UDC: 617.753.3: 617.7-089.243

THE EFFECTIVENESS OF SPHERO-CYLINDRICAL CORRECTION AT A SHORT DISTANCE IN PRESBYOPIC AGE PATIENTS WITH THE FIRST DETECTED ASTIGMATISM

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Introduction. An increase in the proportion of elderly people leads to an increase in degenerative diseases [1]. More than 2 billion people in the world have an age-related physiological decline in accommodation - a presbyopia, when visual disturbance at a close distance is perceived by patients as no less problematic than distant ones [2,3]. Presbyopia has a negative impact on the quality of life of people with the need to work at close distance [4]. It is known that presbyopia is accompanied by various refractive anomalies, astigmatism in particular. It is the most difficult to correct and relates to aberrations of the second (lower) order [5]. However, low degree astigmatism (LDA) rarely is a subject of in-depth study and correction, so even with high visual acuity in the distance, visual acuity worsening is observed relatively shortly before 40 years. Thus, classical optometry investigations rely on the minimal expediency of correction of small (0.5-0.75D) degrees of astigmatism, which are considered by the authors from the standpoint of "physiological" [6]. However, in the structure of astigmatism, 66% of cases fall into a low degree (up to 1.0 D) [7]. The practical results of optical correction without considering the cylindrical component at close dictance do not always satisfy the patient in everyday visual activity. This problem is socially significant due to its proliferation and negative impact on the standard of living and visual performance. At the same time, issues related to the diagnosis and correction of astigmatism in presbyopia are insufficient in the literature and require further study.

Aim. To analyze the effect of sphero-cylindrical and spherical correction in presbyopic patients with the first detected astigmatism at a close distance work.

Material and methods. In the department of ophthalmology of HSEEU "UMSA", 43 patients (86 eyes) were examined at the age from 38 to 59 years, on average 47 ± 0.8 years. All patients have LDA with a difference between two major meridians from 0.5D to 1.0D. Thus, reverse astigmatism (60º to 120º) was detected in 67% (29 patients), and direct (from 0º to 30º and from 180º to 150º) in 33% (14 patients). The exclusion group included: patients over the age of 60 years, patients with irregular astigmatism and correct astigmatism with oblique axes (30º to 60º and 120º to 150º), patients with anisometropy greater than 1.0D and with associated ophthalmologic pathology. At the diagnostic stage, all patients were offered a variant of spherical and sphero-cylindrical optical correction, and the data obtained formed two groups of comparison. At the beginning of the study, 40% (17 patients) did not have optical correction for close distances, and 60% (26 patients) had a previous spherical correction for close distances, which at the study period did not satisfy them. All patients had LDA diagnosed for the first time.

The examination included: a visometry without and with a correction by the Golovin-Sivtsev table from a distance of 5 m; refractometry (Hoya AR-560 autorefractometer); determining the force of a spherical lens by a subjective method; clarification of the force and axis of the cylinder using Jackson's cross-cylinder ± 0,5 D; detection of the leading eye; detection of binocular refractive balance in conditions of polarization light or using prisms in 6.0D; selection of add-ons (Add) taking into account the amplitude of accommodation and individual patient needs (depth of vision); Visometry at a close (33 cm) and average (66 cm) distance using a modified ETDRS test with a selected spherical and sphero-cylindrical correction; cross-line grid test with selected spherical and sphero-cylindrical correction at close (33 cm) and average (66 cm) distances, subjective tolerance of the selected correction.

Results. The following subjective complaints were found in patients without optical correction for a close distance, at the stage of anamnesis collection: the visual acuity was reduced from a distance of 33-40 cm - 40% (17 patients), vagueness of the text - 40% (17 patients), eyes fatigue at close distance work - 33% (14 patients), discomfort in the eyes - 28% (12 patients), headache - 16% (7 patients). Patients with a pre-existing spherical correction for a short distance had following complaints: the need to distance a text with to an average distance of 66 cm - 60% (26 patients), vagueness of the text - 60% (26 patients), fatigue at work -35% (15 patients), a sense of discomfort in the eyes - 21% (9 patients), headache -16% (7 patients).

On average, in all examined patients monocular visual acuity in the distance without correction was 0.83 ± 0.1. The visual acuity from 33 cm distance in patients without optical correction was 0.25 ± 0.07 (45 ± 2.3 optotypes) in average, in patients with pre-existing spherical correction - 0.4 ± 0.02 (55 ± 0,7 optotypes). The visual acuity from 66 cm distance in patients without optical correction, was 0.5 ± 0.12 (47 ± 1.0 optotypes) in average, in patients with pre-existing spherical correction - 0.74 ± 0.1 (52 ± 1,0 optotypes).

