Pars Plana Vitrectomy, Phacoemulsification and Intraocular Lens Implantation for the Management of Cataract and Proliferative Diabetic Retinopathy: Comparison of a Combined Versus Two-Step Surgical Approach

Vitrectomía Pars Plana, Facoemulsificación e Implante de Lente Intraocular para el Manejo de Catarata y Retinopatía Diabética Proliferativa: Comparación de Técnica Quirúrgica Combinada Versus en Dos Tiempos

ABSTRACT

Purpose: To report the intra-and postoperative complications and visual acuity outcomes in pars plana vitrectomy (PPV), phacoemulsification and intraocular lens (IOL) implantation in patients with cataract and proliferative diabetic retinopathy (PDR). A comparison of the combined versus two-step surgical approach is given.

Method: Retrospective uncontrolled interventional clinical trial. Forty-eight eyes of 48 consecutive patients with PDR were included. Twenty-eight (58.3%) eyes with combined surgery and 20 (41.7%) eyes with sequential surgery were analyzed.

Results: Postoperative follow-up time was between 6 and 63 months (mean: 18 months). 1) Combined surgery: Preoperative best-corrected visual acuity (BCVA) ranged from 20/200 to hand motions, and

RESUMEN

Propósito: Describir las complicaciones intra- y postoperatorias y los resultados visuales en vitrectomía vía pars plana (VPP), facoemulsificación e implante de lente intraocular (LIO) en pacientes con catarata y retinopatía diabética proliferativa (RDP). Se realizó una comparación de la técnica combinada versus en dos tiempos quirúrgicos.

Método: Ensayo clínico intervencional retrospectivo no controlado. Se incluyeron 48 ojos de 48 pacientes consecutivos con RDP. Se analizaron 28 (58,3%) ojos con cirugía combinada y 20 ojos (41,7%) con cirugía secuencial.

Resultados: El tiempo de seguimiento postoperatorio fue entre 6 y 63 meses (promedio: 18 meses). 1) Cirugía combinada: Agudeza visual mejor corregida preoperatoria (AVMC) estaba entre 20/200 a movi-
postoperative BCVA ranged from 20/30 to hand motions. BCVA improved in 17 eyes (60.7%), while in 7 (25%) eyes there was no change (≥2 ETDRS lines) in VA, and in 4 (14.3%) eyes BCVA decreased. Postoperative complications included vitreous hemorrhage (VH) in 10 (35.7%) eyes, and fibrinous exudation in 9 (32.1%) eyes. 2) Two-step surgery: Preoperative BCVA ranged from 10/200 to light perception, and from 20/40 to light perception in the postoperative period. Best-corrected visual acuity improved in 15 (75%) eyes, remained the same in 4 (20%) eyes, and decreased in 1 (5%) eye. Postoperative complications included fibrinous exudation in 6 (30%) eyes, and VH in 3 (15%) eyes.

**Conclusion:** Combined PPV, phacoemulsification and IOL implantation as well as the two-step procedure are safe and effective for the management of cataract in PDR. Sequential surgery could be advantageous to BCVA outcomes by minimizing postoperative VH, which is significantly more frequent after combined surgery (Arch Soc Esp Oftalmol 2009; 84: 31-38).

**Key words:** Combined surgical approach, intraocular lens implantation, pars plana vitrectomy, phacoemulsification, proliferative diabetic retinopathy, two-step surgical approach.

**INTRODUCTION**

Frequently, vitreo-retinal diseases and cataracts occur at the same time in patients with proliferative diabetic retinopathy (PDR). Surgical developments for removing cataracts and improvements in intraocular lens (IOL) technologies have increased indications for cataract surgery in diabetic patients. In addition, vitrectomy pars plana (VPP) is successfully performed in several vitreo-retinal diseases. Cataract removal can be combined with VPP if the lens opacities interfere with the adequate visualization of the retina and thus with the surgery. Even so, if the cataract is not significant at the time of the vitrectomy, it may evolve subsequently with a percentage of 68%-80% at a 2-year follow-up. This evolution is much faster in diabetic patients (1-4). However, other predisposing factors for the formation of cataracts include the patient age, pre-existing nuclear sclerosis, lens damage during VPP and the use of silicone oil and intra-vitreous gas (5-7).

Methods for extracting cataracts include lensectomy, extra capsular extraction and phacoemulsification. The latter technique has several advantages over other surgical procedures due to the quick visual recovery and lower post-op inflammation (8,9).

