Clinical analysis of the LS-312MF Mplus® intraocular lens

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PURPOSE: The purpose of the clinical trial was to analyse the far, short and intermediate distance visual acuity, contrast sensitivity and defocus curve in patients with cataract surgery and implantation of the Mplus® intraocular lens.

MATERIAL AND METHODS: Prospective clinical trial of 24 eyes that underwent phacoemulsification and implantation of the Oculentis Mplus intraocular lens. Patients were evaluated intraoperatively one day, one week, and one and three months after the surgery. Far (6 m), short (33 cm) and intermediate (80 cm) distance monocular spontaneous and best corrected visual acuity were measured, as well as contrast sensitivity, pupillometry in different lighting conditions and defocus curves. The presence of dysphotopsias and personal satisfaction were also studied.

RESULTS: The mean far, intermediate and short distance monocular spontaneous Snellen visual acuity one month after the surgery was 0.836±0.171, 0.731±0.130 and 0.824±0.112 respectively. Three months after the surgery the mean far and intermediate distance spontaneous visual acuity did not change, but the short distance visual acuity improved to 0.895±0.116.
Contrast sensitivity was slightly reduced in high frequencies, remaining the same in medium and low frequencies.
The mean depth of focus one and three months after the surgery was + 0.75 in far distance with mean
Snellen visual acuity of 0.8, and +2.00/-1.00 in short distance with mean visual acuity of 0.8.
The presence of dysphotopsias was observed in 20% of the eyes one month after the surgery, being reduced to 9% at three months.
The mean pupil diameter measurement, made at 3 months after surgery in scotopic, mesopic and photopic conditions and its relations with the visual acuity shows that there is not statistically significant connection between visual acuity and pupil diameter variables.

CONCLUSION: regarding the outcomes in far, short and intermediate distance visual acuity, the Mplus® is an efficient lens providing complete independence from glasses.
The contrast sensitivity is in the normal range for healthy eyes between the ages of 20 and 55.
In 50% of the cases some rotation of the lens (from 10 to 45º) could be noticed, but differences in visual acuity between these cases and the ones that kept the lens centered were not observed.
Therefore the rotational displacement of the lens does not affect final visual acuity.
Neuroadaptation seems to be fast and efficient, and we have not observed that short distance visual acuity may be reduced with small pupils.

KEYWORDS: Multifocal intraocular lenses, contrast sensitivity, dysphotopsias, defocus curve, pupillometry.

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INTRODUCTION

At present the success of cataract surgery depends mainly on the selection of the intraocular lens (IOL). The development of new technologies and greater knowledge of the eye optic system had enabled the creation of monofocal intraocular lenses that offer excellent far distance visual acuity[1].

However, many patients experience limitations with these lenses due to the lack of an appropriate short and intermediate distance spontaneous visual acuity. To address this problem, new lenses with multifocal ability, capable of compensating these limitations have been developed.

Multifocal intraocular lenses were used for the first time in the eighties and since then there has been a great evolution in both the design and materials of these lenses, with the appearance of such types as the Mplus®.

The LS-312MF Mplus® multifocal IOL (manufactured by Oculentis GmbH) is a one-piece acrylic bifocal lens; it is biconvex with an asymmetrical[2] rotational[3] design. Its posterior face has a neutral asphericity, while its anterior face is a combination of two spherical surfaces with different radio: a principal surface and an integrated surface, creating two well defined foci in the same axis. It has a +3.00D sector-shaped addition for short vision which is equivalent to +2.25D at the spectacle plane, while intermediate vision is due to the overlap of the high depth of focus in the far and short distance, which allows a smooth transition between zones. The IOL has a 360-degree square-edge design with a continuous barrier effect to prevent lens epithelial cell migration and thus posterior capsule opacification (PCO).

To study the behaviour of the Mplus® lens we have designed a prospective clinical trial that evaluates the far and short distance spontaneous and best corrected visual acuity, the contrast sensitivity and the defocus curves of postoperative patients having undergone cataract surgery and implantation of this intraocular lens.

MATERIAL AND METHOD

The trial includes 24 eyes of 15 patients (9 with bilateral implants and 6 with an unilateral implant) that were admitted to the Ophtalmologycal Integral Center of Bilbao between November 2009 and March 2010. The age range was between 60 and 75.

