cutaneous treated area, clinical signs of deep venous thrombosis, pregnancy, history of intake of non-steroidal anti-inflammatory drugs, isotretinoin, recent exposure to ultraviolet radiations, history of photosensitization or allergies, vitiligo, psoriasis, immunosuppressive diseases, hypertrophic scars or hyperpigmented areas.

We used for treatment a platform which includes a Nd: YAG laser which emits light with a wavelength of 1064nm adequate for the treatment of the telangiectasias of the lower limbs (StarLux 500, Palomar Medical Technologies, Burlington, MA). The patients did not receive any medication prior to the laser procedure. The targeted chromophore is haemoglobin. Depending of the diameter of the telangiectasias, the laser spot varies from 1.5 to 6mm, pulse duration between 10-30ms and the fluency between 350-500J/cm². For thicker and blueish vessels we used larger spots (3 to 6mm) with pulse duration over 20 or 30ms and fluency according to the two mentioned parameters but not more than 350J/cm²

The evaluation was made prior to the treatment and 30 days postoperative. Moreover, images of the treated area were taken with a Cannon G9 camera in order to be able to compare pre-and postoperative statuses. We've taken the shots at the same distance and the device settings (exposure, resolution) were the same for all the group. The efficacy of the treatment was evaluated by each patient and by a doctor using a scale from 1 to 10 (1 being totally unsatisfied and 10 being registered as complete satisfaction) regarding the cosmetic appearance prior the therapy and after the operative sessions.

The main purpose of the study was to determinate the benefits of laser treatment as the doctors and the patients evaluated it.

Secondary, the authors followed the percentage of the local complications (burns, ulcers, hypo and hyperpigmentation, etc.), the potential severe or systemic side effects and the sensibility to treatment in the study group, also using a scale from 1 to 10 (1-the most intensive pain; 10-no pain).

Statistical analysis

The general data were introduced in an Excel file and evaluated using descriptive statistics. Numerical data were visualised as average±standard deviation of the means (SD). A Students's t test was performed to compare pairs of data, for example the satisfaction index averages before the intervention (0-day momentum) and after the intervention (30 days momentum). An Analysis of Variance (ANOVA) testing was performed for comparing more than two data sets, and a Pearson correlation coefficient was considered when evaluating the correlation between two continuous data sets. In all cases, the significance threshold for all testing was set at 5%. The statistic evaluation was performed on all subjects and the parameters were described according to the group age.

Results

There were no mortalities, sever and systemic side effects. On the other side, local complications like erythema and first degree burns that persisted for 3-4 days were considered to be normal therefore we did not take those into account. Nonetheless, we included the second degree burns as local side effects.

The overall satisfaction of the patients following the treatment is represented in Fig.1.

While, initially, the value resulting from patient evaluation was of 6.029 (±1.25) for the whole group, at the end of the therapy (when the treatment was completed) this value rose at 8.703 (±0.833), thus with a clear-cut increase in the second time point, compared to the initial phase (p<0.001).

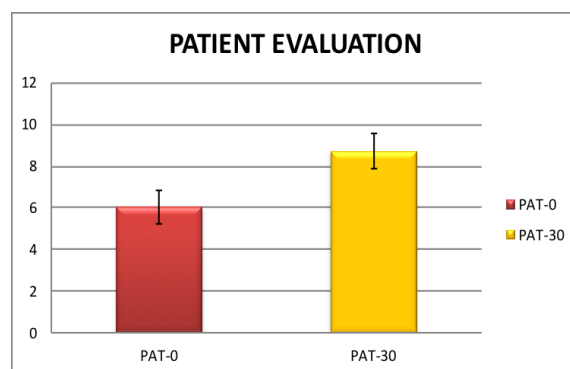


Fig.1. Patients' evaluation of the treatment's results. Error bars represent SD

A comparison of the same parameter, scored by the physician this time (Fig.2), showed that the satisfaction quantification increased from 6.116 (± 0.774) in the preoperative momentum, to 9.000 (± 0.737) after 30 days, again showing a very significant increase between the two moments ($p < 0.001$).

