

# Do patients with age related maculopathy and cataract benefit from cataract surgery?

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## Abstract

**Aims**—To assess the benefits of cataract extraction in patients with age related maculopathy (ARM).

**Methods**—1073 randomly selected cataract operations were reviewed and 99 cases of preoperatively recognised ARM were identified for investigation. Data relating to visual function were retrieved from case notes, and patient responses to a questionnaire were analysed.

**Results**—98% had dry or unspecified ARM. Only 2% had exudative maculopathy. 81% of cases had an improvement in best distance acuity; mean change 0.44 logMAR (change of 6/36 to 6/12). 65% responded to the questionnaire; 67% felt that the operation had been worthwhile, 17% had mixed feelings, and 17% thought it not worthwhile.

**Conclusion**—This study, which is the first of its kind to be reported, shows a clear benefit from cataract surgery in the majority of patients with ARM. However, the prevalence of ARM in this study is lower than expected, suggesting that some patients with both ARM and cataract were not listed for surgery. The design of a prospective study to quantify the subjective and objective benefits of cataract surgery in these patients is outlined and predictors of successful outcome identified. This will promote the development of guidelines for the surgical management of this group of patients.

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Age related maculopathy (ARM) affects approximately 40% of those over the age of 75 years.<sup>1,2</sup> It is the most common maculopathy to affect individuals with cataract, the two conditions occurring with increasing frequency with age.<sup>3,4</sup> ARM currently contributes to around 50% of all those registered as blind and partially sighted in England and Wales<sup>5</sup> and a recent study has suggested that the condition may be becoming more prevalent.<sup>6</sup>

Approximately 1.2 million cataract extractions are performed in the USA,<sup>7</sup> and 105 000<sup>8</sup> in the UK each year. Around 10% of all patients who undergo first or second eye cataract extraction have some form of ARM.<sup>8,9</sup> Although this proportion is rather lower than would be expected from prevalence data, this still constitutes around 100 000 operations in the USA and 10 000 operations in the UK each year.

When treating a patient with ARM and cataract the clinician must decide whether cataract

surgery will be of benefit, a decision that is often difficult to make. Sometimes the patient is listed for surgery on the grounds that there is little to lose. However, the constraints of tight budgets and waiting lists, and the need to target resources, means that medical practice must be evidence based and it is therefore necessary to have reliable data to support the decision of whether or not to operate.

Although previous investigators have identified factors associated with poor outcome following cataract surgery, including the patient age and ocular co-morbidity (especially ARM),<sup>9-16</sup> none has addressed specifically the benefits of surgery in these high risk groups.

We have performed a retrospective analysis of case notes and circulated a self completion questionnaire in order to determine whether patients with ARM benefit from cataract surgery both in terms of visual function and patient satisfaction. In addition, we attempted to identify predictors of benefit and to determine whether we are operating on appropriate numbers of patients in order to pave the way for a future investigation. To our knowledge this is the first study of its kind to be reported.

## Methods

In all, 1073 case notes were randomly selected from computer records and reviewed by two ophthalmologists (GNS, EAL) from the 2264 cataract operations performed during 1994 at Bristol Eye Hospital. Details of all ocular diagnoses in operated eyes were recorded. All cases in which reference was made to ARM (diagrammatically or in writing) before the cataract extraction and who were more than 50 years of age were selected for further investigation. Where both eyes had been operated upon during 1994, the first eye was selected for investigation.

Data were collected from case notes and from a simple, self completion questionnaire sent to the patients' most recent address.

## DATA COLLECTED FROM CASE NOTES

Data collected from the case notes included age, sex, type of procedure and complications, other ocular and systemic diagnoses. The type of ARM and cataract was assessed from the last preoperative record.

In addition, visual acuities at the time of listing and postoperatively (best recorded vision and last recorded vision) were collected. The best acuity (unaided, corrected, or with a pinhole) was used for the analysis assuming this to be most indicative of best visual potential.

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The Snellen acuities were ranked for non-parametric analysis or converted to the  $\log_{10}$  of the Snellen fraction (equivalent of logMAR) for parametric analysis. The logMAR scale was extended assuming counting fingers vision to be equivalent to 1.6 logMAR (Snellen 1.5/60), hand movement vision to be equivalent to 1.9 logMAR (Snellen 0.75/60), and perception of light vision to be equivalent to 2.2 logMAR units (Snellen 0.375/60) as used by Javitt *et al.*<sup>17</sup>

#### DATA COLLECTED FROM THE QUESTIONNAIRE

The questionnaire (reproduced on BJO website: www.bjophthalmol.com) was designed for self completion and kept as short and simple as possible. To encourage response, simple ordinal adjectival scales or categorical response options were employed. All print was black, 18 or 20 point, Arial typeface on white paper. Two versions of the questionnaire were used, one each for operations on the left and right eyes.