For the selection of the patients the mayor inclusion criterion was the presence of cataract liable to undergo surgery, and the exclusion criterias were the following ones: ±1.00D or larger astigmatism, high ametropys (–6.00D or larger myopia and +6.00D or larger hypermetropia) and any other ocular pathologies that could affect visual acuity outcomes, such as glaucoma, corneal dystrophy or degeneration, corneal opacities, diabetic retinopathy, age-related macular degeneration, optic neuropathy, uveitis, amblyopia, ocular motility anomalies and refractive surgery. All the patients were informed both verbally and in writing of the surgical technique and of the potential risks and complications.

Patients were evaluated before and immediately after the surgery, the following day, and one week, one month and three months after the operation. The preoperative evaluation included the following: monocular and binocular spontaneous visual acuity (SVA) and monocular and binocular best corrected visual acuity (BCVA) at 6 meters, measured with the Topcon ACP.8 projection test [Snellen acuity charts under photopic conditions: 70candelas (cd/m^2)], intraocular pressure measured with the Topcon CT.80 air tonometer, slit lamp biomicroscopy, funduscopy, biometry measured with partial coherence interferometry (IOL Master, Carl Zeiss Meditec AG), and corneal Scheimpflug topography and pupillometry measurements (SCHWIND SIRIUS eye top, of SCHWIND eye-tech-solutions GmbH & Co. KG). In addition to this, a previously validated test[4,5] was shown to all the patients; this test included standardized photographs to evaluate the presence of dysphotopsias[6].

In this first visit the dioptric power of the intraocular lens was also calculated to obtain a final estimated refraction between +0.00 and -0.25D. The SRK/T formula was used with the exception of those eyes whose axial length was less than 22 mm; in the latter the Hoffer Q was used.

The surgery was always performed by the same surgeon (J.O.G.), who performed phacoemulsification and LS-312MF Mplus® intraocular lens (fig. 1) implantation in the bag. The surgery was performed with the Ozil system (Infiniti® of Alcon), and topical anesthesia (5% lidocaine) and disposable material were used. The posterior capsule was polished before the IOL was inserted. Paralimbic temporal cornea was chosen for the incision and no suture was applied. Any complications during the procedure were cause for exclusion.

After the surgery, treatment with topical tobramycin and dexamethasone was used every 3 hours; this treatment was then slowly reduced within 30 days.

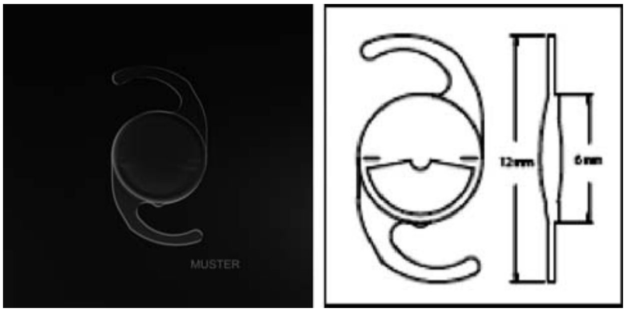

Figura 1. Mplus® IOL of Oculentis, model LS-312MF.

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Intraoperatively and immediately after the surgery, the IOL centering was confirmed by the same surgeon (J.O.G) checking the IOL marks, initially situated at 0-180º and with the sector-shapped addition located inferiorly (as the manufacturer estates). Postoperatively all the patients were evaluated at least four more times, and always by the same technician (B.D.G): the following day, one week, one month and three months after the surgery.

In these four visits the following data were recorded: far (6 m), short (33 cm) and intermediate (80 cm) distance; spontaneous (SVA) and best corrected (BCVA) visual acuity in photopic conditions (70 cd/m^2); intraocular pressure and biomicroscopy (checking the presence of tyndall, corneal edema, cortical remains, glistening, folds or opacity in posterior capsule and IOL position). The fundus was also examined in all of the visits, making sure there were no anomalies after the surgery.

In the one and three-month visits the presence of dysphotopsias was also studied. For this purpose a subjective questionnaire with the following question was shown to the patients: have you noticed flashes, glare, lines, halos or starbursts (light jets on the pavement, road...) when looking at lights at night or on very bright days? If the answer was negative the questionnaire was ended there, but if the answer was positive an objective and specific test was then used. This test consisted of standardized photographs of dysphotopic phenomena that were shown to the patient following a sequence of increasing severity: grade 1 (mild), grade 2 (moderate), grade 3 (severe), grade 4 (very severe). In this way the degree of dysphotopsias was measured.

