de Silva, SR; Riaz, Y; Evans, JR (2014) Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. The Cochrane database of systematic reviews (1). CD008812. ISSN 1469-493X DOI: https://doi.org/10.1002/14651858.CD008812.pub2

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Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract (Review)

de Silva SR, Riaz Y, Evans JR

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Cochrane Database of Systematic Reviews 2014, Issue 1. Art. No.: CD008812.
DOI: 10.1002/14651858.CD008812.pub2.

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[Intervention Review]

Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

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Editorial group: Cochrane Eyes and Vision Group.
Publication status and date: New, published in Issue 1, 2014.
Review content assessed as up-to-date: 13 May 2013.

Citation: de Silva SR, Riaz Y, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database of Systematic Reviews* 2014, Issue 1. Art. No.: CD008812. DOI: 10.1002/14651858.CD008812.pub2.

ABSTRACT

Background

Age-related cataract is one of the leading causes of blindness worldwide. Therefore, it is important to establish the most effective surgical technique for cataract surgery.

Objectives

The aim of this review is to examine the effects of two types of cataract surgery for age-related cataract: phacoemulsification and extracapsular cataract extraction (ECCE).

Search methods

We searched CENTRAL (which contains the Cochrane Eyes and Vision Group Trials Register) (*The Cochrane Library* 2013, Issue 4), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to May 2013), EMBASE (January 1980 to May 2013), Latin American and Caribbean Literature on Health Sciences (LILACS) (January 1982 to May 2013), Web of Science Conference Proceedings Citation Index - Science (CPCI-S) (January 1970 to May 2013), the *meta*Register of Controlled Trials (*m*RCT) (www.controlled-trials.com), ClinicalTrials.gov (www.clinicaltrials.gov) and the WHO International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp/search/en). We did not use any date or language restrictions in the electronic searches for trials. We last searched the electronic databases on 13 May 2013.

Selection criteria

We included randomised controlled trials of phacoemulsification compared to ECCE for age-related cataract.

Data collection and analysis

Two authors independently selected and assessed all studies. We defined two primary outcomes: 'good functional vision' (presenting visual acuity of 6/12 or better) and 'poor visual outcome' (best corrected visual acuity of less than 6/60) at three and 12 months after surgery. We also collected data on intra and postoperative complications, and the cost of the procedures.

Main results

We included 11 trials in this review with a total of 1228 participants, ranging from age 45 to 94. The studies were generally at unclear risk of bias due to poorly reported trial methods. No study reported presenting visual acuity, so we report both uncorrected (UCVA) and best corrected visual acuity (BCVA). Studies varied in visual acuity assessment methods and time frames at which outcomes were reported. Participants in the phacoemulsification group were more likely to achieve UCVA of 6/12 or more at three months (risk ratio (RR) 1.81, 95% confidence interval (CI) 1.36 to 2.41, two studies, 492 participants) and one year (RR 1.99, 95% CI 1.45 to 2.73, one study, 439 participants). People in the phacoemulsification group were also more likely to achieve BCVA of 6/12 or more at three months (RR 1.12, 95% CI 1.03 to 1.22, four studies, 645 participants) and one year (RR 1.06, 95% CI 0.99 to 1.14, one study, 439 participants), but the difference between the two groups was smaller. No trials reported BCVA less than 6/60 but three trials reported BCVA worse than 6/9 and 6/18: there were fewer events of this outcome in the phacoemulsification group than the ECCE group at both the three-month (RR 0.33, 95% CI 0.20 to 0.55, three studies, 604 participants) and 12-month time points (RR 0.62, 95% CI 0.36 to 1.05, one study, 439 participants). Three trials reported posterior capsule rupture: this occurred more commonly in the ECCE group than the phacoemulsification group but small numbers of events mean the true effect is uncertain (Peto odds ratio (OR) 0.56, 95% CI 0.26 to 1.22, three studies, 688 participants). Iris prolapse, cystoid macular oedema and posterior capsular opacification were also higher in the ECCE group than the phacoemulsification group. Phacoemulsification surgical costs were higher than ECCE in two studies. A third study reported similar costs for phacoemulsification and ECCE up to six weeks postoperatively, but following this time point ECCE incurred additional costs due to additional visits, spectacles and laser treatment to achieve a similar outcome.

Authors' conclusions

Removing cataract by phacoemulsification may result in a better visual acuity compared to ECCE, with a lower complication rate. The review is currently underpowered to detect differences for rarer outcomes, including poor visual outcome. The lower cost of ECCE may justify its use in a patient population where high-volume surgery is a priority, however, there are a lack of data comparing phacoemulsification and ECCE in lower-income settings.

PLAIN LANGUAGE SUMMARY

Comparing two different techniques of removing cataracts

Cataract is a clouding of the lens in the eye and is one of the leading causes of blindness worldwide. The only method of treatment for this condition is surgery to remove the opacified lens and to replace it with a new lens, usually made of plastic. There are various surgical techniques for removing the lens, and in this review we compare two of them: phacoemulsification and extracapsular cataract extraction (ECCE).

