

# Laser Assisted Reduction of Axillary Hyperhidrosis (LARAHA) – evaluation of success up to 24 months after the treatment

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## ABSTRACT

The objective of this study was to evaluate the safety and efficacy (reduction of axillary sweating) up to 24 months after subdermal Nd:YAG laser treatment of Axillary Hyperhidrosis.

**Method:** A retrospective study was conducted on 32 patients (23 females and 9 males) who received subdermal 1064 nm NdYAG laser treatment of axillary hyperhidrosis on both axillas between May 2008 and November 2010. The majority of patients (27) received only one treatment while 5 patients came back for a second touch-up treatment. Laser energy of approx. 200 J/cm<sup>2</sup> was delivered to sweat-producing areas. These areas were detected prior to surgery with an iodine - starch test. Assessment of the axillar sweating reduction was made subjectively by patient self evaluation and objectively by a comparison of sweat-producing surface area as measured by the iodine starch test. Patients were asked about post-op pain, recovery time and potential compensatory sweating, and about their general satisfaction with treatment.

**Results:** An average sweating reduction of 93 % was measured by iodine - starch tests at one to three months after treatment. 87% of patients assessed their final sweating reduction as better than 50%, seven of them (22%) had results in the range of 76-100% reduction. All adverse effects proved to be transient with average duration of approx. 3 weeks. A large majority of the patients (75%) expressed their satisfaction with the treatment and its outcome (grades 2 and 3) and 97% of them would recommend this treatment to their relatives and friends.

**Conclusions:** Laser assisted reduction of axillary hyperhidrosis with NdYAG laser is an effective and safe method for the permanent and significant reduction of axillary sweating.

**Key words:** axillary hyperhidrosis, laser treatment, Nd:YAG laser

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## I. INTRODUCTION

Hyperhidrosis in the armpit region is a very unpleasant condition for both men and women at all ages, especially during the summer. Numerous treatment modalities have been used in an attempt to treat axillary hyperhidrosis including topical and systemic medications and surgical methods. The most common method is the use of botulinum toxin to temporarily disable the sweat glands [7,8,9]. All of these methods have their limitations and side effects; for these reasons new methods are constantly being sought. One newer technique involves the use of lasers for the selective thermal destruction of sweat glands. The proponents of this technique claim that it is a permanent solution, with the additional advantages of being minimally invasive and safe. The purpose of this study is to assess the efficacy, safety, and permanence of this treatment.

## II. MATERIALS AND METHODS

32 patients suffering from moderate-to-severe axillary hyperhidrosis were treated subdermally by Nd:YAG 1064 nm laser under tumescent local anesthesia using the Schavelzon-Blugerman technique [1,2]. All treatments were executed at a single center, Dr. Maletic's Polyclinic in Daruvar, Croatia in the period between May 2008 and November 2010.

At the baseline consultation visit patients were examined to determine their suitability according to the inclusion and exclusion criteria. All patients submitted to treatment had passed inclusion criteria and had provided written informed consent form.

### Inclusion and Exclusion Criteria

All patients testified to long-term suffering from excessive axillary sweating which could be categorized by scores 3 and 4 on the Hyperhidrosis Disease Severity Scale (HDSS) [6].

Patients were of both sexes (72% of females and 28% of males), aged between 17 and 51 years (average 30,6 years) with Fitzpatrick skin types I to III.

**Table 1: Patients demographic data**

|                 |          |
|-----------------|----------|
| <b>Gender</b>   |          |
| Females         | 23 (72%) |
| Males           | 9 (28%)  |
| <b>Mean age</b> | 30,6     |
| <b>Range</b>    | 18-51    |

All patients underwent iodine - starch tests which allowed for the measurement of their sweat-producing areas (in square centimeters). All patients also responded to a questionnaire.

Exclusion criteria were pregnancy, intake of photosensitive drugs, the reception of intradermal botulinum toxin within the last nine months, a history of connective tissue disorders (collagen / scarring) and compromised skin condition in the axillar regions.

**Treatment procedure**

Laser assisted reduction of axillary hyperhidrosis is a surgical procedure executed under local tumescent anesthesia, where the apocrine glands are destroyed with the laser energy and removed from the armpit with suction probe (modified Blugerman-Schavelzon model) [1].

