Abstract: Cataract surgery and intraocular lens power calculation is challenging in patients with anterior megalophthalmos and cataract, with postoperative refractive surprise frequently reported. Deep anterior chamber in these patients substantially influence effective lens position. To minimize possibility of refractive surprise, we used Haigis formula that takes into account anterior chamber depth in the lens power calculation for our patient. Cataract was managed by phakoemulsification with standard intraocular lens implanted in the capsular bag. Postoperatively, satisfying refractive result was achieved and refractive surprise was avoided.

Key words: Anterior megalophthalmos, cataract surgery, intraocular lens, power calculation.

INTRODUCTION

Anterior megalophthalmos is a rare bilateral hereditary disorder in which megalocornea (defined as horizontal corneal diameter greater than 13 mm) is associated with enlarged anterior segment of the eye (1). While in the simple megalocornea there are no additional ocular abnormalities, in the anterior megalophthalmos various other findings are present including iris hypoplasia, stromal atrophy, iris transillumination defects, pigment dispersion syndrome, myopia, cataract, lens subluxation and luxation, and glaucoma. Clinical diagnosis of anterior megalophthalmos can be confirmed by biometry findings of low vitreous index (vitreous length/axial length x100 < 69%) (2).

Intraocular lens calculation is challenging in these patients, with postoperative hyperopic refraction frequently reported (3). Many commonly used formulas doesn’t take into account anterior chamber depth (ACD) when calculating intraocular lens (IOL) power. This can cause erroneous estimation of effective lens position in these unusual eyes (8). We therefore used Haigis formula (9) to calculate IOL power in this particular patient, to minimize possibility of refractive surprise. Large capsular bag is often present in these eyes, adding inaccuracy in prediction of final IOL position, if in-the-bag placement is planned.

In this report we described a case of anterior megalophthalmos with normal-sized cataractous lens. Cataract was managed by phakoemulsification with standard intraocular lens implanted in the capsular bag. Postoperatively, satisfying refraction was achieved within 0.25 D of targeted in both eyes.

CASE REPORT

A healthy 30-year-old man was referred to our department because of the bilateral vision loss due to advanced cataracts. His visual acuity was reduced to counting fingers at 1 m in the right eye, and at 3 m in the left. Slit-lamp biomicroscopy of both eyes revealed signs of anterior megalophthalmos: enlarged corneas, deep anterior chamber, iris transillumination defects and white cataract in the right eye (Figure 1), while incipient in the left. Refraction of his right eye could not be obtained, and of the left eye was mildly myopic. Anterior segment biometry data was collected by Allegro Biograph (Wave Light) as follows: average keratometry OD: 37.79 D (8.79 mm; n = 1.332), and OS: 37.92 D (8.76 mm; n = 1.332). Anterior chamber depth (ACD) and lens thickness (LT) for the right eye were 5.03 mm and 3.96 mm, and for the left eye 5.21 mm and 4.05 mm, respectively. Axial length of the right eye was 25.80 mm, and 26.80 mm of the left, measured by immersion echography. Horizontal white-to-white
for the right and the left eye was 13.56 mm and 13.24 mm, respectively. Intraocular pressure was 16 mmHg bilaterally, measured by Goldmann applanation tonometer. There were no phacodonesis in any eye, but iridodonesis was present in both.

Calculated vitreous index was 65.15 % for the right, and 65.45% for the left eye, confirming diagnosis of anterior megalophthalmos. UBM of the anterior segment revealed normal crystalline lens of 9.26 mm equatorial diameter in the right eye, concave iris configuration and elongated stretched zonules (Figure 2). Findings were similar for the left eye, with diameter of 9.24 mm.

Power of the intraocular lens was estimated with various formulas utilizing Biograph proprietary software, aiming emmetropia. Haigis formula indicated 21.5D IOL for the right eye, while other formulas predicted lower power IOLs for emmetropia. Calculation for the left eye was 18.0D. Prediction error of some commonly used formulas for the patient right eye are listed in Table 1.

Cataract surgery of the right was performed in sub-Tenon anesthesia. Temporal clear corneal incision was made by 2.4 mm knife, anterior capsule was stained with trypan-blue dye, DisCoVisc viscoelastic was injected into the anterior chamber, paracentesis incision was performed for second instrument placement, and continuous circular capsulorhexis was successfully finished. Viscoelastic material was added between iris and anterior capsule, to prevent lens iris diaphragm retropulsion syndrome (LIDRS), which is expected to occur in such a case. Phaco probe was inserted through the main incision and nucleus was chopped and aspirated. Cortical material was then aspirated with unimanual irrigation/aspiration handpiece. Single piece foldable intraocular lens Acrysof SA60AT (Alcon Laboratories, Inc.) of 21.5D was implanted in the capsular bag. Subsequently, viscoelastic material was removed and operative wounds were hydrated using balanced salt solution (BSS). A month later, second eye was operated in the same manner.

