Review Article

Indication for cataract surgery. Do we have evidence of who will benefit from surgery? A systematic review and meta-analysis

Line Kessel,[1,2] Jens Andresen,[3] Ditte Erngaard,[4] Per Flesner,[5] Britta Tendal[2] and Jesper Hjortdal[6]

[1]Department of Ophthalmology, Rigshospitalet - Glostrup, Glostrup, Denmark
[2]Danish Health and Medicines Authorities, Copenhagen, Denmark
[3]Skanderborg Eye Clinic, Skanderborg, Denmark
[4]Department of Ophthalmology, Næstved Hospital, Næstved, Denmark
[5]Odense Eye Clinic, Odense, Denmark
[6]Department of Ophthalmology, Aarhus University Hospital NBG, Aarhus, Denmark

ABSTRACT.
The need for cataract surgery is expected to rise dramatically in the future due to the increasing proportion of elderly citizens and increasing demands for optimum visual function. The aim of this study was to provide an evidence-based recommendation for the indication of cataract surgery based on which group of patients are most likely to benefit from surgery. A systematic literature search was performed in the MEDLINE, CINAHL, EMBASE and COCHRANE LIBRARY databases. Studies evaluating the outcome after cataract surgery according to preoperative visual acuity and visual complaints were included in a meta-analysis. We identified eight observational studies comparing outcome after cataract surgery in patients with poor (<20/40) and fair (>20/40) preoperative visual acuity. We could not find any studies that compared outcome after cataract surgery in patients with few or many preoperative visual complaints. A meta-analysis showed that the outcome of cataract surgery, evaluated as objective and subjective visual improvement, was independent on preoperative visual acuity. There is a lack of scientific evidence to guide the clinician in deciding which patients are most likely to benefit from surgery. To overcome this shortage of evidence, many systems have been developed internationally to prioritize patients on waiting lists for cataract surgery, but the Swedish NIKE (Nationell Indikationsmodell för Katarakt Ekstraktion) is the only system where an association to the preoperative scoring of a patient has been related to outcome of cataract surgery. We advise that clinicians are inspired by the NIKE system when they decide which patients to operate to ensure that surgery is only offered to patients who are expected to benefit from cataract surgery.

Key words: cataract – evidence – indication – visual acuity

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Introduction

Cataract is a clouding of the lens of the eye interfering with visual function. Globally, cataract is the leading cause of blindness and impaired visual acuity (Resnikoff et al. 2004). Cataract surgery is one of the most commonly performed elective surgical procedures performed in westernized countries. Indications for cataract surgery are changing with more patients being operated at younger ages and better visual acuities (Behndig et al. 2011; Kessel et al. 2011; Lundstrom et al. 2015). The annual number of surgeries increases (Solborg et al. 2015) and is expected to double within the next two decades (Tuulonen et al. 2009; Kessel 2011). This probably reflects increasing demands for optimum visual function in patients as well as improved outcomes and safer procedures lowering the physician's barrier for indication. A Finnish study showed that a surprisingly large proportion of patients with preoperative visual acuity 0.8 or better and in whom visual acuity could be improved by glasses still chose to have cataract surgery (Falck et al. 2012).

Cataract is diagnosed clinically at the slit lamp. Objective measurements may assist the clinician in the diagnosis. Most objective systems measure the degree of light scattering, for example the dynamic light scattering method

(Datiles et al. 2008) or straylight measurements (van der Meulen et al. 2012). Scheimpflug photography is another objective method, and a correlation to increased phacoemulsification time and energy has been demonstrated (Kim et al. 2009). Furthermore, visually based grading systems of cataract are available, for example AREDS (AREDS study group 2001) and LOCS III (Siik et al. 1999). All of these assisting methods show a certain degree of correlation, but none of them are good at predicting the outcome after cataract surgery (Vianya-Estopa et al. 2009; Skiadaresi et al. 2012).

The expected postoperative visual outcome is important when advising the patient on whether to have cataract surgery. The preoperative status of the posterior pole, that is retina and optic nerve, is essential for the expected visual outcome, but they can be challenging to evaluate correctly prior to cataract surgery, especially in patients with very dense cataracts. Potential vision tests, such as critical flicker frequency and optimal reading speed, potential acuity metre and laser interferometry, have been suggested as indicators of postoperative visual gain, but their predictive value is limited (Douthwaite et al. 2007; Vianya-Estopa et al. 2009).

The great majority of patients experience an improvement in visual function after cataract surgery (Lundstrom et al. 1998; Porela-Tiihonen et al. 2015), but one of 10 patients perceive increased difficulties 6 months after surgery compared to the preoperative state (Lundström et al. 2002). On the other hand, even patients with very good preoperative visual acuity (20/20) may have a subjective improvement in visual function postoperatively (Amesbury et al. 2009). Even in patients with low predicted probability for improvement in visual function, cataract surgery has been shown to be cost-effective (Naeim et al. 2006).