To detect the location of sweat glands and obtain an objective measure of method efficacy an iodine - starch test was performed on all patients prior to treatment. Photographs of sweat-producing areas were taken and surface areas were calculated.

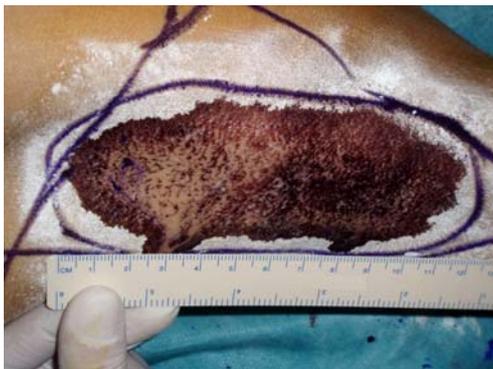


Fig. 1: An example of iodine-starch test and of measurement of sweat-producing axillar region

The sweat-producing areas ranged from 14 cm<sup>2</sup> up to 84 cm<sup>2</sup> per axilla. The average surface area of all sweat producing areas (64 axillas) before treatment was 31 cm<sup>2</sup>

Treatments were executed with 1064 nm NdYAG

(Fotona XP-2, Slovenia) using a 600 µm fiber and 3 mm cannula. Laser energy was delivered in quasi-continuous mode, with a power of 10 W, a repetition rate of 40 Hz and a pulse-duration of 300 µsec. An average of 211 J/cm<sup>2</sup> of laser energy was delivered to the sweat-producing area.

**Table 2: Measured values of sweat-producing areas and laser energies applied in 64 treated axillas**

|                     | <b>Treated area (cm<sup>2</sup>)</b> | <b>Energy applied (J)</b> | <b>Energy Density (J/cm<sup>2</sup>)</b> |
|---------------------|--------------------------------------|---------------------------|--|
| <b>Mean values:</b> | 31                                   | 6.333                     | 211                                      |
| <b>range:</b>       | 14 - 84                              | 3.026 - 15.112            | 137 - 291                                |



Fig. 2: Treatment detail – subdermal laser action

During the treatment the skin surface was cooled with cold air (Cryo6, Zimmer, Germany) to prevent surface skin temperatures from reaching beyond 40 °C.

After the treatment patients received bandages and compression garments to wear for 48 hours. Post-op recovery of all patients was checked by telephone interviews on day 2, one week and one month after the treatment.

To optimize the results five (15%) patients got secondary touch-up treatment one to two months after the first treatment.

Assessment of axillary sweating reduction was performed by comparing the results of iodine - starch tests before and after pictures and the subsequent calculation of residual sweat-producing areas.

All patients were additionally interviewed for their self-assessment of degree of axillar sweating reduction,

post-op pain, adverse effects, time to full recovery, potential compensatory sweating and general satisfaction with treatment and its outcome. Degree of sweating reduction was graded using a four-point scale: 0 (0-25%), 1 (26-50%), 2 (51-75%) and 3 (76-100%). A similar four-point scale was used for evaluation of the level of satisfaction: 0 (not satisfied) 1 (somewhat satisfied), 2 (satisfied) and 3 (very satisfied).

Interviews with the patients were held in January 2011. For most of the patients (15/32 or 47%) the interview was done 18 to 24 months after the treatment, for 7 patients (22%) this follow-up was 12-18 months after the treatment, 5 patients (16%) were interviewed 6-12 months after and only 5 patients had follow up shorter than 6 months.

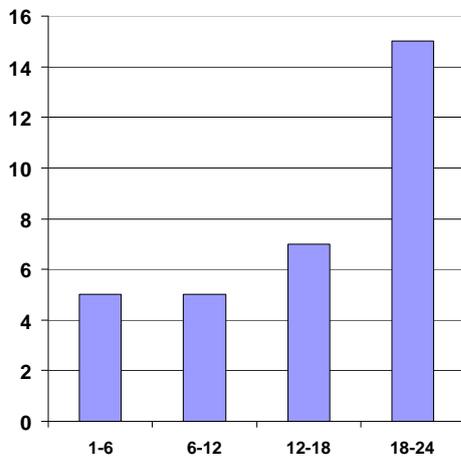


Fig. 3: Almost 70% of patients had follow-up of 12 months and longer in the moment of assessment of the treatment results. 47% of patients assessed the success of their treatment 18 - 24 months post-op.