Contrast sensitivity (CSS) was monocularly evaluated at 6 meters and in mesopic lighting conditions (6.5 cd/m^2). For this purpose the Vision Contrast Test System of Vistech Consultans Inc.® (VCTS) was chosen. This test uses an eye-chart of sine waves measuring spatial frequencies between 1.5 and 18 cycles/grade.

Defocus curves were carried out with the best optic correction and in photopic lighting conditions (70 cd/m^2).

Six months after the surgery a telephone survey was carried out to evaluate the patient's degree of visual satisfaction, from 1 to 10, in far, short and intermediate distance, and the potencial need for glasses.

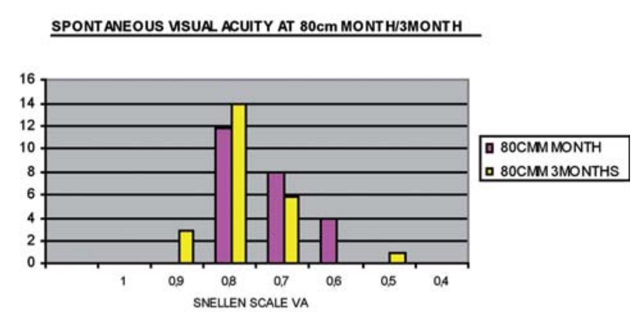
All calculations of statistical data analysis have been estimated with the statistical program SAS System V:9.2, the statistical significance has been assumed when $p < 0.05$

RESULT

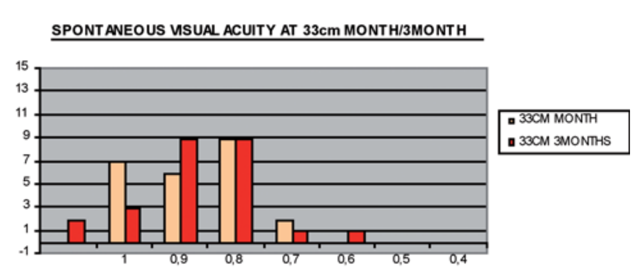
In this study 24 eyes of 15 patients (6 men and 9 women) were analyzed. Of these, 15 were right eyes and 9 were left eyes. Nine patients received bilateral Mplus® implants and six patients received unilateral ones. The mean far (6 m) distance for monocular spontaneous visual acuity at one and three month was 0.836±0.171 Snellen; the mean intermediate (80 cm) distance monocular spontaneous visual acuity at one month was 0.731±0.130 and at three month was 0.763±0.093; and the mean short distance (33 cm) monocular spontaneous visual acuity was 0.824±0.112 one month after the surgery improving to 0.895±0.116 at three months (graphs 1 and 2). On the other hand, the mean far, intermediate and short distance monocular best corrected visual acuity was 0.896±0.135, 0.797±0.085 and 0.911±0.128 respectively one month after the surgery, and the mean far, intermediate and short distance visual acuity was 0.947±0.158, 0.802±0.102 and 0.935±0.118 respectively at three months.

It has been performed a descriptive analysis about visual acuity evaluating the link between spontaneous and best corrected visual acuity, and the different types of visual acuities were categorized in two groups: spontaneous and best corrected, in the different distances: far, intermediate and short; both groups were compared using the test of chi-cuadrado.

Table 1 shows the mean monocular (n=24 eyes) and binocular (n=15 patients) spontaneous and best corrected visual acuity in far, short and intermediate distance, as well as the percentage of patients who have 0.7 or better monocular and binocular spontaneous visual acuity in Snellen scale and the percentage of patients who have 1.00 or better monocular and binocular best corrected Snellen visual acuity, one and three months after the surgery.



Graph 1. Change in intermediate distance (80 cm) monocular SVA one and three months after the surgery (n=24 eyes).



Graph 2. Change in short distance (33 cm) monocular SVA one and three months after the surgery (n=24 eyes).

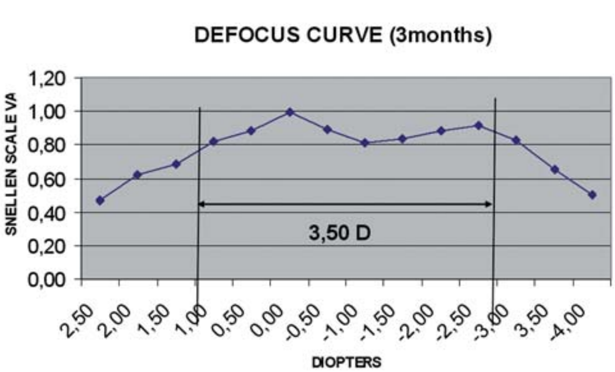
Table 1: Monocular and binocular Snellen SVA and BCVA. VA* is calculated from a sample of 24 eyes and 15 patients with both eyes operated (the mean VA redounded to the highest)

