CLINICAL SCIENCE

The Auckland Cataract Study: co-morbidity, surgical techniques, and clinical outcomes in a public hospital service

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Aim: To prospectively assess cataract surgery in a major New Zealand public hospital by defining presenting clinical parameters and surgical and clinical outcomes in a cohort of subjects just below threshold for treatment, based upon a points based prioritisation system.

Methods: The prospective observational study comprised 488 eyes of 480 subjects undergoing consecutive cataract operations at Auckland Hospital. All subjects underwent extensive ophthalmic examination before and after surgery. Details of the surgical procedure, including any intraoperative difficulties or complications, were documented. Postoperative review was performed at 1 day and 4 weeks after surgery. Demographic data, clinical outcomes, and adverse events were correlated by an independent assessor.

Results: The mean age at surgery was 74.9 (SD 9.6) years with a female predominance (62%). Significant systemic disease affected 80% of subjects, with 20% of the overall cohort exhibiting diabetes mellitus. 26% of eyes exhibited coexisting ocular disease and in 7.6% this affected best spectacle corrected visual acuity (BSCVA). A mean spherical equivalent of –0.49 (1.03) D and mean BSCVA of 0.9 (0.6) log MAR units (Snellen equivalent approximately 6/48) was noted preoperatively. Local anaesthesia was employed in 99.8% of subjects (94.9% sub-Tenon's). The majority of procedures (97.3%) were small incision phacoemulsification with foldable lens implant. Complications included: 4.9% posterior capsule tears, 3.8% cystoid macular oedema, and one case (0.2%) of endophthalmitis. Mean BSCVA after surgery was 0.1 (0.2) log MAR units (6/7.5 Snellen equivalent), with a mean spherical equivalent of –0.46 (0.89) D, and was 6/12 or better in 88% of all eyes. A drop in BSCVA, thought to be directly attributable to the surgical intervention, was recorded in a small percentage of eyes (1.5%) after surgery.

Conclusion: This study provides a representative assessment of the management of cataract in the New Zealand public hospital system. A predominantly elderly, female population, frequently exhibiting significant systemic illness and coexisting ocular disease, relatively advanced cataracts, and poor BSCVA, presented for cataract surgery. The majority of subjects underwent small incision, phacoemulsification, day case surgery. While almost 90% achieved at least 6/12 BSCVA post-surgery, approximately 5% sustained an adverse intraoperative event and 1.5% of eyes exhibited a reduction in BSCVA postoperatively.

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Cataract surgery is one of the most common operations performed in the Public Health Service in New Zealand/Aotearoa. The public health system in New Zealand is very similar to, but predates, the UK National Health Service (NHS). Over the past 10 years, advances in surgical equipment, techniques, and intraocular lens (IOL) design have enabled cataract surgery to evolve towards day case, small incision, sutureless, phacoemulsification surgery with foldable lens implantation under local anaesthesia.[1] Within New Zealand, a government directed policy to rationalise elective surgery, within limited health funding, has led to a points based system for cataract surgery. However, the visual disability of those at the threshold for surgery, and the outcome of cataract surgery, have not been clearly addressed within the New Zealand public health system.[2] In a large, prospective study of consecutive cataract procedures we have attempted to establish presenting patient parameters, current surgical practice, and clinical outcomes within a major teaching hospital in New Zealand.

SUBJECTS AND METHODS

Auckland Hospital contains the largest public hospital ophthalmic department in New Zealand, with 21 consultant ophthalmic surgeons and 10 fellows/registrars. This service provides more than 3000 operative procedures and 48 000 outpatient reviews each year for the population of the Greater Auckland Metropolitan region (population approximately 1.3 million). The University of Auckland Discipline of Ophthalmology is situated adjacent to Auckland Hospital and all university employed medical staff hold honorary clinical appointments and provide surgical services to the public hospital ophthalmology department. Approximately half of all cataract surgery in Auckland is performed within the public hospital system, the remainder being carried out in the private healthcare sector.

