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Nd: YAG Laser Posterior Capsulotomy Rates in Myopic Eyes after Implantation of Capsular Tension Ring

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Background: The aim f this study was to evaluate the effect of capsular tension ring implantation during cataract surgery on the incidence of neodymium: YAG (Nd: YAG) laser posterior capsulotomy in myopic (axial length [AL] ≥25.00 mm) eyes.

Material/Methods: In this retrospective study, the records of the cases of 117 myopic patients who underwent cataract surgery between January 2004 and January 2011 were reviewed. A total of 153 eyes with an axial length of 25 mm or higher were included in the study with consideration of exclusion criteria mentioned below. Eyes were grouped by presence or lack of capsular tension ring (CTR+ and CTR–, respectively).

Results: The study included 153 eyes from 107 myopic patients. Hydrophilic acrylic IOL and capsular tension ring (CTR) were implanted in 78 eyes (CTR+ group), and 75 eyes received only the hydrophilic acrylic IOL (CTR– group). Six eyes (7.6%) in CTR+ and 16 eyes (21.3%) in CTR– required Nd: YAG laser capsulotomy within 7 years. The difference between the 2 groups was statistically significant (p=0.021).

Conclusions: Because CTRs significantly decrease subsequent need for Nd: YAG laser posterior capsulotomy in myopic patients, are very inexpensive, and provide other benefits, our data suggest that the use of CTRs in myopic eyes undergoing cataract surgery with an hydrophilic acrylic IOL implantation is advantageous and should be standard practice.

MeSH Keywords: Cataract Extraction • Myopia • Posterior Capsulotomy

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Background

High myopia has been shown to be a risk factor for cataract development [1,2]. Cataract surgery in highly myopic patients poses certain challenges, and is also prone to postoperative complications such as posterior capsule wrinkling, posterior capsule opacification (PCO), and retinal detachment, all of which require special techniques and solutions to minimize their frequency.

There have been many reports of highly myopic patients developing PCO after cataract surgery and requiring Nd: YAG laser surgery [3–5]. The reported incidence of PCO in pseudophakic myopic eyes varies from 25% to 61% [3,5–8]. However, most of the data about PCO in myopic eyes in the literature are from patients with PMMA IOLs [3–5]. With hydrophobic acrylic IOL implantation, it has been shown that high myopia and long axial length did not correlate with the extent of PCO [9], and Nd: YAG laser posterior capsulotomy was reported at rates of 2–3.5% [9,10]. It is especially important that PCO and laser capsulotomy rates should be minimized in cases of high myopia, because Nd: YAG laser capsulotomy is reported to increase the risk of retinal detachment 3.9-fold in myopic eyes [11].

Implantation of a CTR in the capsular bag to stabilize the zonular apparatus was first reported by Hara et al. in 1991 [12]. In myopic eyes, CTRs provide intraoperative stabilization of the lens capsule diaphragm during irrigation/aspiration and in the long-term stabilize the position of the IOL and possibly reduce secondary fibrosis [13]. Nishi et al. reported that in patients who received CTR with square (truncated) edges, CTRs significantly reduced PCO, as well as anterior capsule fibrosis and shrinkage. They concluded that CTRs may be useful in certain patient populations: those at high risk of developing eye complications from capsule opacification requiring Nd: YAG laser capsulotomy, patients who are likely to undergo vitreoretinal surgery and photocoagulation, and pediatric cataract patients [14].

In this study we aimed to evaluate whether CTR implantation in adjunct to hydrophilic acrylic IOL prevents PCO in myopic cataracts.

Material and Methods

Data from 167 eyes from 117 myopic patients that underwent cataract surgery between January 2004 and January 2011 were analyzed retrospectively according to patient records. Eyes with an axial length (AL) exceeding 25 mm were included in the study regardless of accompanying ocular pathology such as posterior staphyloma, chorioretinal atrophy, macular pathology, or peripheral retinal degeneration. Patients who did not return for follow-up examinations, patients with a history of ocular surgery, and patients with glaucoma, uveitis, or complicated cataract were excluded from the study. Patients younger than 50 years old and patients with diabetes mellitus were also excluded. Furthermore, eyes with intraoperative complications such as posterior capsule tear or iris trauma were excluded.

All the patients were informed preoperatively about the cataract surgery and the presumptive benefits of CTRs according to the literature. Informed consent for the cataract surgery was obtained from all patients. CTR implantation was only performed when informed consent was available for CTR implantation. In this retrospective study, the CTR+ group includes the patients who consented to the implantation of CTR. Since 2004, CTR implantation has been a standard procedure of our clinic in myopic eyes with an axial length of 25 mm or higher when informed consent is available. All of the CTR+ procedures were performed by the same surgeon, whereas CTR– procedures were performed by different surgeons with equal experience.

