Factors affecting the required power in Nd: YAG laser Posterior capsulotomy after cataract surgery

Furkaan Majied Hamied*, F.I.B.M, Opth, I.C.O.; Khalid Ibrahim Riah** , Ph.D;
Amal Abdul allah Sakban** ,M.Sc
*Dept. of Surgery, College of Medicine, University of Al- Qadisiya
**Dept. of Physiology, College of Medicine/ University of Al-Qadisiya

Abstract

Background: thinking of posterior capsule after cataract surgery is a common problem affecting vision, Nd:YAG poster capslotomy is the main treatment.
Objectives: to determent the factors affecting the required power of Nd: YAG capsulotomy to open the opacified of posterior capsule.
Methods: In this study 67 patients were exposure of Nd:YAG laser from (Nidek yc 1600 model) laser device, which start with power of 1mj. The duration of this study last for 10 months.
Results: The results showed inverse proportion between the power used and the age of the patients, this results were similar in patients with hypertension and diabetes mellitus. The dose of Nd:YAG laser has a wide variety relative to the duration after cataract surgery.
Conclusions: the most effective factor in the power of Nd:YAG capsulotomy is the age increase relasionship.
Keywords: Nd:YAG laser, thick posterior, and posterior capsulotomy.

الخلاصة

أكثر المضاعفات شيوعا بعد جراحة ساد العين هي عتمة محفظة ا لعدسة والتي تؤثر على الرؤية ، وان ال Nd:YAG ليزر هو العلاج الرئيسي.
الهدف:هدفت هذه الدراسة الى معرفة العوامل التي توءثر على مقدار الطاقه اللازمه من ال Nd:YAG ليزرلفتح المحفظه المعتمه.
طريقة العمل: في هذه الدراسة 67 مريض تعرضوا الى طاقة Nd:YAG ليزر (بواسطة جهاز الليزر نوع Nideck yc موديل 1600) والتي تبداء بمقدار 1mj، وقد استمرت هذه الدراسة لمدة 10 أشهر.
الاستنتاجات: يعتبر زيادة العمر العامل الاكثر شيوعا في تأثير طاقة ال Nd:YAG ليزر، بحيث كانت العلاقة عكسيا.

Introduction

Nd:YAG (neodymium-doped yttrium aluminium garnet; $Nd:Y_3Al_5O_{12}$) is a crystal that is used as a lasing medium for solid-state lasers. The dopant, triply ionized neodymium, typically replaces yttrium in the crystal structure of the yttrium aluminium garnet (YAG), since they are of similar size. Generally the crystalline host is doped with around 1% neodymium by atomic percent.[1]

Nd:YAG lasers are used in ophthalmology to correct posterior capsular opacification, a complication of cataract surgery, and for peripheral iridotomy in patients with acute angle-closure glaucoma, where it has superseded surgical iridectomy. Frequency-doubled Nd:YAG lasers (wavelength 532 nm) are used for pan-retinal photocoagulation in patients with diabetic retinopathy[2]. The Nd:YAG, which can be used to power a quartz-laser scalpel, is particularly useful because of its high penetration

of optical tissue and its haemostatic properties. [3]

Thick or opacified posterior capsule is a part from reducing visual acuity, it may impair contrast sensitivity, glare, or monocular diplopic [4]. The incident of PCO is reported to be 20.7% at 2 years and 28.4% 5 years after cataract surgery.[5]

Pathologically posterior capsular opacification occur either by elsching pearsl (bladder cells, wedl cells), occur by proliferation and migration of theresidual equatorial epithelial cells along the posterior capsule, this type mostly occur in children. Or it may be formed by capsular fibrosis, due to fibrous metaplasia of epithelial [6]. Peripheral fundal visualization with scleral indentation capsular [7].

The opacified posterior capsule should be opened by laser (laser is a collimated, coherent and monochromatic light rays) [8].

Type of laser is Nd. YAG laser which work by photodistruption; temperature of treated localized microscopic area of tissue is increased from 37 Cº to 15000 Cº. on optical breakdown at the desired site, electrons are striped from the atoms of target tissue resulting in development of plasma field and bubble. This leads to hydrodynamic and acoustic shock wave, which mechanically tears the tissue microscopically [9].

Patients requiring posterior capsulotomies were treated with power ranges from 0.4 mJ to 3.1 mJ, with the majority of eyes receiving 40 applications at 1.4 mJ. Vitreous strands were cut with an average of 60 applications at a power setting of 2.1 mJ. Dense cyclitic membranes required a power setting of 4.1 mJ and needed 100-150 applications [10].