In other words, it is challenging to determine which patient will benefit from cataract surgery. Then, how do we know who to operate and when to operate? The aim of this study was to provide evidence-based recommendation on which patients with age-related cataract are most likely to benefit from surgery. There may be other indications for cataract surgery, for example prior to vitreoretinal or glaucoma surgery, improved monitoring of retinal disease, myopinization, phacomorphic or phacolytic glaucoma, but the present systematic review is focused on the bulk majority of patients who are operated to improve visual function. The study was initiated by an initiative by the Danish Medicines and Health Authorities to provide evidence-based national Danish guidelines for cataract surgery.

Methods

The systematic review and resulting meta-analysis were performed based on the principles described in the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system (Guyatt et al. 2011f). We first defined the topic of the systematic review using the PICO approach (Guyatt et al. 2011a). In short, PICO stands for Patient (P), Intervention (I), Comparison (C) and Outcome (O). For this specific review and meta-analysis, we formulated two specific questions:

(1) Will the patient with age-related cataract and poor preoperative visual acuity (20/40 or lower) (P) benefit (O) more from cataract surgery (I) than the patient with fair preoperative visual acuity (better than 20/40) (C)?

(2) Will the patient with fair preoperative visual acuity (≥20/40) and subjective cataract-related complaints (P) benefit more (O) from cataract surgery (I) than the patient with poor preoperative visual acuity (< 20/40) but few or no subjective cataract-related complaints (C)?

For both questions, benefit was defined as an improvement in objective visual acuity (2 Snellen lines or greater or a doubling of the visual angle or improvement as defined by the included studies) or subjective visual function assessed by validated questionnaires. Harms of surgery, defined as peri- or postoperative complications as reported by included studies, were also considered as important outcomes. The preoperative visual acuity grouping of fair (>20/40) versus poor (<20/40) was chosen because 20/40 vision is the legal requirement for upholding a driver licence in Denmark.

A systematic literature search was conducted in August 2014 in the EMBASE, MEDLINE, CINAHL and COCHRANE LIBRARY databases using the search term (indication) AND ((cataract surgery) OR cataract extraction). The search was limited to references published in the English or Scandinavian languages. Studies that compared the outcome after cataract surgery in patients with poor and fair preoperative visual acuity, either alone or in combination with preoperative subjective visual acuity, were included in the meta-analysis. Studies that did not report the outcome after cataract surgery in relation to preoperative visual function were excluded from the meta-analysis. Both randomized controlled trials and non-randomized studies were considered for inclusion.

The quality of the included studies was evaluated using the Cochrane risk of bias tool (Higgins & Green 2011) in the review manager 5 Software (Review Manager (RevMan) 2012). In short, the Cochrane risk of bias tool assesses the risk of bias associated with the selection of patients (randomization or patient allocation and concealment of allocation), study performance (blinding of patients and personnel), detection of outcomes (blinding of outcome assessment), attrition of data (such as missing patients or dropouts), reporting of study findings (selective outcome reporting) or other types of bias related to the study design that could affect the internal validity. This part of the systematic review was performed independently by two reviewers (LK and JA). Disagreement was resolved through discussion and consensus.

The quality of the evidence for each prespecified outcome was evaluated across the included studies using the GRADE system in the grade profiler Software (GRADE profiler 2011). Each outcome was analysed for study limitations that could affect the outcome (risk of bias, e.g. lack of allocation concealment or lack of blinding of patients or outcome assessors, incomplete accounting of patients and outcome, selective outcome reporting or other limitations) (Guyatt et al. 2011g), inconsistency (different results between studies) (Guyatt et al. 2011d), indirectness (e.g. use of surrogate measures) (Guyatt et al. 2011c), imprecision (large confidence intervals or the lack of statistical strength) (Guyatt et al. 2011b) and risk of publication bias (e.g. lack of reporting of negative findings)

Table 1. Characteristics of included studies.