Patients were divided into 2 groups: In the CTR+ group, in-the-bag IOL implantation with CTR was performed; in the CTR- group, only in-the-bag IOL implantation was performed after cataract removal.

The study was approved by the ethics committee of the Medical Faculty of Ataturk University. The research followed the tenets of the Declaration of Helsinki.

The AL was measured by immersion A-scan ultrasonography by the same technician. IOL power was calculated using the SRK/T formula.

The preoperative and postoperative patient examination included assessment of visual acuity, intraocular pressure measurement, and fundus examination. Patients with 0.7 (LogMAR) or lower best corrected visual acuity were operated on.

A single piece, biconvex, hydrophilic acrylic IOL (6.0-mm optic, 12.5-mm haptic diameter) with square edges was implanted in both groups. In cases requiring a negative power IOL, patients were implanted with a zero power IOL after a fully informed consent for a targeted myopic error. Eyes in the CTR+ group also received a round-edged open poly (methyl methacrylate) CTR with 13 mm diameter. All the patients were implanted with the same type IOL. In addition, the CTR+ group was implanted with the same type of CTR.

The surgical stages were: 3.0-mm limbal incision (superior temporal for right eyes, superior nasal for left eyes); approximately 5.5-mm diameter continuous curvilinear capsulorrhexis using capsulorrhexis forceps; hydrodissection and phacoemulsification, followed by removal of visible cortex by bimanual irrigation/

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Table 1. Patients demographics.

	CTR+	CTR–	*P* value
Number of eyes for analysis	78	75	–
Age (y)			
Mean ±SD	65±9	68±10	.91
Range	50–85	50–89	
Sex (M/F)	43/12	36/16	.38
Right/left eye	43/35	35/40	.34
Axial length (mm)			
Mean ±SD	28.90±2.19	28.1±2.84	.051
Range	25.16–32.5	25.1–34.81	
Duration of follow-up (mo)			
Mean ±SD	40.76±23.66	42.79±18.76	.56
Range	5–96	5–86	

CTR+ eyes with capsular tension ring and IOL; CTR– eyes with IOL without capsular tension ring; SD – standard deviation.

Table 2. Nd: YAG laser posterior capsulotomy rates.

	CTR+ (n=78)	CTR– (n=75)	*P* Value
Nd: YAG capsulotomy	6 (%7.6)	16 (%21.3)	.021

CTR+ eyes with capsular tension ring and IOL, CTR– eyes with IOL without capsular tension ring.

aspiration; CTR and hydrophilic acrylic IOL implantation or just IOL implantation; and removal of viscoelastic by aspiration.

Postoperatively, all patients used topical steroid and antibiotic eye drops 5 times daily; the regimen was tapered every week thereafter. Patients were asked to return for postoperative follow-up visits at 15 days, 1 month, 6 months, 1 year, and once annually thereafter.

The decision to perform Nd: YAG laser posterior capsulotomy was based on biomicroscopy with patient complaints of blurred vision coupled with losing 2 or more decimal lines of visual acuity.

The results in CTR+ and CTR– were compared, and the differences between groups were calculated after patients with missing data were removed from the analysis. The chi-square test was used to compare sex and Nd: YAG laser capsulotomy rates. Student's t-test was used for the other statistical analyses.

Results

We excluded 3 patients under 50 years old, 5 patients who did not return for follow-up appointments, 1 diabetic patient, and 1 patient with complicated cataract.

A total of 107 patients were included in the study. The mean age of the patients was 66.3±9.3 (SD) years (range 50–89 years); there were 28 (26.1%) men and 79 (73.8%) women. Cataract surgery was performed in both eyes of 46 patients and in 1 eye in 61 patients. The study included 78 eyes in the CTR+ group and 75 eyes in the CTR– group, for a total of 153 myopic eyes. The mean follow-up time for the CTR+ group was 40.7±23.6 months and 42.7 months ±18.7 for the CTR– group ($p>0.05$). Patient characteristics are shown in Table 1. No statistically significant differences were found between the 2 groups in sex, age, laterality, or mean axial length.

All patients had uneventful single-piece hydrophilic acrylic IOL implantation. All patients were implanted +13 D or lower power IOL. Zero power IOL was implanted in 20 CTR+ patients and 17 CTR– patients. Among patients who received zero power IOL, there were 6 in the CTR+ group and 4 in the CTR- group who needed a negative-power IOL.

Nd: YAG capsulotomy was required within 7 years in 6 eyes (7.6%) in the CTR+ group and in 16 eyes (21.3%) in the CTR- group, and the difference between the 2 groups was statistically significant ($p=0.021$) (Table 2). The mean time between cataract surgery and Nd: YAG laser posterior capsulotomy was 25.8±1.9 months for CTR+ patients and 22.6±1.6 months for CTR- patients ($p=0.001$).

