CYSTOID MACULAR OEDEMA FOLLOWING NEODYMIUM: YAG LASER CAPSULOTOMY A PROSPECTIVE STUDY

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SUMMARY

Neodymium:YAG laser capsulotomy was performed in 65 eyes of 65 patients because of vision loss due to posterior capsular opacification or wrinkling following uneventful extracapsular cataract extraction with intraocular lens implantation. Eyes with pre-existing macular pathology were excluded from this study. In all of the eyes the posterior capsule was successfully opened. None developed clinical or angiographic cystoid macular oedema. One eye developed retinal detachment nine months after capsulotomy.

Extracapsular cataract extraction is currently the most widely used technique for removal of senile cataract. Since the posterior capsule is left intact the anatomical relations of the posterior segment remain undisturbed thereby reducing the rate of potential postoperative vitreoretinal complications including cystoid macular oedema (CMO).[1,2,3] This operation is however often associated with opacification of the posterior capsule, which occurs at a rate of 25% to 50%.[4,5,6,7] The resulting deterioration in visual acuity necessitates posterior capsulotomy, which is currently performed using the Neodymium:YAG (Nd:YAG) laser. Although safer and less invasive than surgical discission this procedure is nevertheless thought to be associated with numerous complications, such as increased intraocular pressure,[8,9,10,11,12] corneal endothelium damage,[8,9] pitting of the intraocular lens,[10,11] retinal tears and detachment,[8,9,12,13,14,15,16,17,18,19] uveitis[12,20] and CMO.[8,9,12,13,17,18,19,21]

The object of this prospective study was to investigate the occurrence of CMO following Nd:YAG laser capsulotomy in eyes free of pre-existing macular pathology that might preclude accurate evaluation of the appearance and/or progression of CMO. All 65 eyes included in this series had undergone uneventful extracapsular cataract extraction with intraocular lens implantation and in 53 of them fluorescein angiography was performed before Nd:YAG capsulotomy. Particular attention was paid to possible risk factors that might predispose the lasered eyes to the development of CMO, such as the level and total amount of energy used, the time period between cataract surgery and laser capsulotomy, the size of the opening made in the posterior capsule, and the post-capsulotomy elevation of intraocular pressure.

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PATIENTS AND METHODS

Patients

Neodymium:YAG laser posterior capsulotomy was performed in 85 consecutive eyes of 84 patients who had undergone uneventful extracapsular cataract extraction and subsequently experienced deterioration in visual acuity as a result of opacification or wrinkling of the posterior capsule. Of these eyes, 19 (18 patients) were excluded from this study because of pre-existing macular pathology such as age-related macular degeneration, preretinal fibrosis, myopic macular changes, background diabetic retinopathy and CMO. One eye was excluded because an intraocular lens had not been implanted. The study population therefore consisted of 65 eyes of 65 patients, 42 women and 23 men. The mean age at treatment was 72.2 years (range, 50 to 88 years). One of the 65 eyes underwent a combined surgical procedure that included trabeculectomy and cataract extraction with posterior chamber lens implantation.

Surgical procedure

Extracapsular cataract extraction was performed by manual expression of the lens nucleus and aspiration of the cortex with a McIntyre cannula. Intraocular lenses were of the modified J-loop type with a 10-degree anterior angulation. The lens was inserted into the posterior chamber with the use of sodium hyaluronate, which was removed on completion of the procedure.

Capsulotomy

Neodymium:YAG laser capsulotomy was performed not

Table I. Time period between cataract extraction and Neodymium:YAG capsulotomy

Months	No. of eyes	(%)
2	1	(1.5)
3	2	(3.1)
4	1	(1.5)
5	4	(6.2)
>6	57	(87.7)
	Total 65	(100)

less than two months after cataract surgery. Following determination of the size of the pupil and the position of its centre, drops of tropicamide 1% were instilled to dilate the pupil. Capsulotomy was performed with the Q-switched Nd:YAG laser without a burst mode. A contact lens was used in all cases. Perforation of the posterior capsule was attempted at energy levels of 1.3 to 1.6 mJ; if necessary, this was increased in 1 mJ steps until an opening was achieved. Following the capsulotomy, eye drops of 0.1% dexamethasone sodium phosphate with 0.5% neomycin were instilled three to four times daily for one week. Hypotensive therapy was applied when needed.

Follow-up

Comprehensive ophthalmic evaluation before and after capsulotomy included best corrected visual acuity, applanation tonometry, biomicroscopy, and fundal examination by indirect ophthalmoscope and Goldman contact lens. In 53 of the 65 eyes fluorescein angiography was scheduled one week before and eight to ten weeks after capsulotomy; however, in those cases where capsular opacification precluded adequate visualization of the posterior pole fluorescein angiography was performed, on the same day as, or the day after, capsulotomy (instead of one week before lasering). In the remaining 12 eyes fluorescein angiography was performed only eight to ten weeks after the capsulotomy. Angiographs were taken up to 30 mins after intravenous injection of 5 ml of 10% sodium fluorescein. Each angiogram was interpreted by a retinal specialist who was given no other information about the patient's macular status. Cystoid macular oedema was diagnosed when fluorescein angiography revealed perifoveal dye leakage compatible with CMO as described by Gass and Norton.[22]

After capsulotomy, patients were instructed to present themselves for eye examinations at 24 hours, one week, one month, two months, four months, and six months.

