

Visual Outcome after the Implantation of a Trifocal Diffractive Multifocal Intraocular Lens: Results of a Presbyopic and Cataract Population in a Private Practice Setup

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Abstract

Purpose: To evaluate outcome of a trifocal diffractive multifocal Intraocular Lenses (MIOL) in presbyopic lens exchange and cataract surgery in a single center private practice set up.

Patient and Methods: One hundred and thirteen AT Lisa Tri trifocal MIOL were implanted in 80 patients aged 53.7 ± 5.74 years. Follow up was done at 1, 6 and 12 months. Uncorrected distance, intermediate and near acuity were evaluated.

Results: Uncorrected distance visual acuity (UCDVA) was preoperatively 0.47 ± 0.31 . Average uncorrected distance/intermediate/near visual acuity (UCD/I/NVA) postoperatively were $0.86 \pm 0.14/0.44 \pm 0.1/0.73 \pm 0.12$ at 1 month, $0.83 \pm 0.18/0.45 \pm 0.1/0.73 \pm 0.12$ at 6 months and $0.84 \pm 0.14/0.40 \pm 0.1/0.68 \pm 0.16$ at 12 months. Postoperative refractive outcome correlated significantly with lower UCDVA when the residual astigmatism was greater than 1 diopter.

Conclusions: In a private practice set up trifocal MIOL outcome was satisfactory in a predominantly presbyopic age group especially for uncorrected distance and near visual acuity. Residual corneal astigmatism had a significant impact on uncorrected visual acuity for distance.

Keywords: Trifocal Intraocular Lenses; Cataract Surgery; Refractive Lens Exchange; Presbyopia

Abbreviations

IOL: Intraocular Lens; MIOL: Multifocal Intraocular Lens; UCDVA: Uncorrected Distance Visual Acuity; UCIVA: Uncorrected Intermediate Visual Acuity; UCNVA: Uncorrected Near Visual Acuity; BCDVA: Best Corrected Distance Visual Acuity; ND-YAG-Laser: Neodymium-Doped Yttrium Aluminium Garnet Laser

Introduction

In presbyopic as well as cataract surgery trifocal intraocular lenses have become very popular [1-5], providing spectacle-independence and good uncorrected distance and near acuity [6-9]. At the same time, it has been reported that trifocal lenses are superior in terms of intermediate vision compared to traditional or bifocal diffractive intraocular lenses [3].

In prospective multicenter trials for FDA approval and for other similar government bodies, usually best case scenario are presented, where patients selection and expected outcome is extremely regulated. After these lenses have been approved, they are mainly used in private practice setups where the profile of patients demanding spectacle-independence and an excellent vision in all distances maybe quite different from study populations in controlled academic studies.

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In this paper, we analyzed the data of patients who had been operated in a private practice setup. We might call this a “real world scenario”.

Materials and Methods

In this single center interventional case series 80 patients who had cataract surgery (N = 6) or presbyopic lens exchange (N = 74) were implanted with the Acri Lisa Tri 839MP, trifocal diffractive intraocular lens (Zeiss, Oberkochen, Germany). All patients had signed informed consent for the surgical procedure as well as for data processing.

Postoperative refractive visual outcome was assessed by a trained optometrist, Data analysis was done by a reading center at the Department of Ophthalmology at the University of Heidelberg. Statistical analysis was performed using non-parametric tests analysis including Mann-Whitney U-Test and Spearman Correlation evaluation. One hundred thirteen trifocal lenses have been implanted in these 80 patients. The patients were followed up at day 1, month 1, 6 and 12.

The study population was aged between 30 to 75 years, mean age between was 53.7 ± 5.74 years.

Preoperative mesopic pupil size was 5.64 ± 66 mm. Corneal endothelial cell count was on average $2868,04 \pm 2 26,57$ cells/mm²

Preoperative uncorrected visual acuity was 0.47 ± 0.31 (decimal scale), uncorrected near visual acuity was preoperative 0.26 ± 0.20 . Spherical refraction was -0.62 ± 1.95 and cylinder was 0.87 ± 0.48 diopters.