	Spontaneous Snellen scale visual acuity at 1 month		Best corrected Snellen scale visual acuity at 1month		Spontaneous Snellen scale visual acuity at 3months		Best corrected Snellen scale visual acuity at 3months	
	Intermediate	**0.7 or better (%)**	**Intermediate**	**1.00 or better (%)**	**Intermediate**	**0.7 or better (%)**	**Intermediate**	**1.00 or better (%)**
Far (6 m)								
Monocular	0.8	77.27%	0.9	45.45%	0.8	81.82%	0.95	54.55%
*Binocular	0.9	90%	1.05	80%	0.7	95%	1.05	90%
Intermediate (80 cm)								
Monocular	0.7	59.10%	0.8	–	0.7	68.20%	0.8	–
*Binocular	0.8	90%	0.9)	–	0.8	95%	0.9	–
Short (33 cm)								
Monocular	0.8	75.73%	0.9	10%	0.9	90.45%	0.95	83.36%
*Binocular	0.9	95%	0.95	70%	0.9	95%	0.95	90%

All patients present a spontaneous binocular visual acuity for far distance bigger than 0.7; they present this characteristic in best corrected binocular visual acuity too in the same distance, but it is not statistically significative (p=0.22). The same happens with the intermediate and short distance visual acuity (p=0.22 and p= 0.58, respectively).

The mean spherical equivalent was -0.42D, with a standard deviation of ±0.018D, one month after the surgery, and -0.18D with a standard deviation of ±0.015D at three months; In our sample, mild ametropias [(+0.75/-1.00D) with mean visual acuity of 0.798±0.052], and residual astigmatisms [(–0.75/+0.50D) with mean visual acuity of 0.702±0.158] with spherical equivalent short to –0.25D were tolerated.

The mean depth of focus, measured with defocus curves, was + 0.75 in far distance with a mean visual acuity of 0.8 and +2.00/-1.00 in short distance with a mean visual acuity of 0.7, at one and three months (graph 3). The outcomes one month and three months after the surgery are shortly the same.



Graph 3. Defocus curve at three months.

Graph 3 shows two main peaks: in 0.00D with BCVA of 1.00 and in -2.50D with BCVA of 0.9, due to the two principal foci of vision that this bifocal IOL has.

In our study the mesopic contrast sensitivity[7] measured at three months was in the normal range for healthy eyes between the ages of 20 and 55 (table 2, graph 4, shadowy area), although the patients in our group are between 60 and 75 year old.

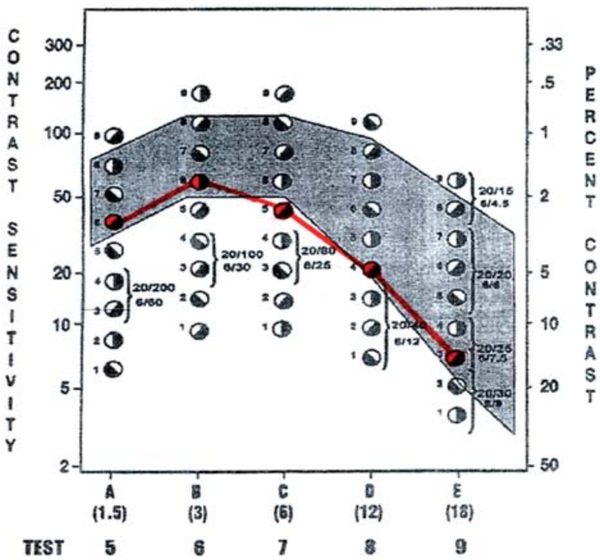
The frequency and percentage of the categorical variables, like dysphotopsia, pupillometry and OCP, have been calculated with the test of McNemar for paired samples.

Considering the presence of dysphotopsias 20% of the patients had some dysphotopsias one month after the surgery, being positive (halos, scattering, arc of light) and of grade 2 in 18%, and negative (temporal shading) and of grade 1 in 2%. These symptoms were reduced at three months, affecting 9% of the patients and being all of them positive (arc of light) and of grade 1 at this point.