Local medical ethics committee approval was obtained before commencement of this study. All subjects enrolled in

Abbreviations: ANOVA, analysis of variance; BCVA, best corrected visual acuity; BSCVA, best spectacle corrected visual acuity; CF, counting fingers; CMO, cystoid macular oedema; ECCE, extracapsular cataract extraction; IOL, intraocular lens; IOP, intraocular pressure; UAVA, unaided visual acuity

this study had been placed on the Auckland Healthcare Services reserve waiting list for cataract surgery between January 1997 and March 2000, and lived in the Greater Auckland Metropolitan region. The creation of additional health funding, in late 1999, enabled 500 extra cataract procedures to be performed to address this reserve waiting list (subjects who were currently below the points threshold for surgery). Therefore, subjects were invited by letter to have surgery performed through the University of Auckland by the Auckland Hospital surgical team. Patients wishing to be considered for surgery attended the university discipline of ophthalmology for preoperative assessment. All subjects were offered the opportunity to undergo cataract surgery, following standard protocols, within Auckland Hospital and were also invited to participate in this prospective study. However, it was made clear that participation in the study was entirely voluntary and would not affect the subject's future clinical management in any way. Subjects were asked to provide personal details, complete a medical and medication questionnaire, and bring their current distance and reading spectacles to the preoperative assessment.

In the government directed Auckland Cataract Surgery Prioritisation System, the greater the sum of prioritisation points accrued by the patient, to a maximum possible of 100, the higher the priority for surgery. A maximum of 40 points could be awarded for distance vision if best corrected visual acuity (BSCVA) was reduced to counting fingers in both eyes (CF/CF). However, even with a cataract reducing BSCVA to counting fingers in one eye, good vision in the fellow eye—for example, 6/12, would reduce the points score for distance vision impairment to 12 points, and vision of 6/12 in both eyes would only score 7 points. Ocular clinical modifiers added or subtracted points to this distance vision score to produce an overall "visual acuity and clinical modifier score" of up to a maximum of 60 points—for example, posterior segment disease requiring prompt treatment such as diabetic retinopathy would add 20 points, or significant glare from posterior subcapsular cataract 10 points; however, untreatable posterior segment disease such as age related macular degeneration reduced the final score by −10 points. The remaining 40 possible points were awarded under three categories: (a) ability to work, give care, or live independently (0–10 points), (b) other non-ocular disability (0–10 points), (c) severity of visual impairment in everyday life—for example, reading, driving, fine work, recognising faces, etc (0–20 points). Before this initiative, patients scoring less than 34 points were deemed to fall below the stipulated threshold for surgery within the public service and were placed on the reserve list, with no guarantee of progressing to surgery, and were re-evaluated only on request from the patient or their general practitioner. This study involved the treatment of subjects just below threshold for treatment—that is, between 26–34 points on the prioritisation scheme. However, this threshold level moves up and down, depending on demand and healthcare funding. Indeed, although the cataract prioritisation scoring system has changed slightly since completion of this study, at the time of writing (July 2001), no reserve waiting list for cataract surgery exists in Auckland and all subjects with a points score equivalent to 24–26 or greater in the original system, are now guaranteed cataract surgery within 6 months.

Consistent with accepted assessment standards, all visual acuities were performed under standard illumination conditions using the logarithmic minimum angle of resolution (log MAR) scale. A single examiner (AFR) obtained full ophthalmic and medical history and performed an ophthalmic and medical examination. This included anterior segment slit lamp biomicroscopy assessment, dilated funduscopy, measurement of intraocular pressure (IOP) (Tonopen), manual keratometry (Topcon OM-4), autokeratorefractometry (Topcon KR.8100), corneal elevation topography (Orbscan II, Bausch & Lomb), and axial length measurement (Tomey AL-200) on both eyes of all subjects.

Treatment of all subjects followed routine surgical protocol at Auckland Hospital, with surgery performed by one of 26 surgeons. The particular choice of surgical technique was entirely at the discretion of the individual surgeon; however, each surgeon was asked to complete a standard proforma immediately after the procedure, detailing the specific features of the surgical techniques utilised. Recorded data included procedure type (phacoemulsification, primary extracapsular cataract extraction (ECCE), or phacoemulsification conversion to ECCE), position and type of incision (superior, or temporal, with scleral or corneal approach), placement of intraocular lens (capsular bag, sulcus, anterior chamber), and number of sutures. The type of anaesthesia used was documented, as was the level of anaesthesia and akinesia, rated by the surgeon as "complete," "incomplete," or "none." All eyes received cefazolin 100 mg, as either a 0.5 or 1.0 ml subconjunctival injection, at the end of the procedure.