Questions were designed to be as direct and clear as possible and were based upon questions commonly used in the clinical setting. They focused upon the main preoperative complaints and the effects of the operation upon these, and inquired into aspects of visual function, including near and distance tasks, visual field, and the effect of vision upon everyday activities. For each aspect of visual function, the questionnaire assessed difficulties preoperatively and determined whether any improvement had occurred and whether this lasted. In addition, further questions assessed the patient's current difficulties. The same method was used for scoring answers to preoperative and current difficulties. A further question asked whether the operation had been worthwhile.

The questionnaire was sent to all patients still thought to be alive and included a stamped addressed envelope for return. Three weeks later, if no reply had been received, an attempt was made to contact the patient by telephone. If patients had received the questionnaire they were encouraged to complete and return it as soon as possible; if no questionnaire had been received then a second was sent. No questionnaires were completed over the telephone in an attempt to eliminate bias. Missing data or spoilt questionnaire responses were omitted from analyses.

Both parametric and non-parametric analyses were performed. Student's *t* tests were used to assess the difference between sample means, Mann-Whitney U tests and Wilcoxon's matched pairs test were used to compare ranked improvement in visual acuities and disabilities, and  $\chi^2$  tests with Yates's correction (or Fisher's exact test) were used for cross tabulations. All percentages are to the nearest percentage.

## Results

Altogether, 33% (353/1073) of operated eyes had associated ocular pathology and 9% (99/1073) had preoperatively diagnosed ARM. In addition, a further 39 cases of ARM (28% of

Table 1 Ocular disease in operated eyes of reviewed cataract patients

Ocular disease	Those with preoperative ARM (n=99)	Whole sample (n=1073)
No other disease	70 (71%)	720 (67%)
Cornea/external eye disease	0 (0%)	14 (1%)
Retina/choroidal disease	14 (14%)	124 (12%)
Glaucomas	19 (19%)	125 (12%)
Orbital disease	0 (0%)	3 (0.3%)
Strabismus	0 (0%)	10 (1%)
Amblyopia	1 (1%)	12 (1%)
Neuro-ophthalmic disease	1 (1%)	13 (1%)
Uveitis	1 (1%)	12 (1%)
Ocular trauma	0 (0%)	10 (1%)
ARM	99 (100%)	99 (9%)

all those with ARM) were diagnosed postoperatively. These were not included in the analysis.

#### DESCRIPTIVE DATA

Of the 99 patients with ARM, 76 (77%) were female and the mean age at operation was 83.4 years (range 70–100 years). Seventy four (75%) operations were on first eyes and 32% of these were either awaiting or had had cataract surgery on their second eye at the time of the review. Nineteen per cent (19/99) of operated eyes had concurrent glaucoma and 14% (14/99) retinal or choroidal disease, the most common of which was diabetic retinopathy (Table 1). Seventy one (71/99) per cent of operations were extracapsular cataract extractions, 22% (22/99) were phacoemulsification extractions, 5% (5/99) were combined procedures (cataract extraction and trabeculectomy), and one was an accidental intracapsular cataract extraction. Ninety nine per cent (98/99) of operations resulted in the placement of a posterior chamber intraocular lens. Sight affecting preoperative or postoperative complications occurred in 3% (3/99) of cases (vitreous loss, iris prolapse, cystoid macular oedema); in addition, one patient died postoperatively.

Ninety eight per cent (97/99) of operated eyes had dry or unspecified ARM and 2% severe (active or inactive exudative disease). In fellow eyes the proportions were 91% and 6% respectively with 3% having no evidence of ARM.

#### DISTANCE ACUITY

At listing 9% (8/92) of operated eyes had a distance visual acuity of 6/12 or better. This proportion increased to 61% (60/98) for best postoperative distance acuity and decreased a little to 45% (44/97) for last recorded distance acuity. The mean and median distance acuities including Snellen equivalents are recorded in Table 2 and a boxplot of the preoperative visual acuity compared with the best postoperative visual acuity illustrates the improvement in vision (Fig 1).

