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Conventional pseudophakic monovision – visual function, patient satisfaction and complications

Monowizja po obustronnej operacji zaćmy – funkcja wzroku, zadowolenie pacjentów oraz powikłania

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Streszczenie: Cel: ocena funkcji wzroku, zadowolenia pacjenta i powikłań po operacji zaćmy z zastosowaniem standardowej pseudofakijnej monowizji – obserwacja 3-miesięczna.
Metody: u 20 pacjentów z wyselekcjonowanej grupy (40 oczu) w średnim wieku 62,15 ± 7,22 roku, u których 3 miesiące wcześniej wykonano zabieg obuocznego usunięcia zaćmy z wszczepem soczewek jednoogniskowych (Alcon SA60AT) wg standardowej procedury monowizji (docelowa refrakcja: oko dominujące – emmetropia, oko przeciwległe – -2,0 D), oceniono obuocznie: nieskorygowaną ostrość wzroku do bliży, widzenia pośredniego i dali (logMAR), czułość kontrastową do dali i bliży (CS- CSV-1000), stopień niezależności od okularów, stopień zadowolenia pacjenta (Type Q) i powikłania.
Wyniki: średnia korekcja do dali w oczach dominujących wynosiła -0,01 D ± 0,14, w oczach niedominujących do bliży -1,85 ± 0,19 D. Trzy miesiące po zabiegu pacjenci uzyskali bardzo dobrą obuoczną ostrość wzroku do dali i bliży i odległości pośredniej, u większości pacjentów nie była konieczna dodatkowa korekcja (średnie obuoczne: UDVA -0,03 ± 0,09, UNVA 0,1 ± 0,11, UIVA 0,39 ± 0,17). Obuoczna CS w adaptacjach mezopowej, fotopowej do dali i fotopowej do bliży mieściła się w granicach normy wiekowej. Większość pacjentów (80%) nie wymagała żadnej dodatkowej korekcji okularowej. Niezależność od okularów do dali, bliży i odległości pośredniej wynosiła kolejno 100%, 80% i 90%. Ogólne zadowolenie pacjentów było wysokie (9,40 /10). Nie obserwowano powikłań pooperacyjnych.
Wnioski: w wybranej grupie pacjentów operacje zaćmy ze wszczepem soczewek jednoogniskowych wg procedury konwencjonalnej monowizji (E, -2,0 D) pozwalają na uzyskanie bardzo dobrej obuocznej funkcji wzroku, znacznego uniezależnienia od okularów oraz ogólnego zadowolenia pacjentów.

Słowa kluczowe: pseudofakijna monowizja, funkcja wzroku, zadowolenie pacjenta, powikłania.

Abstract: Financial disclosure: the authors have no financial interest in any of the methods or products described in this manuscript.
Purpose: To evaluate visual function, patient satisfaction and complications after cataract surgery with conventional pseudophakic monovision in a 3-month follow-up.
Methods: The following parameters were evaluated in a group of 20 selected patients (40 eyes) mean age: 62.15 ± 7.22 years, who underwent bilateral cataract surgery with monofocal lens implantation (Alcon SA60AT) in the conventional monovision procedure 3 months earlier (target refraction: dominant eye-emmetropia, fellow eye – -2.0 D): binocular uncorrected visual acuity for near, intermediate distance and distance (logMAR), contrast sensitivity (CS-CSV-1000), spectacle independence, patient satisfaction (Type Q) and complication rate.
Results: The mean prescription for distance was in -0.01 ± 0.14 D in dominant eyes, and -1.85 ± 0.19 D for near in nondominant eyes. Three months after surgery, patients had a very good binocular distance, near as well as intermediate visual acuities (-0.03 ± 0.09, -0.1 ± 0.11, and -0.39 ± 0.17, respectively). Binocular contrast sensitivity values under mesopic and photopic conditions for distance and under photopic conditions for near fell in the reference range for age. Most patients (80%) did not require any additional correction. Spectacle independence for distance, near and intermediate distances was 100%, 80% and 90%, respectively. General patient satisfaction was very high (9.40/10). There were no postoperative complications.
Conclusions: Cataract surgery with monofocal lens implantation during a conventional monovision procedure (E,-2.0 D) in a selected group of patients offered a very good binocular visual function, a substantial spectacle independence and overall patient satisfaction.

