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Comparison of sulcus implantation of single-piece hydrophilic foldable acrylic and polymethylmethacrylate intraocular lenses in eyes with posterior capsule tear during phacoemulsification surgery

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PURPOSE. *To compare the results of sulcus implantation of acrylic and poly(methylmethacrylate) (PMMA) intraocular lens (IOL) in eyes with posterior capsule tear during phacoemulsification surgery.*
METHODS. *In all eyes a posterior capsule tear developed during phacoemulsification surgery and an IOL to the ciliary sulcus was implanted primarily. A total of 89 eyes of 88 patients received hydrophilic foldable acrylic IOL (acrylic group). A total of 72 eyes of 72 patients received PMMA IOL (PMMA group). The mean age was 67.1 years and 68.1 years and postoperative follow-up period was 19.2 months and 17.9 months in acrylic and PMMA groups, respectively.*
RESULTS. *Temporary corneal edema appeared in 33 eyes and 26 eyes, elevation of intraocular pressure in 17 eyes and 12 eyes, anterior chamber inflammatory reaction in 5 eyes and 5 eyes, clinical cystoid macular edema in 7 eyes and 12 eyes, and decentered IOL in 4 eyes and 3 eyes in acrylic and PMMA groups, respectively. Late postoperative endophthalmitis developed in two eyes of the PMMA group. Rhegmatogenous retinal detachment developed in one eye in each group. Final best-corrected visual acuities were 5/10 and above in 73 eyes (82.02%) in the acrylic group and 5/10 and above in 42 eyes (58.33%) in the PMMA group. Postoperative final induced astigmatism was 0.5±0.5 D (SD) in the acrylic group and 1.11±0.65 D (SD) in the PMMA group (p=0.0001) (independent samples t-test).*
CONCLUSIONS. *Increased astigmatism is more frequently seen in the PMMA group. The implantation of foldable acrylic IOL in the sulcus after posterior capsule tear maintains the advantages of small incision surgery. (Eur J Ophthalmol 2007; 17: 595-600)*

KEY WORDS. *Posterior capsule tear, Sulcus implantation, Phacoemulsification*

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INTRODUCTION

Posterior capsule tear is an undesirable, widespread intraoperative complication of phacoemulsification surgery and one that can arise at any stage of surgery. Despite advanced equipment and technology, it is sometimes difficult to prevent. During phacoemulsification procedure in which posterior capsule tear develops it is important to preserve the advantages of small incision regarding low astigmatism, the provision of a closed system, rapid wound healing, and early visual rehabilitation (1, 2).

Depending on several factors, such as the size of the posterior capsule tear, the visibility of the capsular

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margins, the status of the capsular support, and the experience of the surgeon, the intraocular lens (IOL) may be implanted in the bag, ciliary sulcus, or anterior chamber (3). When wide posterior capsule tear has developed most surgeons implant a 6.0 or 7.0 mm poly(methylmethacrylate) (PMMA) IOL in the sulcus (4, 5), and some a foldable IOL in the sulcus (6-8).

The aim of this retrospective study is to investigate and compare the outcomes of two group of eyes with acrylic foldable (9) and PMMA IOL implantation to the ciliary sulcus after posterior capsule tear development during phacoemulsification surgery, regarding their short- and long-term functional results and complications.

METHODS

This study included 161 eyes operated in the time period of 1998–2003. In all the eyes a posterior capsule tear developed during phacoemulsification surgery and an IOL to the ciliary sulcus was implanted primarily. Eighty-nine eyes of 88 patients received single piece hydrophilic 6.0 x 12.5 mm, modified C loop, no angle foldable acrylic IOL (DgR Hydroflex, MDR) (acrylic group). Posterior capsule tear developed in both eyes of a patient with bilateral posterior polar cataract in the acrylic group. Seventy-two eyes of 72 patients received 6.0 or 6.5 x 13.5 mm PMMA IOL (Corneal New Six) (PMMA group). The mean age was 67.1 years (range 33 to 84 years) and 68.1 years (range 38 to 86 years) and postoperative follow-up period was 19.2 months (range 12 to 36 months) and 17.9 months (range 12 to 36 months) in the acrylic group and the PMMA group, respectively.