18% of the patients presented positive dysphotopsia at one month; of these, 9% still had it at three month. However, all the those that had negative dysfo-

Table 2: Mean contrast sensitivity at three months, in LogMar values vs. standard CSS max-min value

Spatial Frequency	Average 3months/Standard max-min CSS LogMar
A (1.5)	1.845LogMar/2.230-1.845LogMar
B (3)	85LogMar/220-85LogMar
C (6)	70LogMar/185LogMar
D (12)	32LogMar/85LogMar
E (18)	10LogMar/26LogMar



Graph 4. Contrast sensitivity mean at 3 month.

topsia at one month, did not show it at three months. Nevertheless, through the McNemar test for paired samples, it is concluded that there is not statistically significant connection between both variables (p=0.25).

On the other hand, 59.09% of the lenses were centred and almost 40% of the lenses had suffered some rotation (13.64%-clockwise rotation and 27.27%-counter clockwise rotation) with respect to their initial intraoperative position one month after the surgery, reaching 50% at three months.

The following table (table 3) shows the distribution of the lenses at three months according to the rotation suffered and the short distance spontaneous visual acuity that they achieved.

In 40% of the eyes the lens suffered some rotation regarding its initial position within one month after the IOL implantation; in 7 cases it was a clockwise rotation and in 4 it was a counter clockwise rotation (fig. 2). In all these cases the rotation was between 10 and 20º, except in one eye that suffered a 45º rotation and whose short distance SVA was 0.9. The mean short distance SVA in the eyes that suffered some rotation (clockwise or counter clockwise rotation) was 0. 9. The only case that achieved a short distance SVA of 0.6 was one patient whose lens remained centred (table 4). Vertical or horizontal displacements of the lens were not found in any of the cases within the three months of follow-up.

Regarding biomicroscopic evaluation, 9% of the eyes showed some degree of posterior capsule opacification (PCO) at three months, but none of them needed treatment.

The mean pupil diameter measurement, made at 3 months after surgery in scotopic, mesopic and photopic conditions, was 4.1.981±0.689mm, 4,128±0.591 mm, 3,268±0.691 mm respectively. Nevertheless, through the McNemar test for paired samples, it is concluded that there is not statistically significant connection between visual acuity and pupil diameter variables (table 5). Only one patient with pupil diameter bellow 4 mm in all lighting conditions (2.8 mm-scotopic,

Table 3: Short distance monocular SVA at three months according IOL position (n=24 eyes)

Visual Acuity Snellen scale	1.00 (nº eyes)	0.9 (nº eyes)	0.8 (nº eyes)	0.7 (nº eyes)	0.6 (nº eyes)	Total eyes
Centered	1	7	3	0	1	12
Clockwise rotation 10-20º	3	0	3	1	0	7
Clockwise rotation >30º	0	1	0	0	0	1
Counter clockwise rotation 10-20º	1	2	1	0	0	4

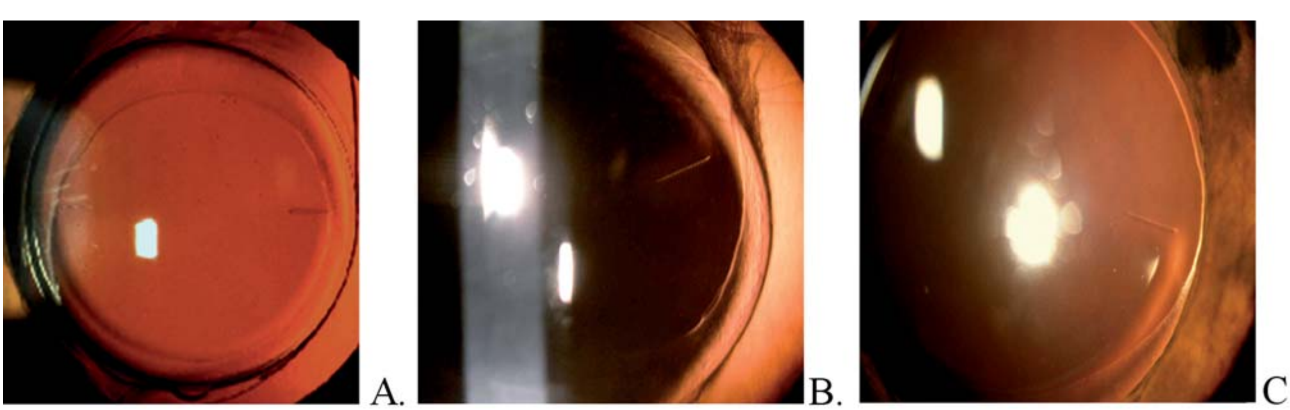


Figura 2. A. Centered IOL. B. Counter clockwise rotated IOL. C. Clockwise rotated IOL.