Procedures for removing cataracts and repairing posterior segment diseases can be made sequentially with a 2-stage surgical procedure: first a posterior segment surgery followed by lens extraction. A single stage procedure can also be carried out, combining cataract surgery with vitreo-retinal pathology surgery in a single operation (10). Cataracts surgery in vitrectomized eyes involves special circumstances which include loss of the vitreous support, instability of the posterior capsule, weakness of the zonules and posterior capsular plates (11,12). We have not found a great amount of literature comparing directly the results of combined surgeries with the sequential procedures. However, these results are controversial (3,13-18).
This study made a retrospective analysis of the intra- and post-op complications, difficulties and the results of combining VPP, phacoemulsification and IOL implant in PDR patients with cataracts. These results were compared with those obtained in patients submitted to phacoemulsification and IOL implant as a secondary procedure after vitrectomy.

**SUBJECTS, MATERIAL AND METHODS**

A retrospective review of medical and surgical histories of 48 eyes of 48 consecutive patients with PDR and cataracts. Vitrectomy pars plana was performed on 28 eyes (58.3%) combined with phacoemulsification and IOL implant (combined surgery), while phacoemulsification and IOL implant was performed on 20 eyes (41.7%) after vitrectomy (sequential surgery). All the patients had a clinically significant lens opacity at the time of surgery. The combined surgery was performed when the cataracts were quite significant and hindered the visualization of the posterior pole. Sequential surgery was performed when the cataracts were not significant enough to hinder the visualization of the posterior pole. The patients were intervened in our centers between January 2002 and December 2005 with the prior approval of the institutional ethics committee and the signature of an informed consent. In addition, this study was made in accordance with the ethical standards of the 1964 Helsinki declaration.

Thirty-six eyes (75%) had previous pan-retinal photocoagulation (PRP). The exclusion criteria included macular ischemia established with fluorescein angiography (whenever possible). All procedures were carried out under monitored peri-bulbar local anesthesia. In the sequential surgery group the cataracts extraction was made in previously vitrectomized eyes when the retina was stable and the subsequent cataracts were regarded as the cause of the visual loss. In the 48 cases, the phacoemulsification technique was similar, and in the combined procedures group the cataracts were removed prior to vitreo-retinal surgery. A 3.2 mm wide and 1.5-2.0 mm long incision was made in the temporal limbus in clear cornea, the 5.0 -6.0 mm curved capsulorhexis was completed and the phacoemulsification was performed together with the extraction of the cortex. The anterior chamber and capsular sac were filled with viscoelastics and the foldable IOL was implanted. In all combined surgery patients, a standard, 3-port vitrectomy pars plana with an intra-ocular light source was used for the vitreo-retinal surgery with an infusion cannula sutured at the site of the lower temporal sclerectomy. The sclerectomies were made at 3.5 (phakic) or 2.5 (pseudo-phakic) mm posterior to the limbus in the upper temporal, upper nasal or lower temporal quadrants. The sclerectomies and conjunctiva were sutured. The retinal tears were treated immediately. Combined and sequential surgery were performed by three surgeons (PRA, MHB, and JFA).

The following information was obtained for each patient: age, sex, pre- and post-op best corrected visual acuity (BCVA), intra-ocular pressure (IOP), indication for vitreo-retinal surgery, intra-op observations and complications, follow-up length, post-op complications (neovascular glaucoma, fibrinous exudation, retina detachment, macular edema and recurring vitreous hemorrhage) and additional surgical procedures.

A routine ophthalmological assessment was made pre-op and post-op on days 1 and 7, and after 3, 6, 12 and 18 months for all patients. This assessment included BCVA, applanation tonometry, biomicroscopy and fundus exploration with direct and indirect ophthalmoscopy. The uncorrected and best corrected visual acuity was measured utilizing the ETDRS cards. In our study, visual acuity was considered to be stable when the variation was equal to or below two ETDRS lines. The visual results and complications were compared between the groups.

**RESULTS**

In this study the patients had a mean follow-up of 18 months (range: 6 to 63 months). The mean age of our patients was of 59 years (range: 28-82) in the sequential surgery group and of 57 years (range: 36-76) in the combined surgery group. Seventy percent of patients in the sequential surgery group were men compared to 39.3% in the combined surgery group (Table I). The primary indications for vitrectomy in both groups are summarized in Table II. The indications were vitreous hemorrhage (VH) (combined surgery: 60.7%, sequential surgery: 65%) and tractional retina detachment (TRD) (combined surgery: 39.3%, sequential surgery: 35%).

Laser endophotocoagulation was utilized in all patients in both groups. Combined endolaser and
cryopexia were necessary only in one case of the combined surgery group. For endobuffering after vitrectomy, the most frequently used agent was C3F8 gas (combined surgery: 42.8%, sequential surgery: 30%). Silicone oil was utilized in one eye (3.5%) in the combined surgery group and in two eyes (10%) of the sequential surgery group. Air was used in six cases (21.4%) in the combined surgery group. In the sequential surgery group cataracts surgery was made within an average of 4.5 months (range: 2-9 months) after the VPP.

