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Posterior chamber lens implantation techniques in posterior capsular rupture

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PURPOSE. *To evaluate posterior chamber lens implantation techniques and their results in patients in whom posterior capsular rupture and zonular dialysis arose during cataract operation.*

METHODS. *Forty-three cataractous eyes of 43 consecutive patients with complicated cataract operations such as posterior capsular rupture or zonular dialysis were accepted into this prospective study between November 1999 and January 2001. Intraocular lens implantation to ciliary sulcus was achieved without sutures in 19 cases (Group 1), with one suture from 12 o'clock quadrant in 14 cases (Group 2), and with two sutures from 3 to 9 o'clock quadrants in 10 cases (Group 3). Patients were followed up for 3 months after operation and evaluated for best-corrected visual acuity, refractive astigmatism, corneal edema, anterior chamber depth and inflammation, synechia at angle, intraocular pressure, lens tilt and decentration, intraocular hemorrhage, cystoid macular edema, and retinal detachment.*

RESULTS. *There was no difference among groups in best-corrected visual acuity, refractive astigmatism, corneal edema, anterior chamber depth and inflammation, intraocular pressure, lens tilt and decentration, cystoid macular edema, or retinal detachment. Anterior chamber and vitreous hemorrhage and peripheral anterior synechia were significantly higher in Group 3 when compared with Group 1 (p=0.009, p=0.009, and p=0.004).*

CONCLUSIONS. *In all cases with posterior capsular rupture and zonular dialysis, different posterior chamber lens implantation techniques could be performed, beginning with the least invasive procedure suitable for the conditions with the least complications. (Eur J Ophthalmol 2004; 14: 7-13)*

KEY WORDS. *Ciliary sulcus intraocular lens implantation, Posterior capsular rupture, Scleral fixated lenses, Zonular dialysis*

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INTRODUCTION

As the older population increases, cataracts, or opacities of the lens, are more frequently encountered. Cataracts, is the most common cause of treatable blindness comprising 41.8% of the blind population (1).

From the time of Jacques Daviel, who made the first cataract extraction through an inferior corneal incision in 1745 (2), cataract surgery has evolved and changed considerably. Today, small and self-healing incisions, phacoemulsification technique, and foldable intraocular lens (IOL) implantation under topical anesthesia form the basis of cataract surgery.

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IOL implantation is the mainstay of modern cataract surgery (2, 3). As the natural place for the crystalline lens is the capsular bag in the posterior chamber, it is preferable to implant the IOL there to achieve the best visual outcomes with the least complications. However, posterior capsular rupture and zonular dialysis have been the most common and serious intraoperative complications of cataract surgery, and vitreous loss may also occur, so it may be difficult to implant the IOL in this place properly every time. In such cases, implantation of the IOL to ciliary sulcus, scleral sutured posterior chamber IOL implantation, or anterior chamber lens implantation may be necessary.

In this study, the posterior chamber lens implantation techniques and their results were evaluated for patients in whom posterior capsular rupture and zonular dialysis occurred during cataract operation.

METHODS

Forty-three cataractous eyes of 43 consecutive patients whose cataract operations were complicated by posterior capsular rupture or zonular dialysis were accepted into this prospective study. Patients admitted to the study presented at the İzmir Atatürk Training and Research Hospital Eye Clinic between November 1999 and January 2001. IOL were implanted in the posterior chamber in all cases. Optic and overall diameters of each IOL (foldable acrylic or silicone lenses and polymethylmethacrylate [PMMA] lenses) were 6.00 mm and 13.00 mm, respectively, except for scleral fixated PMMA IOL, whose optic and overall diameters were 6.50 mm and 13.50 mm, respectively.

There were 23 men (53.5%) and 20 women (46.5%). Their ages ranged from 46 to 86 years (mean ± standard deviation 69.7±8.50 years). Twenty right eyes (46.5%) and 23 left eyes (53.5%) were included.

Patients were divided into three groups. Group 1 included 19 patients (44.2%) whose IOL were implanted to the ciliary sulcus in front of the anterior capsule without any sutures. Group 2 included 14 patients (32.6%) whose IOL were implanted to ciliary sulcus in front of the lens capsule and fixated to the sclera by one suture of one haptic from the 12 o'clock quadrant. Group 3 included 10 patients (23.3%) in whom the capsular support was insufficient in whom IOL were implanted to the ciliary sulcus and fixated to sclera by two sutures of two haptics from 3 and 9 o'clock quadrants.