All subjects were reviewed by the same surgical team on the day following surgery and a standardised postoperative clinical assessment form was completed. If the first day review was satisfactory, eyes were commenced on either topical antibiotics (chloramphenicol 0.5% eye drops, four times daily) and topical corticosteroids (prednisolone acetate 1% eye drops four times daily), or a steroid antibiotic combination (dexamethasone 0.1% and neomycin 0.35% eye drops four times daily), and reviewed at 4 weeks after surgery. Additional medications or review appointments were provided at the discretion of the surgeon or on an emergency basis.

Four weeks after surgery the same independent investigator who had performed all preoperative assessments (AFR) reviewed all subjects. A full assessment including measurement of visual acuity, measurement of IOP, autorefraction, slit lamp assessment, fundal examination, and computerised elevation topography was performed. Subjects with unaided visual acuity poorer than 6/7.5 were sent to their local optometrist for formal refraction and spectacle provision as necessary. Spectacle refraction and best spectacle corrected visual acuity (BSCVA) data for these subjects were subsequently forwarded to the investigators by these optometrists. All subjects with uncomplicated operative procedures and outcome were discharged from hospital follow up at the 4 week post-surgery review.

Consistent with previous analyses involving log MAR scores, for statistical analysis, CF vision was converted to 6/300, hand movements to 6/600, and projection of light to 6/1200 to provide continuous data.[3] Statistical analyses were performed using SPSS (Statistical Package for the Social Sciences).

RESULTS

A total of 480 subjects, who underwent a total of 488 cataract operations over the first 9 months of the year 2000, were enrolled in this study. The mean age of the group was 74.9 (SD 9.6) years (range 34.7–94.3 years) with a female predominance (62%). Self reported ethnic origins were 72% European-Caucasian, 8% Maori, 10% Pacific Islander, 4% Asian (east of India), 3% from the Indian subcontinent, and 3% other. Patient characteristics are presented in Table 1. Maori and Pacific Islanders presented for surgery at an earlier age, 68.2 (9.5) (n=39) and 67.7 (9.0) (n=49) years respectively, than European-Caucasian subjects (77.5 (8.2) years). This difference was significant ($p<0.001$, analysis of variance (ANOVA)) for both groups. Prevalent medical co-morbidity is presented in Table 2. Comparison of diabetes with ethnicity revealed that 58% of Pacific Islanders, 38% of Maori, and 10% of European-Caucasian people had diabetes mellitus. Only 95 (20%) subjects did not have documented coexisting systemic medical disease.

Preoperative biometry (n = 488) demonstrated a mean axial length of 23.13 (1.03) mm and a mean keratometry of

Table 1 Preoperative subject and ocular characteristics (n = 488 eyes of 480 subjects)

Age (years)		
Mean (SD)	74.9 (9.6)	
Range	34.7–94.3	
Sex (female)	62%	
Right eye	n = 242	
Left eye	n = 246	
No previous contralateral cataract surgery	n = 212	
Previous contralateral cataract surgery	n = 268	
Ethnic origin		
European	n = 346 (72%)	
Pacific Islander	n = 48 (10%)	
Maori	n = 38 (8%)	
Asian	n = 33 (7%)	
Other	n = 15 (3%)	
BSCVA	Mean	Median
Eye for cataract surgery (log MAR)	0.88 (0.6)	0.5
Fellow eye (log MAR)	0.2 (0.4)	0.2

BSCVA = best spectacle corrected visual acuity; log MAR = log minimum angle of resolution; log MAR 0.88 corresponds to approximately 6/48+1 and log MAR 0.2 to approximately 6/9 Snellen equivalent.

Table 2 Reported co-morbid medical conditions. Only those with incidence greater than 1% presented. Only 95 (19.8%) subjects had no coexisting systemic medical disorder (n = 480)

	Number	Percentage
Hypertension	220	46
Diabetes mellitus	98	20
Angina	78	16
Asthma	54	11
Cerebrovascular event	49	10
Congestive heart failure	39	8
Myocardial infarct	35	7
Cardiac arrhythmia	34	7
Obstructive airways disease	24	5
Dysthyroid disease	25	5
Oesophageal reflux	18	4
Gout	14	3
Peripheral vascular disease	14	3
Current smokers	56	12