RESULTS

No clinical or angiographic evidence of CMO was found in any of the 65 eyes following Nd:YAG laser capsulotomy.

Table II. Energy levels used for capsulotomies

Engery level (mJ)	No. of eyes	(%)
1.3–2	16	(24.6)
2.1–3.2	45	(69.2)
3.3–5	4	(6.2)
	Total 65	(100)

The average time interval between cataract extraction and capsulotomy was 20.1 months (range, two to 54 months). In 61 eyes (93.9%), the interval was five months or more (Table I).

The mean follow-up period after capsulotomy was 8.3 months (range, two to 16 months). In 58 eyes follow-up was conducted for at least five months and in 50 for at least six months. In all but one eye capsulotomy was successfully performed in a single treatment session. The energy levels required for adequate capsulotomy ranged from 1.3 to 5 mJ (see Table II). The total energy delivered (i.e., the energy level multiplied by the total number of pulses at that power setting) is recorded in Table III. The mean total energy level required in order to achieve a satisfactory capsulotomy was 56.9 mJ (range, 7.5 to 234 mJ).

The posterior capsule was successfully opened in all eyes. The opening sizes are recorded in Table IV. The mean diameter of the capsular opening was 2.7 mm (range, 1.4 to 4.2 mm).

Within one hour after capsulotomy, elevation of the intraocular pressure (IOP) above the pre-lasering baseline level was noted in 44 eyes (68%). The mean evaluation in IOP was 4 mm Hg (range, one to 28 mm Hg); in 22 eyes (33.8%) the IOP was 5 mm Hg or more above the baseline and in nine (13.8%) the elevation was 10 mm Hg or more. An increase in IOP to an absolute pressure higher than 22 mm Hg within an hour of the treatment was noted in 12 eyes (18.5%), of which three (4.6%) exhibited an IOP higher than 30 mm Hg. Hypotensive treatment was prescribed for all 12 of these eyes; 24 hours later, none of them had IOP higher than 21 mm Hg.

Initial and final visual acuity results are presented in the Figure. All but one eye showed an improvement in vision (98.5%). Improvement was equivalent to at least three lines on the Snellen chart in 51 eyes (78.5%) and between one and two lines in 13 (20%). In the one eye with visual deterioration (1.5%), this was equivalent to one line. One (1.2%) eye developed retinal detachment nine months after capsulotomy. This was an emmetrophic eye that had undergone extracapsular cataract extraction with posterior lens implantation, in which the total energy used for the capsulotomy was 60.2 mJ, and the opening size was 4 mm.

DISCUSSION

The incidence of CMO after Nd:YAG capsulotomy reportedly varies between 0 and 2.3%.[9,12,13,17,18,19,20,21] However, most of the studies related to this complication are retrospective and therefore do not exclude the possi-

Table III. Total energy* used for capsulotomies

Energy level (mJ)	No. of eyes	(%)
7.5–50	26	(40.0)
51–100	34	(52.3)
101–150	3	(4.6)
>151	2	(3.1)
	Total 65	(100)

*The energy level multiplied by the total number of pulses at that power setting.

Table IV. Opening sizes for capsulotomy

Diameter of opening (mm)	No. of eyes	(%)
1.4–2	22	(33.8)
2.1–3	30	(46.2)
3.1–4.2	13	(20)
	Total 65	(100)

bility of pre-existing pseudophakic CMO. Lewis *et al.*[20] carried out a prospective study of 136 patients, none of whom developed CMO during their follow-up after the Nd:YAG capsulotomy. In that study fluorescein angiography was performed prior to capsulotomy in order to exclude the possible pre-existence of CMO that might have been related to previous cataract surgery. Similarly, in our prospective study, fluorescein angiography performed prior to capsulotomy in 53 patients disclosed no evidence of CMO. Moreover, no clinical or angiographic signs of CMO were detectable in any of our patients eight to ten weeks after undergoing Nd:YAG laser capsulotomy. Although our patients were clinically examined three times during the first month after the capsulotomy, we cannot exclude the possibility that during the time between capsulotomy and fluorescein angiography some of our patients may have developed angiographic CMO which resolved before the angiographic examination was performed. Even assuming this to be the case, however, clinical experience has shown that angiographic CMO alone has no deleterious effect on visual acuity and tends to disappear after four weeks.[23,24] It should be remembered that in 12 of our patients fluorescein angiography was not performed prior to capsulotomy, and we therefore cannot rule out the possible existence of CMO in some of them at the time of the procedure. It seems likely, however, that the capsulotomy had no deleterious effect in these patients, since none of them showed any evidence of CMO by the time angiography was performed, i.e., eight to ten weeks after the capsulotomy. Winslow and Taylor found an average interval of eight weeks between Nd:YAG capsulotomy and the diagnosis of clinical CMO.[13] In our study, post-capsulotomy follow-up over a six month period showed that CMO did not develop subsequent to angiography in any of our patients. We believe that eyes with pre-existing macular pathology may be difficult to distinguish from eyes that develop CMO after capsulotomy, and should not therefore be included in an analysis of final results.