Table 4: Summary of the analyzed data of the Mplus® IOL one and three months after the surgery

Visual Acuity Snellen scale	Mean values at 1 Month	Mean values at 3 months
Far monocular SVA	0.836±0.171	0.836±0.171
Short monocular SVA	0.824±0.112	0.895±0.116
Far monocular BCVA	0.896±0.135	0.947±0.158
SE spherical equivalent	-0.42D ±0.018D	-0.33D ±0.015D
Depth focus	±0.75, SVA far 0.8 +2.00/-1.00 SVA short 0.7	±0.75, SVA far 0.8 +2.00/-1.00 SVA short 0.7
Dysphotopsias	20% (18% positive, 2% negative), grade 2	9%, (positive), grade1
IOL Stability (Rotated)	30% rotated, SVA mediun 0.95	50% rotated, SVA mediun 0.95

2.61 mm-mesopic and 2.10 mm photopic) 3 months after surgery, presented better corrected monocular visual acuity of 0.8 right eye/0.9 left eye and 0.9 right eye/0.9 left eye far and short distance respectively.

Table 5: Monocular Snellen BCVA in different distances with the mean diameter pupil in photopic conditions (n= 24 eyes, the mean VA redounded to the highest)

	VA in photopic lighting conditions (70 cd/m²) at 3months	
	4.1.981±0.689mm	
	Mean best corrected Snellen visual acuity at 3months	**1.00 or better (%)**
Far (6m)		
Monocular	0.95	54,55%
Intermediate (80 cm)		
Monocular	0.8	–
Short (33 cm)		
Monocular	0.95	83.36%

Six months after the surgery a telephone survey was conducted to evaluate the patients´ degree of visual satisfaction, from 1 to 10, in far, short and intermediate distance, and the potential need for glasses. The following table (table 6) shows the survey questions and the mean values.

DISCUSSION

When evaluating a lens quality, the visual acuity (measured with eye-charts) cannot be the only parameter to study, because it only shows a part of the visual function. For this reason our trial also included the study of contrast sensitivity and the presence of dysphotopsias.

The Mplus® lens does not behave like a refractive, diffractive, apodized diffractive[8] or mixed (combination of refractive and diffractive design in the same lens) multifocal lens[9-11].

Table 6: Outcomes of the telephone survey made 6 months after the surgery

Mean satisfaction level	Rated 8.5 on 10
Dependence on glasses for far vision	No one
Dependence on glasses for short vision	1 patient with glasses of. +1.00 Add. for occasional use with binocular implants,
Intermediate vision (computer…)	Rated 7.8 on 10
Dysphotopsias (halos, glare…)	Only one patient, who had binocular implants, ocasionally in grade 1 and only in one eye with artificial Light.
Double images	No one
Would you undergo surgery again with the same IOL?	YES, 86.67% of the sample (13 patients; 2 with a monocular implant and 11 with binocular implants), 6.66% DON´T KNOW (1 with monocular implant).
Would you recommend this IOL?	YES, 80% of the sample (12 patients; 2 with monocular implant and 10 with binocular implants), 13.33% DON´T KNOW (2 with binocular implants)

Refractive multifocality is based on the optic principle of refraction, that is to say, on the change of direction of the light when it goes through two media with different refractive index. Refractive lenses are divided into different areas; these areas consist of concentric rings of different dioptric power which provide different focal points to facilitate the refraction of the light of each distance (far, intermediate and short distance)[9,10]. Therefore there will be two main foci of vision and multiple secondary foci inside and outside the main optic axis of vision[9].

In the case of diffractive multifocal lenses the concept changes due to the principle of diffraction, since the light is divided by the steps present in the optical of the lens developing light waves that are in the same phase (constructive) and thereby create one focal point, or light waves that are in a different phase (destructive) which eliminate the light of the focus, making up two main focal points. Due to these interferences some light is inevitably lost[10], since there will be less light concentrated in each focal point thus, reducing visual quality[9].

