

Comparing outcomes of cataract surgery: challenges and opportunities

Martin McKee, Justin M. Whatling, John L. Wilson and Andrew Vallance-Owen

Abstract

Background There is an increasing demand for routine assessment of surgical outcomes. However, for assessments to be valid, it is essential to understand the influence of patient characteristics on outcomes. The VF-14 visual function instrument offers a possible means of monitoring outcomes of cataract surgery. This article examines lessons learned in the course of an attempt to do this.

Methods One thousand and ninety-eight patients (41 per cent male and 59 per cent female) undergoing cataract extraction in 29 private hospitals within the British United Provident Association (BUPA) chain in the United Kingdom completed the VF-14 before and at 4 months following surgery. Outcome was measured in terms of absolute post-operative score achieved. The demographic factors associated with post-operative VF-14 score were examined using multivariate analysis, adjusting for baseline score.

Results Women undergoing cataract extraction had worse pre-operative visual function than men. Post-operative VF-14 score was stable as the age of the patient increased, until age 85, after which it declined. The reduction in final outcome in older people was explained in part by their worse post-operative scores but also was associated with increasing age independent of pre-operative score.

Conclusion First, although many patients undergoing cataract extraction at an advanced age will achieve excellent results, older age does reduce the outcome that can be expected. Consequently, comparisons of performance of units or surgeons undertaking cataract surgery must take account of the age spectrum being treated. It is not enough simply to add a health status measure to an existing administrative database. Further research is needed to understand the reasons for the poorer outcomes at older ages, in particular the role of co-existing eye disease and development of data systems must take account of the additional information required to make appropriate adjustments.

Keywords: cataract, quality of life, outcomes

Introduction

It is now well established that, in aggregate, cataract removal is effective in improving visual function, as assessed by the VF-14. However, there is less information on the benefit obtained by older patients, an issue of growing importance given evidence that older patients with many conditions often receive less intensive management than their younger counterparts,^{1,2}

a finding that may be linked to the exclusion of older people from many clinical trials that leads to an absence of evidence of effectiveness of treatment in this population.³

The VF-14 survey instrument offers a validated means of assessing the impairment to visual function caused by eye disease, capturing important aspects of the patient's perception of the disease that are not captured either by measurement of visual acuity or generic health status measures.⁴ Although developed in the United States, it has been subsequently revalidated in several other countries, where it has been shown to perform equally well.⁵ The questionnaire asks about difficulties due to vision when wearing glasses with each of 14 activities. The respondent replies are no difficulty (4), a little (3), moderate (2), great deal (1), unable (0). Their average score over the 14 questions is then multiplied by 25 to get a score out of 100. Any items not applicable are excluded from the average.

In fulfilment of their responsibility to monitor clinical performance, British United Provident Association (BUPA) owned hospitals have instituted a wide-ranging programme to measure outcomes attained by the patients that they treat. In most cases, outcome is assessed in terms of change in a generic health status profile, the SF-36. However, at an early stage it became apparent that this measure was not appropriate for patients undergoing cataract surgery⁶; indeed, paradoxically, many patients reporting a satisfactory outcome also experienced a decline in the SF-36 scores, a phenomenon also reported elsewhere⁷ and now understood to reflect their improved mobility, unmasking latent locomotor problems. As a consequence, the VF-14 was substituted for patients undergoing cataract surgery. This article takes advantage of

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the large database that has resulted, containing information on over 1100 patients undergoing cataract surgery to ask whether the benefit obtained, in terms of visual function, varies with age.

Methods

The potential study population comprised all patients undergoing phakoemulsification with or without lens implant in 29 BUPA-owned hospitals between November 2001 and May 2004 (with the latest follow-up in September 2004). BUPA is one of the largest providers of private hospital services in the United Kingdom.

In the database, it was not possible to differentiate patients undergoing surgery for cataract from those where the procedure was for refractory purposes, so the analysis was limited to procedures undertaken by those surgeons who, on enquiry, were identified as only performing the former. All patients completed an initial questionnaire which included the VF-14 pre-operatively and were requested to complete a second one at home 4 months post-operatively.