43.69 (1.64) dioptres (D). A mean spherical equivalent of −0.49 (2.96) D (range −18.63 to +16.88D) was noted, with mean BSCVA of 0.9 (0.6) log MAR units (Snellen equivalent of approximately 6/48). Mean refractive astigmatism (n = 420) was −1.20D (1.03) (range 0.0 to −7.50D). The mean BSCVA before cataract surgery is highlighted in Figure 1 and Table 1. The BSCVA in the eye to be operated upon, when assessed in Snellen equivalent, demonstrated that in 24% of eyes BSCVA was 6/60 or poorer, while 47% exhibited better than 6/60 but worse than 6/12 BSCVA. The remaining 29% were 6/12 or better.

In 31% of eyes, fundal examination revealed minimal age related macular changes such as fine retinal pigment epithelial stippling or occasional hard drusen. However, in 37 eyes (7.6%) coexisting conditions, such as significant age related macular degeneration, diabetic retinopathy requiring macular laser treatment, macular holes, and previous vascular occlusions, necessitated a very guarded prognosis for postoperative BSCVA. Coexisting ocular diseases that might influence clinical outcomes of cataract surgery are presented in Table 3.

The 26 public hospital and university surgeons who performed the cataract surgery comprised 17 consultants, three fellows, and six registrars. The mean number of cases per

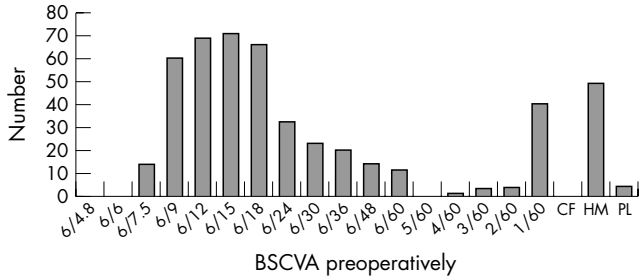

Figure 1 Best spectacle corrected visual acuity (BSCVA) in cataract affected eye before cataract surgery (n = 488 eyes)

Table 3 Coexisting ocular disease in eyes listed for cataract surgery (n = 488)

	Number*	%*
Glaucoma	45	9.2
Diabetic retinopathy	37†	7.6
ARMD affecting visual acuity	25	5.1
Corneal disease	9	1.8
Macular surgery	6‡	1.2
Retinal vein/artery occlusion	3	0.6
Previous retinal detachment	3	0.6

ARMD = age related macular degeneration.
*Some eyes exhibited more than one coexisting ocular disease; †diabetic retinopathy with history of macular laser (n=3); ‡epiretinal membrane peel (n = 4) and macular hole surgery (n = 2).

surgeon was 19 (23) (range 1–105). Sub-Tenon's approach, performed by an anaesthetist, was the most common local anaesthetic technique used (94.8%, n = 463) and the surgeons reported that 95% (n = 441) had complete and 5% (n = 22) incomplete, ocular anaesthesia. No eyes were reported to have exhibited no anaesthesia. Akinesia resulting from sub-Tenon's local anaesthetic block was reported as complete in 89% (n = 414), incomplete in 10% (n = 44), and none in 1% (n = 5). Topical/intracameral anaesthesia accounted for 4.7% (n = 23) of total procedures while general anaesthesia and peribulbar anaesthesia were performed only once each.

The majority of surgery was performed by small incision (3.75–4.1 mm) phacoemulsification (97.3%, n = 475) with the insertion of a foldable IOL; however, 1.6% (n = 8) of procedures commenced as planned phacoemulsification were converted to ECCE. In cases completed by phacoemulsification (n = 467), the incision types were clear corneal in 81.3% (n = 380) and superior scleral tunnel in 18.6% (n = 87) of eyes. Clear corneal incisions were performed temporally in 93% (n = 353) and superiorly or superotemporally in 7% (n = 27) of eyes. Eighty five per cent of small incision phacoemulsification procedures (n = 397) did not require a suture; however, 16% (n = 61) of clear corneal incisions and 10% (n = 9) of scleral tunnel incisions received at least one suture. ECCE was performed as the primary procedure in 2.7% (n = 13) of cases.