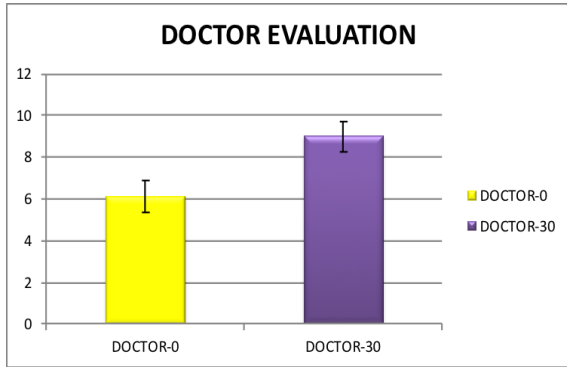


Fig.2. Evaluation of the treatment's results, made by the physician. Error bars represent SD

The degree of concordance between the scores given by patients and physicians was next assessed by calculating a Pearson correlation coefficient between these two sets of data. At the initial moment, the correlation was weak ($r = 0.295$, $p < 0.05$), while after 30 days, there was a strong correlation between the two evaluation processes ($r = 0.787$, $p < 0.05$), asserting that the increase of satisfaction at the second time point was beyond any doubts of subjectivity. There were noticed a relative homogenous data of the patients and the physician. Definitely, we were expecting identical results because the patient evaluated the new situation (after 30 days) without recalling the initial stage. In the meanwhile the physician had the benefit given by the taken photos therefore the evaluation's result was much more objective. Moreover, we tried to assess the treatment results according the age groups using the same pattern. The results are presented in fig.3, from the patient and doctor's perspective, initially and after 30 days.