In the combined surgery group, pre-op BCVA ranged between 20/200 and hands movement (average: 5/200) and post-op BCVA between 20/30 and hands movement (average: 10/200). In seventeen (60.7%) eyes BCVA improved, seven eyes (25%) exhibited no changes (>2 lines ETDRS) in BCVA, and in four eyes (14.3%) BCVA diminished. In comparison, the pre-op BCVA of the sequential surgery group ranged between 10/200 and perception of light (average: 5/200) and between 20/40 and perception of light (average: 10/200) in the post-op period. BCVA improved in fifteen eyes (75%), remained the same in four eyes (20%) and diminished in one eye (5%) (table III).

Complications were detected in 18 eyes (64.3%) in the combined surgery group and in 11 eyes (55%) in the sequential group. Intra-op complications included retinal tears (combined: 7.1%, sequential: 15%), subretinal hemorrhage (combined: 3.5%) and posterior capsular tears (combined: 3.5%, sequential: 5%). Table IV describes the post-op complications encountered in this study. The most common complications in the combined surgery group were vitreous hemorrhage (VH) in 10 (35.7%) eyes and fibrinous exudation in nine (32.1%); whereas VH was observed in three eyes (15%) and fibrinous exudation in six eyes (30%) in the sequential group. The formation of a pre-pupilar membrane was more frequent after combined surgery (10.7%) than in the sequential surgery group (5%). Neovascular glaucoma (NVG) arose in 3 eyes (10.7%) in the combined surgery group and in three eyes (15%) which had been previously vitrectomized. However, this was

### Table I. Demographic data of patients*

<table>
<thead>
<tr>
<th></th>
<th>Combined Surgery</th>
<th>Sequential Surgery</th>
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<tbody>
<tr>
<td>No. of eyes</td>
<td>28 (58.3%)</td>
<td>20 (41.7%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
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<tr>
<td>Average</td>
<td>57</td>
<td>59</td>
</tr>
<tr>
<td>Range</td>
<td>36-76</td>
<td>28-82</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>17 (60.7%)</td>
<td>6 (30%)</td>
</tr>
<tr>
<td>Male</td>
<td>11 (39.3%)</td>
<td>14 (70%)</td>
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<tr>
<td>Follow up (months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>16.5</td>
<td>19.8</td>
</tr>
<tr>
<td>Range</td>
<td>6-63</td>
<td>9-40</td>
</tr>
<tr>
<td>Visual acuity (ETDRS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-op range</td>
<td>20/200 - MM</td>
<td>10/200 - PL</td>
</tr>
<tr>
<td>Post-op range</td>
<td>20/30 - MM</td>
<td>20/40 - PL</td>
</tr>
</tbody>
</table>

* ETDRS = Early Treatment Diabetic Retinopathy Study. MM = Hand Movement. PL = Perception of light.

### Table II. Indications for vitrectomy*

<table>
<thead>
<tr>
<th>Indication</th>
<th>Combined Surgery (n= 28)</th>
<th>Sequential Surgery (n=20)</th>
</tr>
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<tbody>
<tr>
<td>Vitreous Hemorrhage</td>
<td>17 (60.7%)</td>
<td>13 (65%)</td>
</tr>
<tr>
<td>TRD</td>
<td>11 (39.3%)</td>
<td>7 (35%)</td>
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* TRD = Tractional Retina Detachment.

### Table III. Visual acuity results*

<table>
<thead>
<tr>
<th>Visual acuity (ETDRS)</th>
<th>Combined Surgery (n= 28)</th>
<th>Sequential Surgery (n=20)</th>
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<tbody>
<tr>
<td>Improvement ≥ 2 lines</td>
<td>17 (60.7%)</td>
<td>15 (75%)</td>
</tr>
<tr>
<td>Within 2 lines</td>
<td>7 (25%)</td>
<td>4 (20%)</td>
</tr>
<tr>
<td>Reduction ≥ 2 lines</td>
<td>4 (14.3%)</td>
<td>1 (5%)</td>
</tr>
</tbody>
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* ETDRS = Early Treatment Diabetic Retinopathy Study.
medically controlled with topical anti-glaucomatous drugs, except in one patient of the combined surgery group who required filtrating surgery. In the combined surgery group macular edema was evidenced in 5 eyes (17.8%). The sequential surgery group exhibited macular edema in 4 eyes (20%). Additional complications included opacification of the posterior capsule in one eye (3.5%) of the combined surgery group and also in one eye (5%) of the sequential surgery group. Only one case of post-op retina detachment occurred in this study, in the sequential surgery group. No cases of endophthalmitis or decentring or IOL capture occurred in any of the groups.