Study id	Methods	Participants	Interventions	Outcomes	Notes
Davis 2012 (Davis et al. 2012)	Prospective cohort study Reports outcome in first- and second-eye cataract surgeries Fraser Health Authority, British Columbia, Canada	Patients listed for cataract surgery Mean age: 73 yrs. Range: 45–94 yrs, the majority were women	Cataract surgery Group 1: preop VA ≥0.5 Group 2: preop VA 20/100-20/50	Mean (SD) change in VF-14 score (both eye surgery) was 4.2 (10.3) in Group 1 (n = 27) and 11.5 (12.0) in Group 2 (n = 24)	The authors have no competing interests
Douthwaite 2007 (Douthwaite et al. 2007)	Non-randomized, interventional study Reports the effect of different potential vision tests Department of Optometry, University of Bradford, UK	Patients with age-related cataract waiting for cataract surgery Group A1: age* 75 (54–83), pre-op logMAR† 0.31 (0.09) Group A2: age* 74 (56–85), pre-op logMAR† VA 0.85 (0.47)	Cataract surgery Group A1: moderate cataract, no ocular comorbidities Group A2: advanced cataract, no ocular co-morbidities	Postoperative VA (logMAR)†: Group A1: −0.02 (0.07) Group A2 −0.03 (0.08)	Funding: not reported
Garcia-Gutierrez 2014 (Garcia-Gutierrez et al. 2014)	Non-randomized, prospective cohort study Reports clinical outcomes and patient satisfaction after cataract surgery Hospital Galdakao-Usansolo, Bizkaia, Spain	Patients with age-related cataract Demographics of study population: mean age 73 yrs, 42% males	Cataract surgery Group 1: pre-op VA ≤0.4 Group 2: pre-op VA ≥0.5	Subjective satisfaction (very satisfied + satisfied): Group 1: 3180/3501 Group 2: 632/674	Funding: public and private funds. No conflict of interests reported
Kanthan 2011 (Kanthan et al. 2011)	Population based cohort study Reports intermediate (0–5 yrs) and longer-term (5–10 yrs) visual outcome after cataract surgery Department of Ophthalmology. Universities of Sydney + Melbourne	Persons aged 49 + living in the Blue Mountains area, Australia	Cataract surgery Group 1: pre-op logMAR letters read ≤39, ~0.5 Snellen Group 2: pre-op logMAR ≥40 > 0.5 Snellen	Postop VA ≤39 at 5 yrs: Group 1: 5/28 Group 2: 5/93	Funding: the Australian National Health and Medical Research Council
Lundström 1999 (Lundstrom et al. 1999)	Database study Data extraction from the National Swedish Cataract Register based on 35 different departments	Patients with cataract 66% female, age ranging from 20 to 90+, mean age was 75.5 yrs	Cataract surgery Group 1: pre-op VA ≤0.4 Group 2: pre-op VA ≥0.5	Subjective improvement/benefit after cataract surgery: Group 1: 538/604 Group 2: 1219/1329	Funding: National Board of Health and Welfare Sweden
Lundström 2013 (Lundstrom et al. 2013)	Database study Based on the European Registry of Quality Outcomes for Cataract and Refractive Surgery (15 countries)	Patients with age-related cataract undergoing cataract surgery Mean age 73.9 yrs, 60% women	All patients had cataract surgery Group 1: pre-op VA ≤20/40 Group 2: pre-op VA ≥20/32	Objective improvement in VA: Group 1: 112384/113709 Group 2: 249572/254359	No financial or proprietary interests declared
Rosen 2005 (Rosen et al. 2005)	Non-randomized interventional study Reports VF-14 outcomes after cataract surgery from 9 group practice ophthalmologists, Southern California Kaiser-Permanente Medical Group	Patients scheduled for cataract surgery Age* 72.5 (8.6), 39.5% women	Group 1: pre-op VA ≥20/40 Group 2: pre-op VA ≤20/50	VF-14 at 4 months, mean (SD): Group 1: 94.82 (5.36) Group 2: 94.59 (8.81)	No conflict of interests reported

Table 1. (Continued)

Study id	Methods	Participants	Interventions	Outcomes	Notes
Saw 2002 (Saw et al. 2002)	Non-randomized, observational study Reports outcome after cataract surgery based on pre-op characteristics Singapore National Eye Center, Singapore	Patients with age-related cataract ECCE (28.7%) or phacoemulsification (71.3%) 157 of 204 were 65 yrs or younger	Cataract surgery Group 1: pre-op VA ≤0.5 Group 2: pre-op VA >0.5	VA improvement: Group 1: 175/234 Group 2: 212/221	Funding: Singapore National Eye Center

Outcomes are reported as rates (numbers affected/whole group) unless otherwise stated. SD: standard deviation. Post-op: postoperatively. Pre-op: preoperative. VA: visual acuity. VF-14: visual function questionnaire 14. Yrs: years. * median (range) † mean (standard deviation).

(Guyatt et al. 2011e). According to the GRADE system, evidence based on randomized controlled trials start as high-quality evidence and non-randomized studies start as low-quality evidence, but the quality of the evidence for each of the prespecified outcomes can be downgraded based on the assessment of each of the limitations mentioned above. The quality of evidence can also be upgraded if the effect is very strong or the data point towards a dose–response effect.

Continuous data were analysed according to differences in mean treatment effects and their standard deviations. Dichotomous outcome data were analysed by calculating risk ratios. The review manager 5 Software (Review Manager (RevMan) 2012) was used for estimation of overall treatment effects. Random-effects models were used to calculate pooled estimates of effects.

Results

A systematic literature search yielded 778 hits. Of those, 67 references were considered to be of potential interest and these references were obtained in full text and read thoroughly. We identified eight observational studies that compared the outcome after cataract surgery in patients with poor and fair preoperative visual acuity (Lundstrom et al. 1999, 2013; Saw et al. 2002; Rosen et al. 2005; Douthwaite et al. 2007; Kanthan et al. 2011; Davis et al. 2012; Garcia-Gutierrez et al. 2014). The characteristics of included studies are presented in Table 1, and risk of bias assessment for the included studies is presented in Table 2. We did not identify any studies that compared the outcome of cataract surgery in patients with poor preoperative visual acuity and few subjective complaints to patients with fair preoperative visual acuity and many subjective complaints or any other combination of preoperative visual acuity and visual complaints. We did not identify any randomized trials evaluating the effect of cataract surgery based on preoperative visual characteristics. The literature search revealed furthermore 59 studies that did not fulfil the criteria for inclusion, and hence, those studies were excluded. A list of excluded studies and reasons for exclusion is provided in Table S1.