As the data were obtained from an administrative database and not in the framework of a specially designed research project, the amount of patient data was relatively limited. In particular, there were no data on co-morbidities, such as co-existing eye disease. It was therefore only possible to look at the effect of age and gender on outcome. Age at the time of surgery was calculated from the patient's date of birth. Outcome was assessed as the absolute score achieved at 4 months post-operatively using the VF-14.

The initial analysis employed visual inspection of the data to identify approximate inflection points, plotting baseline and follow-up scores. Given the instability in the numbers in each single year of age category, a five-point moving average was used to smooth the curves. This suggested that those above and below certain ages achieved worse outcomes, with an apparent linear decline as one moved away from the central age band over which outcomes were relatively stable. The next step was to quantify more precisely the relationship between age and outcome. Given the appearance on visual inspection, the model was specified as one in which there was a linear relationship of outcome with age over a broad age range but with additional affects of age above and below certain inflection points. For older ages, where the precise inflection point was less easy to define from visual inspection, this first involved a series of regressions around the apparent inflection points, using follow-up VF-14 as the dependent variable, to identify the best fitting model. In these regressions, the range of possible inflection points examined ranged from 4 years above and below the apparent point. This best fitting model was then used in the final analysis in which multiple linear regression was used to assess the contribution of age, gender and baseline VF-14 score.

Results

One thousand one hundred and seven of 1142 patients completed an initial questionnaire (96.9 per cent), of whom 1098 (99.2 per cent) completed one post-operatively and thus are available for analysis. The overall response rate was thus 96.1 per cent. Respondents consisted of 449 men (41 per cent) and 641 women (59 per cent) (in eight cases sex was not recorded). The median age of men was 75 years and of women 77. The mean pre-operative VF-14 score was 82.6; the corresponding post-operative figure was 94.8. The association of baseline and follow-up VF-14 scores with age is shown in Fig. 1. Between 45 and about 85 both baseline and follow-up scores remain stable, after which both decline relatively steeply.

Baseline and follow-up VF-14 scores were higher in men than women ($p = 0.002$). In most age groups, women undergoing surgery had worse pre-operative levels of visual function than men (Table 1).

Figure 1 suggests that follow-up VF-14 score begins to decline after about 85 years of age, a figure confirmed by the comparison of goodness of fit in models setting the inflection point between 81 and 89. Consequently, in the final model, the first variable was defined as increasing by 1 unit for each year above 85 (over_85), with other ages set at zero. The second was calculated as each year under 50 (under_50), which increased by 1 unit for each year under 50. Two models were generated. The first examined the effects of the two age-related variables plus gender; the second added baseline VF-14 score. The results are summarized in Table 2. In summary, when only age and gender in combination are taken into account, there is no significant decline in follow up VF-14 score until the age of 85, after which there is a reduction of 1.2 units per year (1.4 if the non-significant trend in age beyond 50 is removed from the model) in the expected follow-up VF-14

Table 1 Baseline and follow-up scores by gender and age band (means and standard deviations)

| | Male | | | Female | | | N |
|-------|------|-----------|-----------|--------|-----------|-----------|------|
| | n | Base line | Follow-up | n | Base line | Follow-up | |
| <50 | 13 | 86 ± 15 | 94 ± 7 | 9 | 84 ± 11 | 94 ± 7 | 22 |
| 50-54 | 17 | 84 ± 12 | 94 ± 7 | 8 | 78 ± 15 | 94 ± 6 | 25 |
| 55-59 | 23 | 89 ± 9 | 98 ± 2 | 26 | 74 ± 24 | 95 ± 6 | 49 |
| 60-64 | 31 | 77 ± 21 | 96 ± 11 | 41 | 79 ± 16 | 95 ± 9 | 72 |
| 65-69 | 44 | 86 ± 13 | 98 ± 4 | 59 | 86 ± 10 | 97 ± 6 | 103 |
| 70-74 | 92 | 86 ± 15 | 96 ± 7 | 115 | 85 ± 14 | 96 ± 8 | 207 |
| 75-79 | 96 | 86 ± 15 | 98 ± 4 | 151 | 81 ± 18 | 94 ± 13 | 247 |
| 80-84 | 81 | 86 ± 13 | 95 ± 6 | 141 | 81 ± 19 | 92 ± 12 | 222 |
| 85-89 | 40 | 85 ± 15 | 96 ± 6 | 68 | 78 ± 21 | 91 ± 14 | 108 |
| 90+ | 12 | 78 ± 18 | 85 ± 20 | 23 | 62 ± 21 | 81 ± 22 | 35 |
| Total | 449 | 85 ± 15 | 96 ± 8 | 641 | 81 ± 18 | 94 ± 12 | 1090 |