The Mplus® lens is a bifocal lens with an aspherical and neutral posterior face and whose anterior face is a combination of two spherical surfaces, with different radio of curvature, which create the two main foci of vision: one for far distance vision and the other one for short distance vision (the latter is achieved with the sector-shaped of +3.00 located inferiorly). Due to the optic design of the lens, it behaves like two monofocal lenses, being less the light that is lost, because the only step that exists between the sector-shaped addition and the rest of the optical gives out a phantom image located outside the main optic axis of vision where the two main foci are situated. Therefore it is a lens that behaves like a monofocal lens for far distance vision in its whole optical, except in the sector-shaped addition used for short distance vision. The limit between these areas (for far distance and short distance vision) is the only point of the lens where the light refracts to another focus outside the main axis, and due to the coincidence between the vertex of the surface and the origin «0» of the lens, there is not an image jump, achieving on this way a perfect transition between far and short distance vision (image jump and secondary focus inside the main axis are thus avoided). Thanks to all of foci this, the lens has less light scattering, more quantity of light concentrated in its two main focus of vision and less overlap of images[3]. The other multifocal lenses, however, have multiple curves and steps that cause more light scattering and thereby, more light loss in the main foci of vision at the retina, a reduction of the visual quality and CSS[7,10]. This could explain the good outcomes in CSS obtained in our sample, which are in the normal range for patients between the ages of 22 and 55, as well as the low incidence of dysphotopsias[2,3].

With this lens, far distance Snellen BCVA was better than 0.7 in all of the cases, with a mean of 0.947±07158. These results are similar to those obtained with other multifocal lenses[7,8,11-13]. Authors such as Alfonso et al obtain mean binocular Snellen BCVA of 0.98 (0.034LogMar) with aspherical multifocal IOL that have +4.00 addition[10], or of 0.96 (0.06LogMar) with +3.00 addition[11].

Short distance Snellen SVA was 1.00 in 22.72% of the cases, being 0.8 or better in 95.56%, and therefore similar to the results obtained with other multifocal lenses[7,8].

The intermediate distance vision that the patients achieve with the Mplus® lens is due to the overlap that exists between the far distance and short distance focus depth[2,3,14,15], which enables a functional intermediate distance vision. In our trial obtained a mean intermediate distance monocular Snellen SVA of 0.7, being 0.8 or better in 68.18% of the cases, and not worse than 0.5 in any of the cases. When intermediate distance SVA was analyzed binocularly, 95% of the patients had a visual acuity of 0.8 or better.

We have evaluated the intermediate and short distance visual acuity without optic correction because the mean spherical equivalent was -0.33D, with a standard deviation of ±0.015D, at three months; therefore, we do not considered it significant.

Regarding intermediate and short distance binocular SVA, our outcomes are not very different to those obtained in other studies with multifocal lenses of different optic design. Authors such as Alfonso et al[12] recently evaluated the intermediate distance BCVA in spherical and aspherical multifocal lenses and obtained results similar to ours.

The percentage of patients with dysphotopsias at three months was 9%, being all of them positive and of grade 1 (arc of light), we believe that this type of manifest dysphotopsia, «arc of light», may be due to design of the lens, overall to the sector-shaped bottom. This percentage is quite low if we compare it with the one associated to other multifocal or monofocal lenses[6], since in the trial carried out by Cisneros et al 85% of the patients with the ZM900(MF) Tecnics multifocal lens had positive dysphotopsias at 6 months (using the same test).

Some rotation (≥10º clockwise or counter clockwise) of the lens[16], with respect to the manufacturer´s mark, was observed in 50% of the eyes at three months. In all of the cases this rotation was between 10 and 20º, except in one eye that suffered a 45º rotation and whose short distance Snellen SVA was 0.9. The mean short distance SVA in the eyes that suffered some rotation (clockwise or counter clockwise rotation) was 0.9, similar to the mean of the whole sample. The only case that achieved a short distance Snellen SVA of 0.6 was one patient whose lens remained centred, thus a decrease in short distance visual acuity can not be assigned to the rotation of the lens (table 2). We want to emphasize that vertical displacements of the lens were not found in any of the cases within the three months of follow-up.

Therefore, the lens works with one focus or the other independently[3]. We think that its visual function is not affected by the quantity of light and its direct influence on pupil function like in others lens model[14].

CONCLUSION

The Mplus® lens is effective in providing the patients with adequate visual acuity in far, short and intermediate distance. In this case, intermediate distance visual acuity may probably be due to the good focus depth that is two main foci present when they overlap.

Adaptation, satisfaction and tolerance have been high in the patients that have andergone suffered the implantation of this lens, achieving a satisfactory visual quality in the three distances (far, short and intermediate distance). The low incidence of dysphotopsias (halos, glare and/or overlap of images) is remarkable, resulting in a better image quality without the light scattering that diffraction causes, and a better CSS because of less loss of light in each main focus.