Visual acuity after cataract surgery

We identified four observational studies that compared the visual acuity after cataract surgery in patients with poor or fair preoperative visual acuity (Saw et al. 2002; Douthwaite et al. 2007; Kanthan et al. 2011; Lundstrom et al. 2013). The studies reported the gain in visual acuity in three different ways: as the mean value in the two compared groups, as the number of patients with an improvement in visual acuity or as the number of patients with postoperative visual acuity 20/40 or less. None of the studies reported gain in visual acuity as our prespecified outcome of a doubling of the visual angle.

Mean visual acuity after cataract surgery in patients with fair versus poor preoperative visual acuity

Visual acuity outcome was compared in patients with fair (logMAR: 0.31 (0.09) mean (SD), corresponding to ~20/40) and poor (logMAR 0.85 (0.47), mean (SD), corresponding to 20/125 to 20/160) preoperative visual acuity (Douthwaite et al. 2007). Included patients had cataract but no other significant ocular comorbidities. The time from cataract surgery to follow-up visit was not reported. Mean postoperative visual acuity was −0.02 logMAR (~20/20) in patients with fair preoperative visual acuity, and it was −0.03 logMAR (~20/20) in patients with poor preoperative visual acuity. There was no difference in visual acuity after surgery in the patients with poor or fair preoperative visual acuity (see Fig. 1).

Number of patients with postoperative visual acuity 20/40 or less in patients with fair versus poor preoperative visual acuity

Visual acuity outcome was reported in one study as the number of patients with a visual acuity of ≤39 ETDRS letters read (~20/40 or less) 5 years after cataract surgery in patients with preoperative visual acuity of ≤39 ETDRS letters read (poor visual acuity, corresponding to <20/40) or ≥40 ETDRS letters read (fair visual acuity, corresponding to >20/40) (Kanthan et al. 2011). In the group of patients with poor preoperative visual acuity, 17.9% had a postoperative visual acuity 5 years after surgery of ≤39 ETDRS

Table 2. Risk of bias assessment.

Study id Bias	Davis 2012 (Davis et al. 2012)	Douthwaite 2007 (Douthwaite et al. 2007)	Garcia-Gutierrez 2014 (Garcia-Gutierrez et al. 2014)	Kanthan 2011 (Kanthan et al. 2011)	Lundström 1999 (Lundstrom et al. 1999)	Lundström 2013 (Lundstrom et al. 2013)	Rosen 2005 (Rosen et al. 2005)	Saw 2002 (Saw et al. 2002)
Random sequence generation	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)	High risk (Not randomized)
Allocation concealment	Unclear risk (Not reported)	Low risk ('Subjects were recruited as consecutive cases over a 12-month period')	Low risk ('We recruited consecutive patients . . . . . . between October 2004 and July 2005')	Low risk ('All residents of these two postcode areas who were aged 49 years or older were eligible and invited to participate')	Low risk ('In these departments the questionnaire was given to all patients operated upon during the month of March 1995')	Low risk ('The coding guidelines for the collection state that all consecutive cases should be reported during the study period')	Low risk ('All consecutive adult patients presenting for first- or second-eye cataract surgery were invited to participate')	Low risk ('Patients . . . were systematically sampled in a 1-in-10 fashion until . . . 500 patients joined')
Blinding of participants and personnel	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)	High risk (Unblinded study)
Blinding of outcome assessment	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)	Unclear risk (Not reported)
Incomplete outcome data	High risk (820 patients were invited to participate. 360 agreed to participate)	Unclear risk ('23 subjects were lost to the study ')	High risk ('7438 patients were recruited for the study. . . After the intervention, 4335 completed the final questionnaire')	Unclear risk ('There were 152 participants (212 eyes) . . . who returned to the 5-year examinations' but data is only presented for 121 eyes at 5 yr follow-up)	Unclear risk ('2970 cataract extractions were performed. . . The postoperative questionnaire was completed by 2266 patients')	Low risk ('The majority of surgeries are . . .from countries that contribute with transferred data from existing registries or electronic medical records')	Unclear risk ('Baseline and 4 months postoperative data were available for 233 patients of the 321 patients enrolled in the study')	Unclear risk ('500 patients joined the study, 65 patients did not agree to join the study. Forty patients did not have cataract surgery and were excluded)
Selective reporting	High risk (Does not report the number of complications depending on preoperative characteristics)	High risk (The distribution of postoperative complications in patients with advanced versus moderate cataract not reported)	High risk (Does not report the number of complications depending on preoperative characteristics)	High risk (Does not report the number of complications depending on preoperative characteristics)	High risk (Does not report the number of complications depending on preoperative characteristics)	Low risk (Risk factors for worse visual outcome is presented as the coefficients of a logistic regression analysis)	High risk (Does not report the number of complications depending on preoperative characteristics)	High risk (Does not report the number of complications depending on preoperative characteristics)
Other bias	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)	Low risk (Not likely)

The table presents the risk of bias evaluation for the included studies according to the Cochrane handbook definitions (Higgins & Green 2011). Risk of bias assessment includes selection bias (random sequence generation and allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), reporting bias (selective reporting) and other bias. Risk of bias was graded as high, unclear or low.