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In the CTR– group, 2 patients (2.6%) had retinal detachment at 15 and 19 months after cataract surgery. For both patients, Nd: YAG laser capsulotomy was not necessary before or after retinal detachment surgery.

Discussion

In the present study, capsulotomy rates were found to be lower with CTR implantation, and there was a significant difference in Nd: YAG laser posterior capsulotomy rates between myopic eyes that did and did not receive CTRs. Some studies defined myopia based on refraction [9]; however, we defined myopia based on AL because in refractive myopia, the overall refractive power of the eye depends on the cornea and lens as well as AL [10]. It is well documented that nuclear cataract causes myopic shift.

It has been reported that in myopic eyes, implantation of low-power or zero-power IOL decreases the rate of PCO compared to patients who did not receive an IOL [15].

In the literature, Nd: YAG laser posterior capsulotomy incidence was higher in myopic eyes after phacoemulsification with PMMA IOL implantation [3–5]. Pucci et al. reported that in high myopia patients (mean age 41.6±7.2 SD) who underwent clear lens aspiration and PMMA IOL implantation, 5 (20%) later required Nd: YAG laser capsulotomy [16]. In a study by Güell et al., 30 myopic patients (mean age 42.8, range 30–49) underwent cataract surgery primarily for refractive purposes and 25 eyes (56.8%) developed PCO that resulted in the need for Nd: YAG laser capsulotomy [5]. These results may be attributable to PMMA IOLs, or may be related to the younger patient population, because phacoemulsification was performed for refractive correction in these groups. In a study by Neuhann et al., cataract surgery with phacoemulsification was performed on a group of highly myopic patients with an average age of 64.83±12.47 SD and 73.2% of the patients received a PMMA IOL. Among these patients, 43.2% eyes required laser capsulotomy [17].

Abhay et al. reported that in patients that received a single-piece acrylic IOL following cataract surgery, the incidence of central PCO in the myopic group was greater compared to the control group, although the density of PCO was not significantly different between the groups. In the myopic group, 1 patient (2%) required Nd: YAG laser capsulotomy [10]. Hayashi et al. implanted sharp-edged hydrophobic acrylic lenses and reported that the rate of Nd: YAG laser capsulotomy was 3.5% in the high myopia group; they also stated that the lenses used had been effective in decreasing the rate of PCO in highly myopic eyes [9]. In both studies, hydrophobic acrylic IOLs were used and the incidence of PCO was significantly lower compared to patients who received PMMA IOLs.

The CTR was designed to stabilize the capsule in eyes with zonular weakness or dehiscence [18,19]. In highly myopic eyes without an IOL, CTR helps to maintain the circular contour of the capsular bag and the shape of the capsulorrhexis [19]. The capsular bending ring (CBR) is an open, band-shaped device with sharp edges, which may be advantageous in some situations. Nishi et al. found that CBRs significantly reduced PCO and anterior capsule fibrosis and shrinkage [20]. It has been suggested that CBR implantation may be beneficial in certain patient populations, including those at high risk of developing ocular complications from capsular opacification requiring Nd: YAG laser capsulotomy, patients who are likely to undergo vitreoretinal surgery, those who require good fundus visualization for photocoagulation, and pediatric cataract patients [14,20]. Menapace et al. concluded that CBRs with a rectangular cross-section and sharp edges have the potential to prevent PCO and anterior capsule fibrosis [21]. A recent study concluded that implantation of capsular tension ring with acrylic IOL significantly reduces PCO and Nd: YAG laser capsulotomy incidence in myopic eyes [22].

Despite using round-edged CTRs in our patients, the rate of Nd: YAG laser capsulotomy and the mean time between cataract surgery and Nd: YAG laser capsulotomy in the CTR+ group was significantly lower. Using sharp-edged CTRs could decrease the rate even further.

In an experimental study, Lee et al. reported that although the capsular bag diameter was larger in porcine eyes, after implantation of 13.5-mm IOLs, only eyes that received CTRs maintained the capsular opening and shape. They also stated that IOL stabilization was better in rabbit eyes that received CTRs [23]. However, further research is required to evaluate the effect of CTRs on IOL stabilization in human eyes. Vass et al. concluded that the capsular bag diameter (CBDm) correlated negatively with corneal power (P) and positively with AL *in vivo*. The regression formula developed may be useful for preoperative identification of eyes with a very large or very small CBDm [24]. Based on these data, it can be predicted that capsular bag diameter may be larger in highly myopic eyes and CTRs may be beneficial in preventing capsular wrinkling, capsular phimosis, and providing IOL stabilization in these eyes.

Conclusions

Because CTRs significantly reduce the incidence of Nd: YAG laser capsulotomy in myopic eyes and provide other benefits to patients, we conclude that the implantation of CTRs with hydrophilic acrylic IOLs during cataract surgery in highly myopic patients is advantageous.

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Statement

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The authors declare that they have no conflict of interest to the publication of this article.

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