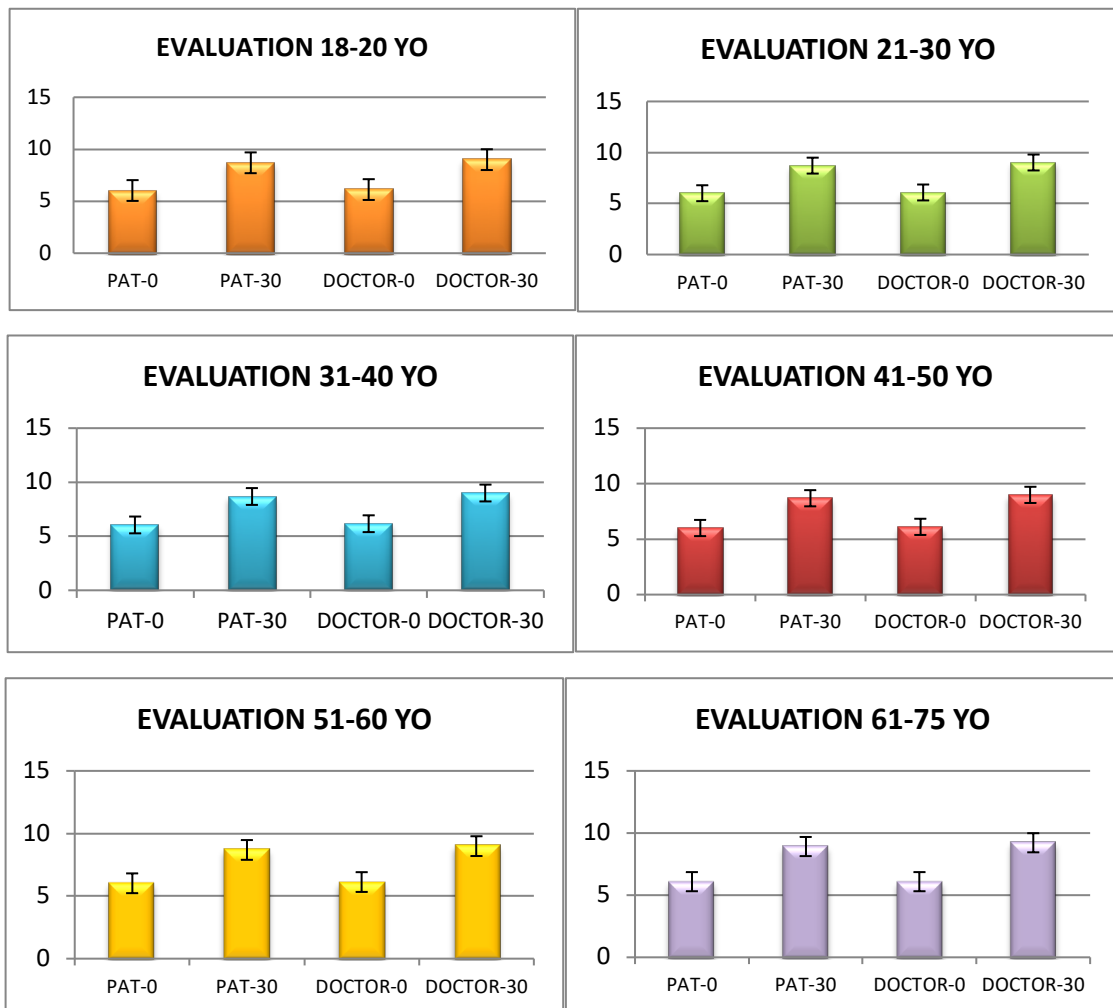


Fig.3. Patient's and doctor's evaluation of treatment's results depending on age groups. Error bars represent SD

Table 1 presents the analysis (t-test) of the treatment's results from patient's perspective, on different age groups (preoperative and 30 days

after). As we can observe, all differences have been deemed significant ($p < 0.05$).

Table 1. Paired t-testing comparing preoperative to post-operative patient satisfaction rates

| PAC 0/PAC-30 | 18-20yo | 21-30yo | 31-40yo | 41-50yo | 51-60yo | 61-75yo |
|--------------|---------|---------|---------|----------|---------|----------|
| P | 0.016 | <0.001 | <0.001 | 0.000799 | <0.001 | 0.011081 |

Results are very significant statistically for all group ages demonstrating the efficiency of the treatment which is not influenced by age.

Table 2 presents the analysis (t-testing) of the treatment's results from physician's perspective,

on different age groups (preoperative and 30 days after).

All differences have been deemed even more significant ($p < 0.001$).

Table 2. Paired t-testing comparing preoperative to post-operative physicians satisfaction rates

| MED-0/MED-30 | 18-20yo | 21-30yo | 31-40yo | 41-50yo | 51-60yo | 61-75yo |
|--------------|---------|---------|---------|---------|---------|---------|
| p | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Figures 4a and 4b presents a result immediately after treatment; in figures 5a and

5b we present a result 30 days after treatment.