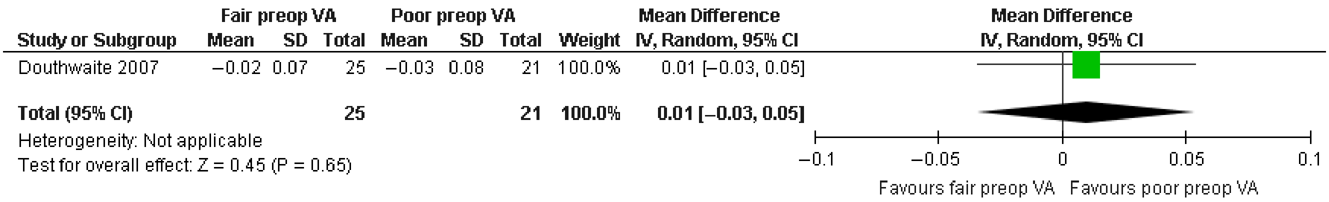

Fig. 1. Postoperative visual acuity (logMAR) in patients with fair or poor postoperative visual acuity (VA). CI, confidence interval; SD, standard deviation; IV, inverse variance.

letters compared to 5.1% in the group with fair preoperative visual acuity. The difference between the groups was statistically significant (see Fig. 2). The main reported cause of poor postoperative visual acuity was age-related macular degeneration.

Improvement in visual acuity

Three of the included studies reported the number of patients who had an improved visual acuity after cataract surgery (Saw et al. 2002; Kanthan et al. 2011; Lundstrom et al. 2013). None of the studies provided a definition of 'improved visual acuity'. Fair preoperative visual acuity was defined as ≥40 ETDRS letters read in one study (Kanthan et al. 2011), ≥0.63 Snellen in one study (Lundstrom et al. 2013) and >0.5 Snellen in one study (Saw et al. 2002). Correspondingly, poor preoperative visual acuity was defined as ≤39 ETDRS letters read in one study (Kanthan et al. 2011) and ≤0.5 in two studies (Saw et al. 2002; Lundstrom et al. 2013). Follow-up time after cataract surgery was 5 years in one study (Kanthan et al. 2011), <2 months in one study (Lundstrom et al. 2013) and 3 months in one study (Saw et al. 2002). In total, 98.1% of patients with fair preoperative visual acuity had an improvement in visual acuity after cataract surgery versus 98.8% of patients with poor preoperative visual acuity. The difference was not statistically significant (see Fig. 3).

Subjective visual outcome after cataract surgery

We identified four studies that compared the subjective visual outcome after cataract surgery in patients with poor or fair preoperative visual acuity (Lundstrom et al. 1999; Rosen et al. 2005; Davis et al. 2012; Garcia-Gutierrez et al. 2014). The studies reported subjective visual function in different ways. Two studies asked patients to rate the outcome after cataract surgery (Lundstrom et al. 1999; Garcia-Gutierrez et al. 2014), and two studies evaluated the subjective visual function using the Visual Function (VF-14) questionnaire (Rosen et al. 2005; Davis et al. 2012).

Subjective visual outcome based on patient ratings

Two studies asked patients to rate the subjective visual outcome after cataract surgery. One study asked patients whether they were 'Very satisfied', 'Satisfied' or 'Not satisfied' (Garcia-Gutierrez et al. 2014). One study evaluated whether the patients had 'Very good benefit' or 'Not very good benefit' from cataract surgery based on the Catquest questionnaire preoperative and postoperative scores (Lundstrom et al. 1999). Poor preoperative visual acuity was defined as ≤0.4 (20/50) and fair acuity as ≥0.5 (20/40) in both studies (Lundstrom et al. 1999; Garcia-Gutierrez et al. 2014). There was no difference in the rating of subjective visual outcome after cataract surgery between patients with poor or fair preoperative visual acuity (see Fig. 4).

Subjective visual outcome based on VF-14 questionnaire

One study evaluated subjective visual function at 7 weeks after cataract surgery using the Visual Function (VF-14) questionnaire (Davis et al. 2012), and another study evaluated subjective visual function at 4 months using the VF-14 questionnaire (Rosen et al. 2005). Fair preoperative visual acuity was defined as ≥20/40 in both studies. Overall, there was no difference in the postoperative VF-14 score between patients with fair or poor preoperative visual acuity (see Fig. 5).

