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The accuracy of IOL power calculation formulas for eyes of axial length exceeding 24.5 mm

Dokładność metod kalkulacji mocy soczewek wewnątrzgałkowych implantowanych do gałek ocznych o długości przekraczającej 24,5 mm

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Streszczenie: Cel: porównanie dokładności 6 metod kalkulacji mocy soczewek wewnątrzgałkowych (SRK II, SRK/T, Binkhorst, Hoffer Q, Holladay 1, Haigis) w przypadku obliczania mocy soczewek implantowanych do gałek o długości przekraczającej 24,5 mm.
Materiał i metody: 61 pacjentom operowanym z powodu zaćmy starczej, u których długość operowanej gałki ocznej wahała się od 24,51 mm do 26,72 mm, skalkulowano moc soczewki wewnątrzgałkowej wg sześciu formuł (SRK II, SRK/T, Binkhorst, Hoffer Q, Holladay 1, Haigis). Podczas operacji zaćmy wszczepiano implant o mocy wyliczonej metodą Holladay 1. W 30. dniu po zabiegu sprawdzano ostrość wzroku pacjentów na tablicy Snellena.
Wyniki: 54 pacjentów (88,5%) uzyskało ostrość wzroku 1,0 na tablicy Snellena. Stosując pozostałe metody kalkulacji, pełną ostrość wzroku uzyskano by w następujących przypadkach: SRK/T – 39 pacjentów (63,9%), Hoffer – 22 pacjentów (36,1%), Binkhorst – 21 pacjentów (34,4%), Haigis – 7 pacjentów (11,5%), SRK II – 5 pacjentów (8,2%).
Wnioski:
1. Metoda Holladay 1 jest zalecana do kalkulacji mocy soczewek wewnątrzgałkowych implantowanych do gałek dłuższych niż 24,5 mm.
2. Formuła SRK/T wydaje się satysfakcjonująca w omawianych przypadkach.

Słowa kluczowe: kalkulacja mocy soczewek wewnątrzgałkowych, długość gałki ocznej przekraczająca 24,5 mm.

Summary: Purpose: To compare the accuracy of different IOL power calculation formulas for eyes of axial length exceeding 24.5 mm.
Material and methods: 61 patients were examined, whose ocular axial lenght ranged between 24.51 mm and 26.72 mm. Preoperatively, the IOL power for each patient was calculated using six different formulas (SRK II, SRK/T, Binkhorst, Hoffer Q, Holladay 1, and Haigis). The power of the actually implanted IOL was based on Holladay 1 formula. Visual acuity was measured using Snellen chart on the 30th postoperative day.
Results: 54 patients (88.5%) achieved full visual acuity (1.0 on Snellen chart) after cataract surgery. If other power calculation formulas were used for the actual IOL, this would be achieved respectively in: SRK/T – 39 patients (63.9%), Hoffer Q – 22 patients (36.1%), Binkhorst – 21 patients (34.4%), Haigis – 7 patients (11.5%), SRK II – 5 patients (8.2%).
Conclusions:
1. Holladay 1 formula is recommended for intraocular lens power calculation for eyes of axial length exceeding 24.5 mm.
2. SRK/T formula also seems to be satisfactory for these cases.

Key words: IOL power calculation formula, eyes longer than 24.5 mm.

Introduction

The intraocular lens power calculation formulas can be divided into four groups:

1. The first generation – Binkhorst, SRK (Sanders-Retzlaff-Kraff) – based on following variables: axial length (AL), corneal power (K), lens constant (A)
   $P = A - 2.5 \cdot AL - 0.9 \cdot K$ P – implant power
2. The second generation – SRK II – based on variables: AL, K, A+C (modified A according to axial length)
   $P = A - 2.5 \cdot AL - 0.9 \cdot K + C$
3. The third generation – Hoffer Q, Holladay 1, SRK/T – based on anterior chamber depth (ACD) as variable.
4. The fourth generation formulas – Haigis, Olsen, Holladay 2 – many variables – AL, K, ACD, age, lens thickness (LT), vitreus chamber depth (VCD).

Having many IOL power calculation formulas available, the question is which formula fits best for patients with ultra axial lenghts, i.e. eyes – longer than 24.5 mm or shorter than 22.0 mm.

Material

61 patients (42 women and 19 men) at the age of 58 to 79 yrs (mean age o 71.25 y.o.) were examined, whose ocular axial length ranged between 24.51 mm and 26.72 mm. Strict

inclusion and exclusion criteria were applied. All patients were diagnosed with the age related cataract and their visual acuity (BCVA) was 0.2 to 0.7 using Snellen chart. Patients after refractive surgery, retinal deteachment or with other ocular comorbidities were excluded from the research.

Methods

Prior to cataract surgery, the IOL power for each patient was calculated using six different formulas (SRK II, SRK/T, Binkhorst, Hoffer Q, Holladay 1 and Haigis).

Autorefractokeratometer was used for corneal power measurement. Axial length, referred to as a distance from corneal apex to retinal internal limiting membrane was measured using contact method of ultrasonography. Holladay 1 implant power was selected after cataract phacoemulsification. Acrylic foldable intraocular lenses were implanted. Visual acuity was measured using Snellen chart on 30th postoperative day.