The IOL was placed within the capsular bag in 97% (n = 471) of cases, in the ciliary sulcus in 3% (n = 16), and in the anterior chamber in only one case. In one case an IOL was planned but not inserted because of intraoperative complications. The most frequently used IOL (87%) was the Alcon Laboratories Acrysof MA60 foldable, acrylic, lens with an A-constant of 118.9. The majority of the remaining lenses (12%) were Pharmacia and Upjohn, foldable, silicone, CeeOn 911A and 920 lenses, with A-constants of 118.3 and 118.6, respectively.

Adverse surgical and clinical events at the time of surgery and within the first 4 weeks after surgery are presented in Table 4. The posterior capsular rupture rate was 4.9% (24 of

Table 4 Intraoperative and postoperative adverse events (n = 488 eyes)

	Number	%
Intraoperative (n = 488)		
Posterior capsule tear	24	4.9
Iris prolapse/iris trauma	21	4.3
Wound retraction/burn*	19	3.9
Manipulation of small pupil	14	2.9
Subject unable to lie still	13	2.7
Incomplete capsulorrhexis	11	2.2
Dropped lens fragment	4	0.8
First day after surgery (n = 483)		
Intraocular pressure (>30 mm Hg)	21	4.3
Wound leak requiring suture	9	1.9
Minimal wound leak	6	1.2
Vitreous in anterior chamber	6	1.2
Decentred IOL†	5	1.0
Endophthalmitis	1	0.2
Four weeks after surgery (n = 476)		
Suture induced astigmatism (>1.0D)	28	5.8
Cystoid macular oedema	18	3.8
Anterior chamber cells (≥2+)‡	15	3.2
Anisometropia	2	0.4
Corneal decompensation	2	0.4
Aphakia	1	0.2

No choroidal haemorrhage or retinal detachments were reported. IOL = intraocular lens.
*All wound retractions/phaco burns were mild and treated only by intraoperative suture; †required surgical manipulation (n = 2); ‡anterior chamber cells = post-surgical mild anterior uveitic response.

488 eyes). In four of these eyes lens fragments were "dropped" into the vitreous (0.8%) and overall 18 (75%) of 24 eyes with capsular tears underwent automated vitrectomy during the primary surgical procedure. Capsular tears or ruptures occurred in 15 of 320 eyes (4.7%) operated on by consultant surgeons and nine of 168 eyes (5.4%) operated upon by fellows or registrars under supervision. These differences were not statistically significant ($p>0.05$).

Clinically apparent cystoid macular oedema (CMO) was reported in 3.7% (n = 18) of eyes post-surgery. Only five of these 18 eyes underwent intravenous fluorescence angiography to establish the degree of CMO. Employing Fisher's exact test, no statistically significant associations were identified between the occurrence of CMO and: posterior capsule rupture ($p=0.6$), iris prolapse/trauma intraoperatively ($p=0.5$), manipulation of small pupil ($p=0.09$), raised IOP greater than 30 mm Hg on day 1, or anterior chamber activity (>2+ cells) at 4 weeks ($p=0.08$).

Five patients did not attend the follow up appointment the day after surgery and three patients died from unrelated causes within 4 weeks of their surgery. A total of 12 (2.4%) subjects did not attend the review appointment at 4 weeks after surgery. The preoperative clinical parameters and the surgical variables of this small group did not differ from the study group as a whole, and therefore did not influence outcome results.

The unaided visual acuity (UAVA), BSCVA, and spectacle refraction 4 weeks after surgery, was available in 476 (97.5%) eyes. In 33 eyes (6.8%), because of patient choice, or to avoid anisometropia, the intended refractive end point was neither emmetropia nor low myopia (<−0.75D). Excluding these 33 eyes, overall, 90.5% of 443 eyes exhibited 6/18 or better UAVA, with 67.7% of eyes reaching the New Zealand driver's licence requirement of 6/12 unaided vision. Over half the eyes achieved 6/9 unaided (53.0%) and 17.1% obtained 6/6 or better UAVA.