Results

The axial length measured with the IOL-master was 24.22 ± 1.21 mm, K1 preoperatively was 43.55 ± 1.73 diopters, K2 was preoperatively 44.19 ± 1.8 diopters. The target refraction calculated with the IOL-master was on average -0.09 ± 0.20 calculated in 5 eyes with Haigis, in 2 eyes with Hoffer Q, in 7 eyes with Holladay 1 and in 99 cases with SRK/T IOL calculation formulae. Target spherical equivalent for all eyes was on average -0.13 ± 0.39 diopters. Achieved final spherical equivalent (at 1 month follow up) was -0.09 ± 0.20 diopters. The difference was 0.04 ± 0.39 diopters.

Implanted IOL power ranged from +12 up to +24 D (average $18.9 \pm 2,7$ diopters). The majority of patients were preoperatively myopic.

Uncorrected distance visual acuity (UCDVA) increased from preoperatively 0.46 ± 0.5 to 0.86 ± 0.14 after 1 month (n = 60), 0.83 ± 0.16 after 6 months (n = 58) and 0.84 ± 0.14 after 12 months (n = 31) (Figure 1a).

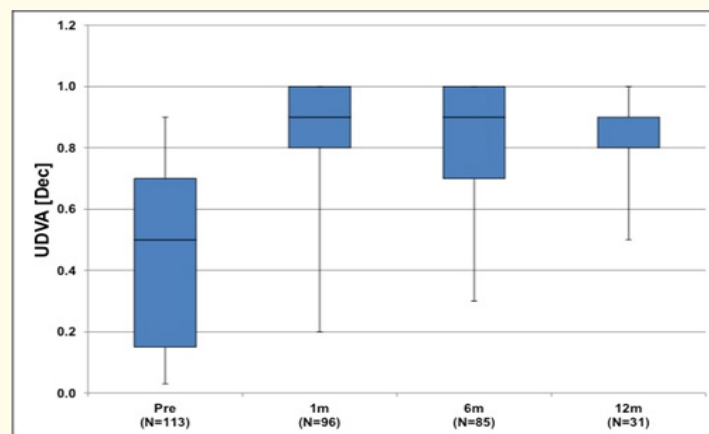


Figure 1a: Development of uncorrected distance visual acuity (UCDVA) over 12 months.

Uncorrected intermediate visual acuity (UCIVA) was not measured preoperatively. Postoperatively UCIVA was 0.44 ± 0.1 after 1 month ($n = 60$), 0.45 ± 0.1 after 6 months ($n = 58$) and 0.40 ± 0.1 after 12 months ($n = 31$) (Figure 1b).

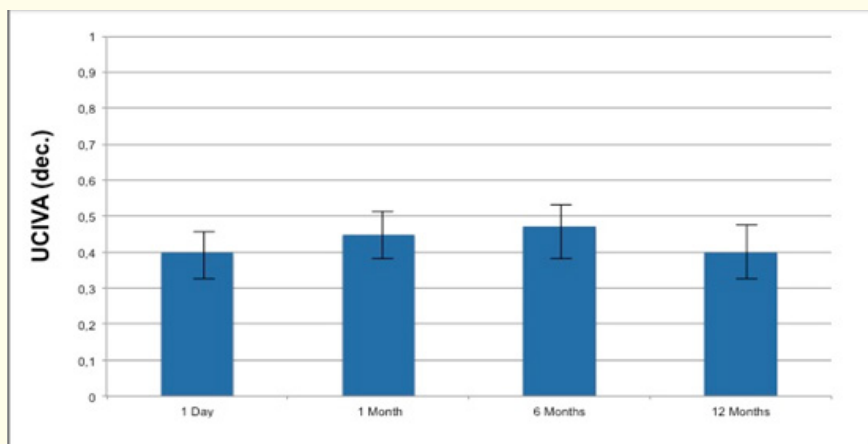


Figure 1b: Development of uncorrected intermediate visual acuity (UCIVA) over 12 months.

Uncorrected near visual acuity (UCNVA) increased from 0.28 ± 0.1 to 0.73 ± 0.12 between day 1 and 6 months and 0.68 ± 0.16 after 12 months. See also Figure 1c.