Patients were also asked to assess the difference, if any, between the sweat reduction they experienced one month after treatment and the reduction they were experiencing around the time of the interview.

### III. RESULTS

Measurements of sweat-producing areas before and after the treatment were taken on 30 axillas of 15 patients who came for follow-up control visits one to three months after treatment. The average measured sweating reduction was 93%, with results ranging from 73% to 100% as shown on Fig. 4.

Results of patients' assessments are presented on Fig. 6. One month after treatment 87% (28/32) of patients reported a 50% or better decrease in sweating. 37% of patients reported a 75% or better decrease in sweating. In six patients, sweat production increased

between the 1 month follow-up appointment and the interview, as determined by self-assessment, indicating a partial reoccurrence of hyperhidrosis. Five patients reported an increase of 1 category, 1 patient reported an increase of 2 categories (with categories as shown in Fig. 6).

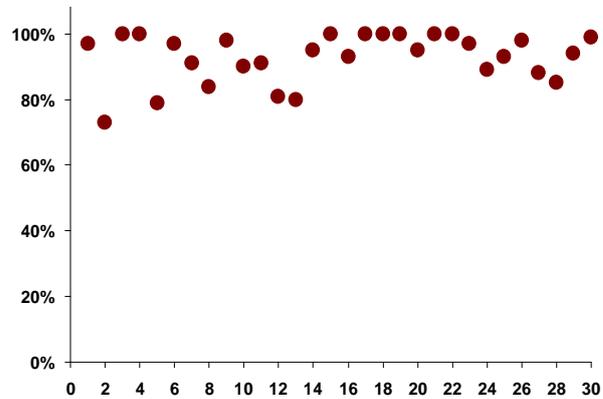


Fig. 4: Reduction of sweat-producing areas up to three months after the treatment as measured from 30 treated axillas.



Fig. 5: An example of before and after pictures of iodine-starch test used for measurement of sweating reduction. The result of this particular pair of pictures was 97% reduction.

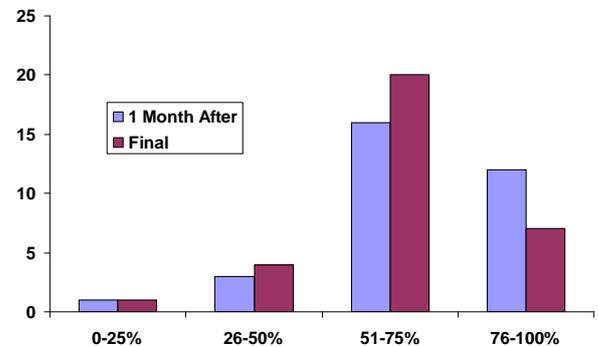


Fig. 6: Patients' assessment of sweating reduction after the treatment

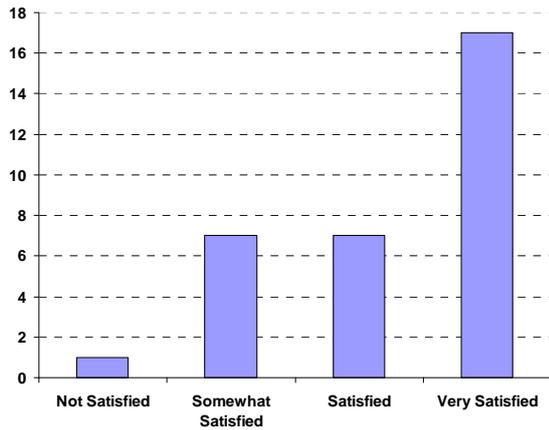


Fig. 7: Patients' satisfaction with the treatment and results

A large majority of the patients (84%) assessed their final sweating reduction as better than 50% out of which 22% said their improvement was better than 75%.