Patient's and Methods

Our study started from January of 2009 to October of 2009, conducted on 67 eyes, of different sexes, age ranged from 4 to 90 old of them exposed by (Nidek yc 1600 model) laser device to extra capsular cataract extraction and posterior chamber intraocular lens implantation by the same surgeon in Al – Diwaniyah teaching hospital, polymethy methacrylate (PMM) was the material of implanted lenses.

Significant thickening of posterior capsule was managed by YAG laser capsulomy at least six months post operatively in adult and earlier in children to prevent amblyopia, laser power started with 1mj then increase accordingly and if high power required then 2 session was needed to prevent complications of aggressive laser, until 3.5 to 4 mm diameter of the opening is completed. The application of laser done according to Hersh method, by starting with 1mj, and increasing the power until start puncturing of the posterior capsule [11].

Statistical analysis

Analysis of data was carried out using the available software computer statistical package of SPSS- 10.0.

Data were presented in simple measures of frequency, and mean. The significant of different means (data from different power, different age, different number of spots, and duration). Statistical significance was considered whenever the P value was equal and less than 0.05.

Results

The range in the patients (with significant post operative thickening of posterior capsule) age groups included in this study were shown in table (1.1).

Figure 3 and 4 showed the results of power at different values versus age (years) at both below and above 40 years. The power was decreased, this occur at each increased of age. Even in hypertensive and in diabetic patients; higher age groups require less power to form an Nd YAG posterior capsulotomy (Fig.5) and (Fig.6) in a sequence.

Table (1.1): Frequency distribution of patients age groups.

Age in year	No. of patient
< 10	4
10- 20	5
20- 30	3
30- 40	3
40- 50	4
50- 60	8
60- 70	23
70- 80	13
80- 90	4
Total	67

High age sum require less number of spots, as seen in (Fig.1), and less maximum required power (Fig.2).

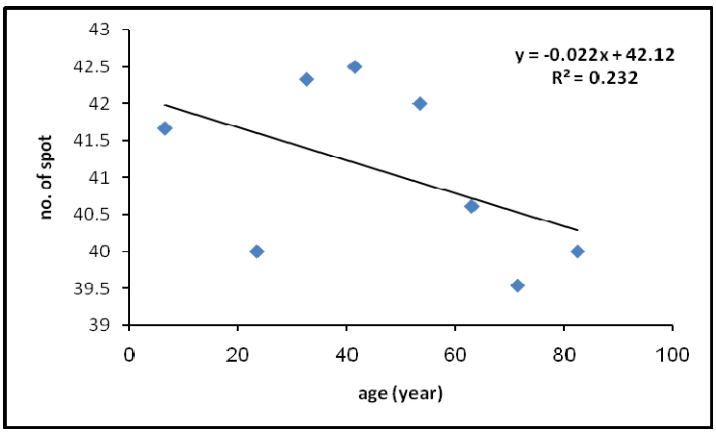

Figure. Represent the relation between the No. of spot relative to the age (years).

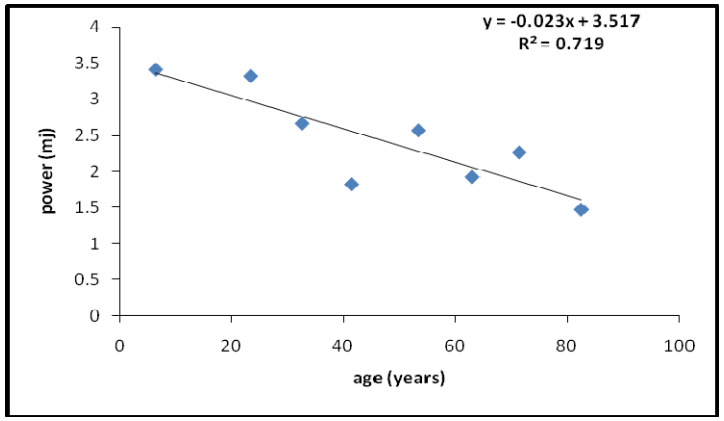

Figure 2. Show the relation between power (mj) and the age of the patients (years).