A search was performed of the literature in May 2013 for studies comparing the two techniques and 11 randomised controlled trials were identified which included a total of 1228 participants. These trials included participants with age-related cataract and were conducted in Europe, South America and the Far East. We evaluated these for any biases that may have affected the data, extracted data according to pre-determined criteria and performed analyses of the pooled data from all studies where possible.

There were few studies that reported outcomes which met our pre-defined criteria. The studies were generally at unclear risk of bias due to poorly reported trial methods and the overall quality of the evidence for different outcomes ranged from moderate to very low. Phacoemulsification gave superior results at both three and 12-month time points. Complications were higher in the ECCE group than the phacoemulsification group. However, two out of three studies that reported costs indicated that ECCE was cheaper than phacoemulsification.

In summary, on the basis of the few studies that reported outcomes that we could include in our analysis, visual outcomes were better with phacoemulsification and complications were lower with this technique. However, ECCE was cheaper and in lower income countries ECCE may therefore have a role in maximising the number of people that can be treated with limited resources.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON [Explanation]

Phacoemulsification compared with extracapsular cataract extraction for age-related cataract

Participant or population: people with age-related cataract
Settings: hospital
Intervention: phacoemulsification
Comparison: extracapsular cataract extraction

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	ECCE	Phacoemulsification				
Presenting visual acuity >= 6/12 12 months after surgery					⊕⊕◯◯ low[1,2]	No trials reported presenting visual acuity; 1 trial in a higher-income setting reported uncorrected and best corrected visual acuity of 6/9 or better at 12 months. Both were in favour of phacoemulsification: UCVA RR 1.99 (95% CI 1.45 to 1.73), BCVA RR 1.06 (95% CI 0.99 to 1.14)
Best corrected visual acuity <6/60 12 months after surgery	145 per 1000	90 per 1000 (52 to 152)	RR 0.62 (0.36 to 1.05)	439 (1)	⊕◯◯◯ very low[1,3,4]	Only 1 study in a higher-income setting reported this outcome so the results may not apply in lower-income settings

Posterior capsule opacification 12 months after surgery	300 per 1000	114 per 1000 (66 to 198)	RR 0.38 (0.22 to 0.66)	571 (2)	⊕⊕⊕◯ moderate[5]	Posterior capsule opacification was reported in 1 study (Katsimpris 2004) (RR 0.23, 95% CI 0.09 to 0.58) and laser capsulotomy in 1 study (MEHOX 2004) (RR 0.50, 95% CI 0.25 to 1.01) (I^2 = 43%)
Other complications	See comments					2 cases of retinal detachment were reported in MEHOX 2004, both in the phacoemulsification group (OR 7.04, 95% CI 0.44 to 112.93) Cystoid macular oedema was reported in 2 studies and was more common in the ECCE group (Katsimpris 2004; MEHOX 2004) (OR 0.29, 95 5 CI 0.10 to 0.86) Endophthalmitis was reported in MEHOX 2004 with 3 cases (1%) in the phacoemulsification group and 1 case (0.4%) in the ECCE group
Quality of life	See comments					No data reported
Costs	See comments					Kara-Junior 2010 reported a cost of surgery of USD 242.23 for phacoemulsification and USD 155.50 for ECCE MEHOX 2004 reported a

		cost of GBP 359.89 for phacoemulsification and GBP 367.57 for ECCE Rizal 2003 reported a cost of MYR 1978 for phacoemulsification and MYR 1664 for ECCE

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **ECCE:** extracapsular cataract extraction; **RR:** risk ratio; **OR**: odds ratio; **UCVA:** uncorrected visual acuity

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.

Assumed risk estimated from control group risk across studies.
[1]Downgraded for inconsistency: only one study so we were not able to assess consistency.
[2]Downgraded for indirectness: no study reported presenting visual acuity.
[3]Downgraded for imprecision: wide confidence intervals, effect uncertain.
[4]Downgraded for indirectness; cut-point <6/9 not <6/60.
[5]Downgraded for indirectness: majority of events come from study that measured laser capsulotomy rather than posterior capsule opacification.

BACKGROUND

Description of the condition

Cataract is the opacification of the normally transparent lens of the eye and occurs as a result of denaturation of lens proteins. This cloudiness can cause a decrease in vision and may lead to eventual blindness. Most cataracts are age-related. Initially, cataracts may not affect vision if the cataract remains small or at the periphery of the lens. If the cataract forms in the area of the lens directly behind the pupil, vision may be significantly impaired. Changes are not thought to be reversible and surgery is currently the only treatment option, where the cataract is removed and a replacement lens is inserted into the eye.