Postoperative course was unremarkable with both eyes. Best corrected visual acuity of the right eye reco-

| IOL power | SRK II | SRK T | Holladay I | Hoffer Q | Haigis |
|-----------|--------|-------|------------|----------|--------|
| 21.50     | –1.66  | –1.39 | –1.10      | –0.57    | 0.00   |
| 21.00     | –1.26  | –1.00 | –0.73      | –0.22    | 0.35   |
| 20.50     | –0.86  | –0.62 | –0.37      | 0.13     | 0.69   |
| 20.00     | –0.46  | –0.25 | 0.00       | 0.47     | 1.03   |
| 19.50     | –0.06  | 0.12  | 0.35       | 0.81     | 1.37   |

Comment: All formulae except Haigis would suggest lower power IOL to achieve emmetropia, leading to hyperopic surprise.
Normal size of the crystalline lens, as in our patient, allows secure and stable in the bag placement of an IOL which, in turns, aids in accuracy of power calculation. Additional power adjustments are only needed if the IOL is planned to be iris-fixated or capsulorhexis captured, as is the case with large or unstable capsular bag. One such a case was reported by Galvis V. and coauthors (10). Haigis formula was used in that case to calculate Artisan iris fixating lens power, with excellent refractive result.

Various other formulas are used to calculate IOL power, many of them are based only on two parameters, namely keratometry and axial length. This may explain hyperopic refractive result in some of these unusual eyes. On the other side, formulas that includes other relevant parameters (ACD, lens thickness, white-to-white measurement and other) like Haigis, Holladay II and Olsen (15), have a potential to more accurately predict postoperative refraction. In a case report of de Sanctis and Grignolo (16), Holladay II formula has been shown to be very accurate in their patient with X-linked megalocornea. Assia and coauthors (6) recently described a case of cataract surgery with IOL implantation in anterior megalophthalmos. After having hyperopic refractive surprise with SRK-T formula, they back-calculated IOL power using Holladay II formula, and concluded that IOL selection and refractive result would be similar. It remains unclear whether preoperative ACD was used in power calculation in that case. However, authors suggested the use of Holladay II formula to calculate IOL power in megalophthalmic eyes with very deep anterior chamber and wide WTW. Review of refractive results of reported cases of cataract surgery in eyes with anterior megalophthalmos, where IOL was placed in the capsular bag, is shown in Table 2.

### Table 2. Previous and current reports of in-the-bag IOL placement in anterior megalophthalmos

| Author/year | Formula | Achieved refraction (SE) |
|-------------|---------|--------------------------|
| Zare, 2011  | SRK-T   | OD +0.75 D               |
| Marques Vaz, 2007 | n/a    | OD +0.75 D OS +1.75 D  |
| Assia, 2009 | SRK-T   | OD +2.25 D (+2.90 D from target) OS +1.00 D (+2.25 D from target) |
| Hegde, 2012 | SRK II  | OD +2.50 D               |
| Javadi, 2000 | SRK-T   | 1. OD –1.75 D OS –2.50 D 2. OD –0.825 D OS +0.25 D 3. OS –0.50 D |
| Orczykowska, 2013 | SRK-T | OS +1.00 D               |
| De Sanctis and Grignolo, 2004 | Holladay II | OD +0.48 D from target OS –0.25 D from target |
| Current, 2015 | Haigis  | OD –0.25 D (-0.25 D from target) OS +0.25 D (+0.25 D from target) |
There are fewer reports of myopic postoperative surprise. Javadi et al. (17) reported postoperative myopic surprise in the majority of their cases. Axial length was measured by ultrasound, but it wasn’t stated whether it was accomplished by contact biometry, what may be the source of error. The other two published reports of myopic refraction after surgery are cases with sutured IOL, either through iris and capsule, or between iris and capsule (12, 13). Myopic refraction can be explained in these eyes by anterior shift of sutured IOL.

An interesting approach to IOL power calculation was utilized by Jain et al. (14). They used SRK II formula, and added 2 D to emmetropic calculation. The IOL optic was sulcus fixated and captured through the capsulorhexis. Final refraction was emmetropic in one eye, and mildly myopic in the other.

We showed in our case that the error that may result from the classical formulas using only the K-reading and the axial length for the prediction of ELP can be avoided by using Haigis formula in these extreme eyes. Secure capsular bag fixation of the standard intraocular lens provided stable and satisfying refractive outcome.

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**Abbreviations:**

- ACD — Anterior chamber depth
- LT — Lens thickness
- OD — Oculus dexter
- OS — Oculus sinister
- IOL — Intraocular lens
- UBM — Ultrasound biomicroscopy
- ELP — Effective lens position
- WTW — White-to-white
- BSS — Balanced salt solution
- D — Dioptr
- K — Keratometry
- LIDRS — Lens-iris diaphragm retropulsion syndrome
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