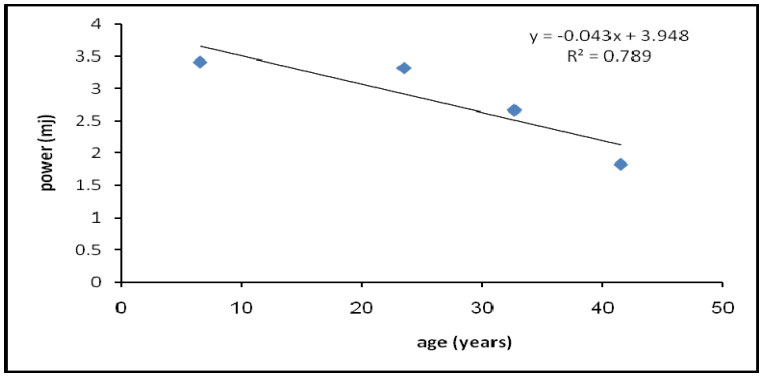

Figure 3. Represent the relation between the power in (mj) used relative to the age (years) of patients below 40 years.

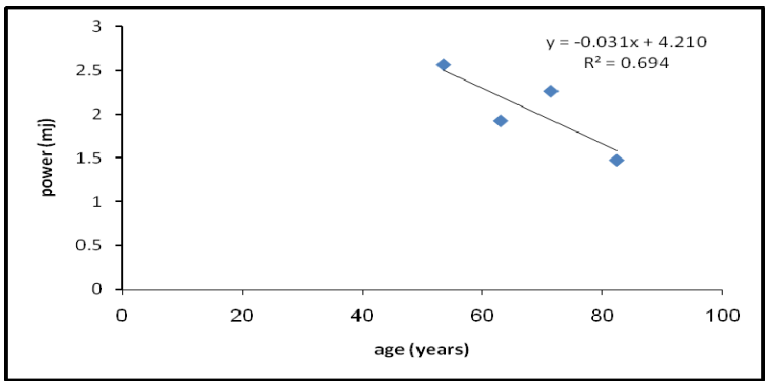

Figure 4. Represent the relation between the power in (mj) used relative to the age (years) of patients above 40 years.

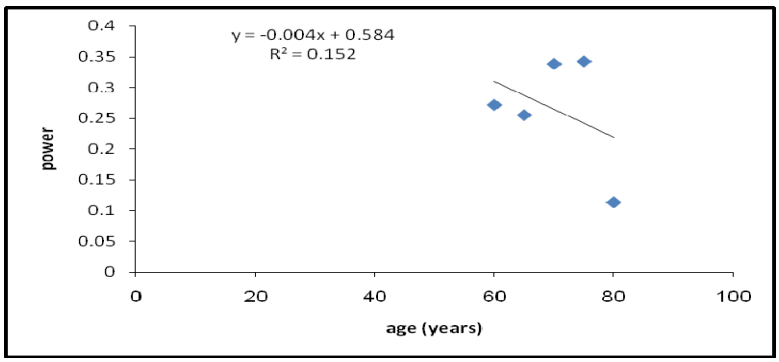

Figure 5. Show the relation between the power (mj) used relative to the age (years) of patients with hypertion (H.T).

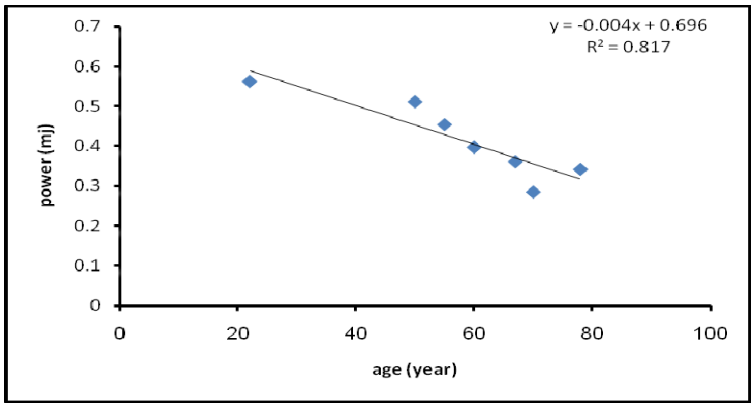

Figure 6. Represent the relation between the power in (mj) used relative to the age (years) of patients with diabetes (D).

In surprising findings, we found the duration between the operation and doing laser procedure for the patients has a little effect in the required power (Fig.7).