The standard surgical procedure was performed under topical or peribulbar anesthesia according to the preference of the surgeon. A temporal clear corneal three-step incision was made and a side port opened. For anterior continuous curvilinear capsulorhexis (CCC) of 5–6 mm in diameter, chondroitin sulphate 4% and sodium hyaluronate 3% (Viscoat) was used. Following hydrodissection, phacoemulsification was performed with a phaco machine (Alcon Legacy Series 20000). The cortical remnants were cleaned using the machine's automatic irrigation/aspiration (I/A) system. If the posterior capsule was ruptured, the nuclear, epinuclear, and cortical remnants were cleaned with decreased aspiration rate by phacoemulsification or dry aspiration according to the surgical stage. An anterior vitrectomy was performed when needed after this cleaning and the implantation of an IOL to the ciliary sulcus was made when intracapsular implantation was not adequate and if the capsular support was good. The choice of the IOL to be implanted was made according to the skill and preference of the surgeon. The incision was enlarged to 3.5–4 mm in the acrylic group and to 6.5–7 mm in the PMMA group. The distance between iris and anterior capsule was augmented by the injection of sodium hyaluronate 1.4% (Healon GV) to the ciliary sulcus and the implantation was made properly. The incision was closed by corneal hydration or one suture in the acrylic group and by two sutures in the PMMA group. Sutures were removed in 1 month in the acrylic group and in 2 months in the PMMA group.

In the postoperative period topical dexamethasone 0.1%, antibiotic, and indomethacin drops were applied for 1 month, and 1% tropicamide for 1 week in all eyes.

Best-corrected visual acuities (BCVA), short- and long-term complications, induced astigmatism, and IOL centration were evaluated.

Statistical analysis was performed using independent samples *t*-test, the chi-square test, or Fisher exact test. p Values of 0.05 or less were considered significant.

RESULTS

Anterior vitrectomy was performed in 50.56% (45 eyes) and in 61.11% (44 eyes) in the acrylic group and the PMMA group, respectively (p=0.238) (chi-square). Preoperative BCVA was 1/10 and below in 63 eyes (70.78%) and between 2/10 and 5/10 in 26 eyes (29.21%), 1/10 and below in 45 eyes (62.5%), and between 2/10 and 5/10 in 27 eyes (37.5%) in the acrylic group and the PMMA group, respectively.

The most frequent cause of reduced vision in the early period was corneal edema and it was observed in 33 eyes (37.07%) and in 26 eyes (36.11%) in the acrylic group and the PMMA group, respectively, and was resolved within 7 to 10 days. Anterior chamber inflammatory reaction developed in 5 eyes (5.62%) and in 5 eyes (6.94%) and disappeared within 5 to 7 days of

treatment in both groups. Minimal peripheral residual cortex was seen in 6 eyes (6.74%) and in 4 eyes (5.55%) in the acrylic group and the PMMA group, respectively, and was resorbed and disappeared within 1 month. No surgical intervention was required in any of the patients.

Intraocular pressure (IOP) elevation developed in 17 eyes (19.10%) and in 12 eyes (16.66%) during the early postoperative period in the acrylic group and the PMMA group, respectively. A topical and oral antiglaucomatous treatment was applied. Five of the patients in the acrylic group and seven of the patients in the PMMA group with IOP elevation stopped using their antiglaucomatous medication within 1 month. The glaucomatous patients who were under antiglaucomatous therapy before surgery, 12 patients (13.48%) in the acrylic group and 5 patients (6.94%) in the PMMA group, continued their preoperative therapeutic regimen.

Clinical CME observed at biomicroscopic fundus examination developed in 7 eyes and in 12 eyes in the acrylic group and the PMMA group, respectively, between 1 and 6 months postoperatively. The final BCVA remained below 5/10 in 7 eyes and in 8 eyes in the acrylic group and the PMMA group, respectively. This difference is not statistically different (p=0.14) (chi-square). Anterior vitrectomy was performed in 57.14% and 66.66% of the eyes developing CME in the acrylic group and the PMMA group, respectively (p=1.0) (Fisher exact test).

The IOL implanted in the sulcus was decentered in 4 eyes (4.49%), 1 of which was corrected 3 days postoperatively, and in 3 eyes (4.16%) in the acrylic group and the PMMA group, respectively (p=0.732) (Fisher exact test). Because the others had no adverse effect on vision, they were followed, and no corrective intervention was required. In the acrylic group the dislocated IOL in one eye was corrected by rotation 1 day postoperatively according to the capsule support and remained stable at follow-up. There was no need for IOL removal in any patient.

Late postoperative endophthalmitis after the first month developed in two eyes of the PMMA group; these eyes received intravitreal antibiotic injections in the company of topical and systemic antibiotic administration. The therapy was successful without the need for surgical intervention but BCVA remained at 1/10 and 5/10 for these eyes. Two eyes, one in each group, developed rhegmatogenous retinal detachment, and they were successfully managed by classical retinal surgery (Tab. I).