Most of the patients (53% or 17/32) were very satisfied with the treatment and their results, 22% of patients were satisfied (7/32) and somewhat satisfied (7/32) and just one patient (3%) was not satisfied. All but one would recommend this treatment to their friends.

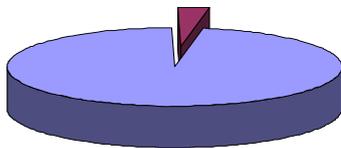


Fig. 8: 97% of patients (31/32) would recommend Laser Assisted Reduction of Axillary Hyperhidrosis to their relatives and friends

Twenty-six patients (81%) did not notice any compensatory sweating after axillary sweating was reduced. Two (6%) patients reported increased sweating in abdomen region, two (6%) reported increase on palms, one (3%) on feet and one (3%) on feet and palms. Reported increases ranged between 10% and 50%.

**Table 3: Adverse effects as reported by patients during the post-op recovery period**

| Adverse effects      | at 48 h | at 1W | at 4W | at 6W |
|----------------------|---------|-------|-------|-------|
| pain                 | 14      | 1     | 0     | 0     |
| hematoma             | 3       | 1     | 0     | 0     |
| edema                | 4       | 1     | 0     | 0     |
| pulling sensation    | 3       | 1     | 1     | 0     |
| partial skin erosion | 1       | 1     | 0     | 0     |

All patients replied to questions about post-op pain and other adverse effects, their severity and duration. Fourteen patients (44%) reported mild to moderate

pain lasting one or two days after the treatment. One patient reported that the pain lasted 5 days. There were a few cases of hematoma (3) and edema (4) as well as of a pulling sensation (3) which were all transient and absent 6 weeks after the treatment. There was one case of partial skin erosion, which was medically treated and was fully solved at 4 weeks post-op. In average patients were estimated their time to full recovery to 3 weeks.

#### IV. DISCUSSION

Subdermal laser treatment of axillary hyperhidrosis is a relatively new technique the development of which was associated with the development of laser lipolysis and laser assisted liposuction. Both methods utilizing the same basic equipment for tumescent delivery, laser irradiation and suction. At the very beginning of the development of this method Klopper, Fisher and Blugerman [1] showed that it could fill the gap between non-surgical methods yielding very modest or temporary results (such as botox) and more aggressive surgical therapies. As the further work of Schavelzon, Blugerman and others demonstrated on large sample of 252 patients [2] this method gives very good long term results with a minimal level of transient side effects.

In our retrospective study we collected and assessed as much data as possible. All of the data was collected in the period between May 2008 and November 2010. When composing this study we faced several challenges. In this period 53 patients had been successfully treated, however not all of their cases had been fully documented with pictures of iodine-starch tests before the treatment, although this test was done on all patients. Also, when interviewing all of the treated patients we were not able to collect answers from all of them, further reducing the patient base for this study. Lastly, we didn't succeed in obtaining follow-up iodine-starch photographs from all of the interviewed patients. However, we believe that the 30 axillas (as shown on Fig. 4) we succeeded in fully studying give a very reliable indication of method efficacy and safety.

This retrospective analysis of 32 cases, based on objective photographic measurements and subjective patients' assessments shows that subdermal 1064 nm Nd:YAG laser therapy is an efficacious and safe method for treatment of axillary hyperhidrosis.

Both efficacy assessments gave very good results; objectively measured results were higher than those subjectively assessed by patients. We believe that the reasons for these differences are based in: a) different accuracy of assessment instruments – quite precise

measurement of the surfaces against relatively rough 4 grade scale with 25% steps and b) a tendency of patients to forget the severity of their hyperhidrosis before the treatment. Two examples shown below on Fig. 9 and Fig. 10 are giving good illustration of differences in sweating reduction assessments.



Fig. 9: Patient No. 14 - iodine-starch test before and two months after the single laser treatment



Fig. 10: Patient No. 31 - iodine-starch test before and three months after the single laser treatment

Both patients from Fig. 9 and Fig. 10 assessed their sweating reductions with grade 2 (51-75%), while measurements of sweat-producing areas gave calculated reductions of 100% on both axillas for patient No. 14 and 84% (right) and 91% (left) for patient No. 31. It is noteworthy that both of these patients gave their assessments more than one year

after the second iodine-starch test was performed as well as that their assessments of sweating reduction at one month post-op and at final state were the same.