Quality of the evidence

Quality of the evidence was evaluated using the GRADE approach (Table 3). The quality of evidence ranged from low to very low. According to the GRADE system, observational studies start as low-quality evidence. The level of evidence was further downgraded for two outcomes (the number of patients who experienced an improved postoperative visual acuity and the number of patients who experienced a subjective improvement in postoperative visual

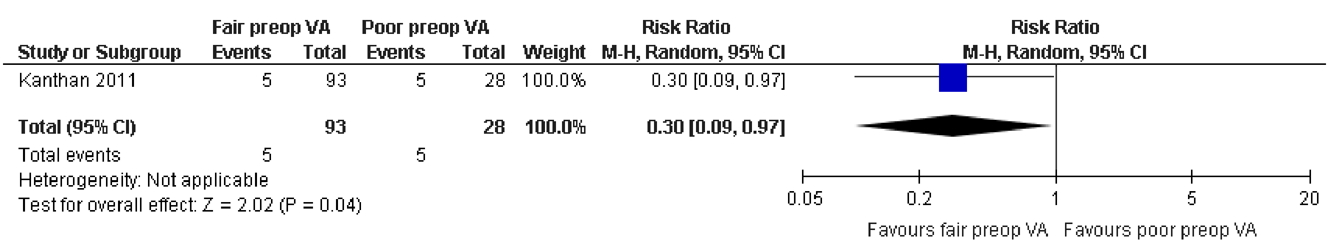

Fig. 2. Number of patients with postoperative visual acuity (VA) of 39 ETDRS letters or less (~20/40) at 5 years after surgery. CI, confidence interval; M-H, Mantel–Haenszel.

Study or Subgroup	Fair preop VA Events	Fair preop VA Total	Poor preop VA Events	Poor preop VA Total	Weight	Risk Ratio M-H, Random, 95% CI
Kanthan 2011	26	93	23	28	23.6%	0.34 [0.24, 0.49]
Lundström 2013	249572	254359	112384	113709	38.8%	0.99 [0.99, 0.99]
Saw 2002	212	221	175	234	37.6%	1.28 [1.19, 1.39]
Total (95% CI)		**254673**		**113971**	100.0%	**0.85 [0.64, 1.13]**
Total events	249810		112582			

Heterogeneity: Tau² = 0.06; Chi² = 72.63, df = 2 (P < 0.00001); I² = 97%
Test for overall effect: Z = 1.12 (P = 0.26)

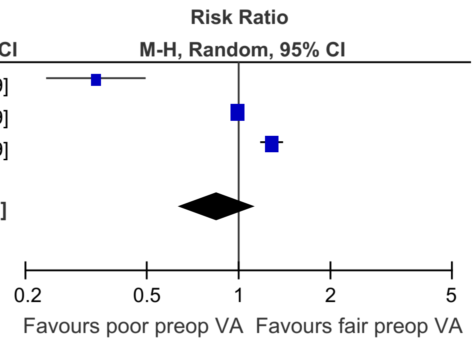

Fig. 3. Number of patients who had an improved visual acuity (VA) after cataract surgery. CI, confidence interval; M-H, Mantel–Haenszel.

Study or Subgroup	Fair preop VA Events	Fair preop VA Total	Poor preop VA Events	Poor preop VA Total	Weight	Risk Ratio M-H, Random, 95% CI
Garcia-Gutierrez 2012	3180	3501	632	674	51.8%	0.97 [0.95, 0.99]
Lundström 1999	1219	1329	538	604	48.2%	1.03 [1.00, 1.06]
Total (95% CI)		**4830**		**1278**	**100.0%**	**1.00 [0.94, 1.06]**
Total events	4399		1170			

Heterogeneity: Tau² = 0.00; Chi² = 9.80, df = 1 (P = 0.002); I² = 90%
Test for overall effect: Z = 0.08 (P = 0.94)

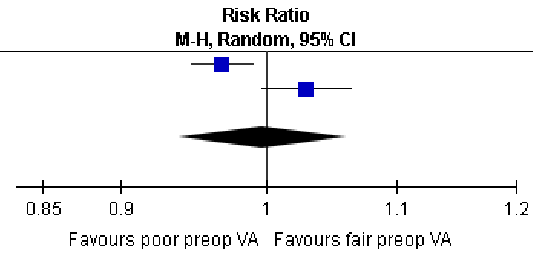

Fig. 4. Number of patients who reported an improvement in subjective visual function after cataract surgery. CI, confidence interval; M-H, Mantel–Haenszel; VA, visual acuity.

Study or Subgroup	Fair preop VA Mean	Fair preop VA SD	Fair preop VA Total	Poor preop VA Mean	Poor preop VA SD	Poor preop VA Total	Weight	Mean Difference IV, Random, 95% CI
2.2.1 VF-14 score								
Rosen 2005	94.82	5.36	18	94.59	8.81	180	57.0%	0.23 [−2.56, 3.02]
Subtotal (95% CI)			**18**			**180**	**57.0%**	**0.23 [−2.56, 3.02]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.16 (P = 0.87)								
2.2.2 Change in VF-14 score								
Davis 2012	4.2	10.3	27	11.5	12	24	43.0%	−7.30 [−13.48, −1.12]
Subtotal (95% CI)			**27**			**24**	**43.0%**	**−7.30 [−13.48, −1.12]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.32 (P = 0.02)								
Total (95% CI)			**45**			**204**	**100.0%**	**−3.01 [−10.32, 4.30]**

Heterogeneity: Tau² = 22.37; Chi² = 4.74, df = 1 (P = 0.03); I² = 79%
Test for overall effect: Z = 0.81 (P = 0.42)
Test for subgroup differences: Chi² = 4.74, df = 1 (P = 0.03), I² = 78.9%