Accordingly, we excluded 19 of the original series of 85 consecutive cases. Another eye was excluded because it did not receive an intraocular lens, and was therefore presumably at greater risk, relative to pseudophakic eyes, of developing CMO because of a change in the anatomical relationship between the anterior and posterior segments resulting from bulging and rupture of the vitreous face. Rupture of the vitreous face would allow hyaluronic acid to diffuse out of the vitreous, leading to vitreous liquefaction with subsequent development of CMO.[25] We believe that the presence of an intraocular lens can at least partially compensate for the torn posterior capsule.

It has been suggested that the longer the interval between cataract surgery and capsulotomy the smaller the risk of CMO development,[20] and that the incidence of retinal complications can also be reduced by delaying of the secondary discission.[26] We accordingly performed capsulotomy at least five months after cataract extraction in most cases. However, even among those eyes where capsulotomy was performed four months or less after cataract surgery (four eyes (6.1%), none developed CMO (Table I).

Although the relationship between the size and total energy used for capsulotomy and the subsequent development of CMO is not yet clearly understood, it seems that a smaller opening may better retain the barrier effect and that the use of lower energy levels may reduce the risk of CMO development after the capsulotomy. We therefore aimed to achieve a small but effective opening in the posterior capsule while keeping the initial energy setting and the amount of total energy used as low as possible. As shown in Tables II and III, the energy setting was no higher than 5 mJ and the total amount of energy used for capsulotomy did not exceed 151 mJ. It is possible that higher energy levels may induce CMO; our experience has shown, however, that it is unnecessary to use higher energy levels than those used in this series in order to achieve satisfactory opening of the posterior capsule in most cases.

One eye (1.2%) developed retinal detachment nine months after capsulotomy. Previously reported rates for this complication range from 0.08% to 4.1%.[12,13,14,15,16,17,18,19] The eye in our series was emmetropic, and since as much as nine months had elapsed between capsulotomy and the appearance of retinal detachment we consider it doubtful that the detachment was related to the capsulotomy.

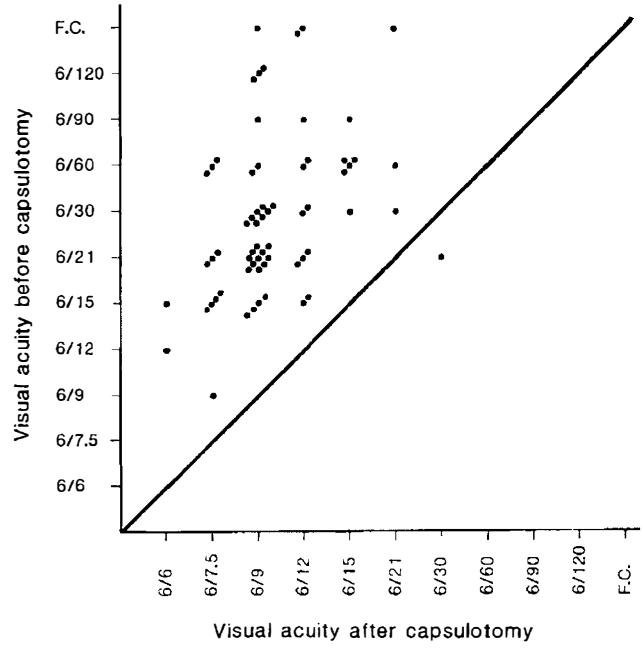

Figure. *Visual acuity results after Nd:YAG laster posterior capsulotomy.*

No correlations were found in this study between the appearance of CMO and the amount of energy used, the opening size, the time period between cataract surgery and capsulotomy, or post-capsulotomy elevation of IOP. It should however be pointed out that our series comprised a selected group of patients, all of them pseudophakic and without any pre-existing macular pathology. The effect of Nd:YAG capsulotomy in patients with pre-existing macular pathology should be studied separately, since this is a procedure performed in the age group of patients among whom macular pathology of different aetiologies is very common. The results of our study show that in eyes with normal fundoscopic findings, Nd:YAG capsulotomy is a safe and reliable procedure, and yields satisfactory improvement of vision.

Key words: Capsulotomy, cystoid macular oedema; Nd:YAG capsulotomy.

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