The World Health Organization (WHO) estimated from a recent global review of surveys that in 2002 37 million people worldwide were blind (Passolini 2004; Resnikoff 2004) and that age-related cataract remained the leading cause of blindness globally (as it was in 1990). Fifty per cent of world blindness is thought to be due to cataract and the majority of blinding cataract is found in developing countries. The contribution of cataracts to blindness globally is likely to grow due to an ageing population and unsuccessful attempts to control this blinding condition in low and middle-income countries .

Blindness and severe visual impairment have a significant impact on the socioeconomic development of individuals and societies. Cataract surgical treatment leads to substantial long-term savings in healthcare and social expenditure. Savings also accrue from the reduced commitment made by family members caring for a visually impaired person. Women have a significantly higher risk of cataract blindness or being visually impaired than men, mainly because of their higher incidence of cataract and inadequate access to eye health care, which is often provided preferentially to men (Lewallen 2002). The resulting downward socioeconomic spiral can be reversed through widely available, appropriate, cost-effective and curative surgical interventions (Kuper 2008; Polack 2008; Polack 2010).

Description of the intervention

Phacoemulsification was first described in 1967 by Charles D. Kelman, an American ophthalmologist (1930-2004). It is the most commonly performed method of cataract extraction in the developed world. A small incision is made in the cornea (with a standard size of around 2.75 mm, but may range from 2.2 mm to 3.2 mm) and the crystalline lens is removed by ultrasonic fragmentation leaving the posterior lens capsule intact. This allows for a synthetic intraocular lens (IOL) to be inserted through the corneal incision into the capsular bag. The small incision allows rapid visual rehabilitation postoperatively and low induced astigmatism. This technique requires a phacoemulsification machine which may cost GBP 20,000 to 45,000 and the costs of required disposable equipment and maintenance are also high. Phacoemulsification requires extensive surgical training, particularly the necessity to carry out a continuous capsulorhexis.

Extracapsular cataract extraction (ECCE) was introduced with the development of microsurgical techniques in the early 1980s. The lens contents are removed through a large 12 mm incision leaving the posterior lens capsule intact. As with phacoemulsification, this keeps the anatomical barrier between the posterior and anterior segments of the eye intact and may reduce the risk of posterior segment complications. A posterior chamber IOL can then be placed in the capsular bag (Apple 1989; Duane 1986). If no IOL is implanted, aphakic glasses or contact lenses must be used.

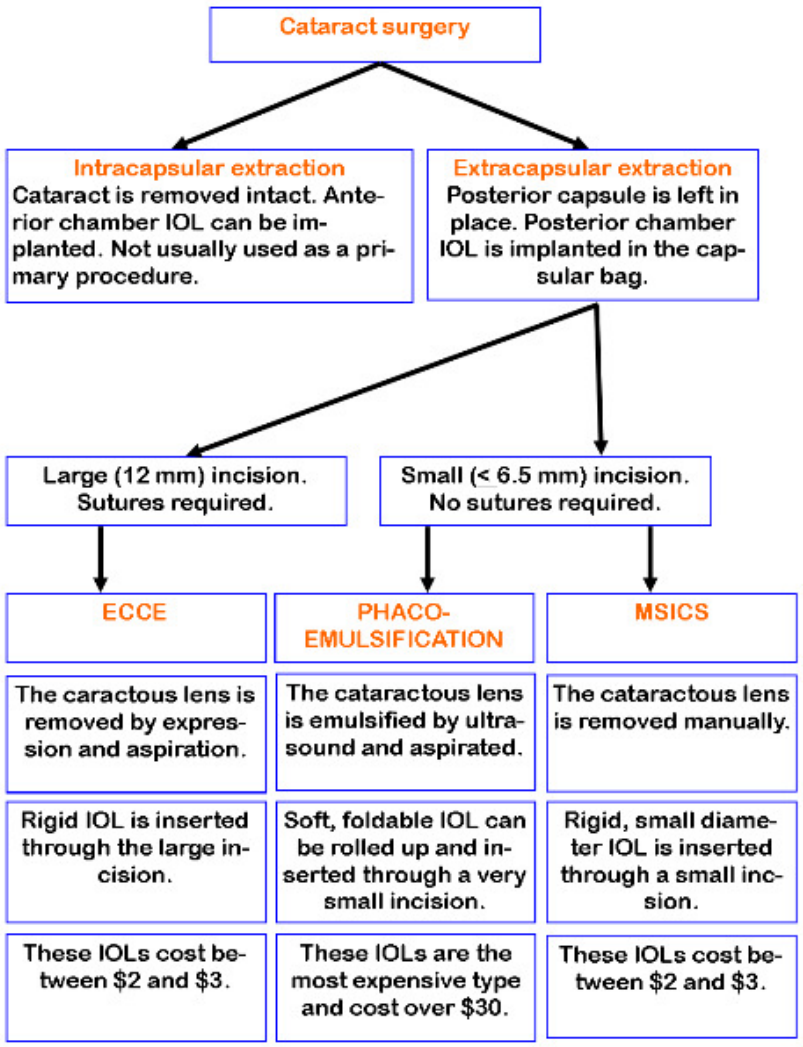
Extracapsular surgery has been the preferred method of extraction in economically disadvantaged countries and most surgeons in developing countries have been trained to use this method. ECCE may result in more induced astigmatism in the short-term compared to phacoemulsification and a longer visual rehabilitation postoperatively. Patients who have had sutured ECCE will usually need to return to have the sutures removed in clinic, in order to achieve the best visual acuity. Further technological development has led to many surgeons in developing countries adopting sutureless ECCE surgery or manual small incision cataract surgery (MSICS).

