A COMPARISON OF SLIT-LAMP SUPPORTED VERSUS HAND-HELD BIOMETRY

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SUMMARY

Biometry allows determination of the final refractive outcome following cataract extraction with intraocular lens implantation. We compared the accuracy of axial length measurement performed with the slit-lamp supported biometry probe versus a hand-held technique. The two methods of biometry were performed on 32 patients undergoing endocapsular cataract extraction with lens implantation. One of the methods was selected at random in order to predict implant power for a desired refractive outcome using the SRK-T formula. There was no difference in 'within-subject' variance of axial length measurement between the two methods ($t = 1.74$, $p = 0.091$), and there was no difference in refractive outcome when the power calculations for the two techniques were compared ($t = 0.12$, $p = 0.906$). The hand-held technique provides a useful alternative method of biometry in 'difficult' patients.

Biometry is usually performed with the ultrasound probe supported on a tonometer carriage, with the patient's head supported on a chin rest and the forehead held against a head band. Elderly infirm patients, those with spondylosis and children find this arrangement awkward, making accurate measurement difficult. An alternative method is to hold the ultrasound probe manually without requiring the patient to adopt a pre-determined position. The purpose of this prospective study was to compare the accuracy of slit-lamp versus hand-held biometry.

MATERIALS AND METHODS

Thirty-two patients were studied. All underwent biometry using the slit-lamp (SL) and the hand-held (HH) techniques with the Allergan Humphrey applanation biometer (model 820). Examinations were performed by four of the authors, although

both methods of biometry were performed by the same examiner in each patient. The order in which the two methods were used was not randomised; the authors did not think that bias would be introduced for either method, since the acceptance of a reading was based upon the quality of the scan and not on the measurement. Seven measurements were taken for each method, and a trimmed mean was calculated by discarding the highest and the lowest measurements. Axial length, keratometry and desired refraction were entered into the SRK-T¹ formula to calculate the lens power required to achieve desired refraction for each technique.

One of the biometry methods was randomly selected, the implant power to achieve a desired refraction was then chosen and the appropriate implant inserted during endocapsular surgery. All patients received 7 mm IOLAB PMMA implants. Patients were refracted 3 months following surgery. The difference between the predicted and achieved refractive outcome for the selected method was calculated. The accuracy of the other (non-selected) method was assessed by comparing the refractive outcome predicted by that technique for the implant power inserted with the observed final refraction.

RESULTS

Axial Length Measurement

Thirty-two patients had axial length measurements by the SL and HH techniques. Reproducibility was assessed by calculating the 'within-subject' variance² for each patient (Table I, columns 3 and 5) and comparing the two methods with a paired t -test. This showed a trend towards increased variance for the HH method but did not reach significance ($t = -1.74$, $p = 0.091$).

The mean axial lengths for both methods were compared for each patient. Agreement between the two methods was assessed using a standard plot of the difference between the two methods (HH-SL) versus their average² (Fig. 1); this graph shows no

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Table I. Comparison and statistical analysis of the slit-lamp and hand-held biometry methods

Case no.	Trimmed mean axial length, slit-lamp (mm)	Variance, slit-lamp (mm)	Trimmed mean axial length, hand-held (mm)	Variance, hand-held (mm)	δ refraction, slit-lamp (DS)	δ refraction, hand-held (DS)
1	23.042	0.05812	23.004	0.09548	1.41	1.36
2	23.506	0.15868	22.348	0.01567	2.55	0.33
3	24.62	0.01535	23.876	0.03733	N/A	N/A
4	23.49	0.0031	23.658	0.20162	-1.112	-0.73
5	24.332	0.07627	23.474	0.00838	0.33	-1.45
6	23.678	0.03357	23.642	0.03667	-1.2	-1.11
7	22.966	0.51773	21.614	0.02183	-0.75	-1.08
8	21.966	0.42143	22.026	0.47518	0.14	1.01
9	25.9	0.29825	22.088	0.25557	-3.6	0.885
10	23.73	0.03365	24.07	0.11425	N/A	N/A
11	24.6	0.03435	24.356	0.40218	-0.1	-0.65
12	22.744	0.00273	22.052	0.09175	N/A	N/A
13	22.018	0.00132	23.09	0.10108	0.25	1.2
14	21.114	0.02303	21.552	0.01042	-0.545	0.495
15	23.792	0.02772	23.424	0.03263	0.83	-0.34
16	23.348	0.11222	23.614	0.19133	0.49	1.23
17	23.098	0.00072	23.126	0.01003	0.405	0.475
18	21.02	0.00205	21.81	0.4446	0.83	2.82
19	22.122	0.01152	22.47	0.74455	1.14	1.96
20	24.316	0.42788	23.8	0.16435	1.595	0.505
21	23.694	0.00668	24.006	0.01403	-1.32	-0.69
22	22.454	0.25513	22.204	0.01808	0.51	0.98
23	22.636	0.01268	24.288	0.03487	1.02	4.71
24	23.98	0.12665	23.312	0.00297	-0.13	-1.53
25	22.928	0.00757	22.73	0.0214	N/A	N/A
26	24.744	0.07398	25.042	0.45192	-0.88	-0.33
27	22.106	0.00813	22.362	0.54137	0.09	-0.72
28	22.86	0.42685	22.338	0.00697	2.14	0.78
29	22.47	0.00635	22.728	0.17502	0.91	1.51
30	22.658	0.35707	22.704	0.77563	2.19	2.29
31	22.106	0.00813	22.362	0.54137	N/A	N/A
32	22.454	0.25513	22.204	0.01808	-0.35	-0.12