Phacoemulsification was done in 15 cases (34.9%), and extracapsular cataract extraction (ECCE) in 28 cases (65.1%). In all cases, operations were done under retrobulbar anesthesia.

For patients in whom phacoemulsification was planned, clear corneal tunnel incisions were performed from the 11 o'clock quadrant and, after continuous curvilinear capsulorrhexis (CCC), chip and flip or divide and conquer techniques were used. Whenever posterior capsule was ruptured as a complication of the operation, vitreous body was suppressed by the use of viscoelastic substances. There was no vitreous loss in the cases in whom hyaloidea was intact (eight cases); in the others (seven cases), vitreous loss was so little that anterior vitrectomy was not necessary. CCC borders were checked and found healthy in all cases. Cortical remnants were removed manually by using simcoe cannulas. Then, foldable acrylic or silicone posterior chamber lenses were implanted to the ciliary sulcus anterior to the capsule without any sutures. At the end of the operation, the wound was controlled by sponges to check the presence of vitreous. No vitreous was found at the incision site. None of the cases were converted to ECCE.

In patients in whom ECCE was planned, a fornix based conjunctival dissection was made; after cauterization, midlimbal incisions were performed from 10 to 2 o'clock quadrants. An envelope capsulotomy or CCC technique was used for anterior capsulotomy. Whenever the posterior capsule ruptured or zonular dialysis developed as a complication of the operation, vitreous body was suppressed by the use of viscoelastic substances and capsulotomy borders were checked. If necessary, anterior vitrectomy was performed by sponges mechanically. Cortical remnants were removed manually by using simcoe cannulas. Whenever capsular support was sufficient, sulcus implantation of PMMA IOL without sutures was performed. If not, PMMA IOL was placed in front of the residual capsule behind the iris to ciliary sulcus and the upper haptic of the PMMA IOL was sutured to the sclera, 1.5 to 2 mm posteriorly to limbus, passing through ciliary sulcus at the 12 o'clock quadrant, with 10/0 polypropylene sutures. Next, the needle was passed through the scleral side of the incision and the free end of the polypropylene suture was bound within the midlimbal incisional openings. If capsular support was insufficient for conventional and one haptic sutured IOL implantation techniques, scleral flaps were prepared from 3 and 9 o'clock quadrants. A scleral fixation PMMA lens was fixated to the ciliary sulcus by 10/0 polypropylene sutures passing through the holes of its haptics from 3 and 9 o'clock quadrants. Scleral flaps were closed with 10/0 nylon sutures. Corneascleral wound was closed with 10/0 nylon sutures and conjunctiva was closed with 8/0 vicryl sutures.

Subconjunctival gentamycin+dexamethasone was injected in all cases postoperatively.

On the first postoperative day, corneal edema, anterior chamber hemorrhage and inflammation, and vitreous hemorrhage were noted.

Patients were followed for 3 months. At the end of the third month, best-corrected visual acuity (BCVA), refractive astigmatism, corneal edema, intraocular pressure, and anterior chamber depth were evaluated, as well as the condition of the anterior chamber angle where the sutures were passed, tilts and decentrations of lens, presence of vitreous bands at the wound, and occurrence of cystoid macular edema (CME) and retinal detachment.

SPSS version 7.5 and Epi info version 6.0 were used for the evaluation of results. For statistical significance, p was assumed to be significant at <0.05. Pearson chi-square, Fischer chi-square, and Yates chi-square tests were used to compare results in each group. The Kruskal-Wallis test was used in the comparison of the groups.

RESULTS

In 12 patients (27.9%), the posterior capsular opening was less than 30% of the whole perimeter, and in 31 patients (72.1%), the posterior capsular opening ratio was more than 30%. If CCC or capsulotomy borders were stable, IOL were implanted to the ciliary sulcus in front of the anterior capsule without any sutures, even though the posterior capsular opening ratio was greater than 30%.

In 35 patients (81.4%), hyaloidea did not remain intact and there was vitreous loss due to posterior capsular rupture in the operation. There was no statistically significant difference among groups when they were compared on the occurrence of vitreous loss. Mild corneal edema seen on the first postoperative day was not different among groups (p=0.28) (Tab. I), and regressed by the end of the third month in all cases.

