OBJECTIVE ASSESSMENT OF POSTOPERATIVE RESULTS OF INTRAOCULAR LENSES

SUMMARY

Purpose: To prospectively compare postoperative results of two premium intraocular lenses EnVISTA (Bausch and Lomb) and AcrySof IQ (Alcon), focusing on glistenings and posterior capsule opacification. The evaluation of glistenings was done using Image J software and posterior capsule opacifications were quantified with OSCA system.

Methods: Twenty patients (7 men and 13 women) with bilateral cataract were included. EnVista intraocular lens (IOL) was implanted in one eye and AcrySof IQ IOL in the second eye of each patient. Objective evaluation methods were used for assessment. Glistenings was quantified with ImageJ software and PCO using the Open-Access Systematic Capsule Assessment (OSCA) system (Devised by Aslam TM, Edinburgh, United Kingdom). Complete ophthalmological evaluation including evaluation after pupil dilation was done and digital images of intraocular lenses were obtained. The results of 2-, 4-, 6- and 12-month follow-up were compared.

Results: Twenty patients were analyzed 2 months, 16 patients 4 months, 14 patients 6 months and 13 patients 12 months after cataract surgery. There was only minimal difference in best corrected visual acuity between EnVista and AcrySof group. The glistenings in the EnVista IOLs was objectively lower than in the AcrySof IOLs during whole follow-up period. In contrast to PCO, in eyes with AcrySof IOL was lower PCO score.

Conclusion: Development of new materials and techniques of cataract surgery is the topic of ophthalmologists worldwide. Reduction of glistenings and PCO is one of the main aims, objective measurements is important part of assessment of postoperative results after cataract surgery.

Key words: glistenings, posterior capsule opacification, EnVista, AcrySof IQ, Image J software, OSCA system

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INTRODUCTION

The aim of this study was to assess postoperative results with a focus on glistenings and posterior capsule opacification (PCO) in the case of the premium intraocular lenses (IOL) EnVISTA (Bausch and Lomb) and AcrySof IQ (Alcon), with the use of objective assessment methods.

With regard to intraocular lenses, the term glistenings refers to the phenomenon created by micro-vacuoles filled with fluid that form inside the optics of soft intraocular lenses, when the IOL comes into an aqueous environment (fig. 1). The influence on visual function is controversial, explanation due to glistenings is described only very rarely (8, 20, 22). Posterior capsule opacification is defined as a complex of changes in the region of the lens capsule, leading to its opacification (1), in which the main role is played by the migration and proliferation of epithelial cells of the human lens between the artificial intraocular lens and the lens capsule. Posterior capsule opacifications may again deteriorate the patient’s vision after cataract surgery. The assessment of glistenings and PCO can be performed by subjective, subjective-objective (semi-quantitative) or objective methods.

In our study we quantified glistenings using the computer program Image J and quantified posterior capsule opacifications using the objective software OSCA system.

METHOD

In total 20 patients with bilateral cataracts were included in the study, specifically 7 men and 13 women with an average age of 71.5 years, within the range of 58 to 79 years. The patients underwent uncomplicated cataract surgery in both eyes at the Department of Ophthalmology of the University Hospital in Hradec Králové. An EnVista IOL was implanted in one eye and an AcrySof IQ IOL in the other. The patients were operated on by one of three experienced surgeons.

A standard ophthalmological examination including autorefractometer, determination of best corrected visual acuity and examination of the posterior segment in artificial mydriasis (Unitropic 1% gtt, Neosynephrine 10% gtt) was performed preoperatively, as well as 2, 4, 6 and 12 months after cataract surgery. Postoperatively we photographed the IOL at follow-up examinations, focusing on glistenings on a slit lamp with an inbuilt CSO Epsilon Lyrae camera. The slit lamp was set to 25x enlargement, with a beam width of 2 mm, maximum length, at an angle of 45 degrees with maximum light intensity. Photographs were taken after focusing on the micro-vacuoles in the intraocular lens. The entire region of the posterior capsule was documented after focusing on PCO in retroillumination. Assessment of glistenings and PCO was performed using objective software.
RESULTS

Two months after surgery 20 patients were examined, four months after 16 patients, six months 14 patients and twelve months after surgery 13 patients. In the EnVista group preoperative corrected visual acuity was 0.62 (0.4-0.8) and in the AcrySof Group 0.62 (0.2-0.8). The postoperative results are summarised in the table (table 1). Postoperative corrected visual acuity increased to an average value of 0.85 and remained stable in both observed groups (graph 1).