Key words: pseudophakic monovision, visual function, patient satisfaction, complications.

Introduction

Spectacle independence is the main goal of modern cataract surgery. The loss of accommodation can be compensated by intraocular lens (IOL) implantation. Currently, there are many methods of presbyopia correction such as multifocal (1), accommodating (2) IOLs as well as monovision (3). Many surgeons have used multifocal IOLs achieving good near and distance UCVA. Newer models or mix of different multifocal lens types (4) also offer satisfying intermediate UCVA. Despite the introduction of improved refractive, diffractive or hybryd diffractive-

-refractive multifocal IOLs, changes in pupil diameter can cause visual discomfort (5). Additionally, patients usually have to pay for multifocal lenses, as they are not commonly reimbursed in the private and state funded healthcare setting. Accommodative IOLs do not typically cover accommodative expectations and high percentage of patients has a postoperative posterior capsule opacification (6).

Pseudophakic monovision was first described in 1984 by Boerner and Thrasher (7) but only few studies of this procedure have been published since then (3). Pseudophakic monovision is frequently used by ophthalmic surgeons. Handa et al. (8) and Ito et al. (9) evaluated satisfaction of pseudophakic monovision patients as 80–90%. Monovision can be conventional (10) or crossed (11) depending on the correction technique used for the dominant eye. For conventional monovision, eye dominance is determined by using the hole card test. The dominant eye is corrected for distance and the nondominant eye for near. This method has been used after cataract surgery for at least 10 years (3).

In this study, we report the visual function, patient satisfaction and complications after cataract surgery with conventional pseudophakic monovision.

Patients and methods

Twenty patients after the uneventful pseudophakic monovision surgery using monofocal IOLs (AcrySof SA60AT – Alcon) were analysed. The informed consent of all patients was obtained. The Declaration of Helsinki was complied with throughout the study.

The inclusion criteria included: 40–70 years of age, bilateral cataract, preoperative corneal astigmatism less than 1.0 D, and patient motivation for spectacle independence.

The exclusion criteria included: corneal astigmatism greater than 1.0 D, strabismus and concomitant ocular diseases, patients whose work requires precise binocular vision, as well as unrealistic patient expectations.

Preoperative evaluation

The dominant eye for distance vision was determined using the hole-in-card. The nondominant eye was corrected for near vision. Partial coherence interferometry (IOL Master, Carl Zeiss Meditec) or ultrasound scan were performed for preoperative biometry. In order to calculate IOL power, the SRK/T or Hoffer Q formulas were used. The target refraction was emmetropia in the dominant eye and -2.0 D in the nondominant eye.

Surgical Technique

All procedures were performed by one surgeon (WL).

Standard ultrasound cataract phacoemulsification (Infiniti) was performed under topical anesthesia (Alcaine) and a monofocal, AcrySof SA60AT IOL was implanted in the capsular bag through a 2.6 mm temporal corneal incision using an injector. The dominant eye was operated first and the fellow eye was treated 3 weeks later. The routine antiinflammatory and antibacterial topical treatment was continued for 4 weeks postoperatively.

Postoperative evaluation

The postoperative evaluation was performed at three months and included: binocular uncorrected distance visual acuity (UDVA) [logMAR-EDTRS chart (4 m)], uncorrected near visual acuity (UNVA) [logMAR chart (35 cm)], uncorrected intermediate visual acuity (UIVA) [logMAR chart (60 cm)], binocular photopic (85 cd/m^2), mesopic (3 cd/m^2) distance (2.5 m) and binocular photopic (85 cd/m^2) near (35 cm) contrast sensitivities (CS- 1.5, 3, 6, 12, 18 c/deg, CS-CSV-1000, F.A.C.T), spectacle independence, patient satisfaction (modified TyPE Questionnaire described by Leyland et al) (12) and complication assessment.