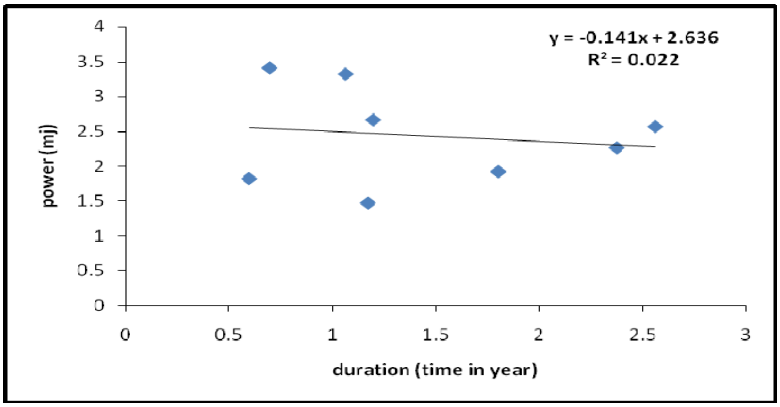

Figure 5. Represent the relation between the power in (mj) used relative to the duration of oprative time (years).

Discussion and Conclusions

Our study aimed to assess the required power to open the opacified posterior capsule in patients with cataract surgery and posterior chamber intraocular lens.
Younger age groups usually have a thicker opacified posterior capsule after cataract surgery so they need higher power [6]. That can be seen clearly in our results.
High power has a higher risk of complications such as retinal detachment and cystoids macular oedema so we started with 1mj power and increasing it until 4 mj so the eye may need more than one session to avoid complications. This is in agreement with Patton N. et. al, 2004 [6].
In comparison to Zaidi & Askari; the mean energy used for the laser capsulotomy was 28.73 mj, the average number of shots required for the capsulotomy was 14.1 [12].
No studies to date have done to assess the factors affecting the required power for Nd: YAG capsulotomies.
The fine focus with reduced power setting mean that the amount of energy passing into the posterior chamber is minimized [13].

Conclusions

The most effective factor in the power of Nd:YAG capsulotomy is the age increase relasionship.

Recommendations

Our study ensured that the most effective factor in the power of Nd:YAG laser in posterior capsulotomy is the age (inverse relationship), so we should put in our mind that the procedure can be divided into two or even three sessions in younger age groups to prevent the complications of increasing power (macular edema and retinal detachment).

References

1- Koechner, walter. Solid- state laser: Engineering (2rd ed), Springer- verlag. ISBN 3- 540- 18747- 2, 203, pp 48- 53.
2- Moskalik K, Kozlov A, Demin E, and Bioko E. The efficacy of facial skin cancer treatment with high- energy pulsed neodymium and Nd: YAG lasers: photomedical laser surgery, 27 (2):345-349. Doi:10. 1089/ Pho. 2327, 2008.

3- Innovative medical group, Microlight laser. History of low level laser therapy: 2004.
4- Jack J. Kaniski. Clinincal ophthalmology: 6th ed, Butter worth Heinemann, 2008, 358-359.
5- Schaumberg DA. Dana MR. Christen WG. A systematic overview 0f the incidence of posterior capsule opacification: ophthalmology, 1998; 105: 1213- 1221.
6- American Academy of ophthalmology. Basic and clinical science course: ophthalmic pathology and intraocular tumors, section 4, 2002- 2003; pag, 96.
7- Patton N, Aslam TM, Bennett HG and Dhillon B. Does a small central Nd: YAG posterior capsulotomy improve peripheral fundal visualization for vitreoretinal surgeon: Department of ophthalmology, Edinburgh, 2004.
8- American Academy of ophthalmology. Basic and clinical science course: opthics, Refraction, and contact lenses, section 3, 2002-2003, page; 36.
9- Bhattacharyya. Step by step laser in ophthalmology: Jaypee Brothers Medical Publishers, 1st , 2009, pag; 14.
10- Indian Journal of ophthalmology. Clinical study of the neodymium: yttrium aluminum- garnet (ND:YAG) laser: 2005-2010.
11- Hursh P. ophthalmic surgical procedures: little Brown & company, Printed in the United States of America, 1st, 1988, pag; 380.
12- Zaidi M. Askari S. effect of Nd:YAG laser posterior capsulotomy on anterior chamber depth: Intraocular pressure, and refractive status, Aligarh muslim University, volume 5, 2004.
13- Mainster MA. Sliney DH. Belcher CD 3rd and Buzney SM. Laser photodisruptors: Damage mechanism, instrument design and safety. Ophthalmology, 1983;90(8): 973-91.