Results

54 patients (88.5%) achieved full visual acuity (1.0 on Snellen chart) after cataract surgery. If other power calculation formulas were used for the actual IOL, this would be achieved respectively in: SRK/T – 39 patients (63.9%), Hoffer Q – 22 patients (36.1%), Binkhorst – 21 patients (34.4%), Haigis – 7 patients (11.5%), SRK II – 5 patients (8.2%) (Fig. 1., 2.).

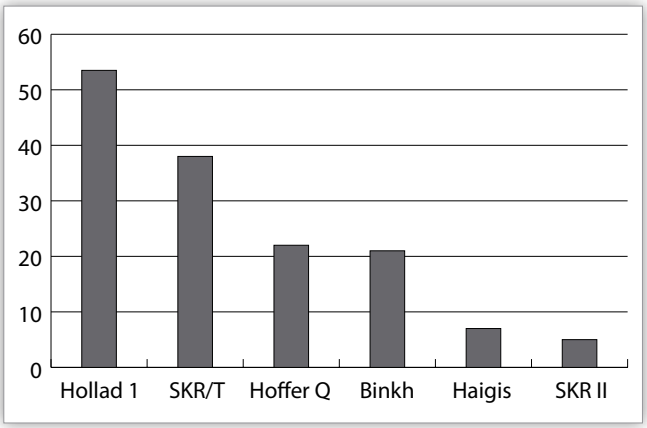

Fig. 1. Visual acuity of 1.0 on Snellen chart (no. of patients) for each individual intraocular lens power calculation formula.

Ryc. 1. Liczby pacjentów z pełną ostrością wzroku, którą uzyskano po zastosowaniu poszczególnych metod kalkulacji mocy soczewki wewnątrzgałkowej.

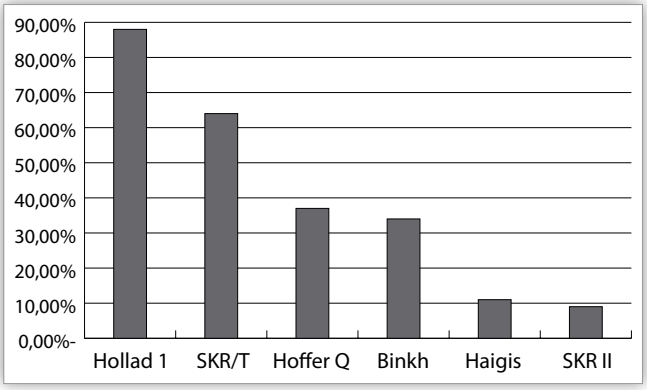

Fig. 2. Visual acuity of 1.0 on Snellen chart (% of patients) for each individual intraocular lens power calculation formula.

Ryc. 2. Odsetek pacjentów z pełną ostrością wzroku, którą uzyskano po zastosowaniu poszczególnych metod kalkulacji mocy soczewki wewnątrzgałkowej.

Discussion

The choice of an accurate IOL power calculation formula for eyes of axial length exceeding 24.5 mm is still a challenge. According to Zuidervaart and Luyten the IOL power calculations using Holladay 1 and SRK/T formulas were the most effective in terms of refractive outcomes in long eyes (1). However, Lee, Qazi and Pepose showed that Holladay 2 formula is the most accurate for IOL power calculation for long eyes (2). Ioannides gave similar conclusions in his research (3). Nevertheless, Aristodemou et al. in their research proved that Holladay 1 formula used for calculating the IOL power for eyes with axial length between 24.5 mm and 26.0 mm gave the best results, whereas for eyes longer than 27.0 mm SRK/T formula was a more precise one (4). However Donoso et al. showed that SRK/T formula was the most accurate for IOL power calculation for long eyes (5). Szaflik et al. also came to the same conclusion in their research (6). On the other hand, Narvaez et al. proved that Holladay 1, Holladay 2, SRK/T and Hoffer Q formulas gave comparable results in IOL power calculation for eyes longer than 24.5 mm (7), while Bang et al. showed that Haigis formula is the most accurate in IOL power calculating in long eyes, at the same time achieving very good results using Holladay and SRK/T formulas (8). Similarly, Terzi et al. showed the IOL power calculated using Haigis formula offered the best refractive outcome in eyes longer than 26.0 mm (9). It was confirmed by Wang et al. who also showed that there was no difference between Holladay 1, SRK/T and SRK II formulas (10). Olsen pointed to his own formula as the most accurate in IOL power calculation in eyes with axial length exceeding 24.5 mm (11).

As can be seen, there is single IOL power calculation formula to apply to eyes of axial length exceeding 24.5 mm. Most often Holladay formulas are considered (1–4). Many studied pointed to the SRK/T formula for calculating IOL power in long eyeballs as the most effective one (5, 6). Some authors suggest that Haigis formula offers the best refractive outcomes in longer eyes (8–10), whereas some think that the choice of IOL power calculation formula is negligible (7).

My study shows that Holladay 1 formula for IOL power calculation offered the most accurate results in eyes of axial length exceeding 24.5 mm. It is similar to the results obtained by Zuidervaart and Luyten et al., as well Aristodemou et al. (1, 4). The significant accuracy of SRK/T formula in my research was confirmed by the conclusions drawn by Donoso et al., and Szaflik et al. (5, 6).

In my opinion choice of correct IOL power calculation formula is crucial as good visual acuity is still the most anticipated parameter for patients after cataract phacoemulsification.

Conclusions

Holladay 1 formula is recommended for intraocular lens power calculation for eyes with axial length exceeding 24.5 mm.

SRK/T formula also seems to be satisfactory for these cases.

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