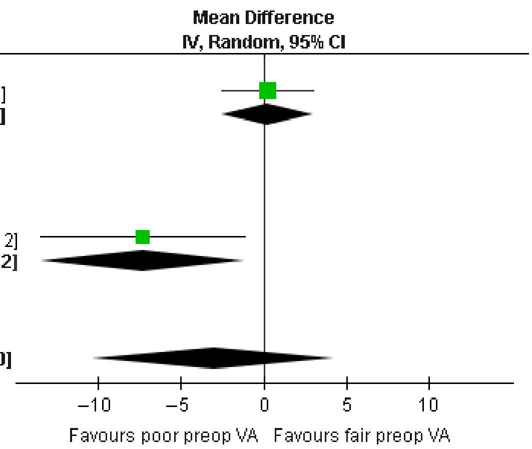

Fig. 5. Subjective visual function measured using the visual function questionnaire (VF-14). CI: confidence interval. IV, inverse variance; SD, standard deviation; VA, visual acuity.

acuity) because of inconsistent findings between the included studies.

Discussion

Whereas it is usually not difficult for the clinician to decide if a patient has cataract, it can be challenging to decide whether or not to offer surgery to the patient in question. The present study was carried out after an initiative by the Danish Health and Medicines Authorities to provide evidence-based recommendations on the indication for surgery for age-related cataract. The aim was to determine which preoperative characteristics best predict the visual gain, both subjective and objective, after cataract surgery in order to ensure that cataract surgery is offered to the patients who are most likely to benefit from surgery. The aim was not to set a barrier to reduce the number of surgeries performed. We decided to compare the outcome in patients with poor versus fair preoperative visual acuity and found eight observational studies that fitted the inclusion criteria (Lundstrom et al. 1999, 2013; Saw et al. 2002; Rosen et al. 2005; Douthwaite et al. 2007; Kanthan et al. 2011; Davis et al. 2012; Garcia-Gutierrez et al. 2014). We also wanted to compare the outcome after cataract surgery in patients who were characterized by a combination of preoperative visual acuity findings and preoperative subjective visual function, but we could not find any studies that fitted the inclusion criteria. We found that preoperative visual acuity was a poor predictor for postoperative visual function. This finding is perhaps not surprising as postoperative visual function depends more on the status

Table 3. Quality of evidence and summary of findings.

Outcomes	No of Participants (studies) Follow-up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with poor pre-op VA	Risk difference with fair pre-op VA (95% CI)
Objective visual outcome after cataract surgery					
Postoperative BCDVA (logMAR)	46 (1 study)	⊕⊕⊖⊖ Low			The mean postoperative BCDVA (logMAR) in the group with fair pre-op VA was 0.01 higher (worse) than in the group with poor pre-op VA (0.03 lower to 0.05 higher)
Number of patients with post-op VA ≤0.5	121 (1 study)	⊕⊕⊖⊖ Low	RR 0.3 (0.09 to 0.97)	179 per 1000	There were 125 fewer per 1000 patients ending with a post-op VA of ≤0.5 in the group with fair pre-op VA compared to the group with poor pre-op VA (from 5 fewer to 162 fewer)
Number of patients who improved in VA	368 644 (3 studies)	⊕⊖⊖⊖ Very low† due to inconsistency	RR 0.85 (0.64 to 1.13)	988 per 1000	There were 148 fewer per 1000 patients who experienced an improved VA after cataract surgery in the group with fair pre-op VA compared to the group with poor pre-op VA (from 356 fewer to 128 more)
Subjective visual outcome after cataract surgery					
Number of patients with subjective improvement	6108 (2 studies)	⊕⊖⊖⊖ Very low† due to inconsistency	RR 1 (0.94 to 1.06)	915 per 1000	There were 0 fewer per 1000 patients with subjective improvement of visual function in the group with fair pre-op VA compared to the group with poor pre-op VA (from 55 fewer to 55 more)
Mean VF-14 score	198 (1 study)	⊕⊕⊖⊖ Low			The mean VF-14 score was 0.23 higher in the group with fair pre-op VA compared to the group with poor pre-op VA (2.56 lower to 3.02 higher)
Change in VF-14 score	51 (1 study)	⊕⊕⊖⊖ Low			The mean change in VF-14 score was 7.3 lower in the group with fair pre-op VA compared to the group with poor pre-op VA (13.48 to 1.12 lower)

BCDVA, best corrected distance visual acuity; CI, Confidence interval; logMAR, logarithm to the minimal angle of resolution (lower values indicate a better visual acuity); pre-op, preoperative; post-op, postoperative; RR, Risk ratio; VA, visual acuity; VF-14, visual function questionnaire (ranges from 0 = blind to 100 = perfect visual function).
GRADE Working Group grades of evidence.
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.
† Inconsistent results between studies.

of the retina and optic nerve than on the degree of the cataract that is removed. Nonetheless, preoperative visual acuity is often used as the primary indicator for cataract surgery (Baun et al. 2001; Falck et al. 2008; Helsedirektoratet 2009). Although preoperative visual acuity is not a good predictor of the outcome of cataract surgery, it is efficient in regulating the number of required surgeries. A Spanish study showed that when the barrier was 20/40, the needed surgical volume was 69 000 cataract surgeries per million inhabitants over the age of 50 years versus 51 000 cataract surgeries per million inhabitants over the age of 50 years when setting the barrier at 20/50 (Comas et al. 2008).