Improvements in distance visual acuity averaged a 2.74 times improvement in minimum angle of resolution (MAR) ( $p=0.000$ ) for best postoperative visions and 1.86 times improvement for last recorded acuity ( $p=0.000$ ). Overall, the best postoperative distance visual acuity showed improvement when compared with

Table 2 Distance acuities in operated eyes

	Mean – logMAR (Snellen equivalent)	Median – logMAR (Snellen equivalent)	n
Listing distance acuity	0.80 (6/38)	0.78 (6/36)	92
Post-op best distance acuity	0.36 (6/14)	0.30 (6/12)	98
Post-op last distance acuity	0.53 (6/20)	0.48 (6/18)	97

listing acuity in 81% (84/91) of patients, and last recorded postoperative acuity showed improvement in 76% (68/90). If we assume that a >0.2 logMAR change in distance acuity represents real change (taking into account testing variability<sup>18-20</sup>), 68% (62/91) of cases still show an improvement between the time of listing and their best postoperative acuity and 53% (48/90) between listing and their last recorded acuity.

Of the 15 patients whose distance visual acuity was poorer at their last visit than at listing (mean deterioration 0.55 logMAR, 3.55 times increase in MAR), 10 showed progression of ARM, two had developed choroidal neovascularisation, one had significant (≥3 diopres) astigmatism, one had suffered a central retinal vein occlusion resulting in thrombotic glaucoma, and the other developed cystoid macular oedema. Despite this visual deterioration, three of the 12 who completed the questionnaire reported that their operation had been worthwhile (possibly reflecting improvement in other visual functions or a temporary improvement in acuity).

QUESTIONNAIRE RESPONSES

Sixty five per cent (64/99) completed the questionnaire an average 1.75 years after their operation. Of the remainder, 11 had died, three

Table 3 Preoperative visual symptoms

Visual symptom	Proportion reporting
Difficulty reading	61% (39/64)
Difficulty with distance vision	58% (57/64)
Misty/foggy vision	34% (22/64)
Blurred vision	33% (21/64)
Dazzle/glare	14% (9/64)
Blinkered vision	14% (9/64)
Distortion	13% (8/64)
Black patch or blob in vision	11% (7/64)
Diplopia	9% (6/64)

were insufficiently motivated to complete the questionnaire when contacted by telephone, two had developed dementia, one was too deaf to communicate on the phone, one was severely ill, and the other had changed address; 17 others neither replied to the questionnaire nor were contactable by telephone.

The main preoperative problems that patients reported are recorded in Table 3. These improved in 66% (41/62) of cases following the cataract extraction, and 83% (33/40) of these reported lasting improvement. Similar results were reported for near vision, distance vision, function/activity, and visual field.

Sixty seven per cent (40/60) of questionnaire respondents reported that their operation had been worthwhile (52% (31/60) very, 12% (7/60) moderately, 3% (2/60) slightly), while 17% (10/60) thought that the operation was not worthwhile and 17% (10/60) had mixed feelings.

Of those patients who thought their operation successful, a greater proportion (74–90%) recorded improvement in their main preoperative problems, near and distance acuity, function/activity, and visual field compared with those with mixed feelings or who felt their

		Best postoperative Snellen visual acuity								
		6/6 or better	6/7.5 or 6/9	6/12	6/18	6/24	6/36	6/60	6/60–CF	HM
Preoperative Snellen visual acuity	6/6 or better									
	6/7.5 or 6/9		2							
	6/12	3	2				1			
	6/18	3	8	4	4	1				
	6/24	1		3	4	1			1	
	6/36	1	12	2	4	2	3		1	
	6/60	1	2	2	1					
	6/60–CF	2	5	2	1	1	2	2	1	
	HM		1							

Figure 1 Frequency table showing improvement in distance visual acuity. Shading in cells approximately proportional to cell frequency. The down sloping diagonal represents no change in visual acuity, cells below and to the left represent an improvement in visual acuity. CF= counting fingers; HM= hand movements. Missing data have been omitted (n=91). Where Snellen equivalent falls between common chart test sizes the nearest poorer acuity has been used.

Table 4 Results of questionnaire—perceived benefit of operation in relation to improvement in preoperative symptoms, near vision, distance vision, function/activity, and visual field

	Worthwhile	Not worthwhile/ mixed feelings	p Value ( $\chi^2$ )
Main problem(s)	90% (36/40)	17% (3/18)	10 <sup>-6</sup>
Near vision	87% (33/38)	15% (3/20)	10 <sup>-6</sup>
Distance vision	90% (35/39)	30% (6/20)	10 <sup>-5</sup>
Function/activity	79% (30/38)	5% (1/19)	10 <sup>-6</sup>
Visual field	74% (26/35)	6% (1/16)	1.4×10 <sup>-5</sup>

Demoninators vary owing to missing data.

operation not to have been worthwhile (Table 4). Similar findings emerged comparing preoperative difficulties to present difficulties and for reported lasting improvements. Those who reported the operation to be worthwhile had a larger improvement in distance acuity (0.30 compared with -0.11 logMAR—listing to last postoperative p=0.003), and better last postoperative distance acuity (0.45 compared with 0.81 logMAR (p=0.003)) despite similar listing acuities (0.73 compared with 0.68 logMAR).