In eight cases, sex was not recorded. All differences between baseline and follow-up scores are significant ($p < 0.0001$) except for males aged 90+ ($p > 0.05$).

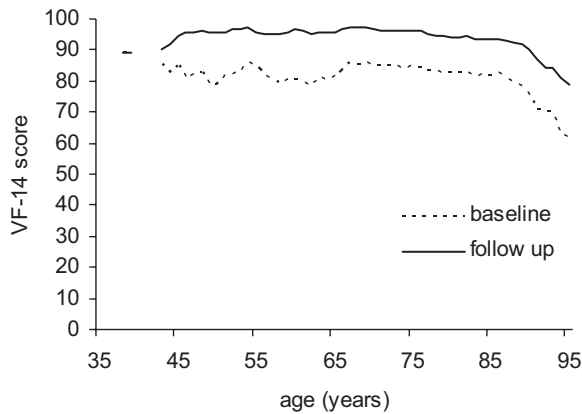


Figure 1 Weighted moving average of baseline and follow-up scores by age.

score. However, once baseline visual function is taken into account (with each additional unit associated with an improvement in follow-up score of 0.25), then the loss of follow-up score beyond age 85 is only 0.7 per year. Thus, among those over 85, although poorer baseline function predicts some element of the lower attainment, increasing age remains important.

Discussion

Main finding of this study

This study shows that older people undergoing cataract removal in BUPA hospitals have a good probability of achieving an excellent outcome but also that their probability of achieving this outcome is less than among younger patients.

What is already known on this topic

A report using the American Academy of Ophthalmology National Eyecare Outcomes Network (NEON) found that, among 2603 patients on whom all information was available, the

mean score (possible range 0–100) improved from 71.6 to 93.1.⁸ In the Cataract PORT study, also undertaken in the United States and with 717 patients, the mean score improved from 75.5 to 93.2.⁹ The Barcelona I-PORT study, of 157 patients undergoing cataract surgery, reported an improvement in mean score from 64 to 85.7,¹⁰ whereas one with 460 patients in Singapore found an improvement in mean scores from 80.1 to 93.5.¹¹

Some studies have looked at the impact of age on improvement in visual function¹² or co-existing eye disease, in both cases showing a negative effect. However, the studies that have looked at variations in outcomes have either been relatively small or have looked only at very broad age groups. For example, the Barcelona I-PORT study looked at three age groups: 50–64; 65–74 and 75 and over. This found no difference in outcome according to age, although pre-operative VF-14 score was a significant predictor of outcome.¹⁰ In contrast, a study of patients undergoing surgery in four countries found that the odds of achieving a post-operative score of less than 95 increased with age, with those aged 80 and over 2.4 times as likely to achieve a score of less than 95 compared with the index group (aged between 50 and 59), whereas those aged between 70 and 79 were 2.16 times as likely to achieve a score of under 95.¹³ That study did not, however, further subdivide the oldest age group.

What this study adds

Although the absolute score achieved by older people is lower, the absolute difference in pre- and post-operative score is similar to that obtained by younger people and thus, as they start from a lower baseline, the relative gain is greater. Although the VF-14 does not capture all aspects of visual function, it can be used to provide patients with additional information on the likely outcome of surgery.¹⁴

This study also serves as a reminder that clinical databases used in performance monitoring must collect an extended range of data items that will permit appropriate adjustments for differences in case-mix.¹⁵ As is noted in the subsequent section, an effective adjustment mechanism will require detailed consideration of a range of factors including co-morbidities. However the choice of items to be included is likely to be different for each major condition. This has profound implications for the National Health Service Information Strategy.