According to refractometry, all patients were distributed as follows: with simple myopic astigmatism - 47% (20 patients), with complicated myopic astigmatism - 16% (7 patients) and mixed astigmatism - 37% (16 patients). When specifying the force and axis of a cylindrical lens using Jackson's ± 0.5 D cross-cylinder, it turned out that 19% (8 patients) were not sensitive to the cylindrical correction for the distance given to them. In them, the degree of astigmatism according to refractometry reached 0.63 ± 0.01 D. Binocular refractive balance was observed in 79% (34 patients), and 21% (9 patients) had the best vision at the leading eye. All patients were given correction of vision in the distance according to the data of the previous survey methods. Thus, monocular visual acuity from a distance of 5 m with full optical correction was 1.0 ± 0.01 in average, binocular - 1.2 ± 0.04.

At spherical correction the chosen add-on was distributed as follows: Add 0,75 ± 0,12D (38-40 years old); Add 1.25 ± 0.19D (41-45 years old); Add 1.75 ± 0.24D (46-50 years old); Add 2.0 ± 0.2D (51-55 years old); Add 2.25 ± 0.23D (56-59 years old). At sphero-cylindrical corrections: Add 0,5 ± 0,18D (38-40 years old); Add 1.0 ± 0.21D (41-45 years old); Add 1.75 ± 0.22D (46-49 years old) Add 2.25 ± 0.24D (50-55 years old); Add 2,5D ± 0,3D (56-59 years) (Fig. 1).

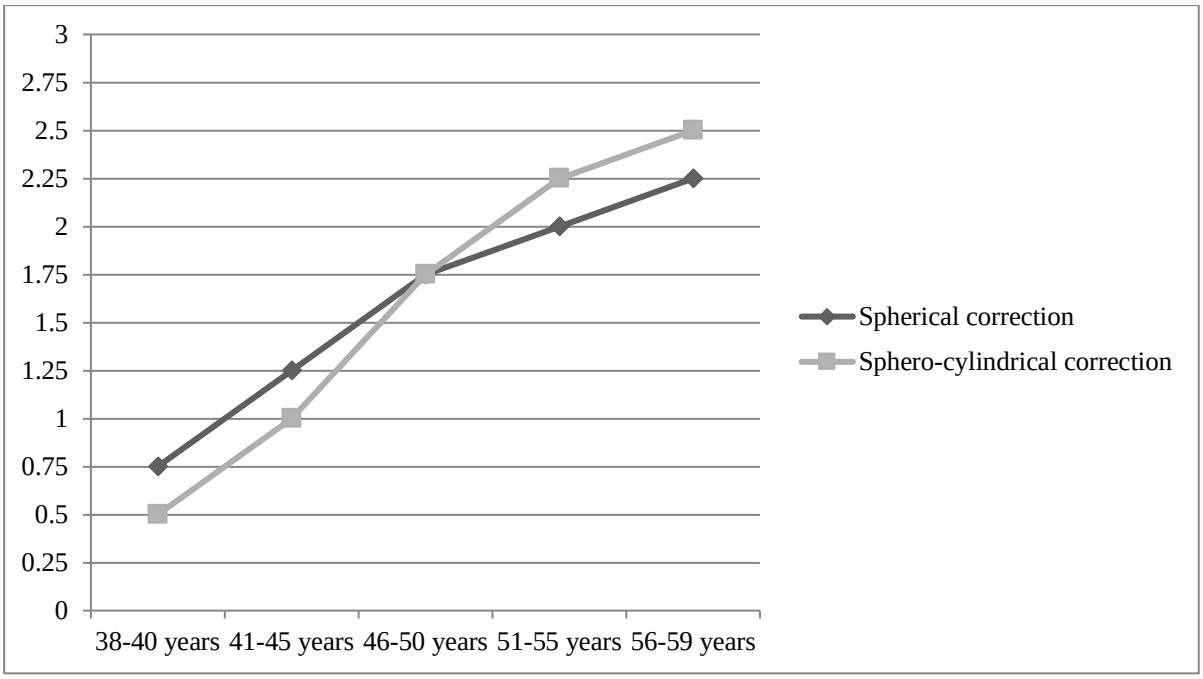


Fig. 1. Comparison of the value of add-on with spherical and sphero-cylindrical correction in patients of all ages.