Fig.4a and 4b. Before and immediately after Nd: YAG treatment

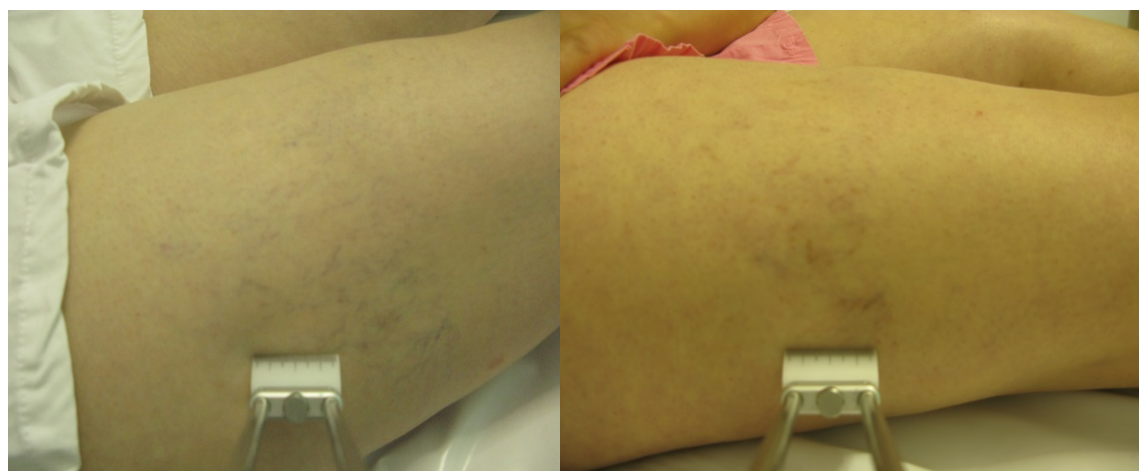


Fig.5a and 5b. Before and 30 days after Nd: YAG treatment

It is well known that laser therapy is a relatively painful method. It is performed without local anaesthetic because it induces vasoconstriction that produces a reduction of the aimed volume with less effective results.

In our study group, the average sensitivity was 7.000 (± 1.075). After loading the results of the patients for the session, we tried to detect the

differences of sensitivity for certain groups. Furthermore, we took in consideration the gender (Fig.6).

The analysis showed an overall increased sensitivity of men, with a value of 6.33 (± 1.0645) the value being statistically important ($p=0.0076$). For the women the same analysis returns a value of 7.077 (± 1.0644).

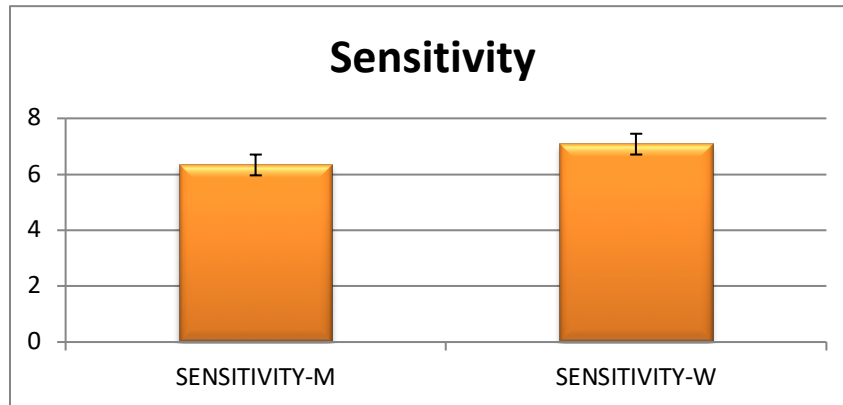


Fig.6 Sensitivity according to gender. Error bars represent SD

Figure 7 shows an increased subjective sensitivity in younger persons (up to 30 years)

and a higher compliance of the patients over 50 years.

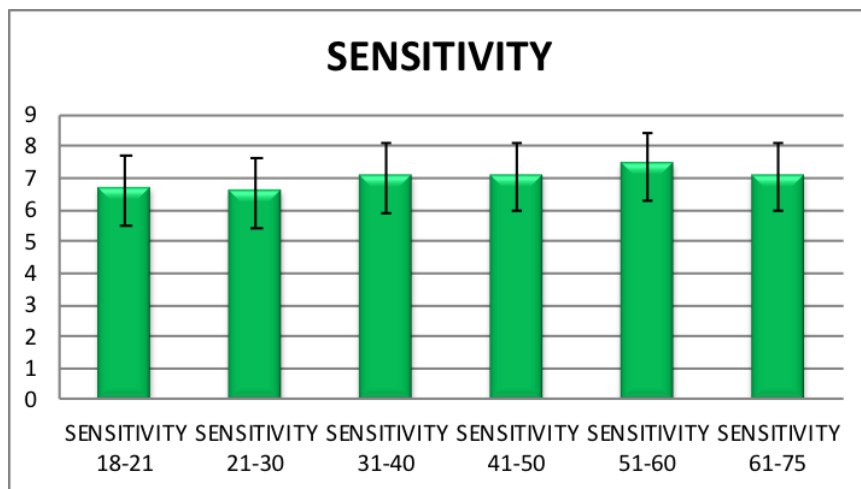


Fig.7. Sensitivity according to age groups. Error bars represent SD

Analysis of variance for all age groups at 30 days after the intervention compared with the first presentation is illustrated in the Table 3.