Results

10 women and 10 men were enrolled in the study. Their mean age was – 62.15 ± 7.22 years. The mean anisometropia between the eye corrected for near and for distance was 2.07 ± 0.3 D. Table I shows the preoperative and postoperative (3 months) results.

Parameter/ Parametr	Near eye/ Oko do bliży (n = 20)	Distance eye/ Oko do dali (n = 20)
Preoperative BCVA (logMAR)/ Przedoperacyjna BCVA (logMAR)	0.70 ± 0.92	0.77 ± 0.90
Axial length (mm)/ Długość gałki ocznej (mm)	23.56 ± 1.09	23.66 ± 1.15
IOL power (D)/ IOL moc (D)	23.50 ± 3.09	21.03 ± 3.31
Postoperative SE (D)/ pooperacyjna SE (D)	1.85 ± 0.18	0.23 ± 0.36

Tab. I. Preoperative and postoperative (3 months) results.
(BCVA – best corrected visual acuity, IOL – intraocular lens, SE – spherical equivalent)

Tab. I. Wyniki przedoperacyjne i 3 miesiące po zabiegu.
(BCVA – najlepsza korekcja, IOL – soczewka wewnątrzgałkowa, SE – ekwiwalent sferyczny)

Postoperative visual function

Table II shows the binocular uncorrected distance visual acuity (UDVA), uncorrected near visual acuity (UNVA) and uncorrected intermediate visual acuity (UIVA) at three months postoperatively.

Characteristics/ Charakterystyka		Resul/ Wyniki
UDVA Mean/ średnia -0.03 ± 0.09 (before/ przed 0.55 ± 0.54)	≥20/20 (LogMAR 0.00)	18 (90%)
	20/25–20/30 (LogMAR 0.1-0.2)	2 (10%)
	20/40 (LogMAR 0.3)	0 (0%)
UNVA Mean/ średnia 0.10 ± 0.11 (before/ przed 0.84 ± 0.34)	LogMAR <0.0	9 (45%)
	LogMAR 0.0– 0.1	9 (45%)
	LogMAG >0.1	2 (10%)
UIVA Mean/ średnia 0.39 ± 0.17 (before/ przed 0.95 ± 0.3)	LogMAR <0.3	7 (35%)
	LogMAR 0.3–0.5	10 (50%)
	LogMAR >0.5	3 (15%)

Tab. II. The mean postoperative binocular UDVA, UNVA and UIVA at 3 months.

Tab. II. Średnia obuoczna UDVA, UNVA, UIVA 3 miesiące po operacji.

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Table III presents the results of binocular, photopic and mesopic uncorrected contrast sensitivity (CS) for distance as well as photopic CS for near.

Photopic distance/ Fotopowa do dali	3 months/ 3 miesiące	Normal range in healthy eyes/ Zakres normy w zdrowych oczach
3 cpd	1.80 ± 0.13	From 1.56 to 2.12
6 cpd	1.89 ± 0.13	From 1.77 to 2.41
12 cpd	1.57 ± 0.20	From 1.42 to 2.10
18 cpd	1.13 ± 0.30	From 0.95 to 1.71
Mesopic distance / mezopowa do dali		
3 cpd	1.77 ± 0.14	From 1.19 to 2.03
6 cpd	1.95 ± 0.20	From 1.20 to 2.12
12 cpd	1.56 ± 0.25	From 0.64 to 1.72
18 cpd	1.07 ± 0.25	From 0.14 to 1.26
Photopic near/ fotopowa do bliży		
1.5 cpd	1.87 ± 0.11	From 1.48 to 1.90
3 cpd	1.91 ± 0.11	From 1.69 to 2.18
6 cpd	1.78 ± 0.22	From 1.69 to 2.18
12 cpd	1.33 ± 0.21	From 1.30 to 1.90
18 cpd	0.85 ± 0.21	From 0.69 to 1.69

Tab. III. The mean postoperative binocular uncorrected photopic and mesopic distance as well as photopic near contrast sensitivity at – 3 months.