When using the modified ETDRS test at a close distance (33 cm) with spherical correction, patients were better able to recognize the presented optotypes in comparison with the sphero-cylindrical correction given to them. Instead, at mid-distance (66 cm), greater clarity and recognition of optotypes were observed with sphero-cylindrical correction (Table I).

Table I

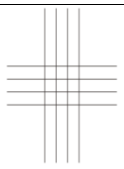
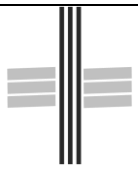
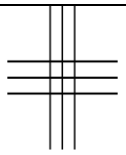
Comparison of visual acuity at close (33cm) and middle (66cm) distances using spherical and sphero-cylindrical optical correction

Group No. comparison	**Visual acuity (33 centimeters)**	**Number of optotypes (33 centimeters)**	**Visual acuity (66 centimeters)**	**Number of optotypes (66 centimeters)**
1–spherical correction	0,95±0,06	73±1,4	0,8±0,05	55±1,0
2–sphero-cylindrical correction	0,61±0,02	64±0,8	1,58±0,01	70±0,02

When using a cross-grate, 93% (40 patients) with sphero-cylindrical correction marked the even clarity of the horizontal and vertical lines from the close (33 cm) and middle (66 cm) distances, while 7% (3 patients) paid attention to the even clarity of the lines only from a distance of 66 cm. All patients with spherical correction noticed uneven horizontal and vertical lines. Thus, at a close distance horizontal lines were accented, and at medium distances - vertical ones (Table II, Table III).

Table II

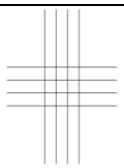
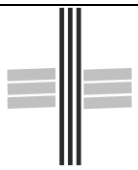
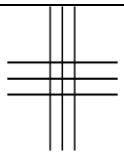
Comparison of cross-line grid clarity with selected spherical and sphero-cylindrical correction at a distance (33 cm)

Number of comparison groups	The clarity of a cross-shaped grid from 33 cm			
	 all lines blurred	 clearer horizontal lines	 clearer vertical lines	 all lines are evenly clear

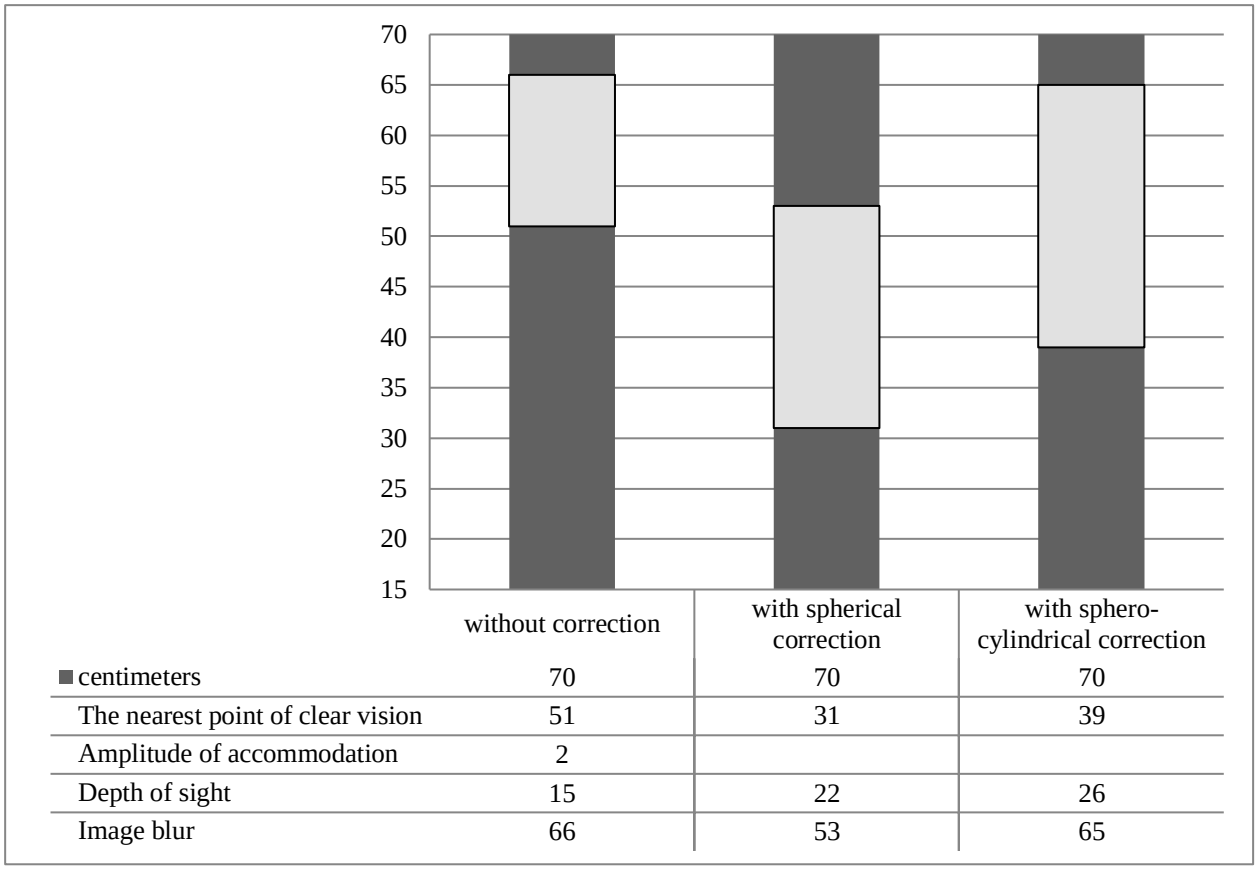
1– spherical correction	-	+	-	-
2– sphero-cylindrical correction	-	-	-	+