Table 5 Best spectacle corrected visual acuity (BSCVA), greater than or equal to 6/12, compared to less than 6/12, at 4 weeks after surgery in relation to intraoperative and postoperative adverse events. Eyes with cystoid macular oedema or tight, astigmatism inducing, sutures were statistically less likely to achieve 6/12 or better BSCVA at 4 weeks after surgery

	BSCVA		
Adverse event	≥6/12 (n = 421)	<6/12 (n = 55)	Fisher's exact test p value
Intraoperative			
Manipulation of small pupil	10	4	0.066
Posterior capsule tear	21	3	0.75
Postoperative			
IOP >30 mm Hg on day 1	19	2	1.0
Wound leak on day 1	14	1	1.0
Anterior chamber cells at 4 weeks	14	1	1.0
Cystoid macular oedema	10	8	0.0003
Tight suture	19	9	0.002
Endophthalmitis	0	1	0.12

Overall, a mean BSCVA of 0.1 (0.2) log MAR units (6/7.5 Snellen equivalent) with a mean spherical equivalent of −0.46 (0.89) D (range −4.12 to +3.37D) and a mean astigmatism of −1.26 (1.02) D was recorded at the 4 week assessment (n = 476). Interestingly, the calculated power of the IOL for emmetropia was 22.2 (2.9) D, but many surgeons had chosen to err towards low myopia (<−0.50D) when choosing IOL power, and the average IOL implanted had a mean power 22.4 (2.7). In 422 (88.6%) of the 476 eyes with refraction at 4 weeks, both preoperative and postoperative refractive astigmatism were available. Mean arithmetic astigmatism changed by −0.06D and 44.5%, 53.3%, 72.3%, and 84.6% of eyes evidenced an empirical, non-vector corrected, postoperative change in refractive astigmatism of less than or equal to 0.50D, 0.75D, 1.00D, and 1.50D, respectively. Surgically induced astigmatism was further assessed by refraction and Orbscan II computerised topography and will be the subject of a separate scientific communication.

Following cataract surgery, 88% of eyes (n = 421) had a BSCVA of 6/12 or better (Table 5), 11% (n = 51) were poorer than 6/12 but better than 6/60, and 1% (n = 4) were 6/60 Snellen equivalent or worse. Three per cent of eyes (n = 14) recorded a drop in BSCVA after cataract surgery of at least one Snellen line, half of these cases were thought to be directly attributable to the surgical intervention and the remainder the result of pre-existing ocular disease. The former group included six eyes that developed postoperative pseudophakic CMO, and one eye, with a preoperative BSCVA of 6/18, that was reduced to 6/36 BSCVA because of postoperative endophthalmitis treated by vitrectomy and intraocular antibiotics. This latter eye had undergone an uncomplicated operative procedure and had received routine intraoperative subconjunctival cefazolin. The remaining seven eyes (1.5%), which each demonstrated a one line decrease in BSCVA following surgery, all had significant pre-existing age related macular degeneration, identified before surgery, and had undergone cataract surgery with a guarded prognosis.

DISCUSSION

This prospective study relates to a catchment population that represents one third of the New Zealand population and involved approximately 20% of New Zealand ophthalmic surgeons. Therefore, other than the slightly greater proportion of Maori and Pacific Islanders in the reported population, we believe this study is reasonably representative of subjects presenting with cataract and their subsequent management in the Public Health Service within New Zealand

The results of this study confirm that the population undergoing cataract surgery in the public sector in Auckland is predominantly elderly and female. Subjects with Maori and Pacific Island ethnicity present approximately 10 years earlier for cataract surgery than European-Caucasian subjects and this may be explained, at least in part, by the dramatically higher proportion with diabetes mellitus.[4] Indeed, 58% of Pacific Islanders and 38% of Maoris exhibited diabetes mellitus compared with only 10% of European-Caucasian subjects. Subjects presenting for cataract surgery have other significant systemic co-morbidities, with almost half being treated for systemic hypertension and more than a third providing a history of other cardiac or cerebrovascular disease.

Access to cataract surgery within the public health system is constrained by a government directed points system in New Zealand.[2] Interestingly, at the commencement of this study, all subjects fell just below the points based prioritisation threshold for cataract surgery, yet exhibited significant visual impairment in the cataract affected eye (Fig 1). While basing prioritisation upon objective criteria, rather than merely upon position on increasingly growing public waiting lists, has obvious merit, this form of healthcare rationing may still deny access to surgery by patients with genuine need.[2] While the scoring system current at the beginning of this study included assessment of aspects of functional ability, such as driving, the BSCVA of the affected, and the contralateral eye, contributed the majority of points. Unsurprisingly, in this context, the visual acuity in the eye intended for surgery was worse than 6/24 in 53% of eyes assessed in this study, whereas the threshold for cataract surgery in Australasia has generally been reduced to 6/6–6/9 in symptomatic patients.[5] Although, in some subjects, there may be cultural reasons for delayed presentation with cataract, many of the subjects in this study had presented for surgery up to 3 years earlier, but with a mean BSCVA of 6/9 in the contralateral eye, none reached the prevailing threshold for surgery.