Glistenings were evaluated by the Image J program, and are expressed in the numbers of points with a size of <0.001 mm\(^2\) on a surface of approx. 3 x 3 mm (square of 300 x 300 pixels). An increase in glistenings was recorded in both intraocular lenses between the 2nd and 4th month and between the 6th and 12th month. By contrast, between the 4th and 6th months a reduction occurred, again in both the observed IOLs (graph 2).

Posterior capsule opacifications (PCO) were assessed by the OSCA system and are expressed numerically by the OSCA score. In eyes with an EnVista intraocular lens a progressive slight increase in PCO was recorded over time, whereas in eyes with an AcrySof IOL the OSCA score fluctuated and throughout the entire period was lower than in the case of the EnVista IOL (graph 3). Over the course of 12 months no YAG capsulotomy was performed in the observed group.

After 2 months the p-value of the randomised test was 0.058, i.e. it was not demonstrated that at least one average difference was other than zero. After 4 months the p-value of the randomised test was 0.190, i.e. it was not demonstrated that at least one average difference was other than zero. After 6 months the p-value of the randomised test was 0.012, i.e. on a 5% level of significance it is possible to assert that at least one average difference was other than zero. This difference is in the values of the OSCA parameter, where the EnVista values are higher than the AcrySof values (the p-value of the randomised test for this variable was 0.010). After 12 months the p-value of the randomised test was 0.023, i.e. on a 5% level of significance it is possible to assert that at least one average difference was other than zero. This difference is in the values of the parameter of glistenings, where the EnVista values are higher than the AcrySof values (the p-value of the randomised test for this variable was 0.006).

Visual acuity of eyes with an AcrySof IQ IOL and an EnVista IOL was comparable throughout the entire postoperative observation period. In the EnVista IOL the incidence of glistenings throughout the observation period was lower than in the AcrySof IQ IOL, and one year after surgery the difference was statistically significant. By contrast, in eyes with an AcrySof IQ IOL a lower incidence of posterior capsule opacifications was recorded, with the largest difference after 6 months. We did not record complaints with different colour of intraocular lenses in both eyes in any of our patients.

DISCUSSION

Glistening of soft IOLs is one of the potential postoperative complications. Although its influence on quality of vision...
is not large, it is necessary to ensure that its development is prevented. Factors influencing the incidence of glistenings include the composition of the material of the intraocular lens, the technique of production and processing, such as the process of sterilisation and exposure of IOL to temperature fluctuations, and last but not least also packaging of the IOL. Glistening is also contributed to by careless handling of the intraocular lens and also folding of the lens (8). Most often this is described in the case of hydrophobic acrylate IOLs (5, 22, 17). The development of glistening is accentuated by glaucoma, concurrent use of local medication and conditions leading to a breach of the haemato-ocular barrier. However, not all opacities in the intraocular lens are caused by micro-vacuoles filled with fluid, and therefore not all opacities can be evaluated as glistenings. In the case of breach of the haemato-ocular barrier changes also occur in the concentrations of proteins and lipids, and the accumulation of phospholipids on the optic of the IOL, which facilitates the penetration of hydrophobic substances. The possibility of objectivisation of glistenings is important, especially upon a comparison of the results of different studies. Micro-vacuoles can be compared thanks to the different refractive index (water – polymer). The size of the micro-vacuoles is stated from 1 to 20 µm, most frequently around 10 µm diameter (3, 20). Larger micro-vacuoles are observed upon higher temperature fluctuation in which an IOL is present, since the temperature increases the loose volume in the acrylate and facilitates the formation of vacuoles filled with fluid. They are dispersed throughout the entire optics. For evaluation of glistenings it is necessary to obtain quality photography of the IOL in large scale enlargement and maximum lighting. Semi-quantitative methods are used in assessment, and recently also a method using the computer program Image J. The most frequently used