Table III

Comparison of cross-line grid clarity with selected spherical and sphero-cylindrical correction at a distance (66 cm)

Number of comparison groups	The clarity of a cross-shaped grid of 66 cm			
	 all lines blurred	 clearer horizontal lines	 clearer vertical lines	 all lines are evenly clear
1– spherical correction	-	_	+	-
2– sphero-cylindrical correction	-	-	-	+

With the use of spherical correction, the average indicator of the nearest point of clear vision was 31 ± 0.5 cm, with sphero-cylindrical - 39 ± 1.2 cm, and in the absence of correction - 51 ± 0.8 cm. The range of vision depth at close distance was the smallest in the absence of correction - 15 ± 0.02 cm, with the use of spherical correction - 22 ± 0.07 cm and at sphero-cylindrical one - 26 ± 0.03 cm (Fig.2).



	without correction	with spherical correction	with sphero-cylindrical correction
centimeters	70	70	70
The nearest point of clear vision	51	31	39
Amplitude of accommodation	2		
Depth of sight	15	22	26
Image blur	66	53	65

Fig.2 Average values of depth of field indicators at close distance.

After choosing an optical correction option, 74% (32 patients) marked the comfort and greater clarity of the image when working at a distance of 40-66 cm using spherical cylindrical lenses, while 26% (11 patients) selected a spherical correction, since they noticed a better subjective portability during reading and had the need for visual work at a distance of less than 33 cm.

Discussion. Thus, the magnitude of the add-on with sphero-cylindrical correction in comparison with the spherical increased at the age of 51-59 years by 0,25D, whereas at the age of 38-45 years, when applying a sphero-cylindrical correction, its value was less than 0,25 D, which, in our opinion, is related to the age volume of accommodation. The average value of visual acuity at close range (33 cm) in patients with spherical correction was better - 0.95 ± 0.06 (73 ± 1.4 optotypes) compared with sphero-cylindrical correction - 0.61 ± 0.02 (64 ± 0.8 optotypes). The mean distance (66 cm) is better in patients with sphero-cylindrical correction - 1,58 ± 0,01 (70 ± 0,02 optotypes) compared with

spherical correction - 0,8 ± 0,05 (55 ± 1,0 optotypes) Almost all patients with sphero-cylindrical correction marked the even clarity of the horizontal and vertical lines of the cross-grate, while using spherical correction, they noticed the unevenness of the clarity of the horizontal or vertical lines. Also, when using spherical correction, the nearest point of clear vision was closer to the eye, compared with sphero-cylindrical correction, but the range of depth of vision at close range was greater when using sphero-cylindrical correction. At the stage of determining the optical correction option, 74% of patients noted the comfort and greater clarity of the image when working at a distance of 40-66 cm using sphero-cylindrical lenses. 26% of patients chose a spherical correction, due to better subjective tolerance in reading and the need for visual work at a distance of less than 33 cm. Of these, 19% were not sensitive to the cylindrical correction given to them at the stage of refinement of the force and the axis of the cylindrical lens in the distance, using Jackson's cross-cylinder ± 0,5D, despite the presence of astigmatism by refractometry of 0.63 ± 0.01D.