Another reason that preoperative visual acuity is a poor predictor of visual gain after cataract surgery may be that preoperative visual acuity is routinely measured monocularly whereas the patient functions binocularly. Patient-perceived visual difficulties might thus be more closely related to the difference in visual function between the eyes than the visual function of each eye evaluated separately. Patients with bilateral cataract have better outcome after bilateral cataract than after unilateral cataract surgery (Lundstrom et al. 2001b), especially when evaluating binocular function and subjective visual function (Castells et al. 2006; Comas et al. 2007; Harrer et al. 2013). The more cataract the second eye has the greateris the benefit of second-eye surgery (Tan et al. 2012). Thus, patients with bilateral cataract should be offered bilateral cataract surgery.

To overcome the shortage of a scientific rationale for the selection of patients eligible for cataract surgery, a number of prioritization systems have been developed internationally. Prioritization systems may assist in reducing waiting times (Roman et al. 2008), but their effect in selecting patients who are likely to benefit from surgery is questionable. The Catalan Agency for Health Technology Assessment and Research Cataract Priority System (CCPS), West Canadian Waiting List [WCWL (Conner-Spady et al. 2005)] and Investigacíon en Resultados de Salud y Servicios Sanitarios [IRYSS (Quintana et al. 2006)] result in different scoring/prioritization of patients waiting for cataract surgery (Quintana et al. 2010). Neither WCWL nor CCPS was good at predicting the outcome after cataract surgery (Las et al. 2010). One study rated appropriateness of cataract surgery based on expert grading; the authors found that cataract surgery resulted in at least two Snellen lines of improvement in 89% of patients rated as appropriate and 68% of those rated as uncertain (Tobacman et al. 2003), showing that even expert grading may not always be reliable in deciding who will benefit from cataract surgery. The Swedish NIKE tool (Nationell Indikationsmodell for Kataraktextraktion) was developed for prioritizing patients on waiting lists for cataract surgery, and it is the only tool that has been shown to be able to predict the benefit of surgery based on preoperative grading (Lundstrom et al. 2006).

None of the included studies reported the risk of harms associated with cataract surgery, for example per- and postoperative complications such as capsule rupture or cystoid macular oedema. One study found that patients with poor preoperative visual acuity were more likely to experience complications during or after surgery (Gonzalez et al. 2014).

Although the majority of patients perceive an improvement in visual function after cataract surgery, nearly 1/10 of patients perceive increased difficulties 6 months after surgery (Lundström et al. 2002). Poor postoperative visual acuity is an important cause of dissatisfaction with cataract surgery (Monestam & Wachtmeister 1999). Older patients and patients with ocular comorbidities are less likely to have a good clinical outcome than younger and eye-healthy patients, and patients with good preoperative self-assessed visual function are less likely to have a good patient-reported outcome (Mollazadegan & Lundstrom 2015). Ocular comorbidity and anisometropia account for the majority of patients with impaired visual function after cataract surgery, but problems with the fellow eye, few preoperative subjective symptoms and postoperative complications are also important causes for non-benefit of cataract surgery (Lundstrom et al. 2000). Patients with ocular comorbidity have worse visual outcomes than those without ocular comorbidities because of the lower potential for visual function (Lundstrom et al. 2001a, 2013), but even patients with fundus pathology may have a favourable visual outcome (Chatziralli et al. 2011; Ostri 2014). Patients with good self-assessed preoperative visual function are more likely to have a poor patient-related outcome (Mollazadegan & Lundstrom 2015), and patients with good preoperative visual function have less possibility of improvement (Espallargues & Alonso 1998).

Conclusion and recommendations

Cataract surgery is the most commonly performed elective surgical procedure in many westernized countries, and yet we have very little scientific data to help the clinician to decide when to offer cataract surgery to an individual patient. Preoperative visual acuity provides a poor indication of the outcome after cataract surgery, but it can be quite efficient in setting a barrier for the number patients eligible for cataract surgery. We performed the present systematic review after an initiative by the Danish Health and Medicines Authority to establish evidence-based national guidelines for the indication for cataract surgery. We found that the Swedish NIKE system (Lundstrom et al. 2006) was the only system with a documented association between preoperative grading and outcome after cataract surgery. Hence, we advise that the NIKE system is implemented in Denmark to ensure that cataract surgery is offered to patients who are likely to benefit from surgery.

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Correspondence:
Line Kessel, MD, PhD, FEBO
Department of Ophthalmology
Rigshospitalet - Glostrup, Nordre Ringvej 57
2600 Glostrup, Denmark
Tel: +45 38 63 47 68
Fax: +45 3863 3739
Email: line.kessel@dadlnet.dk

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Characteristics of excluded studies.