### Table 1 Postoperative results of CVA, glistenings and OSCA score. The results are presented in the form of averages – above and minimum/maximum value – below

<table>
<thead>
<tr>
<th>IOL</th>
<th>2 months postop.</th>
<th>4 months postop.</th>
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<th>12 months postop.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>EnVista</td>
<td>AcrySof</td>
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<td>AcrySof</td>
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<tr>
<td>KZO</td>
<td>0,91</td>
<td>0,86</td>
<td>0,86</td>
<td>0,7–1,0</td>
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<td>0,8–1,0</td>
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<tr>
<th>Glistenings</th>
<th>42,71</th>
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<td></td>
<td>2–170</td>
<td>4–274</td>
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<th>OSCA</th>
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<th>0,90</th>
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<td>0,28–2,10</td>
<td>0,33–1,65</td>
<td>0,22–2,59</td>
<td>0,48–1,35</td>
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Key: IOL – intraocular lens, CVA – corrected visual acuity, OSCA – Open-access Systematic Capsule Assessment, postop. - postoperatively

### Graph 1 Best corrected visual acuity preoperatively and 2, 4, 6 and 12 months after implantation of EnVista and AcrySof intraocular lenses

**Key:** preop. - preoperatively, postop. - postoperatively, M – months

### Graph 2 Postoperative results of glistenings assessed using the Image J program in EnVista and AcrySof intraocular lenses

### Graph 3 Postoperative results of posterior capsule opacifications assessed by OSCA program in eyes with EnVista and AcrySof intraocular lenses

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### Graph 3 Postoperative results of posterior capsule opacifications assessed by OSCA program in eyes with EnVista and AcrySof intraocular lenses
Thorough cleansing of the posterior capsule from mainly proliferative type in the form of Elschnig’s pearls depends on the type of opacification. The most frequent of secondary cataract also has social, economic and medical satisfaction of patients with cataract surgery, later treatment posterior capsule, and in addition to the negative impact on the entire observation of posterior capsule opacifications (10). Proliferations, with a subsequent further increase, which had already been documented also in other studies (20).

Throughout the course of our observation, in which a stabilisation to the entire observation period, whereas in the case of the AcrySof intraocular lens a lower incidence of glistenings was observed, which is in accordance with other studies (7, 9, 10). There was also fluctuation in the incidence of glistenings during the course of our observation, in which a stabilisation to slight reduction took place following the primary increase in glistenings, with a subsequent further increase, which had already been documented also in other studies (20).

The hydrophobic acrylate intraocular lens AcrySof is considered the referential IOL in studies of glistenings, as well as in examination of posterior capsule opacifications (10). Posterior capsule opacifications after cataract surgery cloud the posterior capsule, and in addition to the negative impact on satisfaction of patients with cataract surgery, later treatment of secondary cataract also has social, economic and medical consequences. Solution of PCO causing deterioration of vision depends on the type of opacification. The most frequent treatment is Nd: YAG laser capsulotomy, less frequently suction of mainly proliferative type in the form of Elschnig’s pearls (11, 14).

The AcrySof SA60AT intraocular lens is a soft acrylate lens for which a significantly lower incidence of secondary cataract is described following implantation than in the case of PMMA and silicon IOLs (6). The bioactive material of the optical part of the AcrySof lens creates an enclosed system with the edge of the anterior capsule, and as a result posterior capsule opacification is generally not of a higher degree (12, 18, 21). This was confirmed also during our observation.

CONCLUSION

In our study we demonstrated a lower incidence of glistenings in the EnVista intraocular lens throughout the entire observation period in comparison with the AcrySof IQ IOL. By contrast, a lower incidence of posterior capsule opacifications was recorded in eyes with an AcrySof IQ IOL.

The development of new materials and cataract surgery technologies remains at the forefront of interest of ophthalmologists worldwide. The reduction of glistenings and PCO is one of the aims of cataract surgery, and as a result the objectivisation of these conditions is an important component of the observation of postoperative results.