Anterior chamber inflammation seen on the first postoperative day was not statistically significant among groups (p=0.40) (Tab. I) and diminished with treatment using topical antibiotics and steroids. Resistant inflammation did not occur.

As shown in Table I, anterior chamber and vitreous hemorrhage were not significantly different between Groups 1 and 2 (p=0.42, p=0.42) or 2 and 3 (p=0.07, p=0.07). However, in Group 3, it was statistically higher than in Group 1 (p=0.009, p=0.009).

Table I shows that at the end of the third postoperative month, BCVA (p=0.30), astigmatism (p=0.83), anterior chamber depth (p=0.39), average intraocular pressure (p=0.65), IOL decentration (p=0.98), and tilted lens (p=0.21) were not significantly different among groups. Retinal detachment was seen in two cases in Group 1, in one case in Group 2, and in two cases in Group 3. In one case in Group 1, IOL was luxated into the vitreous in the first postoperative week and vitreoretinal surgery was performed.

At the end of the third postoperative month, irregularities at the pupillary border, iris surface, and peripheral anterior synechia (PAS) at the angle were significantly higher in Groups 2 (p=0.03 and p=0.03) and 3 (p=0.002 and p=0.004) when they were compared with Group 1, although there was no statistically significant difference between Groups 2 and 3 (p=0.36, p=0.61, respectively) (Tab. I).

BCVA improved in all cases (two to eight lines on the Snellen chart). Incarceration of vitreous strands in the wounds was not observed. Postoperative or secondary glaucoma did not develop in any case.

DISCUSSION

Although surgical techniques, instruments, and technology used in cataract surgery have greatly improved, posterior capsular rupture and accompanying vitreous loss are still the most common complications of cataract surgery. IOL implantation is routinely performed except in special cases (4). In the presence of a posterior capsular rupture, we have some alternatives to lens implantation techniques—conventional IOL, iris fixated or angle supported anterior chamber

TABLE I - EVALUATION OF GROUPS ACCORDING TO ANTERIOR AND POSTERIOR SEGMENT SIGNS POST OPERATIVELY

Signs	Group 1 (n=19)	Group 2 (n=14)	Group 3 (n=10)	Total (n=43)
Corneal edema (%)	36.9	28.6	60.0	39.5
AC inflammation (%)	26.3	28.6	50.0	32.6
AC hemorrhage (%)	0	7.1	40.0	11.6
Vitreous hemorrhage (%)	0	7.1	40.0	11.6
BCVA (Snellen lines) (mean ± SD)	5.0±3.1	6.0±3.3	6.0±2.5	6.0±2.9
Astigmatism (Diopters) (mean ± SD)	2.65±1.43	2.57±1.54	2.45±1.57	2.56±1.43
AC depth (mm) (mean ± SD)	3.80±0.36	3.76±0.47	3.66±0.27	3.74±0.37
PAS (%)	10.5	64.3	70.0	46.2
IOP (mm Hg) (Mean ± SD)	12.94±2.52	13.21±0.97	13.6±0.69	13.28±1.39
Pupil irregularity (%)	21.1	64.3	80.0	48.8
IOL tilt (%)	13.3	35.7	10.0	20.5
IOL decentration (%)	21.0	28.6	30.0	28.2
CME (%)	10.5	14.3	10.0	11.6
Retinal detachment (n)	2	1	2	5

AC = Anterior chamber; BCVA = Best-corrected visual acuity; PAS = Peripheral anterior synechia; IOP = Intraocular pressure; IOL = Intraocular lens; CME = Cystoid macular edema

lenses, and iris or scleral fixated posterior chamber lenses—based on the amount of posterior capsular support.

Although it is easier to implant anterior chamber lenses, because of serious complications such as corneal decompensation, uveitis, glaucoma, and macular edema associated with them (5), these lenses are not preferable when posterior capsular rupture takes place.

As the natural place for crystalline lens is the capsular bag in the posterior chamber, implantation of IOL in the posterior chamber is found to be more advantageous than in the anterior chamber when cataract surgery is complicated by posterior capsular rupture. However, when scleral sutures are necessary, there are some problems related to scleral fixation lenses, such as suture erosions, hyphema, peripheral anterior synechia, glaucoma, tilted and decentrated lens, vitreous, choroidal, and suprachoroidal hemorrhage, suture-related endophthalmitis, and retinal detachment (4-6). Also, pigment dispersion, uveal irritation, ciliary body erosion, and recurrent microhyphemas may accompany ciliary sulcus implantations with or without sutures. Besides these complications, in patients with glaucoma, diabetes, cornea guttata, low endothelial count, PAS, CME, and long life expectancy, capsular supported or sutured posterior chamber lenses are more suitable than anterior chamber lenses.