Both sutured and sutureless ECCE leave in place the posterior capsule of the lens.

In the months or years after cataract surgery by either method a small percentage of people will develop a condition called posterior capsular thickening in which the capsule behind the new lens becomes opacified. This can be treated using laser treatment (YAG laser capsulotomy), in which a small opening is made in the back of the lens capsule, which restores vision.

Figure 1 is a flow diagram summarising the different types of cataract surgery.

Figure 1. Types of cataract surgery



IOL: Intraocular lens
ECCE: Extracapsular extraction
MSICS: Manual small incision surgery

How the intervention might work

Cataract surgery consists of removing the cloudy lens of the eye and replacing it with an artificial lens called an intraocular lens (IOL). Intraocular lenses can be made from a range of materials, and they can be made of varying size, shape and refracting power. Before cataract surgery the eye to be operated on is measured so that an IOL of the correct power (strength) can be inserted after the cataract has been removed. The IOL is usually placed inside the 'bag' of the lens capsule inside the eye. Other options for lens replacement include contact lenses and cataract glasses.

Why it is important to do this review

Although phacoemulsification is the most technologically advanced method for providing small incision, sutureless surgery it requires considerable resources in the form of the initial capital outlay for the phacoemulsification machine, and there are considerable ongoing costs due to consumables, maintenance and training of surgeons. It is the procedure of choice for cataract surgery in the Western world.

From a global perspective phacoemulsification is too costly for many developing countries where there is the highest incidence of cataract blindness. Manual small incision surgery and ECCE are alternative techniques available at a lower cost. A key question is whether the resources required for phacoemulsification are justified in a lower-income setting.

This review in its original form 'Surgical interventions for age-related cataract' (Riaz 2006) compared the outcomes of different cataract surgical techniques. The techniques included initially were intracapsular extraction (ICCE), ECCE and phacoemulsification. In 2006 it was revised and a fourth surgical technique (MSICS) was added to the review.

Following consultation with the review authors and the Cochrane Eyes and Vision Group this update has been divided into three smaller reviews each using the same outcome measures but only comparing two surgical methods within each review. The ICCE technique is no longer included as this is method is no longer used as a primary procedure.

The cataract surgical techniques compared in these three reviews are:

1. ECCE and MSICS (Ang 2012);
2. phacoemulsification and ECCE (current review; published protocol Riaz 2010);
3. phacoemulsification and MSICS (Riaz 2013).

OBJECTIVES

The aim of this review is to examine the effects of two types of cataract surgery: phacoemulsification and ECCE.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) only in this review.

Types of participants

Participants in the trials were people with age-related cataract.

Types of interventions

We included trials that compared phacoemulsification with ECCE. With both interventions a posterior chamber IOL is implanted.

Types of outcome measures

Primary outcomes

Postoperative visual acuity

- Proportion of people achieving good functional vision defined as presenting* visual acuity better than or equal to 6/12 in the operated eye.
- Proportion of people with a poor outcome after surgery defined as best corrected visual acuity (BCVA) worse than 6/60 in the operated eye.

*Presenting visual acuity is vision that the person uses in normal life, i.e. with or without glasses, if worn.

Secondary outcomes

- Intraoperative complications
  - capsular rupture with or without vitreous loss
  - iris prolapse
  - postoperative inflammation
  - other complications as reported
- Long-term complications (one year or more after surgery)
  - posterior capsule opacification
  - retinal detachment
  - glaucoma

- cystoid macular oedema
- corneal endothelial cell loss
- corneal decompensation
- other complications as reported

- Quality of life (self care, mobility, social and mental function) as reported
- Cost

Follow-up

We measured outcomes at three months and one year after surgery. As studies may not have reported outcomes exactly at these time points we considered data collection within the following time periods:

- three months: from four weeks to three months;
- 12 months: from six months to less than 18 months.

Search methods for identification of studies

Electronic searches

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) 2013, Issue 4, part of *The Cochrane Library*. www.thecochranelibrary.com (accessed 13 May 2013), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to May 2013), EMBASE (January 1980 to May 2013), Latin American and Caribbean Health Sciences (LILACS) (January 1982 to May 2013), Web of Science Conference Proceedings Citation Index - Science (CPCI-S) (January 1970 to May 2013), the *meta*Register of Controlled Trials (*m*RCT) (www.controlled-trials.com), ClinicalTrials.gov (www.clinicaltrials.gov) and the WHO International Clinical Trials Registry Platform (ICTRP) (www.who.int/ictrp/search/en). We did not use any date or language restrictions in the electronic searches for trials. We last searched the electronic databases on 13 May 2013.