Final BCVAs were 1/10 and below in 6 eyes (6.74%) and 5/10 and above in 73 eyes (82.02%) in the acrylic group, and 1/10 and below in 5 eyes (6.94%) and 5/10 and above in 42 eyes (58.33%) in the PMMA group. There is a statistically significant difference between final BCVA of the two groups (p=0.001) (chi-square). Final BCVAs were 5/10 and above in 90.12% in the acrylic group, in 79.24% in the PMMA group when pre-existing vision impairing factors were excluded (p=0.13) (Chi-square test) (Tabs. II and III).

Postoperative final induced astigmatisms were 0.5±0.5 D (SD) in the acrylic group and 1.11±0.65 D (SD) in the PMMA group (p=0.0001) (independent samples t-test).

TABLE I - POSTOPERATIVE COMPLICATIONS

Complications	Acrylic group (n=89), n (%)	PMMA group (n=72), n (%)	p value
Early temporary corneal edema	33 (37.07)	26 (36.11)	0.89
Early period hypertonia	17 (19.10)	12 (16.66)	0.68
Chronic hypertonia	12 (13.48)	5 (6.94)	0.17
Anterior chamber inflammatory reaction	5 (5.61)	5 (6.94)	0.72
Residual cortex	6 (6.74)	4 (5.55)	0.75
Pupil irregularity	6 (6.74)	10 (13.88)	0.13
Retinal detachment	1 (1.12)	1 (1.38)	0.88
IOL dislocation	1 (1.12)	—	0.36
IOL decentralization	4 (4.49)	3 (4.16)	0.73
Cystoid macular edema	7 (7.86)	12 (16.66)	0.14
Endophthalmitis	—	2 (2.77)	0.11

PMMA = Poly(methylmethacrylate); IOL = Intraocular lens

DISCUSSION

Posterior capsule tear is the most frequent intraoperative complication occurring during phacoemulsification surgery (10). In the majority of cases it is possible to complete the operation after the occurrence of posterior capsule tear (11, 12). The surgeon should take great care to maintain the operation in the closed system according to the stage of posterior capsule tear, and should aim to minimize the risk of vitreous prolapse by decreasing intraocular liquid flow and aspiration. When posterior capsule tear appears along with vitreous prolapse an anterior vitrectomy must be performed. Several authors reported performing anterior vitrectomy because of vitreous loss (6, 13-16). We performed anterior vitrectomy in 45 of 89 eyes (50.56%) in the acrylic group and in 44 of 72 eyes (61.11%) in the PMMA group.

In eyes with posterior capsule tear with limited size, the IOL can be implanted in the bag, but zonular support must be carefully checked out (17). In wide tears without posterior capsular support the IOL can be placed in the ciliary sulcus if anterior capsule integrity is enough to provide good support to the IOL. In our patients, we implanted single piece foldable acrylic IOL in the sulcus in 89 eyes of 88 patients and PMMA IOL in 72 eyes of 72 patients. Onal et al implanted acrylic and PMMA IOL in the sulcus in 50 eyes of 58 eyes developing posterior capsule tear during phacoemulsification surgery (15).

The most frequent cause of reduced vision in the early postoperative period is temporary corneal edema in eyes in which posterior capsule tear developed during phacoemulsification. In our study the rate of temporary corneal edema is 37.07% in the acrylic group and 36.11% in the PMMA group. Onal et al reported one case of bullous keratopathy (1.17%) (15). No bullous keratopathy developed in any eye in our groups. Postoperative IOP elevation may appear in eyes developing posterior capsule tear; the presence of preoperative glaucoma, trabecular blockage by viscoelastic material remaining in the eye, dispersed lens particles and iris pigments, or mechanical damage in the trabecular meshwork can be responsible for postoperative IOP rise. We observed early postoperative IOP rise in 17 eyes (19.10%) and in 12 eyes (16.6%) in the acrylic and PMMA groups, respectively, and the high IOP persisted in the later period in 12 eyes (13.48%) in the acrylic group and in 5 eyes (6.94%) in the PMMA group.