**DISCUSSION**

One of the most common sequels of vitrectomy is the formation and development of cataracts, which ranges between 17% and 80% (1-6,17). Diabetic patients tend to have more pre-op lens opacities than other patients in the same age group. In addition, after the vitrectomy they frequently experience early lens opacities (3,8,15). The diabetic eye is also more vulnerable to surgical trauma than the non-diabetic eye. A surgically deep myosis, a fragile lens capsule with an increased rupture percentage, a longer duration of the surgical intervention, a temporary elevation of the IOP, a greater intensity of post-op inflammation and a higher prevalence of cystoid macular edema have been reported in diabetic eyes (8).

In cases where cataracts coexist with vitreo-retinal pathologies, surgeons struggle to optimize the visualization of the retina during vitreous surgery and improve the post-op visual rehabilitation for their patients, minimizing complications. The issue of removing the cataracts or not in the same intervention as the VPP has not been exhaustively analyzed, but the combination is attractive in an attempt to accelerate the visual recovery of the patient, thus preventing the need of a second operation. Combined surgery is preferred by some surgeons because it has some advantages like a shorter post-op recovery time, a complete extraction of the anterior vitreous structures without the risk of damaging the lens, a good visualization of the posterior pole during vitrectomy and the need of a single operation, thus reducing the inconveniences for the patient as well as risks and costs (2,3,13-15). In addition, pan-retinal photocoagulation is frequently performed on diabetic patients as part of the surgery, reducing the risk of developing neovascularization of the retina and iris (3,13,17). However, there are possible disadvantages such as increased surgical time and pressure on the surgeon, difficulty in visualizing the capsulorrhexis due to the absence or reduction of the red reflex, dehiscence of the surgical wound due to manipulation of the globe during vitreous surgery, intra-op myosis upon extraction of the cataracts, bleeding of anterior structures, loss of corneal transparency due to edema and folds in Descemet’s membrane, inadvertent exchange of fluids in the anterior segment with posterior segment covering agents, de-centering of the IOL and iris capture in eyes with gas, air or silicone oil buffering, and prismatic effects and undesired light reflections during vitreo-retinal surgery caused by the IOL implantation before the procedure in the posterior segment (2,3,5,13,14).

Difficulties and challenges have been described during a sequential surgery. Extremely deep anterior chambers during phacoemulsification, zonular dehiscence, increased mobility of the posterior capsule and loss of nuclear fragments have been reported due to a diminished vitreous support (1,3,6,14). In addition, cataracts surgery in patients with a previous VPP involves longer recovery times, two local or general anesthetics and a frequently inexact biometry (6). In diabetic patients, cataracts surgery may also lead to a worsening of the diabetic retinopathy (3,6,8,15).

There are some papers on combined surgery results in cataracts and retinal diseases (1,3,9,10,15-19) proving that the extraction of cataracts combined with VPP is safe and effective with a quick visual recovery. However, even though a small number of studies have made a direct comparison between the combined surgery results and the sequential surgery results, as far as we know no study has been made with diabetic patients (2,13,14).

In this study, during the follow-up time (average: 18 months; range: 6 to 63 months) we reviewed and compared the results of combined and sequential surgery in PDR patients. The percentage of indications for vitrectomy was similar in both groups, with vitreous hemorrhage and tractional retina detachment being the most common. In the combined surgery group, BCVA exhibited improvement in 17 eyes (60.7%), stability in 7 eyes (25%) and worsening in 4 eyes (14.3%). In the sequential surgery group it was found that visual acuity improved
in 15 eyes (75%) eyes, stability in 4 eyes (20%) and worsening in 1 eye (5%). The BCVA analysis between the study groups revealed an important difference, with the best results being exhibited by the sequential surgery group. However, our study was limited due to its retrospective, non-randomized nature and the small number of cases.

We found non-significant differences in the intra-and post-op complications between the combined and sequential surgery groups. However, a greater percentage of vitreous hemorrhage was observed in the combined surgery group (35.7% vs15%). A similar percentage of inflammatory reaction in the anterior chamber (fibrinous exudation and development of pre-pupilar membranes) was observed in both groups. Chung et al (2), and Treumer et al (14) described similar differences in the fibrinous exudation percentages between the combined and sequential surgery groups. Neovascular glaucoma also had a similar frequency in both groups. However, this was medically controlled with topical anti-glaucomatous drugs. Only one patient required filtrating surgery in the sequential surgery group. This complication has been described in the literature as a complication associated to combined procedures (16). Differences in additional post-op complications such as macular edema, opacification posterior capsule tear and retina detachment were not significant.

To summarize, both the VPP, phacoemulsification and IOL implant combination as well as the sequential procedure are safe and effective in PDR. Sequential surgery could have a slight advantage in BCVA results because it diminishes the possibility of intra-op vitreous hemorrhage, which seems to be more frequent after a combined surgery. Future assessments with a higher number of patients in a prospective randomized study are necessary to determine exactly any differences in the results between both techniques.

REFERENCES