In a similar study, at the end of the third month, Gunenc (7) found BCVA to be 20/25 in his series of 17 eyes in which monohaptic transscleral lens fixations were performed. Uthoff and Teichmann (8) reported that visual acuities increased or did not change in 92% of 624 patients with implantations of transscleral fixated lenses; in the rest of them visual acuities decreased one to two lines. In this study, BCVA improved in all patients. Using a Snellen chart, BCVA were 5.0±3.1 lines in Group 1, 6.0±3.3 lines in Group 2, and 6.0±2.5 lines in Group 3 with no significant difference among groups. Normally BCVA are expected to be higher after the operation in our series, especially in the first group as it is prone to have less trauma and complications. However, in Group 1 there was a high incidence of posterior segment complications, such as CME and retinal detachment, rather than anterior segment complications. These factors are considered to play a role in causing lower BCVA. Also, complications such as anterior chamber hemorrhage, pupillary irregularities, vitreous hemorrhage, CME, and retinal detachment were higher in this series. This results in BCVA being lower than other studies.

Although astigmatism is not comparable among phacoemulsification and ECCE patients, in this study, average refractive astigmatism was 2.65±1.43 D in Group 1, 2.57±1.54 D in Group 2, and 2.45±1.57 D in Group 3, with no difference among them. This finding is comparable to other studies. Although mostly phacoemulsification cases formed the first group, there were still ECCE patients with large incisions in this group. Also, there was no difference in IOL tilt and decentration between groups. These factors influence the degree of astigmatism. Gunenc (7) found refractive astigmatism to be -2.19 D (0.50 to 4.50) in his series. Trimarchi and Stringa (9) reported similar diopters of refractive astigmatism in a similar study. In this study, in addition to midlimbal incisions, the anterior dislocation, decentration, and tilt of the IOL implanted at sulcus may cause such refractive errors.

In this study, no difference among groups was found in the occurrence of mild corneal edema. Because the transscleral fixated lens implantation technique is more complex, traumatic, and time intensive than conventional and capsule-supported sulcus lens implantation techniques, more corneal endothelial injury may be expected in these groups. However, in a study conducted by Lee (10), the transscleral fixated lens implantation technique was not shown to cause corneal endothelial injury more than the conventional posterior chamber lens implantation technique. Gunenc (7) and Uthoff and Teichmann (8) found no corneal edema in their studies. Although these results show that the transscleral fixated lens implantation technique has no additive injury on corneal endothelium, it is known that endothelial cell loss continues in the late postoperative period. So, when possible, the technique without sutures is preferred. Long-term follow-up is needed for cases in this series to determine the exact amount of endothelial injury.

The relatively high vascularity of ciliary sulcus, including the major arterial circle of the iris, entails a high risk of vitreous hemorrhage (11) in sulcus IOL implantations, especially with sutures. In this study, hemorrhage in the anterior chamber and vitreous was significantly higher in Group 3 when compared with Group 1, with no cases having such problems. There was also one case with this problem in Group 2. Gunenc (7) observed anterior chamber hemorrhage in 11.7% of 17 patients on the first postoperative day when he performed transscleral fixated lens implantation technique by one haptic. The hemorrhage was resolved conservatively. Uthoff and Teichmann (8) found in the early postoperative period that vitreous hemorrhage was resolved without further complications in 1.8% of 624 scleral fixated lens implanted patients. When sulcus implantation of IOL without sutures is not possible, fixation of lenses with sutures is thought to be a safe method of surgery in the long period. However, vitreous hemorrhage in the early period may turn into vitreous condensation later and cause vision loss, as in the eight cases who lost one to two lines of BCVA in their series. The place where the suture is passed becomes important in the occurrence of anterior chamber and vitreous hemorrhage. As precise localization of the ciliary sulcus is difficult, and requires the use of endomirrors or endoscopes which are not yet generally available (12, 13), success is mostly dependent on the experience of the surgeon.

