Nd-YAG Laser Therapy for the Anterior Segment of the Eye

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Abstract. Since the introduction of microsurgery by the neodymium-doped yttrium aluminium garnet (Nd-YAG) laser many conventional surgical procedures for the anterior segment of the eye have been superseded. We discuss the current indications, contraindications, techniques and complications encountered in pulsed Nd-YAG laser surgery of the anterior segment.

INTRODUCTION

Posterior capsulotomy and peripheral iridotomy are now the commonest anterior segment procedures to be attempted by Nd-YAG laser in most general ophthalmic centres. Since first reported by Fankhauser et al (1) and Aron-Rosa et al (2), Nd-YAG laser surgery has expanded, with a consequent decline in open surgical procedures. The advantages of the laser technique are that it provides a quick, closed procedure without the risks of surgical entry into the eye or of associated complications such as infection. It is accepted better by patients, may be done for both inpatients and outpatients under topical anaesthesia, and is cost-effective in that expensive hospitalization and associated expenses are minimized.

Photodisruption is, however, incompletely understood. It is known that during optical breakdown, ionization of target tissue occurs, with formation of superoxides and metabolically active free radicals; during plasma formation, further absorption of laser energy gives rise to intense local heating and to the generation of mechanical and acoustic shock waves. There have been an increasing number of published reports of corneal endothelial damage (3), iritis, secondary intraocular pressure rise (4), adjacent damage to the crystalline lens or pseudophakos, vitreous liquification (5), cystoid macular oedema and retinal detachment (6). It is with these thoughts in mind that we discuss the indications, contraindications and techniques of anterior segment therapy, with an emphasis on minimizing the complications. In this latter respect it is most important to use extreme accuracy, with the minimum power and the minimum number of shots to achieve the desired effect. An appropriate contact lens should always be used as it forms part of the optical focusing system of the laser, thus improving accuracy, allowing a higher power density with less total energy and with less adjacent damage. It has the advantage of reducing ocular mobility and obviating blinking.

INDICATIONS

Capsulotomy

Anterior capsulotomy, as publicized by Aron-Rosa (2) using the Nd-YAG laser, has not found wide acceptance in the UK. This is because surgical capsulotomy at the time of extracapsular cataract extraction is usually extremely quick, precise, and unproblematic. By avoiding the use of the Nd-YAG laser for anterior capsulotomy, one can also avoid all the concurrent risks, such as endothelial damage, iritis, laser-induced meiosis and secondary pressure rise. The laser technique may, however, have a place in treating patients with subluxated lenses or lenses with weak zonules and phakodonesis.

Posterior capsulotomy is now the commonest indication for Nd-YAG laser surgery, either with or without pseudophakia. This is, of course, due to the current popularity of extracapsular cataract extraction. The posterior capsule may become wrinkled, giving rise to photopsia and glare, or it may become thickened, either diffusely or by a covering of Elschnig’s pearls which reduce visual acuity. Before
capsulotomy by Nd-YAG laser it is important to assess accurately the visual axis, the ambient pupil size, the thickness of the capsule in various areas, the lines of stress and tension, the intraocular pressure and the state of the peripheral retina, where possible. For thin capsules we use several single-pulse low-energy laser pulses, either in a linear manner across lines of stress which then progressively pull apart, or we do a cruciate capsulotomy which, over the ensuing weeks, will progressively open up under tension. Vitreous herniation is more likely to be avoided with a small capsulotomy than with a large one. This is important if drainage surgery has been done or is imminent. The use of increased laser shots and increased energy produces a greater likelihood of endothelial damage (3), secondary pressure rise (4) and iritis (5), and so we see all patients 2–3 hours after laser surgery for assessment of uveitis and increased intraocular pressure. These complications should be treated appropriately or even prophylactically if complications are anticipated. We arrange a follow-up appointment within the next few weeks or sooner to check the effect and the intraocular pressure and to examine the retinal periphery for breaks.

Intraocular lenses pose somewhat different problems; glass intraocular lenses have been reported to shatter within the eye and thus should be avoided. Patients who have intraocular lenses with dished concave posterior surfaces or with laser ridges are easier candidates for posterior capsulotomy without any ensuing lens marking or pitting. Intraocular lenses with convex posterior surfaces in close apposition to the capsule are more difficult to treat. Retrofocusing is one technique that may be used to avoid lens pitting. However, in our experience, pitting of these lenses is not uncommon, although as long as it is only slight, it appears to give rise to no clinical complications. Pitting should be avoided as monomers or toxins may be released that are deleterious to ocular tissue. The presence of an intraocular lens seems to have some protective effect on the corneal endothelial damage that can result from capsulotomy by Nd-YAG laser (3).

**Secondary cataract or thick capsule**

Patients with thick capsules or secondary cataracts need to be carefully assessed for capsular thickness and areas of stress. It is often safest to treat these patients in multiple sessions and by using low power. Some capsules may be so thick that they require complete photodisruption as they may not spring apart. Usually, however, an adequate gap may be achieved to improve retinal visualization, if not pupillary clearance.

**Soft lens matter**

Soft lens matter trapped between a posterior chamber lens and capsule may pose a problem as it may continue to impair visual acuity for many months. This may be treated by re-operation and by aspiration. We have also found that by photodisrupting the soft lens matter, by using burst mode and low energies, we can turn the lens fibres to a milky fluid which is more rapidly absorbed. These patients are better treated at multiple sessions, with careful monitoring of the corneal endothelium and the intraocular pressure and for any development of uveitis. In some patients, the posterior capsule has been disrupted with a much faster improvement in vision; however, this has led to an admixture of soft lens matter with vitreous which is probably deleterious. In the few patients we have treated with capsule rupture no untoward complication has been detectable clinically.

**Pseudophakic subluxation**

We have treated a number of patients who have lens subluxation due to one loop of a Sinsky-style lens being within the bag, or due to one being out of the bag or due to zonular rupture. It has been possible in a number of patients to divide across the capsule and thus to relieve the tension on the loop within the bag, with some restoration of the centrality of the lens.

**Loops and sutures**

There have been reports that laser energy can be used to divide intraocular lens loops. We feel that this is highly dangerous because the amount of energy required to cut the loop before lens removal is excessive and the complications are too great. It is a relatively simple matter to cut the haptic surgically at the time of removal with less damage. Fine sutures either holding an intraocular lens in position or joining a previous iridectomy may be more safely divided.