systematic variation between the techniques and no discernible pattern. The 95% confidence interval of agreement between the two methods is between -1.1 mm and +1.2 mm.

Refractive Outcome

Twenty-seven patients had completed refraction at 3 months. The predicted refractive outcome for the chosen implant power for both methods was compared with the spherical equivalent of the actual

refractive outcome. Mean difference from predicted refraction (in dioptres) for the slit-lamp method was 0.61 (SD 1.05) and for the hand-held method was 0.58 (SD 1.43) (Table II). A paired *t*-test was applied to the means ($t = 0.12$, $p = 0.906$) and showed no statistical difference between the two methods. There was a trend towards increased variation in the hand-held method but this was not significant ($F = 0.54$, $p = 0.12$).

DISCUSSION

The power of an intraocular lens (IOL) needed to achieve the desired refraction after cataract extraction can be calculated from pre-operative measurements of the corneal power and the axial length.^{3,4} Large refractive 'surprises' can result in asthenopic symptoms, commonly as a result of binocular diplopia and altered depth perception, and in some cases a second operation may be required to exchange the IOL for one of a different power. Accurate prediction of IOL power is therefore desirable. A difference of greater than 2 dioptres from predicted was found in 4 of 27 (14.8%) of the slit-lamp group and 3 of 27 (11.1%) of the hand-held group. This is a relatively small series and we cannot dispute that the degree of error is higher than in other, larger series. The biometer was calibrated and found to be functioning normally. None of the 6

Fig. 1. Difference in axial length measurement between hand-held and slit-lamp methods (HH-SL) plotted against average (HH+SL/2), showing no systematic bias between the two methods.

Table II. Difference between expected and measured refractive outcomes for the slit-lamp and hand-held biometry techniques

	Sample size	Min. (DS)	Max. (DS)	Mean (DS)	SD
δ refraction slit-lamp	27	-3.6	+2.55	0.61	1.05
δ refraction hand-held	27	-1.53	+4.71	0.58	1.43

patients in this series with a final refraction of greater than 2 dioptres from predicted suffered asthenopic symptoms.

The accuracy of IOL calculation is influenced by several factors including the IOL type and its position, corneal curvature readings, and axial length recordings.^{5,6} Studies have shown axial length to be the single most important parameter in the calculation,⁷ being responsible for up to 54% of any unexpected refraction, compared with 11% associated with keratometric error.⁸ Accurate axial length determination in the elderly infirm patient or those with spondylosis presents a challenging problem; difficulty with positioning of the patient on the chin rest can lead to incorrect readings due to poor alignment of the probe and possible excess shortening of the globe as the patient finds it difficult to remain still. A comparison of contact versus a non-contact immersion technique demonstrated superior results of the latter in the older and unstable fixated patient's eye due to less shortening of the globe,⁹ but this method is time consuming, and requires more instrumentation and further training for the technician.

A compromise between accuracy and practicality has to be sought when measuring axial length in these 'difficult' patients. The hand-held contact technique described in this study provides an alternative method of axial length determination. It may be postulated that the hand-held method of contact biometry is less accurate than the slit-lamp mounted probe, due to difficulties with adequate fixation, alignment of the probe with the visual axis and excessive corneal indentation. Significant corneal indentation and resultant apparent shortening of the globe occurs in all manual applanation techniques. Studies using a Biopen (similar to the hand-held method) have shown the effect on refractive outcome to be minimal.¹⁰ This series shows that using a biometry probe from a slit-lamp supported system by hand still gives an unbiased estimate of the axial length. However, a more accurate estimate can be made by repeated measurements (standard error of

the mean = $SD/\sqrt{n}$, where n is the number of measurements). The hand-held method has a trend towards increased standard deviation; if this is thought to be unacceptably high it can readily be compensated for by increasing the number of repeat measurements. The tendency for decreasing accuracy with increasing difference in axial length from the population median was not identified in this group as it did not contain many patients with excessively long or short eyes. This study shows that the hand-held method of biometry is an acceptable alternative in patients unable to manage the slit-lamp method for whatever reason.

Key words: Biometry, Axial length, Intraocular lens implant, Refraction.

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