ORIGINAL RESEARCH PAPER

Volume - 14 | Issue - 09 | September - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

POSTOPERATIVE REFRACTIVE OUTCOMES IN HYPEROPIC EYES WITH SHALLOW ANTERIOR CHAMBER: COMPARATIVE ANALYSIS OF HAIGIS AND HOFFER Q FORMULAS.

Ophthalomology

Dr. Smit Kaushikbhai Shah M.S (Ophthalmology), Assistant Professor, Department of Ophthalmology, Bhagyoday Medical College, Kadi, Mehsana, Gujarat

ABSTRACT

Purpose: To compare the accuracy of Haigis and Hoffer Q intraocular lens (IOL) power calculation formulas in predicting postoperative refractive outcomes in hyperopic eyes with shallow anterior chambers following phacoemulsification. **Methods:** Retrospective comparative study of 60 eyes with axial length <22 mm and anterior chamber depth <2.5 mm. All underwent ultrasound biometry and uncomplicated phacoemulsification with posterior chamber IOL implantation. Predicted refractions using Haigis and Hoffer Q were compared with actual postoperative spherical equivalent refractions at 6 weeks. The primary outcome was mean absolute error (MAE). Secondary outcomes included mean error (ME), and percentages of eyes within ±0.25 D, ±0.50 D, and ±1.0 D of target. **Results:** MAE was 0.14 D for Haigis and 0.32 D for Hoffer Q (p < 0.001). ME was -0.038 D for Haigis and -0.30 D for Hoffer Q. With Haigis, 83.33% of eyes were within ±0.25 D, 100% within ±0.50 D, and 100% within ±1.0 D. With Hoffer Q, 36.67% were within ±0.25 D, 83.33% within ±0.50 D, and 100% within ±1.0 D. **Conclusions:** In hyperopic eyes with shallow anterior chambers, Haigis outperformed Hoffer Q when ultrasound biometry was used. Haigis may therefore be the preferred formula in this subgroup to minimize postoperative refractive surprises.

KEYWORDS

Hyperopia, Shallow Anterior Chamber, Intraocular Lens Calculation, Haigis, Hoffer Q, Cataract Surgery

INTRODUCTION

Accurate intraocular lens (IOL) power calculation is critical in achieving optimal refractive outcomes after cataract surgery. In short, hyperopic eyes with shallow anterior chambers, predicting the effective lens position (ELP) remains challenging [1]. These eyes are particularly sensitive to small errors in biometry, making them prone to refractive surprises.

The Hoffer Q formula has historically been recommended for eyes with axial length <22 mm [2]. However, the Haigis formula incorporates anterior chamber depth (ACD) into its algorithm [3], which may provide better refractive predictability in shallow eyes. While optical biometry is the current gold standard, ultrasound remains widely used in dense cataracts and resource-limited settings [4].

This study aimed to compare the predictive accuracy of Haigis and Hoffer Q formulas in hyperopic eyes with shallow anterior chambers using immersion ultrasound biometry.

METHODS

Study Design

This retrospective comparative study adhered to the Declaration of Helsinki. Informed consent was taken from the patients and confidentiality of the patients was preserved.

Participants

Sixty eyes of 30 patients with hyperopia (axial length <22 mm, ACD <2.5 mm) who underwent uncomplicated phacoemulsification with posterior chamber IOL implantation between March 2025 to June 2025 were included.

Inclusion Criteria: axial length <22 mm, shallow ACD <2.5 mm, age >40 years, uneventful surgery, minimum 6-week follow-up.
Exclusion Criteria: previous ocular surgery, corneal pathology, glaucoma, retinal disease affecting vision, intraoperative complications.

Biometry and Surgery

All patients underwent ultrasound biometry. Keratometry was obtained and IOL power was calculated using both Haigis and Hoffer Q formulas. All surgeries were performed by a single experienced surgeon using standard phacoemulsification and in-the-bag foldable IOL implantation.

Outcomes

- **Prediction Error (PE):** postoperative spherical equivalent – predicted refraction.
- Absolute prediction error (APE).
- **Primary Outcome:** mean absolute error (MAE).
- **Secondary Outcomes:** mean error (ME), and % of eyes within ±0.25 D, ±0.50 D, and ±1.0 D.

Statistical Analysis

Data were analyzed using SPSS and Microsoft Excel. Continuous variables were expressed as mean ± standard deviation. Paired t-test or Wilcoxon signed-rank test was applied as appropriate. A p-value <0.05 was considered significant.