Small incision phacoemulsification (97.5%), with implantation of a foldable IOL, under sub-Tenon's local anaesthesia (95%), has become the favoured technique within Auckland. Although sub-Tenon's anaesthesia is becoming increasingly popular in New Zealand, the United Kingdom, and elsewhere, a recent assessment of trends in cataract surgery (1998), with respect to the USA, Japan, and Denmark, suggested that only ophthalmologists in Japan use predominantly sub-Tenon's anaesthesia as frequently.[6] In the present study a higher proportion of clear corneal temporal incisions than superior scleral tunnel incisions was observed, highlighting local surgical preference. However, Riley *et al*[4] have demonstrated that this population exhibits a median refractive astigmatism of 1.2D that is against the rule in 50% of eyes; therefore, the choice of a temporal approach corneal incision may offer a minor beneficial effect on corneal astigmatism in appropriate cases. In the current study, 76.7% of subjects exhibited 0.75D or less change in refractive astigmatism after small incision phacoemulsification.

Interestingly, a recently published questionnaire survey of all New Zealand ophthalmic surgeons reported that, in 1997 and 1998, only 24% routinely used sub-Tenon's anaesthesia for cataract surgery and only 33% used anterior limbal or clear corneal incisions.[1] The conflicting results of the current study may reflect regional differences in the approach to cataract surgery or, more likely, the rapidity with which cataract techniques evolve, with both sub-Tenon's local anaesthesia and clear corneal phacoemulsification being increasingly adopted nationally. Initial concerns that clear corneal incision might produce significantly greater astigmatism than scleral tunnel incisions seems unfounded. Current techniques of clear corneal incisions produce similar astigmatic change[7 8] to scleral tunnel incisions and, as noted previously, such induced change may actually be beneficial in the older eye with against the rule astigmatism.[4 8]

Review on day 1 after phacoemulsification identified a single case of early endophthalmitis but no other sight threatening adverse events. It is notable that 4.3% of eyes had an IOP greater than 30 mm Hg. Overall, nine eyes (1.9%) required a suture for a wound leak. All of these eyes had undergone temporal approach, clear corneal, phacoemulsification, whereas, no eyes with superior scleral tunnel approach demonstrated aqueous humour leak. Although 16% of corneal incisions were sutured intraoperatively, 2.4% (nine eyes) of corneal incisions required a suture to address wound leak on day 1. This suggests that perhaps a lower threshold for intraoperative placement of a suture, or a modification of wound architecture, should be observed in this population when clear corneal, sutureless phacoemulsification surgery is performed. However, this has to be balanced with the knowledge that all corneal sutures will require subsequent removal and 5.8% of eyes in this study exhibited more than 1.0D of suture induced astigmatism, which was statistically associated with BSCVA of less than 6/12 in almost half of these eyes. Herbert *et al*[9] have recently highlighted the importance of day 1 review, noting 1.5% of subjects with an IOP greater than 30 mm Hg, 0.26% with painless iris prolapse, and 1.8% that required modification of the topical steroid regimen.

The design of the current study, where reporting of intraoperative complications by the operating surgeons was followed by a comprehensive postoperative independent ophthalmic examination, may have advantages in terms of accuracy and consistency over comparable studies of self reporting alone. The observed rates of adverse surgical events are comparable to similar published studies, which have reported posterior capsular rupture rates of between 0% and 9.8% of cases and clinically apparent cystoid macular oedema in 0.6% to 6% of eyes.[3 10–14]