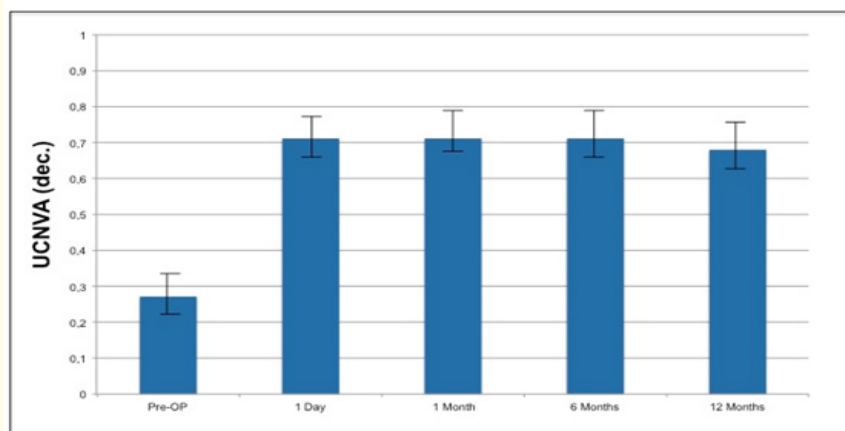


Figure 1c: Development of uncorrected near visual acuity (UCNVA) over 12 months.

Best corrected distance visual acuity (BCDVA) was preoperatively 0.86 ± 0.08 and at Month 1, 6, 12: 0.93 ± 0.13 , 0.91 ± 0.13 , 0.86 ± 0.27 .

Looking at the postoperative UCNVA versus the preoperative UCNVA, 94.3% showed a better UCNVA, 3.7% of patients had a lower postop UCNVA, Zero % of the patients lost two lines or more in terms of uncorrected near visual acuity.

The main reason for outliers in terms of uncorrected distance or near acuity were deviations from target refraction. All together 76.85% of MIOLs were within ± 0.5 diopters of targeted spherical equivalent (SE), 97.8% were within ± 1.0 diopters.

The impact of residual astigmatism on uncorrected distance visual acuity can be seen in the figure 3a (measured at 6 months post-operatively). The residual astigmatism of up to 0.5 diopters had an only slight impact on uncorrected distance visual acuity. Between 0.5

and 1 diopters patients already lost 1 line and > 1 diopter of postoperative astigmatism patients lost up to 4 lines. The correlation between decreasing UCDVA and in-creasing residual astigmatism is statistically significant (Spearman nonparametric regression $r = 0.474$; $p < 0.01$). Figure 3b also shows this correlation on a logarithmic scale.

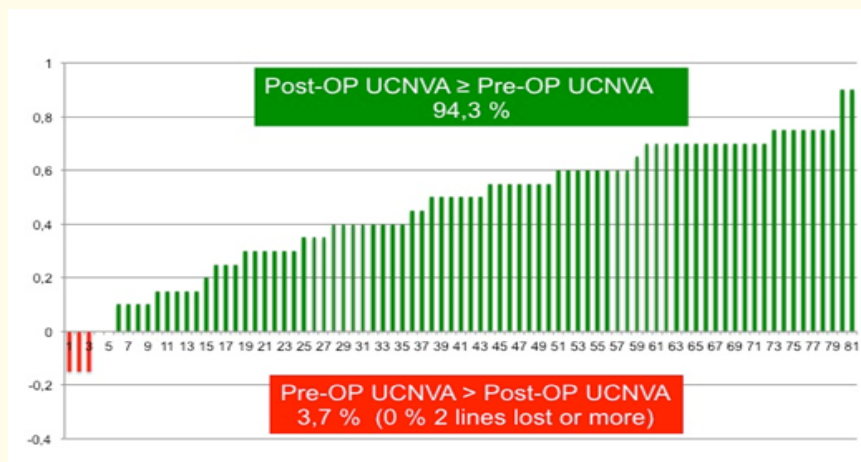


Figure 2: Postoperative UCNVA versus preoperative uncorrected near visual acuity.