Hayashi et al (14) evaluated mean anterior chamber depth in three groups of patients: Group 1 with transscleral posterior chamber IOL suture fixation in 52 eyes, Group 2 with secondary out of the bag IOL implantation after previous ECCE in 51 eyes, and Group 3 with in the bag IOL implantation during phacoemulsification surgery in 50 eyes. This study found the depths shallower in the sutured and out of the bag fixated IOL than in the in the bag fixated IOL, related to anterior localization of lenses in these groups. In the current study, no difference was found among groups in measures of anterior chamber depth. This result is not surprising because the lenses were localized to ciliary sulcus in all groups.

Gunenc (7) found synechia in the angle around the localization of the sutures by gonioscopy in 88% of 17 patients with monohaptic transscleral fixated lens implantation. This was present in 10.5, 64.3, and 70.0% in our study in Groups 1, 2, and 3, respectively. To determine if synechia increases in time or causes glaucoma requires a long period of follow-up. It must be noted that synechia in the angle is mostly seen in fixations with sutures, not in implantations in the sulcus without sutures. So, if possible, the latter method is preferred. Postoperative intraocular pressure change was not observed in any group, as in the Uthoff and Teichmann study (8), even in the eyes with PAS, because synechiae were limited to suture localizations so aqueous outflow was not affected.

In the current study, pupillary irregularities were found in 48.8% of the patients with higher ratios in Groups 2 and 3 than in Group 1. Similarly, Gunenc (7) observed 41.1% pupillary irregularities in his study in which he implanted one haptic sutured transscleral fixated IOL. As there was less vitreous prolapse and manipulations in our Group 1 patients, this may explain the occurrence of fewer pupillary irregularities. Also, a better vitrectomy with automated vitrectors might lower the pupillary irregularities.

Hayashi et al (14) used a Scheimpflug videophotography system to measure lens tilt angle and decentration length. They found that IOL tilt and decentration of the scleral suture fixation were both significantly greater than those after either out of the bag or in the bag fixation. This may be explained by the fact that in most patients who were implanted with transscleral suture fixated lenses, most haptics are not localized in the sulcus. By using four point fixation techniques, the extent of tilt and decentration may be decreased (15). Uthoff (8) found less than 2% significant IOL decentration and no clinically relevant tilt in his series of 624 transscleral fixated lens implantations. In the current study, the amount of lens tilt and decentration was determined biomicroscopically. Although there was found to be 20.5% tilt and 28.2% decentration of lenses, irrespective of groups, these numbers might change when more objective measures are used. There was no difference among groups although we expected to see less tilt and decentration in Group 1. This may be due to insufficient vitrectomies. Decentrations were not severe enough to require recentration. Better vitrectomy and symmetric suture positioning would lower the number and degree of lens tilt and decentration in experienced hands.

In the current study, CME was found in 5 patients (11.6%) clinically at the end of the third postoperative month, with no difference among groups, although CME would be much more expected in Groups 3 and 2 than in Group 1. Irrespective of the IOL implantation technique, posterior capsular opening may be responsible for this result. This ratio ranges between 4.8 and 38.4% angiographically in the literature (8, 16). It is possible to find higher ratios in our series if CME is examined by angiography. Especially in cases with low BCVA that cannot be explained by other means, CME should be suspected and researched.

Retinal detachment was observed in 5 patients (11.6%) in this study in the early postoperative period. This ratio ranges between 0 and 12.1% in the literature (8, 16). These variations between ratios may be related to amount and type of anterior vitrectomies. With automated anterior vitrectors, less traction and more clearance of vitreous is achieved. Mechanical clearance of vitreous by sponges such as done in this study may cause high ratios. The presence of vitreous bands bound to posterior vitreous trigger retinal detachment occurring in the early postoperative period; therefore, performing Nd:YAG-laser vitreolysis, especially in cases with minimal vitreous fibril incarceration, earlier may prevent this complication. Besides this, it must be noted that these retinal detachment cases are seen in the group of complicated cataract surgeries, so high ratios should not be misleading.

In conclusion, there was no difference among groups in which posterior chamber lenses were implanted by different techniques in BCVA, corneal edema, postoperative inflammation, mean anterior chamber depth, IOP, lens tilt and decentration, CME, or retinal detachment ratios. Anterior chamber and vitreous hemorrhages, PAS, and pupillary irregularities were proportional with the number of scleral fixation sutures. In cataract operations with or without complications, posterior chamber lens implantation can be performed using different techniques. Using less invasive techniques where possible to obtain the least complications is recommended.

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