Of the 17% (10/60 patients) who reported that the operation was not worthwhile none reported any lasting improvements in any visual function. Although four achieved a best postoperative distance acuity of 6/12 or better, vision subsequently deteriorated. The last recorded distance acuity was poorer than at listing in six of these patients.

#### FIRST AND SECOND EYE SURGERY

The results of previous first eye surgery showed a mean improvement in distance visual acuity of 0.44 logMAR (p = 0.000) between listing (0.65 logMAR, Snellen 6/27) and best postoperative vision (0.25 logMAR, Snellen 6/11). At the time of listing for the second operation 50% (12/24) of first eyes could see the equivalent of Snellen 6/12 or better.

Analysis of the preoperative difficulties reported in the questionnaire revealed no significant differences between those undergoing first and second eye surgery. However, a greater proportion of first eye operations reported improvement in main preoperative problems, near and distance vision, and in function/activity in comparison with second eye operations, but only reaching statistical significance for function/activity when comparing preoperative with current difficulties (56% (23/41) improvement first eye, 13% (2/15) improvement second eye, p = 0.011).

Where possible the cataract in the operated eye was classified by both type and severity. No relation between lens opacity and benefit of surgery was identified.

#### Discussion

The average age at operation in this study is older than that reported in other cataract series (70–75 years)<sup>8–11 15 21</sup> reflecting the increase in prevalence of ARM above 75 years of age.<sup>1</sup> Coexisting ocular pathology was present in addition to ARM and cataract in 29% of eyes and in agreement with previous findings (25%–36%).<sup>9 16 17</sup> The proportion of second eye operations (25%) was similar to that reported in other non-selected cataract

series<sup>8 10 17 21</sup> indicating that the outcome of first eye surgery probably had little bearing upon the likelihood of being listed for subsequent fellow eye surgery.

Approximately 9% of all eyes undergoing cataract extraction were recognised to have some form of ARM preoperatively and a further 4% (28% of the total with ARM) were diagnosed as having ARM postoperatively. These figures are in accord with those the National Cataract Survey (UK)<sup>9 16</sup> but are rather lower than epidemiological prevalence data would suggest for this age group<sup>1 2</sup> and the figure of 33% of cataract cases with ARM identified in a study from Finland.<sup>13</sup> The proportion of eyes with severe (active or inactive exudative) ARM (2% or 0.2% of all notes reviewed) was also a great deal lower than epidemiological prevalence figures (5.2%<sup>1</sup> in those over 75 years and 7.4% in those over 85 years<sup>22</sup>) and the same Finnish study (4.2%).<sup>13</sup>

These findings suggest that our sample represents a selected population of patients with ARM, possibly reflecting differing access to ophthalmic services (for example, primary carers may attribute poor vision to the presence of known ARM rather than to the development of a cataract) or differing thresholds for, or expectations from, cataract surgery in patients with ARM (ophthalmologists may be reluctant to operate on those with ARM, particularly those with severe disease, on the grounds that they do not anticipate improvement in acuity). The predominance of dry ARM may also go some way to explain the favourable outcomes reported as early ARM has been shown to have little effect on acuity.<sup>23</sup>

The distance acuity recorded in the case notes was converted to logMAR format (as previously described) and used in parametric analyses. It is appreciated that for such analysis to be valid, certain criteria should be met and that the use of data in such a manner may run foul of both truncated and artificially extended scales.<sup>24 25</sup> Parametric tests are, however, more powerful and therefore more sensitive than non-parametric equivalents and should be used in preference where possible. In this study both parametric and non-parametric analyses have also been performed; the results differed only occasionally.

The improvement in visual acuity following operation in this study is similar to that reported in the National Study of Cataract Surgery Outcomes (0.5 logMAR).<sup>26</sup> However, the postoperative acuities are poorer than in other series of cataract extractions in which 80–90% obtain visual acuity of 6/12 or better<sup>11 12 16</sup> and in a similarly aged population with normal eyes.<sup>27</sup> This is likely to reflect the visual impairment due to ARM.

Of those patients whose most recent visual acuity was poorer than that at the time of listing, the vast majority showed progression of ARM. Two developed choroidal neovascularisation following the cataract extraction; however, it is still not clear whether these cases represent complications of surgery<sup>28–30</sup> or the underlying progressive nature of the disease.