See: Appendices for details of search strategies for CENTRAL (Appendix 1), MEDLINE (Appendix 2), EMBASE (Appendix 3), LILACS (Appendix 4), CPCI-S (Appendix 5), *m*RCT (Appendix 6), ClinicalTrials.gov (Appendix 7) and the ICTRP (Appendix 8).

Searching other resources

We searched the reference lists of identified included studies. We contacted study authors and other experts in the field to identify unpublished studies or studies sent for publication or in press.

Data collection and analysis

Selection of studies

Two review authors independently screened the titles and abstracts resulting from the electronic searches. We removed duplicate records and obviously irrelevant titles and abstracts at this stage. We obtained full-text copies of any report referring to definitely or possibly relevant trials. We linked together multiple reports of the same study. We assessed these full-text reports for compliance of studies with eligibility criteria. We assessed trials meeting these criteria for risk of bias.

We documented all excluded studies that we obtained full-text copies of and provided a reason for exclusion.

Data extraction and management

We extracted data using a form developed by the Cochrane Eyes and Vision Group. Two authors extracted data and compared the results for differences. We resolved discrepancies by discussion. We initially addressed any disagreements which could not be resolved by contacting the study authors, and if this was unsuccessful we reported this in the review. Data were entered onto a spreadsheet, checked for accuracy by all study authors, and then cut and pasted into Review Manager (RevMan 2012).

Assessment of risk of bias in included studies

We assessed the risk of bias in each study using The Cochrane Collaboration's tool for assessing the risk of bias (Higgins 2011). We considered the following domains: sequence generation, allocation sequence concealment, masking (blinding), incomplete outcome data, selective outcome reporting and other potential sources of bias. We judged each bias domain as 'high risk of bias', 'low risk of bias' or 'unclear' (indicating either lack of information or uncertainty over the potential for bias). Two review authors independently assessed the risk of bias and disagreement was resolved by discussion. Authors were not masked to the report authors and trial results during the assessment.

Measures of treatment effect

The outcomes for this review were largely dichotomous (postoperative visual acuity and complications). Our measure of treatment effect was the risk ratio. For outcomes that occurred rarely (in less than 10% of the cohort), we used the Peto odds ratio. For continuous outcomes, such as the percentage of corneal endothelial cell loss, we used the mean difference.

Unit of analysis issues

The main unit of analysis issue was how the trial investigators dealt with two eyes. There were several options here: a trial may randomise people to the intervention groups and then apply the intervention and/or measure the outcome in one eye (study eye)

or both eyes. However, if the intervention had been applied to both eyes, it would have been incorrect to analyse eyes without taking into account the fact that the eyes for a person are not independent. Alternatively a trial may randomly allocate eyes to an intervention so each person had a different intervention in each eye. In this case, the pairing would have to be taken into account in the analysis. In the protocol for this review, if the trial had been incorrectly analysed, we planned to contact the trial investigators for further information to enable calculation of a design effect (Perera 2007).

Although it was not always clearly reported, it is likely that people were randomised to treatment and data were reported for one (study) eye of each person in the studies included in this review.

Dealing with missing data

Our analyses are based on available data and assume that missing data are missing at random. We collected data on follow-up by treatment group and the reason for missingness, where available.

Assessment of heterogeneity

We assessed heterogeneity in several ways. Firstly, by documenting clinical and methodological differences between the studies. Secondly, by examining the forest plots to see whether the estimates of effect were consistent, and thirdly by considering the I^2 statistic value and Chi^2 test for heterogeneity (bearing in mind that the Chi^2 test has low power when the number of trials is small).

Assessment of reporting biases

The main reporting biases that we considered were publication bias and outcome reporting bias. For publication bias, we planned to do a funnel plot to assess whether small trials had different effects, however there were not enough trials to carry this out. To assess outcome reporting bias we did a review outcome matrix using the ORBIT classification (Kirkham 2010).

Data synthesis

We analysed data from studies collecting comparable outcome measures with similar follow-up times using either the risk ratio, Peto odds ratio or mean difference as discussed above. Where it was appropriate to combine the results of different studies we pooled data using a random-effects model (unless there were three or fewer trials in which case we used a fixed-effect model).

The outcomes for this review included a number of complications. Initially we tabulated these data only. For outcomes that were commonly reported we went on to do a meta-analysis in order to provide a summary estimate of risk.

Subgroup analysis and investigation of heterogeneity

One potential source of heterogeneity was the length of follow-up. It is possible that visual outcome of surgery varies by length of follow-up - in particular with respect to posterior capsule opacification. In order to include as many trials as possible in the analyses we chose, a priori, a fairly broad follow-up period at 12 months (from six months to 18 months). If trials included in this review had very different follow-up periods, for example some at six months and some at 18 months, we planned to group them into three subgroups: six months, 12 months and 18 months, and allocated trials to these groups depending on when the majority of their participants were followed up. Currently there are not enough data included in the review to do this analysis.