Tab. 3. Results show a better compliance to the treatment in patients between 41 to 50 years old ($p=0,02$)

| | 21-30yo | 31-40yo | 41-50yo | 51-60yo | 61-75yo |
|---|---------|---------|----------|----------|---------|
| p | 0.029 | 0.0598 | 0.002673 | 0.083033 | 0.27787 |

The authors followed the percentage of the local complications for entire group

of patients and there were identified a number of 25 cases (burns-14; hypopigmentation-5; hyperpigmentation-6).

Discussion

For a long period of time, microsclerotherapy was considered the 'gold-standard' for treatment of spider veins of the legs, either by using sodium morrhuate, hypertonic saline, sodium tetradecylsulfate, polidocanol, either other substances [3].

In the last 25 years, lasers and intense pulse light have become more popular as a choice of treatment of these lesions [1,3,4].

The main indications for laser treatment are: hard or impossible to catheterize telangiectasias, vessels resistant to sclerotherapy, sensitive area like perimalleolar areas or popliteal fossa, patients with needle phobia, possible complications after sclerotherapy (hyperpigmentation, ulceration, risk of catheterization of an arteriola) [3,4].

Moreover, the development of numerous spider veins after sclerotherapy represents another indication of laser.

The first therapeutic lasers were made in the '70's and during the '80's the first pulsed dye laser capable to treat acne and blood vessels was invented [6]. Still, these devices were efficient only on very superficial vessels due to their short-wave length (577-630nm).

Nowadays, lasers that emit longer wavelength (like Nd: YAG laser) combined with a larger pulse made it possible to extend the therapeutic area to deeper and larger veins [7].

By setting the spot's diameter, the duration of the pulse and the fluency according to the aimed characteristic, Nd: YAG laser is able to successfully treat red or blue telangiectasias rich in oxygenated or deoxygenated blood [7].

Chromatic purity of lasers is a basic feature because, depending on its value, the action of the device will vary accordingly. This characteristic also represents the base of the selective photo thermolysis process used by lasers and intense pulsed light [8].

Therefore, certain cutaneous compounds (melanine, haemoglobin, water, porphyrine etc.) called chromophores, have different grades of light absorption depending on the wavelength [6].

So, for each chromophore, there is a wavelength that corresponds to an absorption band. Overlapping the graphs of each chromophore leads to wavelengths that can be used to heat an aimed chromophore since the energy that reaches it will transform in heat at that level. For instance, haemoglobin's graphs shows a peak of 570-600nm (which lead to

invention of first lasers for telangiectasias's treatment) followed by a smaller one, over 1000nm [3].

On the other hand, the melanin's absorption decreases gradually as the wavelength increases and results that a short wavelength laser can transmit energy also to the skin melanocytes with the risk of depigmentation. These being said, Nd: YAG laser seems the best option for treatment of spider veins [7,8].

In order to be efficient, laser or intense pulsed light have to produce enough thermal energy to destroy the targeted chromophore but without overheating or damaging the surrounding tissues. Avoidance of these side effects relies on proper settings of the device like: fluency, pulse duration, diameter of the light spot [9].

Another critical biophysics aspect consists in a longer wavelength correlated to a deeper light penetrating the tissues. Therefore, for laser treatment of lesions must be chosen an adequate wavelength for that chromophore but with a sufficient penetration of the tissue to get to the target [10].

The spot size can also influence the result. A larger diameter of the spot leads to a deeper penetration so it is used to treat lesions located in deepest layers of the skin. At the same time, this is useful to shorten the working time when it is a larger area involved. Plus, the dispersion of the energy is larger for smaller spot size but, simultaneously, the amount of required energy is higher as the spot size is larger.

Pulse duration represents the time when the laser acts on the target and it depends of the type and dimensions of the target. A small target will be heated much more rapidly so the duration of the pulse has to be short [11].

A disproportionate of the pulse will most probably cause burns due to excessive diffusion of the heat towards the surrounding structures.