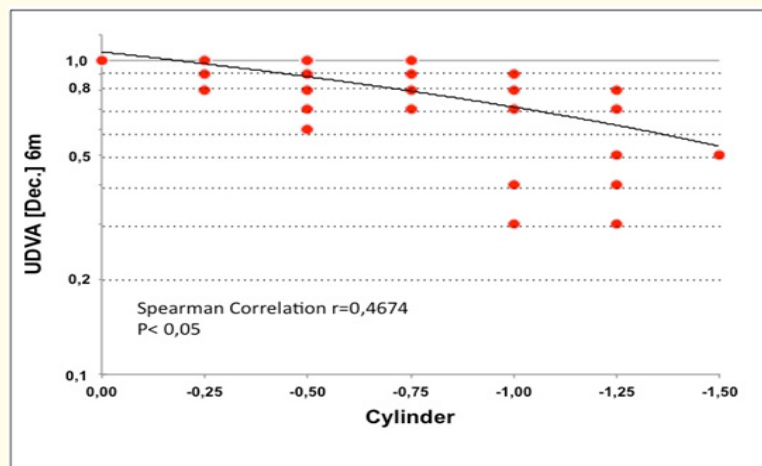


Figure 3: Postoperative UCDVA versus residual astigmatism.

The cumulative ND-YAG-Laser rate for treatment of posterior capsule opacification was 7/113 eyes at 3 months 34/113 at 6 months and 41/113 eyes at 12 months follow up.

Discussion

The study in this “real world scenario” in a private practice included a very heterogeneous patient group in an Asian population. The patients showed good functional out-come of a trifocal diffractive multifocal intraocular lens. Excellent uncorrected near acuity and good uncorrected distance acuity was seen over a follow up of 12 months.

Uncorrected visual outcome more or less depended on how good the final target re-refraction was achieved. More than 0.5 D of spherical equivalent deviation or astigmatic changes of more than 1 diopter had an impact on uncorrected distance visual acuity.

Visual satisfaction even in those cases was still satisfactory as most of these patients achieved a better uncorrected near acuity due to a more myopic final refraction.

In a study by Kretz, *et al.* 91%, 87%, and 79% of eyes with the Acri Lisa Tri MIOL achieved a monocular UCDVA/UCIVA/UCNVA of 0.1 logMAR. Ninety six percent of the patients could perform their daily tasks without problems [1]. Further studies of the same group could show that binocular summation improves uncorrected near/intermediate/distance vision significantly [5,6].

The importance of astigmatic correction and minimizing the residual astigmatism is highlighted in an article by Höhn, *et al.* [7]. They reported uncorrected average VA in all distances between 0.1 to 0.0 logMAR. Gundersen, *et al.* as well as Mojzis P and coworkers also emphasised the excellent outcome of the toric version of trifocal IOLs [3,9]. In another article Gundersen, *et al.* could show that residual astigmatism can lead to laser touch up procedures in up to 10% of cases after trifocal MIOL implantation [2].

Apart from the Acri Lisa Tri MIOL there are similar trifocal IOLs available such as the Physiol FineVision MIOL. Alio and coworkers reported on similar outcome as de-scribed in this paper with uncorrected visual acuity ranging from 0.28 to 0.1 logMAR [7].

This study presented here attempted to show “real world” outcome data with a mod-ern trifocal diffractive IOL. Uncorrected visual acuity data were good in all distances but several patients showed inferior results due to uncorrected residual refractive error especially astigmatism.

As presbyopic refractive lens exchange was the predominantly chosen indication un-corrected near acuity was an important issue in this patient cohort. Here the results were good and not negatively influenced by residual astigmatism.

Intermediate uncorrected visual acuity was lower than described elsewhere [1,5,6]. A possible explanation could be that UCIVA was tested in 80 cm distance. Attia, *et al.* re-ported in their article using the Salzburg Reading Test device a preferred intermediate distance with the AT Lisa Tri of around 60 to 65 cm [4].

It is recommended from this study to choose patients for trifocal MIOL implantation, whose expected postoperative astigmatism can be kept below 1 diopter. If toric trifocals are not available we recommend corneal incisional techniques (including on axis and opposite clear cornea incisions, limbal relaxing incisions etc.) to minimize postoperative astigmatism.

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