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INTRAOCULAR LENS CALCULATION: THE WAIKATO'S FIRST YEAR

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Abstract

Prior to cataract surgery, patients had keratometry readings and ocular axial length measurements performed. The required dioptric power of intraocular lens implant was calculated using this information. The post-operative refractions of 173 eyes were reviewed to determine the effectiveness of this procedure. Some inaccuracies were found. However, overall results were satisfactory.

It was concluded that pre-operative intraocular lens calculation was a useful procedure.

Key words: *Cataract, keratometry, ocular axial length, refraction, spherical equivalent.*

INTRODUCTION

The use of intraocular lenses, as a treatment of aphakia, has become more widespread in recent years. This, in turn, has led to the development of methods of pre-operatively calculating the dioptric power of implant required for each eye. The equipment used for this comprises a keratometer, an ultrasound capable of measuring ocular axial length and a computer with suitable programme.

In February 1985 the Eye Department of Waikato Hospital obtained a new ultrasound unit and programmed computer. After a brief period of familiarisation, the orthoptist set about calculating intraocular lens strengths. This paper reviews the results after the first year of these calculations.

METHOD

Patients

The review includes all patients (173 eyes) who had pre-operative calculations performed by the orthoptist and whose follow-up notes were available to her. Unfortunately, a number of public hospital patients from outlying areas could not be included as, following surgery at Waikato Hospital, their post-operative care was transferred back to their regional hospital.

Equipment

A standard Topcon keratometer was used to take keratometry readings. Initially a Sonometrics DBR 310 ultrasound was used for axial length readings, until this was replaced by the biometry option of the Sonometrics Ocuscan 400. For both instruments the probe used housed a transducer resonant at 12.5 MHz. The computer used was a Texas Instruments Compact Computer 40 with the Binkhorst Intraocular Lens Power Calculation Programme.

Procedure

Patients had their keratometry reading carefully taken and noted. They were then transferred to the slit lamp and, after the installation of local anaesthetic drops, were instructed to keep their eyes still and widely open. The ultrasound A-scan probe was then lightly placed on the cornea and

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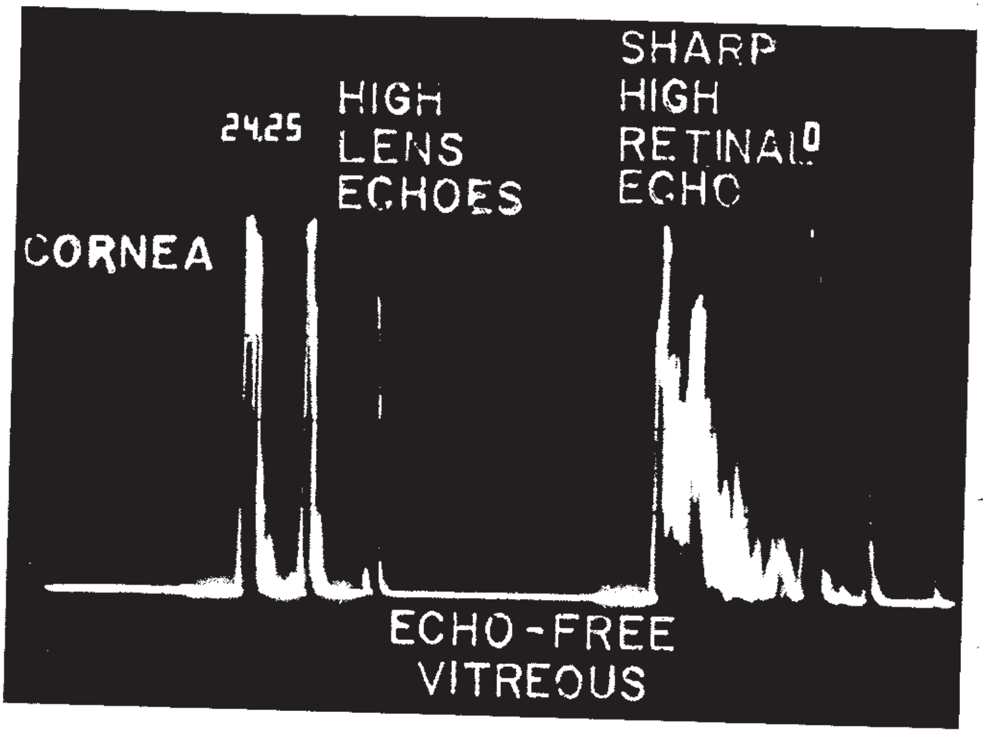

Figure 1: The echoes produced by a well aligned A-scan measuring the axial length.

manoeuvred until a satisfactory series of echoes was obtained (see Fig. 1). The axial length measurement was then noted.