We would also like to point out that, although the manufacturer suggests the +3.00 sector-shaped addition of the lens must be located inferiorly, we have noticed that its position does not affect far, short or intermediate distance visual acuity. We think this may be due to the fact that the focus, either the far distance or short distance focus, works whatever its foveal location, either superior, inferior, nasal or temporal.

Neuroadaptation seems to be fast and efficient, and we have not observed that short distance visual acuity may be reduced with small pupils.

REFERENCES

1. Woodcock M. Shah S, Smith R. Recent advances in customising cataract surgery. Br Med J 2004; 328(10): 92-96.
2. Auffarth GU1, Rabsilber TM1, Philips R2, Novák J3. Oculentis LENTIS Mplus: An innovate multifocal intraocular lens technology. Cataract and refractive surgery today Europe. February 2010. 34-35.
3. Jorge L. Alió. lentis® Mplus LS-312MF; Un nuevo concepto en lentes multifocales.Asociación Española de Tecnología y Cirugía de Implantes, Refractiva y Córnea (2010 ASET-CIRC).
4. Aslam TM, Dhillon B, Tallentire VR, Patton N, Aspinal P. Development of a Forced Choice Photographic Questionnaire for Photic Phenomena and Its Testing - Repeatability, Reliability and Validity. Ophthalmologica 2004; 218: 402-410.
5. Aslam TM, DhillonB. Priciples of pseudofakic photic phenomena. Ophtalmologica 2004; 218: 4-13.
6. Miriam Cisneros, Begoña Díez, Marta Usabiaga, Iñaki Basterra, Javier Orbegozo. Análisis de disfotopsias positivas y negativas en lentes intraoculares acrílica. Comunicación libre Congreso SECOIR 2009.
7. Díaz V, Orbegozo J, Ugalde A, de Luis B, Alberdi J, Romero I. Agudeza visual y sensibilidad al contraste tras implantación de Tecnics MZ9000 y Acrysof Restor. Estudio prospectivo comparativo. Microcirugía ocular. Mar 2006, Num1.
8. Niels E. de Vries, MD, Carroll A.B. Webers, MD, PhD, Robert Montés Micó, PhD. Long-term follow-up of a multifocal apodized difractive intraocular lens after cataract surgery. J Catarat Refract Surg 2008; 34: 1476-1782.
9. Ramón Lorente Moore, Paula Vázquez de Parga Salleras, Claudio Moreno Garcia. Claves en la elección de la lente multifocal. Monografías SECOIR 2007. Capitulo 31, sección 4. Lentes refractivas vs difractivas.
10. Angel López Castro. Combinación de LIO´s refractivas y difractivas: Mix and mactch. Monografías SECOIR 2007. Capítulo 29, sección 4. Lentes refractivas vs difractivas.
11. Alfonso JF, Fernández-Vega L, Amhaz H, Montés-Micó R,Valcárcel B, Ferrer-Blasco T. Visual function after implantation of an aspheric bifocal intraocular lens. J Cataract Refract Surg 2009; 35: 885-892.
12. Jorge L. Alió, Bassam Elkady, Dolores Ortiz, Gonzalo Bernabeu. Clinical outcomes and intraocular optical quality of a diffractive multifocal intraocular lens with asymetrical Light distribution. J Cataract Refract Surg 2008; 34: 942-948.
13. José F. Alfonso, MD, PhD, Luis Fernandez-Vega, MD, PhD, Cristina Puchades, MSc, Robert Montés-Micó, PhD. Intermediate visual function with different multifocal intraocular lens models. J Catarat Refract Surg 2010; 36: 733-739.
14. Julián Cezón Prieto, María José Bautista. Visual outcomes alter implantation of a refractive multifocal intraocular lens with a +3.00D addition.
15. Gerald Schmidinger, Wolfgang Geitzenauer, Bernhard Hahsle, Ulrich-Michael Klemen, Christian Skorpik, Stefan Pieh. Depth of focus in eyes with diffractive bifocal and refractive multifocal intraocular lenses. J Cataract Refract Surg 2006; 32: 1650-1656.
16. Ken Hayashi, Hideyuki Hayashi, Fuminori Nakao, Fumihiko Hayashi. Correlation between papillary size and intraocular lens decentration and visual acuity of a zonal-progressive multifocal lens and monofocal lens. Ophtalmolgy 2001;108: 2011-2017.

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