RESULTS

A total of 60 eyes of 30 patients were included in the analysis. All cases underwent uneventful phacoemulsification with posterior chamber intraocular lens implantation.

The refractive outcomes for both formulas are summarized in Table 1 and Table 2.

For the Haigis formula, the mean error (ME) was -0.038 D and the mean absolute error (MAE) was 0.14 D. In contrast, the Hoffer Q formula yielded a mean error of -0.30 D and a mean absolute error of 0.32 D. The difference in both ME and MAE between the two formulas was statistically significant (p < 0.001).

With regard to refractive predictability, 83.33% of eyes calculated with Haigis were within ±0.25 D of the target refraction, compared with 36.67% using Hoffer Q. Similarly, 100% of Haigis eyes were within ±0.50 D and ±1.0 D, compared with 83.33% and 100% for Hoffer Q, respectively.

Table 1. Refractive Outcomes With Both The Formuale

	Hoffer Q	Haigis
Mean Error	-0.30	-0.03
Mean Absolute Error	0.32	0.14
% within 0.25 (+ or -)	36.67	83.33
% within 0.50 (+ or -)	83.33	100
% within 1.00 (+ or -)	100	100

Table 2. Comparative Refractive Outcomes In Shallow Hyperopic Eyes

Outcome Measure	Hoffer Q (n=30)	Haigis (n=30)	p-value
Mean Error (D)	-0.30	-0.038	<0.001
Mean Absolute Error (D)	0.32	0.14	<0.001
% within ±0.25D	36.67 %	83.33%	
% within ±0.50D	83.33%	100%	
% within ±1.00D	100%	100 %	

DISCUSSION

This study compared Haigis and Hoffer Q in hyperopic eyes with shallow anterior chambers using ultrasound biometry. Haigis demonstrated superior accuracy, with lower mean and mean absolute errors and a markedly higher proportion of eyes within ±0.25 D and ±0.50 D of the intended target.

These findings highlight the importance of anterior chamber depth in predicting effective lens position. The Haigis formula, which incorporates ACD, appears better suited for shallow anterior chambers than Hoffer Q, which relies primarily on axial length and keratometry.

Previous studies support these findings. Aristodemou et al. reported that Haigis performed well across varying axial lengths, particularly in short eyes [5]. Wang and Chang also found that Haigis offered reliable predictability in short eyes compared with Hoffer Q [6]. While Hoffer Q remains a reliable choice in many short eyes [2], our study suggests that in the presence of shallow ACD measured by ultrasound biometry, Haigis provides superior accuracy.

Strengths: clearly defined subgroup, standardized surgical technique, consistent biometry method.
Limitations: relatively small sample size (60 eyes), retrospective design, and no comparison with newer-generation formulas such as Barrett Universal II, Hill-RBF, or Olsen [7].
Future prospective studies using optical biometry and larger cohorts could validate these findings.

CONCLUSION

In hyperopic eyes with shallow anterior chambers measured by immersion ultrasound, the Haigis formula provided significantly greater accuracy than Hoffer Q. Haigis should be considered the preferred formula in this subgroup to minimize postoperative refractive surprises.

REFERENCES

1. Norrby S. Sources of error in intraocular lens power calculation. J Cataract Refract Surg. 2008;34(3):368-376.
2. Hoffer KJ. The Hoffer Q formula: A comparison of theoretic and regression formulas. J Cataract Refract Surg. 1993;19(6):700-712.
3. Haigis W. The Haigis formula. In: Shammas HJ, ed. Intraocular Lens Power Calculations. Thorofare, NJ: SLACK; 2004:41-57.
4. Olsen T. Sources of error in intraocular lens power calculation when using ultrasound and optical biometry. J Cataract Refract Surg. 1992;18(2):125-129.
5. Aristodemou P, Knox Cartwright NE, Sparrow JM, Johnston RL. Formula choice: Hoffer Q, Holladay 1, or SRK/T and refractive outcomes in 8108 eyes after cataract surgery with biometry by partial coherence interferometry. J Cataract Refract Surg. 2011;37(1):63-71.
6. Wang JK, Chang SW. Optical biometry intraocular lens power calculation using different formulas in short eyes. Taiwan J Ophthalmol. 2012;2(1):3-8.
7. Melles RB, Holladay JT, Chang WJ. Accuracy of intraocular lens calculation formulas. Ophthalmology. 2018;125(2):169-178.