Tab. III. Średnia nieskorygowana obuoczna fotopowa, mezopowa do dali oraz fotopowa do bliży czułość kontrastowa – 3 miesiące po operacji.

Spectacle independence

Complete spectacle independence was observed in 80% patients. All patients were spectacle independent for distance, 80% (16/20) were spectacle independent for near and 90% (18/20) for intermediate distances. Four patients- needed additional correction for near (0.50 ± 0.14 D) in order to see better. Only two patients needed additional correction for intermediate distances (+0.37 ± 0.5 D).

Patient satisfaction

Table IV and Table V show patient satisfaction.

From low to medium intensity of glare/halo was detected in 16% of patients.

Question/ Pytanie	Possible answers/ Możliwe odpowiedzi	3 months/ 3 miesiące
General vision satisfaction / Ogólne zadowolenie z widzenia	(0–10)	9.40 ± 1.04
Near vision satisfaction/ Zadowolenie z widzenia do bliży	(0–10)	9.25 ± 1.26
Intermediate vision satisfaction/ Zadowolenie z widzenia odległości pośredniej	(0–10)	9.50 ± 0.88
Distance vision satisfaction/ Zadowolenie z widzenia do dali	(0–10)	9.70 ± 0.66

Tab. V. The modified TyPE Questionnaire: patient satisfaction (binocular, uncorrected vision) – 3 months postoperatively (range 0–10: 0 = not satisfied at all, 10 = completely satisfied).

Tab. V. Zmodyfikowany kwestionariusz TyPE Q: satysfakcja pacjenta (obuoczne, nieskorygowane widzenie) – 3 miesiące po operacji (zasięg 0–10: 0 = całkowicie niezadowoleni, 10 = całkowicie zadowoleni).

Complications

Three months after surgery no postoperative complications were observed. No patient required IOL exchange.

Discussion

Recently, monovision has been adopted in laser corneal refractive surgery (13), conductive keratoplasty (14) to correct presbyopia. Some cataract surgeons also include pseudophakic monovision in their clinical practice (8, 9, 15–17) with promising results. In a survey done in 2007 (18) monovision or mo-

Question/ Pytanie	Possible answers/ Możliwe odpowiedzi	3 months/ 3 miesiące
a) Work difficulty at near/ Trudności w pracy do bliży	(0–4)	0.05 ± 0.22
b) Work difficulty at intermediate / Trudności w pracy do odległości pośredniej	(0–4)	0.10 ± 0.31
c) Work difficulty at distance/ Trudności w pracy do dali	(0–4)	0.25 ± 0.64
c) Work difficulty due to 'glare/halo'/ Trudności w pracy związane z „glare/halo"	(0–4)	0.25 ± 0.64
d) Severity of 'glare/halo' perception / Poziom percepcji „glare/halo"	(0–4)	0.35 ± 0.75

Tab. IV. The modified TyPE Questionnaire (binocular, uncorrected vision) – 3 months postoperatively: work difficulty at near, intermediate and distances and distance (a., b., c.); patient perception of halo and glare/ patient difficulty by halo and glare (d., e.) (range 0–4: 0 = none, 4 = strong/severe).