Postoperative anterior chamber reaction is observed in the early period. Brazitikos et al and Amino and Ya-

TABLE II - POSTOPERATIVE FINAL BCVA

BCVA	Acrylic group (n=89), n (%)	PMMA group (n=72), n (%)	p value
1/10 and below	6 (6.74)	5 (6.94)	0.96
2/10–4/10	10 (11.23)	25 (34.72)	0.001
5/10 and better	73 (82.02)	42 (58.33)	0.001

BCVA = Best-corrected visual acuity; PMMA = Poly(methylmethacrylate)

TABLE III - REASONS FOR POOR VISION (BCVA <5/10)

Reason for poor BCVA	Acrylic group, n (%)	PMMA group, n (%)
Cystoid macular edema	7 (7.86)	8 (11.11)
Glaucoma	4 (4.49)	3 (4.16)
Age-related macular degeneration	2 (2.24)	10 (13.88)
Diabetic retinopathy	1 (1.12)	4 (5.55)
Retinal detachment	1 (1.12)	1 (1.38)
Myopic macular degeneration	1 (1.12)	2 (2.77)
Endophthalmitis	—	1 (1.38)
Retinal artery occlusion	—	1 (1.38)
Total	16 (17.97)	30 (41.66)

BCVA = Best-corrected visual acuity; PMMA = Poly(methylmethacrylate)

makawa reported that postoperative inflammation was more severe in eyes with posterior capsule tear (6, 8). Amino and Yamakawa reported that anterior chamber reaction was increased in eyes with sulcus-to-sulcus fixation because of contact between the IOL optic and the iris and that this persisted, albeit at a low level, for a long time after surgery, and that the presence of this contact was revealed by ultrasound biomicroscopy (UBM) (8). In their studies Amino and Yamakawa and Loya et al showed at UBM examination of lenses implanted into the sulcus in eyes developing posterior capsule tear that they were not all sulcus-to-sulcus but that some were sulcus-to-ciliary body implants (8, 18).

Postoperative endophthalmitis that developed later than the first month in two eyes implanted with PMMA IOL were cured without the need for pars plana vitrectomy but only with intravitreal antibiotic injection in the company of topical and systemic antibiotic administration.

CME is one of the most common causes of visual acuity decrease after cataract surgery. Clinically determined CME may be observed after phacoemulsification surgery, and CME frequency rises after cataract surgery with complications (anterior hyaloid rupture, vitreous loss, dislocated lens, cortex residue, the presence of vitreous bands in the wound site, insufficient wound closure, and chronic inflammation) (19). In our study, clinically significant CME was observed in 7.86% of patients in the acrylic group and in 16.66% of patients in the PMMA group. The percentage of anterior vitrectomy in the eyes developing CME is 57.14% and 66.66% in the acrylic group and the PMMA group, respectively. Although the difference is not statistically significant CME is observed more frequently in the PMMA group than the acrylic group.

IOL centration and stability are important when IOL is implanted into the sulcus in patients developing posterior capsule tear during phacoemulsification surgery. Onal et al reported an IOL decentration in 5 eyes (8.6%) (4 of them implanted with PMMA IOL) (15). In our study the IOL was decentered in 4 eyes (4.49%) and dislocated in 1 eye (1.12%) in the acrylic group and repositioning was performed in two eyes. IOL decentration was observed in 3 eyes (4.16%) in the PMMA group. No IOL tilt was observed with biomicroscopic examination in any group.

In our study, final BCVA of 5/10 and better was observed in 82.02% in the acrylic group and in 58.33% in the PMMA group (p=0.001) but the final BCVAs were 90.12% in the acrylic group and 79.24% in the PMMA group when pre-existing vision impairing factors were excluded (p=0.13). Onal et al reported BCVA of 0.5 and above (82.8%) (15).

Postoperative final induced astigmatism was significantly greater in the PMMA group (p=0.0001). This significance may be related to incision size or suturation techniques, which may differ among different surgeons. It was shown by a previous study that postoperative astigmatism is strongly related to suturing technique as well as wound size (20).

When posterior capsular tear occurs during phacoemulsification surgery the implantation of foldable acrylic IOL in the ciliary sulcus provides to the surgeon the advantages of small incision surgery such as less vitreous loss, low astigmatism, rapid wound healing, and early visual rehabilitation. When posterior capsule tear develops, since it is necessary to widen the incision in order to implant the 6.0 or 7.0 mm PMMA IOL in the sulcus, it is technically difficult to maintain the tunnel incision and with increased vitreous loss the emergence of complications such as CME, peripheral retinal tears, choroidal detachment, and intraoperative hypotony increases (21-23).

Before the IOL is implanted in the sulcus, the anterior vitrectomy must be made adequately, so in the eyes requiring it the anterior capsular and zonular supports must be well analyzed. The presence of capsule residue is particularly important in the lower quadrant for adequate support of IOL.

In conclusion, increased astigmatism and serious sight-threatening complications such as CME and endophthalmitis are more frequently seen in eyes implanted with PMMA IOL after posterior capsule tear during phacoemulsification surgery. Therefore, we suggest that foldable acrylic IOLs be used cautiously for implantation in the sulcus after posterior capsule tear to keep the advantages of small incision surgery and to reduce potential complications.

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