Sensitivity analysis

If there were enough trials contributing to the meta-analyses we planned to investigate the effect of excluding poorer quality trials. In particular, we planned to investigate the effect of excluding trials where allocation concealment was not properly reported and where there was no masking of outcome assessment. However, there were not enough trials included to do this.

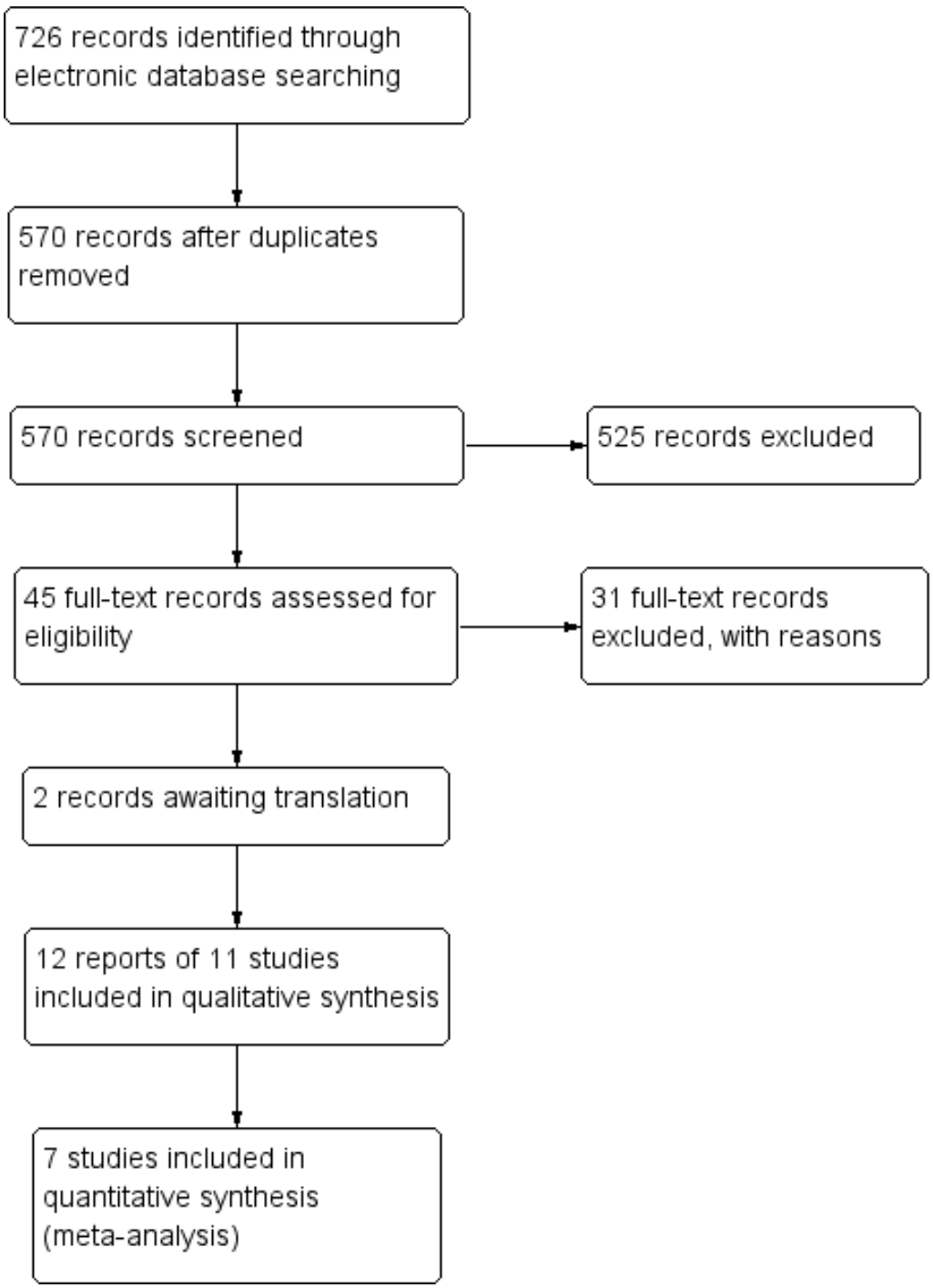
RESULTS

Description of studies

Results of the search

The electronic searches retrieved a total of 726 records (Figure 2). After deduplication we screened 570 records. We excluded 525 records as not relevant to the scope of the review. We obtained full-text copies of 45 records and have included 12 reports of 11 studies in the review (see Characteristics of included studies). We have excluded 31 studies (see Characteristics of excluded studies). Currently two studies are awaiting assessment as we are unable to obtain a translation of the papers and have been unsuccessful in contacting the authors to ask for assistance. If possible we will assess them at a further update.

