LETTERS

Errata in printed Hoffer Q formula

It is still a challenge to calculate the most accurate intraocular lens (IOL) power after refractive surgery, and the various IOL calculation formulas have again become very popular. When we used the Hoffer Q formula as published in the formula appendix,[1] the calculated IOL power was incorrect compared with the power calculated by the Zeiss IOLMaster 3.02 and the Quantel Medical Axis II. We detected 2 errata in the printed Hoffer formula. A minus sign is missing between the brackets, and the value "1,000" means one thousand (Figure 1).

$$P = (1336/(A-C-0.05)) - (1.336 / [(1.336/(K+R)) - ((C+0.05)/1000)])$$

Figure 1. Arrows show corrections in the published Hoffer formula (P = IOL power [D], A = axial length [mm], C = chamber depth [mm], K = K average [D], and R = refractive error at corneal plane [D]).

We hope this will be of help to anyone interested in using the exemplary Hoffer Q formula for research purposes.

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REFERENCE

1. Hoffer KJ. The Hoffer Q formula: A comparison of theoretic and regression formulas. J Cataract Refract Surg 1993; 19:700–712

Reply: I am pleased to hear the good results obtained by Zuberbuhler and Morrell using the Hoffer Q formula as programmed on the Zeiss IOLMaster and Quantel Axis II (both Hoffer Q licensed). Their letter points out a problem that occurred with the Hoffer Q formula's original publication in 1993. The article contained both typographical errors and formula changes that were corrected by an erratum that appeared several months later in 1994 in another volume of JCRS.[1] Those such as Zuberbuhler and Morrell who used the original article to program the formula had no way of knowing that the corrections were published in a later issue.

The 3 mistakes in the original publication were as follows:

1. An important and crucial minus sign was left out of the power formula (P), as Zuberbuhler and Morrell have noted.
2. In the example calculations for the hyperopic eye (example 2), the results for emmetropia and ametropia were switched.
3. I made a change in the parameters to calculate the Q formula for the anterior chamber depth (ACD). In the original article, limits were placed on the ACD. This was replaced with limits on the axial length (A) (see below). Unfortunately, the erratum did not stress that this was a replacement rather than an addition so many used the limitation on the AL as well as the limitation on the ACD, leading to errors in calculation.

In addition to these, a fourth error has occurred. There are 2 limitations placed on the A. The first is as follows: If $A \leq 23$, $M = +1.0$ and $G = 28.0$; if $A > 23$, $M = -1.0$ and $G = 23.5$. The second was added in the errata: If $A > 31$, $A = 31.0$; if $A < 18.5$, $A = 18.5$. These A limitations apply *only* to the Q part of the formula to calculate the effective lens position

$$ACD = pACD + 0.3 \times (A - 23.5) + (\tan K)^2 + \left\{ \left[0.1 \times M \times (23.5 - A)^2\right] \times \left[\tan\left(0.1 \times (G - A)^2\right)\right] \right\} - 0.99166$$

and not to the power formula

$$P = [1336/(A - C - 0.05)] - \{1.336/[(1.336/(K + R)) - ((C + 0.05)/1000)]\}$$

where A = axial length, C = anterior chamber depth or ELP (estimated lens position), K = mean central corneal power, P = IOL power, R = spherical equivalent desired target PO refractive error vertexed to the corneal plane using $R = Rx/(1 - 0.012 \times Rx)$; M and G are changing constants.

Because of these problems, almost everyone attempting to program the Hoffer Q has gotten it wrong. The worst example was the major error by the Tomey ultrasound unit, which led to an article[2] showing that in a series of microphthalmic pediatric eyes, the Hoffer Q had a mean error of 11.44 diopters (D) compared with 2.74 D for the Holladay 1 and 4.40 D for the SRK/T (Table 1). The actual result, when programmed correctly, showed that the Hoffer Q was more accurate than the other 2 formulas in this series (Table 2), with a mean error of 2.78 D; a four-fold error of almost 9.0 D. The authors published an erratum,[3] which states that "[t]he error was caused by the incorrect power calculation program incorporated into the A-scan instrument (UD-7000, Tomey Corp.), which the authors failed to notice. Recalculation using the corrected program indicated that the Hoffer Q formula offered the most accurate predictions for the 5 microphthalmic eyes." It is noteworthy that their results for the Holladay 1 formula were also incorrect. Tomey corrected the error in all their instruments and also issued an apology letter to ophthalmologists around the world.

Because of these problems, I have required manufacturers to obtain a license before selling biometry units with the Hoffer Q formula installed. This license requires that I test the instrument with a series of 500 eyes to ensure the accuracy of the formula in all possible conditions. Every surgeon using the Hoffer Q should ask for assurance from the manufacturer of the device that the program being used is correct and duly licensed.