Limitations of this study

The study included only patients receiving private treatment. In the United Kingdom, about 11 per cent of the population has private health insurance (although an increasing number of patients also self-pay). Consequently, it is plausible that the sample was not entirely representative of the overall population, and it will be important to replicate this study in that population. Of note, the baseline VF-14 values recorded overall were somewhat better than in previously reported studies from elsewhere. However, it is also important to note that the

Table 2 Determinants of follow-up VF-14 score

| | B | Standard error B | β | T | p |
|--|--------|------------------|---------|---------|---------|
| Model 1: adjusted for gender and age variables | | | | | |
| Constant | 97.830 | 0.946 | | 103.456 | <0.0001 |
| Over_85 | -1.243 | 0.245 | -0.168 | -5.076 | <0.0001 |
| Under_50 | -0.053 | 0.036 | -0.049 | -1.472 | 0.141 |
| Gender | -2.110 | 0.628 | -0.100 | -3.358 | 0.001 |
| Model 2: model 1 plus baseline score | | | | | |
| Constant | 76.292 | 1.679 | | 45.433 | <0.0001 |
| Over 85 | -0.730 | 0.226 | -0.099 | -3.236 | <0.001 |
| Under 50 | -0.064 | 0.033 | -0.050 | -1.928 | 0.054 |
| Gender | -0.560 | 0.493 | -0.050 | -1.846 | 0.65 |
| Baseline score | 0.254 | 0.0117 | 0.411 | 14.942 | <0.0001 |

Gender: 0, male; 1, female

baseline values at older ages were lower than those at younger ages, and it may be that the threshold for intervention in this age group is lower in the private sector than in the National Health Service (NHS). These findings confirm the need to take account of the threshold for surgery in comparisons; other research has shown considerable regional variation in the threshold for referral for cataract surgery within the NHS.¹⁶ Furthermore, the finding that adjustment for baseline score renders gender insignificant as a predictor of outcome indicates that differences in threshold for surgery explain the slight difference in outcome between men and women. However, it must be stressed that these findings cannot be extrapolated to the general population because of the possibility of differing indications for surgery and in particular the presence of ocular co-morbidity.

Another factor to be considered is that outcome was assessed at 4 months after surgery, consistent with many other studies using the VF-14. However, recent evidence suggests that the percentage of people continuing to have improved visual function declines over longer periods, especially where there is ocular co-morbidity.¹⁷

The routine use of the VF-14 (and other health status measures) by BUPA has been undertaken as part of a programme to monitor outcomes achieved by individual providers. By taking advantage of a system of data collection in which the VF-14 is an integral part, this study has the benefit of a large sample size, making it possible to examine the consequences of age. This integration of outcome assessment with administrative processes overcomes some of the problems that have beset other attempts to develop outcome monitoring systems.¹⁸ However, the retrospective analysis of these routine data also has many limitations. The reason why those over 85 should do worse is almost certainly because they have co-existing eye disease, such as age-related disorders such as macular degeneration, and this is not reported in the data set. It should also be noted that patients with age-related macular degeneration do benefit from cataract surgery, even if what can be achieved is less than among those with no ocular co-morbidity.¹⁹ In contrast, there is some evidence that patients with diabetic retinopathy may not achieve an improved visual function, despite achieving improvements in visual acuity.²⁰ In addition, it was not possible to distinguish among patients with bilateral cataracts whose undergoing first or second eye surgery, although this can be expected to impact on the outcome achieved.^{21,22} Other potential explanatory variables were also not collected, most obviously the indication for surgery, requiring the exclusion of a large number of cases operated on by surgeons for whom we could not exclude the possibility that surgery was for correction of refractive error. In addition, recent evidence has indicated that pre-operative VF-14 scores are affected by cataract type, independent of visual acuity.²³ This study can therefore only be regarded as an initial analysis that can contribute to other evidence on the determinants of outcome. Of particular importance, given the growing use of measures such as the VF-14

in performance assessment, variables related to many of these determinants are not usually included in routinely collected data so it will be necessary to develop new data systems that extend beyond the usual administrative variables.

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Competing interests

Martin McKee is a member of BUPA's Medical Advisory Panel.

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