

# MISCALIBRATION AND SEVERE COMPLICATIONS AFTER DIODE LASER CYCLOPHOTOCOAGULATION: TWO CASE REPORTS

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## ABSTRACT

Because two similar transscleral cyclophotocoagulation diode lasers with identical power & duration settings induced significantly different postoperative inflammation, we wanted to compare the real output of both lasers.

Using a Power/ Energy Meter (Fieldmaster TM) we compared the output of the two lasers (the Iridis [Quantel Medical] and the Iris Medical [OcuLight SLx]) at different energy levels. At a setting of 600, 1000, 1400, 1700, 2000 and 2500 mW, the measured output for the Iridis and Iris Medical diode laser were respectively 685 and 400 mW, 970 and 650 mW, 1470 and 875 mW, 1700 and 1000 mW, and 1990 compared to 1000 mW.

On the average the output of the Iridis laser was correct and the output of the Iris Medical laser was 40% lower than the setting. Overtreatment and severe complications occurred with the Iridis laser because the manufacturer recommended using wrong power settings based on the Iris Medical laser, which was undercalibrated.

The calibration of cyclophotocoagulation diode lasers should be performed prior to use when changing to a new device and whenever over- or undertreatment is observed.

## RÉSUMÉ

Après l'utilisation d'un nouvel appareil de cyclophotocoagulation au laser à diode, nous avons constaté

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une augmentation significative de l'inflammation postopératoire avec de graves complications, et ce malgré un réglage identique à celui de l'appareil précédemment employé.

Nous avons donc voulu comparer la puissance réelle générée entre les deux lasers. A l'aide d'un appareil de calibration (Fieldmaster TM), nous avons mesuré la puissance générée par les deux lasers à diode (l'Iridis [Quantel Medical] et l'Iris Medical [OcuLight SLx]) et ce à différents niveaux d'énergie.

Aux réglages de 600, 1000, 1400, 1700, 2000, et 2500 mW, nous avons mesuré pour l'Iridis et l'Iris Medical une puissance réelle de respectivement 685 et 400 mW, 970 et 650 mW, 1470 et 875 mW, 1700 et 1000 mW, et de 1990 et 1000 mW.

La puissance générée par l'Iridis était correcte; la puissance générée par l'Iris Medical était en moyenne de 40% inférieure au réglage annoncé. Le surtraitement et les complications sévères qui se sont produites avec l'Iridis étaient dus au fait que le fabricant de cet appareil avait recommandé d'employer le même réglage que celui proposé par Iris Medical, appareil sous-calibré.

Une calibration des lasers à cyclophotocoagulation devrait être effectuée avant l'usage d'un nouvel appareil et lorsqu'un sous- ou surtraitement est observé.

## KEY WORDS

Diode laser cyclophotocoagulation, refractory glaucoma, intraocular pressure, calibration, Iridis, Iris Medical.

## MOTS-CLÉS

Cyclophotocoagulation au laser à diode, glaucome réfractaire, pression intra-oculaire, calibration, Iridis, Iris Medical.

## INTRODUCTION

Cycloablative procedures are often used to treat patients with uncontrolled high intraocular pressures in eyes with refractory glaucoma.

Diode laser cyclophotocoagulation has proven to be a safe and effective procedure compared with cyclocryodestruction. (1,2,9,11) Problems associated with the latter are uveitis, loss of visual acuity, pain and phthisis bulbi. The purpose is to describe two patients who showed signs of overtreatment and severe complications after switching from one diode laser to another.

## PATIENTS AND METHODS

### CASE 1

A 67-year old female with severe diabetic retinopathy, first treated with conventional laser, developed neovascular glaucoma with an intraocular pressure (IOP) of 56 mmHg in the right eye. Diode laser cyclophotocoagulation with the Iris Medical (OcuLight SLx) was performed, followed by two sessions of peripheral cryocoagulation of the retina. Despite this treatment, the intraocular pressure remained high (34 mmHg under maximum therapy) and the eye was painful. She underwent a second diode laser cyclophotocoagulation, this time with a different instrument, the Iridis from Quantel Medical, after which she developed a marked anterior chamber inflammatory reaction, a mature cataract in two days and persisting high intraocular pressures (26 mmHg). This was treated medically, followed by a cataract extraction. For both diode lasers identical power settings were used as described below.

### CASE 2

A 57-year old female with a history of chronic angle-closure glaucoma, who underwent a bilateral trabeculectomy, developed malignant glaucoma after a second trabeculectomy with Mitomycin C in the left eye. For this reason the right eye was treated with diode laser cyclophotocoagulation using the Iridis (Quantel Medical) diode laser. Postoperatively, she developed a malignant glaucoma, rubeosis iridis, a

fibrinous anterior chamber reaction and a white cataract. A vitrectomy combined with lens extraction and endolasercoagulation of the retina was performed. Eventually the IOP normalized with medical treatment and a secondary lens implantation was performed.