Tab. IV. Zmodyfikowany kwestionariusz TyPE Q (obuoczne, nieskorygowane widzenie) – 3 miesiące po operacji: trudności w pracy do bliży, odległości pośredniej i dali (a., b., c.); percepcja „halo" i „glare"/ trudności związane z występowaniem „halo" i „glare" (d., e.) – 3 miesiące po operacji (zasięg 0–4: 0 = żadne, 4 = bardzo uciążliwe).

dified monovision was recommended by 61% of ASCRS members, while the ReSTOR multifocal IOL was preferred by 17.5%. Nowadays monovision, although performed relatively less frequently is still a common surgical approach to achieve spectacle independence. In the study published by Ito M. et al. (9), 78% of patients were spectacle independent 5 years after pseudopkakic monovision, but spectacle independence in those with bilateral multifocal IOLs ranged between 80 and 90% (4, 19). So, whereas the difference in spectacle independence between pseudophakic monovision and multifocal IOL implantation may be not significant, the costs involved differ substantially. The multifocal IOL implantation involves additional costs. Monovision costs no more than ordinary cataract surgery. Before implantation of monofocal lenses in monovision procedure, appropriate patient selection is required, which was done in this study. Patients should be informed monovision may reduce stereopsis, contrast sensitivity and visual field (3). Only patients with realistic expectations who fully understand monovision concept with its advantages and disadvantages make good candidates for the procedure. One of the major advantages of monovision is that any deficit in acuity can be corrected with the occasional use of spectacles, thus it is possible to restore full binocular acuity and quality of vision easily. No strict criteria have been set for pseudophakic monovision and therefore different surgeons apply different designs. Traditional monovision in clicical practice involves correcting the dominant eye for distance and the non-dominant eye for near vision, as it is easier to suppress blurred vision in the non-dominant eye. The target refraction for the dominant eye is emmetropia, and for the non-dominant eye myopia of -2.0 to -3.0 D (20). In our study the non-dominant eye was corrected to approximately -2.0 D (best reading distance of 50 cm) since Ito et al. (9) and Zhang et al. (19) obtained good outcomes with this degree of anisometropia. In our study, LogMAR binocular UDVA was 0.0 in 90% of patients, UNVA $<$ 0.1 in 90% of patients and LogMAR binocular UINVA was at least 0.5 in 85% of patients. The similar, very good of VA outcomes were reported by other authors (9).

It has been described in the literature that some aspects of visual function, for instance contrast sensitivity can decrease after monovision correction (10) especially at high frequencies. The CS outcomes in our study are even better because binocular photopic and mesopic UDVA as well as photopic UNVA were within the reference range compared to the normal population aged 50 to 75 years (21), even at higher spatial frequencies. At the same time they were worse at lower spatial frequencies, which applied to CS for near in particular. Finkelmann et al. (16) also achieved good contrast sensitivity outcomes. One goal of pseudophakic monovision is spectacle independence. In our study 80% of patients were totally spectacle independent which was close to the results obtained by Ito et al. (78%) (9). Probably, the most important factor which affected this high percentage of spectacle independence was not only perfect IOL power calculation and uneventful surgery but also appropriate patient selection for pseudophakic monovision procedure.

As a result of high spectacle independence, the general patient satisfaction as well as satisfaction with distance and near vision was also high, which was previously observed also by Ito et al. (22). It should be noted that only 16% of patients complained about low to medium intensity of glare/halo. Greenbaum (15) reported a similar incidence of halos or glare (20% of patients). The reported halo and glare effects are associated with multifocal IOLs. These symptoms often affect patient satisfaction and are present approximately in 20% of cases (23) albeit low intensity glare and halo were observed even in 50–75% of cases (4). In our study, the analysis of photic phenomena in pseudophakic monovision patients strongly suggests that opposite unlike with multifocal IOLs, glare/halo is not a frequent feature. In our case series no patient needed IOL exchange. In a recent study of multifocal IOL implantation, 7% of patients required IOL exchange (24).

In conclusion, our results confirm the view that cataract surgery with conventional monovision procedure may be an effective approach for a selected group of patients who want to be spectacle independent. Further studies on pseudophakic monovision are required. In a selected group of patients, cataract surgery with monofocal lens implantation during a conventional monovision procedure (E,-2.0 D) offers a very good binocular visual function, a substantial spectacle independence and overall patient satisfaction.

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