Results were computed and, as suggested by Binkhorst,[1] the figures of 2.93 mm, for a vaulted anterior chamber lens, and 4.20 mm, for an angulated posterior chamber lens, were used as estimates of the post-operative cornea to implant distance.

In the case of aphakic patients having a secondary implant, the lack of lens echoes meant the ultrasound beam could not be aligned accurately. However, by using the keratometry readings and refraction, including back vertex distance, the axial length could be calculated.

RESULTS

This review covered 173 eyes measured between February 1985 and January 1986. Of these, three had poor vision post-operatively and were not prescribed glasses — one had optic atrophy, another an infection and the third a posterior staphyloma, which was not recognised during the A-scan. Subsequently, this condition was detected in another patient and, similarly, a previously undiagnosed retinal detachment was picked up on A-scan and confirmed by B-scan ultrasonography. Neither of these patients proceeded to surgery.

The implant power required was calculated to two decimal places but, as the lenses were manufactured in 0.50 dioptre increments, most calculations had to be rounded up or down. For the purposes of this review, a calculated strength with the decimal places between 0.25 and 0.74 were rounded to the half dioptre and between 0.75 and 0.24 to the whole dioptre. Often, however, the surgeons preferred to round up in order to leave the patient slightly myopic, rather than hypermetropic.

Figure 2 shows the strength of intraocular lens used plotted against the spherical equivalent of the final refraction of each of the 170 successful eyes. The different symbols indicate patients

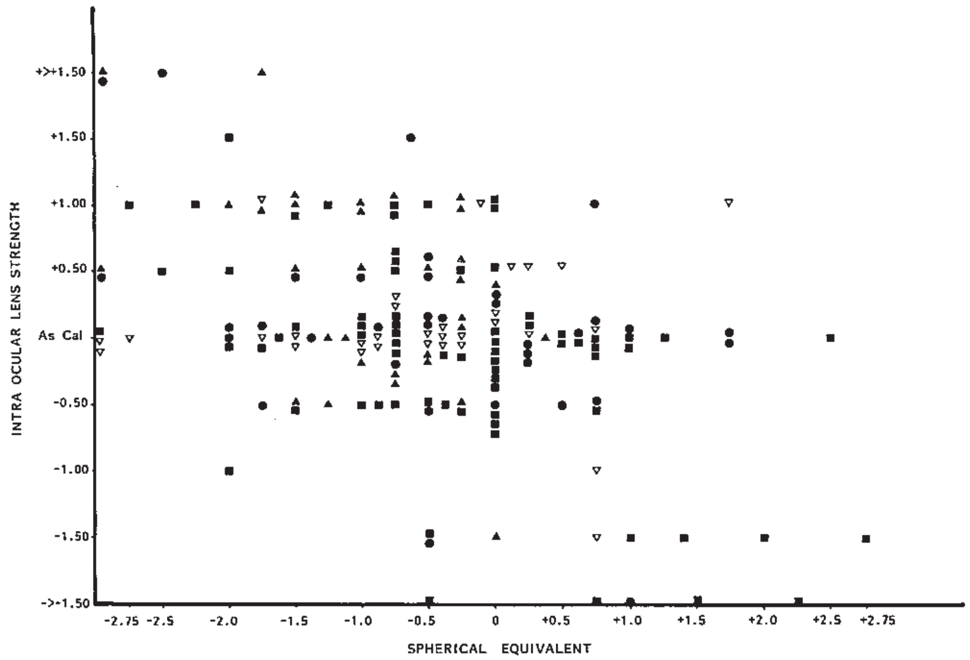

Figure 2: 170 cases showing the spherical equivalent of the post-operative refraction plotted against the strength of intraocular lens inserted.