Figure 2. Study flow diagram.



Included studies

We included 11 randomised controlled trials in this review (Chee 1999; Díaz-Valle 1998; George 2005; Kara-Junior 2010; Katsimpris 2004; Landau 1999; Laurell 1998; MEHOX 2004; Ravalico 1997; Rizal 2003; Stumpf 2006). See Characteristics of included studies.

A total of 1228 people were included in these studies: 34 (Chee 1999); 60 (Díaz-Valle 1998); 112 (George 2005); 205 (Kara-Junior 2010); 94 (Katsimpris 2004); 42 (Landau 1999); 42 (Laurell 1998); 500 (MEHOX 2004); 40 (Ravalico 1997); 60 (Rizal 2003) and 39 (Stumpf 2006). The age of the participants ranged from 45 to 94 years.

The studies were carried out in Brazil (Kara-Junior 2010; Stumpf 2006), Sweden (Landau 1999; Laurell 1998), Singapore (Chee 1999), Spain (Díaz-Valle 1998), India (George 2005), Greece (Katsimpris 2004), the UK (MEHOX 2004), Italy (Ravalico 1997) and Malaysia (Rizal 2003).

Seven studies reported visual acuity outcomes (Chee 1999; George 2005; Katsimpris 2004; Laurell 1998; MEHOX 2004; Ravalico 1997; Stumpf 2006). However, data from four of these studies (Katsimpris 2004; Laurell 1998; Ravalico 1997; Stumpf 2006) were not in a suitable format for use in our analysis. Postoperative endothelial cell loss was reported in four studies (Díaz-Valle 1998; George 2005; Ravalico 1997; Stumpf 2006); postoperative inflammation in two studies (Chee 1999; Laurell 1998); surgically induced astigmatism in two studies (George 2005; MEHOX 2004); cost of surgery in three studies (Kara-Junior 2010; MEHOX 2004; Rizal 2003) and intraocular lens (IOL) haptic position in one study (Landau 1999).

Follow-up ranged from 30 days (Ravalico 1997) to two years (Laurell 1998).

Excluded studies

We excluded 31 studies: see Characteristics of excluded studies for reasons for exclusion.

Risk of bias in included studies

See Figure 3; Figure 4 and individual 'Risk of bias' tables.

Figure 3. 'Risk of bias' graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

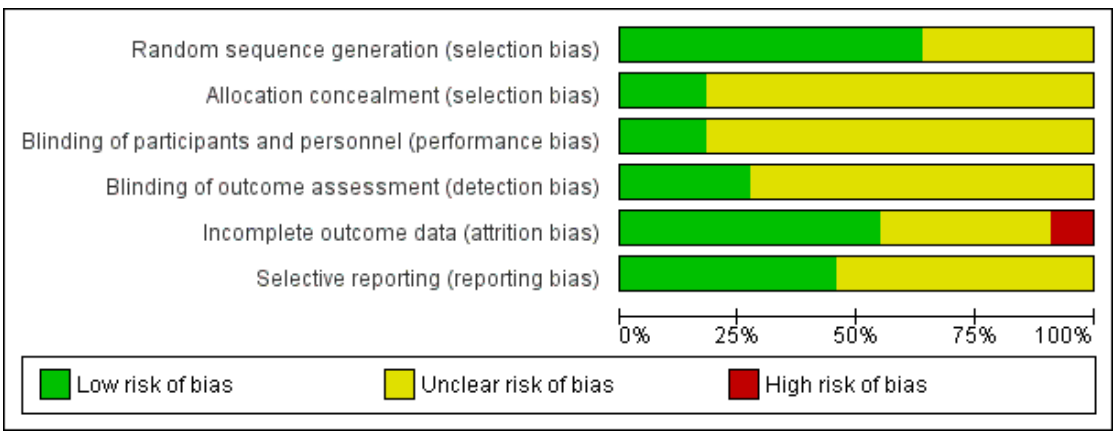
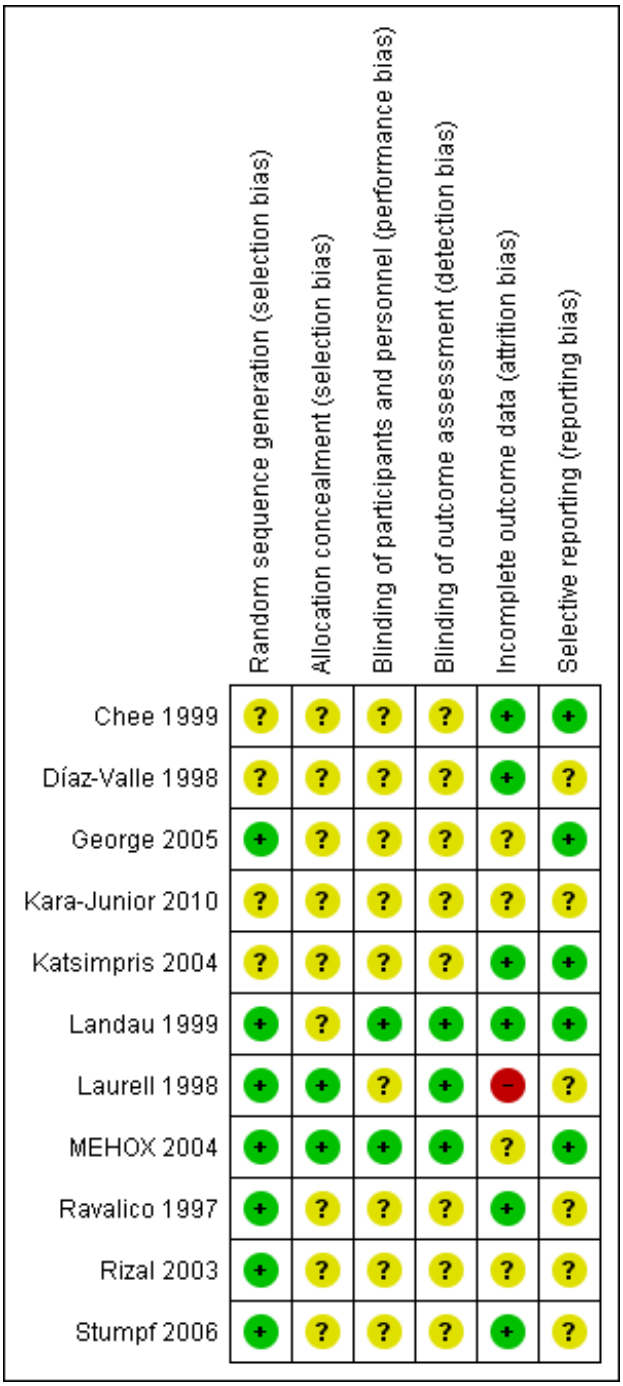