Irrespective of assessment differences, both assessment methods resulted in high degree of sweat reduction and proved the efficacy of laser therapy.

One of the goals of our study was also to determine how permanent the sweating reduction is and if there exists some degree of recurrence of sweating. Only five patients (16%) reported some degree of sweating recurrence while a large majority (84%) reported stable sweating reduction over the period of up to 24 months after the treatment. We believe that recurrences could appear in cases where certain number of sweat glands have been damaged by treatment but not destroyed. In their paper Klopper, Fisher and Blugerman [1] reported differences in recurrence when only suction without laser is used in comparison with laser and suction. The major difference which contributes to longevity of results lies in the thermal destruction of sweat glands with laser energy. Therefore it is of vital importance that the laser energy is evenly distributed across the whole sweat-producing area. The examples in Fig. 9 and

Fig. 10 are illustrative of an excellent coverage of the whole sweat-producing area with laser energy (pictures c) and d) on Fig. 9) vs good but not total coverage (pictures c) and d) on Fig. 10).

The effect of laser photo thermal destruction of sweat glands is shown on Fig. 11. After the laser treatment desquamation and rupture of sweat glands at the level of cellular structure is nicely visible (picture b) on Fig. 11).

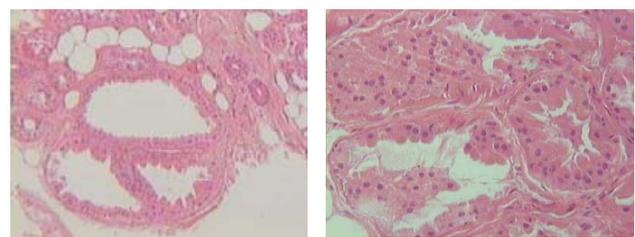


Fig. 11: Histology of tissue specimen taken from right axilla of patient No. 17, before a) and one week post-op b).

Compensatory sweating is the most common side effect of endoscopic thoracic sympathectomy, a surgery to treat severe hyperhidrosis [5]. In our study we tried to determine also if the patients developed compensatory sweating after our treatment.

Although a large majority of patients (81%) did not reported any compensatory sweating after the treatment, there were six patients who reported some

increase in sweating on other body areas after treatment: palms, feet and abdomen. They evaluated these increases to be between 10% and 50%. So far, in other studies which investigated similar treatments of primary hyperhidrosis we have not found any assessment of post-op compensatory sweating to compare our results to. However, although it seems that post-op compensatory sweating is a minor adverse effect of this treatment, it would be interesting to do further, prospective studies using some objective measurements (gravimetry) for better determination and characterization of this phenomena.

Reported adverse effects were few, mild and transient, comparable with adverse effects reported by other authors [1,2,3,4]. We believe that the technique we used (Schavelzon-Blugerman technique of laser assisted reduction of axillary hyperhidrosis with 1064 nm NdYAG laser) is well designed to produce maximal effect and a minimal level of adverse effects, assuming that it is performed by an experienced surgeon and executed in a proper way with adequate laser parameters settings.

Although we used higher quantities of laser energy (200 J/cm<sup>2</sup>) than Klopper, Fisher and Blugerman [1] recommended, we found them to be efficacious and safe when delivered through three-directional non-sequential multiple passes and accompanied with cold air skin cooling.

There were no patients who reported long lasting adverse effects.

## V. CONCLUSIONS

This retrospective study of efficacy and safety of subdermal Nd:YAG laser treatment of axillary hyperhidrosis demonstrated very high efficacy in sweat reduction with minimal side effects. The sweating reductions proved to be stable over a period of up to 24 months after the treatment. Patient satisfaction with the treatment and its outcome, as well as their willingness to recommend this therapy to their relatives and friends, demonstrate the attractiveness of this novel technique for treatment of axillary hyperhidrosis.

Further prospective studies which would include the use of gravimetry and HDSS scale assessments are in preparation. Also additional follow-up of existing patient population at 36 months with repeated iodine-starch test is planned.

## VI. ACKNOWLEDGMENTS

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