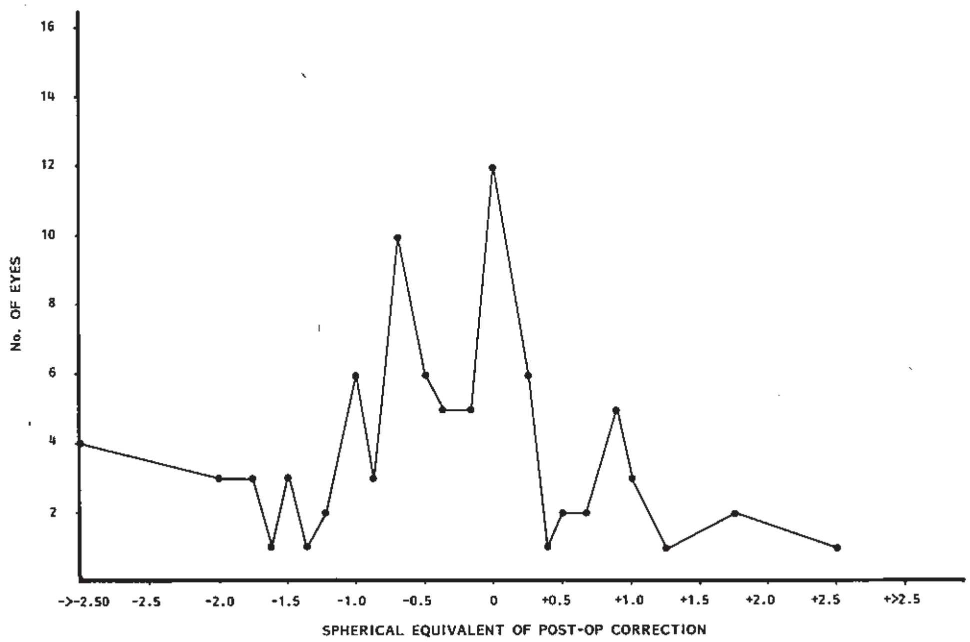

Figure 3: The refractive outcome of 87 eyes which had an intraocular lens of the calculated strength inserted.

under the care of each of the four Hamilton ophthalmologists. One hundred and eight eyes (63.5%) were given lenses as calculated or to the next strongest half dioptre and, of these, 59 (54.6%) had a post-operative refraction with the spherical equivalent of between 0 and −1.00 dioptres. Of the total 170 cases, 13 (7.6%) did not require glasses, but for 33 cases (19.4%) the post-operative refraction included a cylindrical correction equal to, or greater than, ±3.00 dioptres.

Figure 3 shows the post-operative correction of the 87 eyes which had an implant of calculated strength inserted. Ideally, all would have had a spherical equivalent of 0, but this was so in only 12 cases (13.8%). However, 56 (64.4%) had spherical equivalents of between −1.00 and +0.50 and 70 (90.8%) were between −2.00 and +1.00 dioptres. The worst result had a spherical equivalent of −3.50.

In 142 cases the final visual acuity was formally noted. Wearing the appropriate correction, 102 eyes achieved 6/6 or better and another 35 had between 6/9 and 6/12. Four eyes could only achieve 6/18 and one 6/24.

DISCUSSION

Within a short time of the advent of this new technique, many patients were being seen preoperatively. Early results were encouraging and the number of patients being measured rapidly increased until all those booked for surgery had intraocular lens calculation performed as a routine. As experience with the equipment and procedure increased, so did operator expertise — however, it would have been unrealistic to expect perfect technique. Thus, operator error was, no doubt, partly responsible for those results which were poor. Patient co-operation was another factor capable of influencing the reliability of results, as was the degree of cataract present. The more dense the cataract, the greater the difficulty in aligning the ultrasound lens echoes.

The surgeons occasionally chose to use an implant of different strength to that calculated, for example, to approximate the refraction of the other eye, but in other cases the substitution was unavoidable. This was due to the limited stock of lenses held and was particularly so when the calculated strength was unusually high or low. Figure 2 shows that, generally, when a stronger than calculated implant was used, the result was a myopic eye and the reverse was so if a weaker than calculated implant was inserted. This was the expected result and those eyes which fell outside this pattern were of particular concern. Similarly, those eyes at the extremes of the graph in Figure 3 indicate that the calculation was not sufficiently accurate.

Patient satisfaction with the outcome of their surgery was high, even in those rendered moderately myopic, as it allowed them to dispense with their glasses for some tasks.

CONCLUSION

Overall, the results were pleasing, with no very large post-operative errors and two patients having been spared fruitless surgery. The need for increased accuracy of measurements was shown in several cases, although the majority were able to obtain good vision with a relatively low post-operative correction. The calculation of intraocular lens strength appears to be a worthwhile procedure and one which, when performed accurately, is of considerable value to both surgeon and patient.

Reference

1. Binkhorst RD. Intraocular lens power calculation manual, 3rd ed. New York: Richard D. Binkhorst, 1984: 6.