The overall posterior capsular rupture rate in the current study was 4.9%, and comparison of this complication as encountered by consultant surgeons, relative to fellows and registrars under supervision (4.7% *v* 5.4%), highlighted no statistical differences. However, it should be noted that trainees generally performed surgery on more straightforward cases and the lack of statistical difference in such small numbers does not preclude a clinical difference. Assessment of complications by trainee surgeons of registrar (resident) grade in other large studies of phacoemulsification have highlighted an incidence of intraoperative posterior capsular rupture of up to 10%.[10 12] Interestingly, a Royal College of Ophthalmologists (UK) report, by Desai *et al*, noted a posterior capsule tear rate of 4.4% in a National Cataract Study in a healthcare system fundamentally similar to New Zealand's.[13] More recently, Ionides *et al*, in a series of 1420 cataract procedures, noted a similar overall capsular rupture rate of 4.1% in a major UK training hospital and in this series posterior capsule tears occurred in 5.3% of cases performed by surgeons in training.[14] In the current series, automated anterior vitrectomy was performed in 75% of cases of capsule rupture and there was no clinical or statistical association between capsular tear and either CMO or a final BSCVA of less than 6/12. In contrast, Ionides *et al* reported that eyes with a posterior capsule rupture were 3.8 times more likely to have a final BSCVA less than 6/12.[14]

Preoperatively, a large number of advanced brunescent or white cataracts resulting in BSCVA of 6/60 or poorer (24%) were identified. This may bias the complication rate when comparing studies, as these advanced cataracts may be associated with increased risk of adverse surgical events (Tables 4 and 5). This may also account partly for the relatively large numbers of phacoemulsification procedures that required a suture (15%), since more dense nuclei often require phacoemulsification for a longer period at higher power, with greater potential for wound retraction. Unfortunately, since more than one type of phacoemulsification machine was used, phaco parameters could not be compared or correlated in the current study. However, interestingly, in terms of adverse

events in more complex cataracts, Chakrabarti *et al*,[15] in a retrospective study of 222 advanced white cataracts, reported incomplete capsulorhexis in 28% of eyes, but a posterior capsule rupture rate of only 1.9% following clear corneal phacoemulsification.

In this study group, two thirds of eyes achieved 6/12 UAVA and 88% of eyes achieved a BSCVA of 6/12 or better after cataract surgery. However, if those eyes that had a poor visual prognosis preoperatively, because of known coexisting ocular disease, are removed from analysis, the proportion with BSCVA of 6/12 or better increases to 94%. However, while the mean postoperative BSCVA was 6/7.5 for all eyes in the study, special consideration should be given to those patients (1.5%) who had lost lines of BSCVA, thought to be a consequence of the surgical intervention, at the latest follow up. A longer follow up period may show some further improvement in those with CMO in which BSCVA was significantly adversely affected (1.3%).

Only visual acuity and objective measures such as refraction have been reported in this study; however, additional measures such as functional acuity, symptom score, and patient satisfaction are also valuable ways of providing a more comprehensive assessment of outcome following cataract surgery.[16 17] Indeed, the risk of dissatisfaction with outcome of cataract surgery is related to low visual acuity and age related maculopathy in the better eye preoperatively while, overall, the postoperative BSCVA in the operated eye is the single most important factor in terms of patient satisfaction.[18] In this respect, at least 5.0% of eyes in the current study exhibited age related macular degeneration that affected BSCVA preoperatively, and 1.5% of eyes overall had poorer vision postoperatively thought to be related to the surgical intervention. We have assessed the whole study group by satisfaction and functional questionnaires and this will be the subject of a future communication.

Although phacoemulsification has a lower risk of retinal detachment than conventional extracapsular surgery, a series of 1418 phacoemulsification procedures, with approximately one third having undergone Nd:YAG laser capsulotomy, recorded a long term risk of retinal detachment of 0.4%.[19] Owing to the limited follow up, only to the point of outpatient discharge, longer term complications, such as retinal detachment, or the requirement for Nd:YAG laser posterior capsulotomy, were not identified in the current prospective study.

In summary, this Auckland based study highlights that cataract surgery in the New Zealand Public Health Service utilises contemporary surgical techniques, with 97.3% of eyes undergoing small incision phacoemulsification surgery with insertion of foldable intraocular lenses. The results of cataract surgery continue to improve with the predominant use of local anaesthesia (99.8%), which, with small incision phacoemulsification, facilitates day case surgery, early rehabilitation, and improved visual results.[20 21] Despite significant medical comorbidity and relatively advanced cataracts in the population under investigation, surgical complication rates for both experienced and trainee surgeons were found to be consistent with international standards. In this elderly population, 94% of eyes without preoperative non-cataract pathology achieved 6/12, or better, BSCVA, at latest follow up.

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