The fluency is the energy transmitted by the laser reported to the spot's size. This will depend on the dimensions and the depth of the target. The parameter describes the energetic density of the entire pulse, regardless of its duration. Usually, during the treatment, the fluency is the last established parameter being correlated with the clinical response. It is recommended the usage of minimal fluencies to obtain a result and then it can be increased based on the response to the treatment. Furthermore, in areas with less fat tissue (perimalleolar region, anterior view of the tibia) it is advised a 20% reduction of the

fluency due to the reflection phenomenon produced by the periost.

When it comes to sclerotherapy versus laser, we can say that both methods are complementary existing just a small overlap where both can be used. Firstly, Nd: YAG laser indication for treatment of telangiectasias larger than 3mm in diameter is limited for at least 2 considerations [12]: one is the relative profound location of the vessels of the lower limbs and second, the larger vessels have a thin basal lamina.

In these conditions, the usage of light is relative ineffective cause due to the large distance to the target, inevitably it will lead to a widespread of the energy and so, to side effects.

Secondly, if the diameter of the vessels is less than 3mm, Nd: YAG laser is the optimal choice, its efficiency being superior to sclerotherapy [13]. It is obvious that a needle catheterization is very difficult for the thinner vessels.

A major aspect regarding the patient's comfort is the protection of the epidermis during the treatment (there are several cooling methods like: cooling gels, cold air released by an attached device, cooling spray).

This will make possible to use spots with higher fluencies and therefore, better efficacy [4].

These will increase, on one hand, the patient's tolerance to pain allowing the usage of higher fluencies and on the other hand, it will determine less trauma of the epidermis and also decreases the risks of post-inflammatory hyperpigmentations that occurs after this procedure.

The device we used has a sapphire-tipped cooling system that ensures a natural handling and an optimal temperature to protect the skin prior, during and after laser impulse.

The treatment consists in direct transmission of the impulse to the target using different modules of the device (mostly similar with a gun barrel).

Immediately after the impulse was transmitted, the treated area turns white due to sudden constriction of the vessel.

It is indicated to avoid over treating an area due to an insufficient whitening because there is the risk of burns with or without an ulceration, but definitely anesthetic.

The laser impulse once it reaches the vessel has the ability to spread in the close vicinity (according to communicating vessel principle) and further allowing to space the impulse at a few millimeters distance having both an direct

and also obvious advantage over the epidermis. In case of small vessels, the effect of laser is immediately visible to the patient during the treatment.

For larger vessels it can be noticed an increase in color due to intravascular coagulation of the blood, process more notable during sclerotherapy.

Avoidance of sun light and/or photo protection are mandatory for at least 4-5 weeks to diminish the risk of post inflammatory hyperpigmentations [4,6,14].

Treatment of telangiectasias with Nd: YAG laser is accompanied almost always by pain. This can persist also after treatment, but never the same intensity as during the procedure.

Pain killers are rarely needed and also anti-inflammatory drugs or elastic compression opposite as after sclerotherapy.

Depending on the patient's sensitivity, an erythematous area that will persist for 7-10 days and eventually, oedema for 2-3 days, will be noted.

More often, there will be a red dot for up to 3 weeks as a mark of laser impulse application or a small crust sign of a skin burn [4,6,15].

Post procedural hyperpigmentation can occur mostly after treating larger vessels.

Still, that decreases and even resolves after 1-3 months.

If ulcerations appear, they must be treated according to guidelines, with daily bandages, healing occurring after several weeks.

If there are devitalized areas we need to perform gentle debridement.

Usually the healing results with hypo pigmented scars.

Last but not the least, it is essential that during Nd: YAG treatment, to use eye protection glasses with filters the light using the wavelength due to the major risk of damaging the retina.

Conclusions

Nd: YAG laser treatment represents a minimally invasive therapeutic option with minor side effects and major esthetic results.

Laser treatment can be associated with other therapies (microsclerotherapy, radiofrequency, complex surgery) in order to improve peripheral chronic venous insufficiency.

Acknowledgment

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