Both patients were treated under retrobulbar anaesthesia using the same (recommended) protocol. First the conductivity of the probe was roughly assessed by perforating a hole in blackened printing paper at the following power settings: 1 second and 1000 mW. The probe was then carefully cleaned before the treatment was initiated. Subsequent laser applications were spaced one width of the probe tip. We treated 220° of the inferior circumference of the ciliary body with 17-19 impacts of 2 seconds with gentle indentation. Applications started with a power of 1750 mW. If there was no tissue disruption reaction (a "pop" or "snap" sound from within the eye) during the first 2 applications, the power was increased to 2000 mW. If there was a "pop" or "snap" during more than one subsequent laser application, the power was reduced back to 1750 mW. If a "pop" or "snap" sound occurred at 1750 mW during more than one laser application, the power was reduced to 1500 mW, and treatment completed at this power (5,9). The probes of the two diode lasers were slightly different. The fiber optic diameter of the Iris Medical is 600  $\mu$  with a planar polished end protruding 0.7 mm from a handpiece (G-probe), while the fiber optic diameter of the Iridis, also being 600  $\mu$ , has a bulb tip at the end (7,8). For both treatments with the Iridis laser the power setting never exceeded 1750 mW. Since over-treatment occurred using the Iridis laser with the above mentioned power settings, we decided to compare the output of both lasers at different energy levels (600, 1000, 1400, 1700, 2000, 2500 mW), with the Fieldmaster TM (Coherent). A new probe was used for each laser. The Fieldmaster is a rugged, compact microprocessor driven, power and energy meter with a unique combination of an analog and digital meter for laser tuning, with a precise digital display of power or energy on the LCD backplane. The Fieldmaster can be used with all lasers commonly manufactured today, simply by plugging the appropriate sensor head into the console (4).

Table 1

Setting mW	Output Iridis mW (% compared to the setting)	Output Iris Medical mW (% compared to the setting)
600	685 (+14%)	400 (-33%)
1000	970 (-3%)	650 (-35%)
1400	1470 (+5%)	875 (-37.5%)
1700	1700 (0%)	1000 (-41%)
2000	1990 (-0.5%)	1230 (-38.5%)
2500	2440 (-2.4%)	1300 (-48%)

## RESULTS

Table 1 summarizes the results of the output of both lasers at different settings.

The output of the Iridis laser varied from 14% higher to 3% lower than the setting power. The output of the Iris Medical was lower for all settings, with an average of 38.9% deviation.

## DISCUSSION

Ciliary ablation, first with cryotherapy and later with lasercoagulation has been used to reduce the IOP in patients with refractory glaucoma for many years. Diode laser cyclophotocoagulation is associated with less complications than cryocoagulation (1,2,9,11).

We describe two patients with severe complications following cyclophotocoagulation using the Iridis diode laser. The first patient, treated for neovascular glaucoma, developed a marked inflammatory reaction and a rapid mature cataract. She received two diode laser sessions: the first, unsuccessful, with the Iris Medical laser, and the second with the Iridis laser using identical (recommended) power settings. The second patient, with a history of malignant glaucoma after filtering surgery in the other eye, developed the same complications as the first patient in combination with malignant glaucoma and rubeosis iridis. She only received one diode laser session using the Iridis laser. These findings don't correlate with the outcome of several studies suggesting cyclophotocoagulation to be a safe procedure with minimal inflammatory reaction (2,9,10,13).

Overtreatment and severe complications occurred with the Iridis laser because the manufacturer recommended to use identical power settings as used for the Iris Medical laser, not taking into account that the output of the Iris

Medical laser might have been under-evaluated. The calibration of the two diode lasers with the Fieldmaster confirmed the under-evaluation of the output of the Iris Medical laser with an average of 40% and a correct output of the Iridis laser. Hence overtreatment with the Iridis laser at identical power settings. We should have been aware of possible over-treatment since a "pop" was almost always heard at power settings between 1500 and 1750 mW with the latter instrument! The "pop" or "snap" is an audible "alarm" signal that warns for possible over-treatment. Often it is accompanied by excessive pigment dispersion. We don't think however that diode laser cyclophotocoagulation can be performed solely on the base of a "pop" or "snap" technique. Since the above mentioned complications we decreased the recommended power settings of the Iridis laser with 40% and obtained a good IOP lowering effect without complications. We suggest using the following power settings with the Iridis diode laser: starting the applications at 1000 mW and 2 seconds; if no "pop" or "snap" is heard during the first two applications, the power is increased with increments of 100 mW up to a maximum of 1600 mW; if there is a "pop" or "snap" during more than one subsequent laser application, the power is reduced back with increments of 100 mW down to a minimum of 1000 mW. The above mentioned complications, the calibration problem, and the suggested new settings were communicated to both manufacturers.

One might argue that the calibration with the Fieldmaster could have been influenced by the different shapes of the two probes. Indeed the fiber optic diameter of the Iris Medical is 600  $\mu$  with a planar polished end protruding 0.7 mm from a handpiece (G-probe), while the fiber optic diameter of the Iridis, also being 600  $\mu$ , has a bulb tip at the end (7,8). Yet calibration with the Fieldmaster was probably not influenced by the two different shapes of the probe since laser energy is delivered as a coherent beam. Another point of concern in the calibration is the repeated use of probes. A study of Tham et al resulted in an average decrease of 3% in laser energy delivered after repeated use of the G-probe with ethylene oxide sterilization in between (12). Conversely, Buys et al found a slight increase of energy transmission after repeated

use and sterilization (3). As the influence of repeated use on the energy transmission of the probe remains unclear and many clinicians reuse probes, it is important to find a method which assesses the output of the G-probe before use. Hossain et al found the assessment of the cyclodiode G-probe using a grey scale test to be a simple, quick and highly reproducible method (6). They also recommended not reusing the probes more than 7 times.

## CONCLUSION

Calibration of diode lasers is necessary when changing from one device to another, in between repeated use, and whenever signs of over- or under-treatment are observed.

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