Regarding Zuberbuhler and Morrell's note about "1,000" meaning "one thousand," I am perplexed. In America, a comma

Published by Elsevier Inc.
0886-3350/07/$-see front matter
doi:10.1016/j.jcrs.2006.08.054

Table 1. Table 2 from the original article showing the Tomey incorrectly programmed Hoffer Q formula, yielding a mean prediction error greater than 11.0 D, with an error range of 17.6 D.

Table 2. Difference between predicted and actual postoperative refractions.

Formula	Mean ± SD (D)	Range (D)
SRK II	+11.94 ± 7.07	+4.22 to +21.60
SRK/T	+4.40 ± 4.34	+0.40 to +11.17
Holladay 1	+2.74 ± 4.47	−0.56 to +10.20
Hoffer Q	**+11.44 ± 7.49**	**+4.08 to +21.70**

Table 2. Table 2 from the erratum showing the Tomey correctly programmed Hoffer Q formula, yielding the lowest mean prediction error of 2.80 D, with an error range of 9.0 D.

Table 2. Difference between predicted and actual postoperative refractions.

Formula	Mean ± SD (D)	Range (D)
SRK II	+11.94 ± 7.07	+4.22 to +21.60
SRK/T	+4.40 ± 4.34	+0.40 to +11.17
Holladay	+3.03 ± 4.23	−0.56 to +10.20
Hoffer Q	**+2.80 ± 1.83**	**−4.02 to +5.00**

is used to separate the 3 zeroes from the numeral before them; in Europe, a period is used. In America, a "million dollars and 56 cents" is written "$1,000,000.56"; in Europe, it is written "$1.000.000,56." Thus, Zuberbuhler and Morrell may have thought that "1,000" was really 1.000 or the number one. Most have learned this difference. Perhaps using "1000" in the formula publication would have been preferable.

I thank Zuberbuhler and Morrell for pointing out the value of the Hoffer Q formula over the past 13 years and the problems inherent in individuals programming this formula based on the publications without checking it with the author. I apologize for any confusion this has caused.—*Kenneth J. Hoffer, MD*

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3. Erratum. J Cataract Refract Surg 2001; 27:1536

Scleral fixation

I congratulate Hoffmann et al.[1] for their article about scleral fixation via suture retrieval through a scleral tunnel. The use of iris-claw intraocular lenses (IOLs) is a safe method in many cases, such as those mentioned by the authors. However, scleral suturing is done in cases in which the patient has iris problems, such as a scleral ring, or when the IOL requires suturing. In the article by Hoffman et al., this technique is used to prevent the suture ends from protruding from the conjunctiva by keeping them in the scleral tunnel. After looking at other reports on this topic, I would like to make the following points.

1. This method is similar to the scleral flap method in that both use lamellary scleral dissection. It is a modification of the flap created. Especially in eyes in which intraocular pressure is low, preperations of these tunnels could be problematic.
2. The need to prepare 2 tunnels is more time consuming.
3. Each of the prepared tunnel's upper lips is pierced at 2 points. The edges of the knot formed below could be directed upward and protrude from the pierced points.
4. When the knot is being prepared, especially if the tunnel is long, it could be difficult to form a tight knot on the sclera. In this case, the IOL will not be tightly attached to the sclera.
5. As mentioned by Hoffman et al., based on the type of large corneal incision, suturing of the incision could be joined to the scleral suture knot tunnels. Not only would the incision not be closed properly, but contact between the IOL and sclera would be weakened.
6. In my article on scleral fixation,[2] the suture end with the knot is buried in the sclera. The edges will not cause problems because the knot and suture edge lie horizontally in the sclera. By covering the knot with a patch graft, flap or rotation is not needed. Additionally, the technique is quite easy; after it has been learned, it can be performed quickly. The method has been used succesfully in adults and infants.

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REFERENCES

1. Hoffman RS, Fine IH, Packer M, Rozenberg I. Scleral fixation uisng suture retrieval thorugh a scleral tunnel. J Cataract Refract Surg 2006; 32: 1259–1263
2. Baykara M. Suture burial technique in scleral fixation. J Cataract Refract Surg 2004; 30:957–959

Reply: Our approach to scleral fixation does represent a modification of the traditional triangular flap technique, but we believe it offers several advantages not inherent in the traditional approach. The tunnel provides a larger surface area, which facilitates suture passage for an ab interno or ab externo approach. It appears to be easier to dissect than a triangular flap and requires no sutures for closure. Although the construction of 2 tunnels is more time consuming than a procedure in which the suture knot is buried through rotation of a full-thickness scleral pass, it is no less efficient than the dissection of 2 triangular flaps. We currently prefer not to rotate knots because of the possibility of suture breakage. In addition, the larger 9-0 and 8-0 recommendations for suture gauges may further impede knot rotation secondary to the larger knot size.

The technique does require 2 suture passes that are initially placed through the full thickness of the dissected sclera, including the roof. These punctures appear to heal, as would be the case with any suture pass through scleral tissue, and the knot has not eroded or poked through these perforations since it appears to lie midway between the perforations under nonperforated sclera. Tying the sutures allows the knot to slide under the