Conclusions. 1. Spherical correction at a distance of 33 cm gives a clearer visual acuity - 0,95 ± 0,06 (73 ± 1,4 optotypes) compared with sphero-cylindrical - 0,61 ± 0,02 (64 ± 0,8 optotypes)

2. Sphero-cylindrical correction at a distance of 66 cm gives a clearer visual acuity - 1.58 ± 0.01 (70 ± 0.02 optotypes) compared with spherical - 0.8 ± 0.05 (55 ± 1.0 optotypes)

3. When applying sphero-cylindrical correction at close and middle distance, 93% of patients note the even clarity of the horizontal and vertical lines of the cross-shaped grid.

4. The application of sphero-cylindrical optical lenses at close distance gives a 4 cm wider depth range than spherical correction.

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The article presents the results of a survey of 43 patients (86 eyes) aged 38 to 59 years, on average 47 ± 0.8 years. In all patients, weak astigmatism with a cylinder (Cyl) of 0.5 D to 1.0 D was found. At the diagnostic stage all patients were offered a variant of spherical and sphero-cylindrical optical correction, the data we obtained formed two groups of comparison. At the beginning of the study, 40% (17 patients) had no optical correction near, and 60% (26 patients) had spherical correction close, which at the time of the study did not satisfy them. In all patients, astigmatism of the weak degree was diagnosed for the first time.

The average value of visual acuity at close range (33 cm) in patients with spherical correction was better - 0.95 ± 0.06 (73 ± 1.4 optotypes) compared with sphero-cylindrical correction - 0.61 ± 0.02 (64 ± 0.8 optotypes). The mean distance (66 cm) is better in patients with sphero-cylindrical correction - 1,58 ± 0,01 (70 ± 0,02 optotypes) compared with spherical correction - 0,8 ± 0,05 (55 ± 1,0 optotypes). Almost all patients with spherical cylindrical correction marked the uniform clarity of the horizontal and vertical lines of the cross-grate, while using spherical correction, they noticed the unevenness of the clarity of the horizontal or vertical lines. Also, when using spherical correction, the nearest point of clear vision was closer to the eye, compared with sphero-cylindrical correction, but the range of depth of vision at close range was greater when using sphero-cylindrical correction.

Keywords: astigmatism, presbyopia, optical correction.

УДК: : 617.753.3: 617.7-089.243

ДОЦІЛЬНІСТЬ ЗАСТОСУВАННЯ СФЕРО-ЦИЛІНДРИЧНОЇ КОРЕКЦІЇ НА БЛИЗЬКИХ ВІДСТАНЯХ У ПАЦІЄНТІВ ПРЕСБІОПІЧНОГО ВІКУ З ПЕРШЕ ВИЯВЛЕНИМ АСТИГМАТИЗМОМ

Безкоровайна І.М., Ряднова В.В., Наконечний Д.О, Безкоровайна А.О.

В статті представленні результати обстеження 43 пацієнтів (86 очей) у віці від 38 до 59 років, у середньому 47 ± 0,8 років. У всіх пацієнтів виявлений астигматизм слабкого ступеню з циліндром (Cyl) від 0,5Д до 1,0Д. На етапі діагностики усім пацієнтам був запропонований варіант сферичної та сферо-циліндричної оптичної корекції, отримані нами дані сформували дві групи порівняння. На початок дослідження 40% (17 пацієнтів) не мали оптичної корекції зблизу, а 60% (26 пацієнтів) мали попередню сферичну корекцію зблизу, яка на момент дослідження їх не задовільняла. У всіх пацієнтів астигматизм слабкого ступеню був діагностований вперше.

Середнє значення показників гостроти зору на близькій відстані (33 см) у пацієнтів з сферичною корекцією було кращим – 0,95±0,06 (73±1,4 оптотипи) в порівнянні сферо-циліндричною корекцією – 0,61±0,02 (64±0,8 оптотипи). На середній відстані (66 см) краще у пацієнтів з сферо-циліндричною корекцією – 1,58±0,01 (70±0,02 оптотипів) в порівнянні з сферичною корекцією – 0,8±0,05 (55±1,0 оптотипів). Майже усі пацієнти з сферо-циліндричною корекцією відмічали рівномірну чіткість горизонтальних та вертикальних ліній хрестоподібної решітки, натомість при використанні сферичної корекції вони відмічали нерівномірність чіткості горизонтальних або вертикальних ліній. Також, при використанні сферичної корекції найближча точка ясного зору була більш наближеною до ока, в порівнянні з сферо-циліндричною корекцією, проте діапазон

глибини зору на близькій відстані був більшим при використанні сферо-циліндричної корекції.

Ключові слова: астигматизм, пресбіопія, оптична корекція.

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The work is part of the research work of the department: "Clinical and morphological changes of eye structures in degenerative diseases of the organ of vision", № 0114u001456.

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