In spite of the aged population and the retrospective nature of this study, 65% of patients completed the questionnaire. It is appreciated that such self completion questionnaires, especially when circulated by the institution where treatment was performed may be inherently biased. However, no questionnaire was completed in the hospital or with the help of the investigators.

The results of the questionnaire show that the majority of patients with ARM benefit from cataract extraction. They perceive the operation to be worthwhile and report improvement in preoperative symptoms, near visual tasks, distance visual tasks, activity/function, and visual field which were confirmed by comparison of preoperative and current difficulties.

Although Snellen acuity is not necessarily a good measure of cataract surgery outcome,<sup>9 17 26 31-33</sup> the perceived worth of the operation in this study was related to both the improvement in visual acuity and best postoperative acuity.

Seventeen per cent of questionnaire respondents in this study stated that their operation had not been worthwhile and a further 17% had mixed feelings. Where there is uncertainty about the outcome of surgery, as there is in patients with ARM, there will always be a small percentage who do not benefit. It is interesting that 15%–20% of patients in the National Study of Cataract Outcomes (USA) did not report improvement in visual satisfaction, or trouble with their vision 4 months following cataract extraction.<sup>26</sup>

In normal eyes the quality of the optical imaging system (cornea, iris, and lens) is closely matched to the quality of the receiver (retina) with little redundancy in either (as the cone cross sectional diameter approaches the limit of resolution set by diffraction – angle to first minima  $=\lambda/d$ ).<sup>34</sup> There is, however, some evidence that the optical system of the eye may be significantly superior to the photoreceptor grain, thereby compensating for noise and optimising contrast sensitivity but at the expense of aliasing.<sup>35</sup> ARM and cataract are each capable of producing considerable reduction in vision but by different mechanisms. Reduction in macular function may render the patient insensitive to a minor degree of optical degradation (poor contrast/focus or light scatter) of the macula image resulting from cataract with the consequence that cataract surgery may have little benefit. However, if the image degradation reaches a level that it is detectable by the diseased central retina or the peripheral retina, improvement of the image quality is likely to be beneficial. The benefits of surgery in patients with ARM and cataract is likely to reflect the ability to perceive the optical consequences of the cataract.

The most clinically useful objective method for detecting optical image degradation due to media opacity is assessment of fundus detail using a direct ophthalmoscope. Other objective methods of assessment of cataract include lens light scatter/photography. Subjective assessments of the effects of cataract include visual acuity, contrast sensitivity, and disability glare.

Various methods have evolved in an effort to determine macular function behind media opacities. At their most simple, these include colour detection and the use of entoptic phenomena—Haidinger's brushes, Purkinje images, and blue field phenomena.<sup>36</sup> More sophisticated techniques include the use of interferometers,<sup>37 38</sup> potential acuity meters,<sup>14 39</sup> focal electroretinograms,<sup>40</sup> and measurement of oscillatory displacement thresholds.<sup>41</sup> The great variety of instruments and approaches reflects their disappointing performance. Predictions of macular function are particularly inconsistent in patients with combined anterior and posterior segment ocular pathologies and show a tendency for overestimation of visual potential in ARM<sup>38-42</sup> and amblyopia.

In conclusion, this study has shown that the majority of patients with ARM and cataract who undergo cataract surgery perceive cataract extraction to be worthwhile and have improved visual acuity. However, out of a total of 1073 cataract operations reviewed, only 9% were performed on eyes with preoperatively diagnosed ARM, very few of whom had severe disease. This figure is lower than would be expected from prevalence data and suggests that case selection is occurring. It is recognised that this and questionnaire volunteer bias may partly explain the favourable outcomes obtained; however, the study raises two important issues: (i) that patients traditionally thought to have poor prognoses do benefit from cataract surgery, and (ii) that reliable data to support the decision of whether or not to operate do not exist.

The retrospective nature of the study combined with selection bias means that we have been unable to identify predictors of surgical outcome. A prospective study would allow more precise quantification of both the subjective and objective benefits of cataract surgery, identify factors predictive of outcome, and lead to a greater understanding of the interaction of multiple pathologies upon ocular dysfunction. This report is the first step towards a prospective study which will lead to the development of guidelines for the management of these patients. Such a study should be designed so as to recruit patients with not only mild and moderate ARM but also severe ARM. Of paramount importance must be the accurate grading of pathology (cataract and ARM), valid assessments of quality of life indicators, and a variety of measurements of visual functions including reading and distance acuity and contrast sensitivity.

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