Figure 4. 'Risk of bias' summary: review authors' judgements about each risk of bias item for each included study.



Allocation

Seven trials clearly stated how participants were allocated to each arm of the study: four trials described computer-generated randomisation (George 2005; Landau 1999; Laurell 1998; Rizal 2003), one study used sequentially numbered opaque envelopes (MEHOX 2004), one study randomisation numbers (Ravalico 1997) and one study used ballots (Stumpf 2006). Four trials did not state the method of randomisation (Chee 1999; Díaz-Valle 1998; Kara-Junior 2010; Katsimpris 2004).

Allocation concealment was only clearly described in two studies (Laurell 1998; MEHOX 2004).

Blinding

Performance bias

Three studies reported masking of participants as to the nature of surgery (Landau 1999; Laurell 1998; MEHOX 2004). Eight studies did not comment.

Detection bias

Four studies reported that postoperative assessors were masked as to the nature of surgery (George 2005; Landau 1999; Laurell 1998; MEHOX 2004). However, obvious differences in postoperative appearance of the eye in each group may have influenced the ability to mask assessors effectively. Seven studies did not state whether assessors were masked as to the surgical technique.

Incomplete outcome data

Follow-up rates were variable between the included studies: 83% (Landau 1999), 88% (MEHOX 2004), 90% (George 2005), 95% (Laurell 1998), and two studies had 100% follow-up rates (Ravalico 1997; Stumpf 2006). Five studies did not state whether any participants were lost to follow-up or did not complete the study period (Chee 1999; Díaz-Valle 1998; Kara-Junior 2010; Katsimpris 2004; Rizal 2003). Three studies (Landau 1999; Laurell 1998; MEHOX 2004) stated the reason for attrition.

Selective reporting

There were no obvious omissions in reporting results in the included studies. Several papers did not report on visual acuity outcomes or complications, however these were not defined outcomes in these studies. Formal assessment of the potential for selective outcome reporting bias using the ORBIT classification (Kirkham 2010) suggested that most non-reporting was low risk of bias (Table 1; Appendix 9).

Other potential sources of bias

Bias may be introduced into a study if the surgeon or surgeons were not equally experienced in each surgical technique and the groups are unbalanced with respect to surgeon. Four studies stated that surgeons were adequately experienced (George 2005; Kara-Junior 2010; Landau 1999; MEHOX 2004). The remainder of the studies did not comment on the level of surgical experience. In six studies, both surgical techniques were performed by a single surgeon (Díaz-Valle 1998; Katsimpris 2004; Landau 1999; Laurell 1998; Ravalico 1997; Stumpf 2006) and, with the exception of Landau 1999, it is not stated whether the surgeon had equal experience of both techniques.

Effects of interventions

See: **Summary of findings for the main comparison**

Primary outcomes

The primary visual acuity outcomes for this review were presenting visual acuity of 6/12 or better ("good functional vision"), or a best corrected visual acuity of worse than 6/60 ("poor visual outcome"). None of the papers documented presenting visual acuity, and therefore we report both uncorrected and best corrected visual acuity. Three out of seven papers that reported visual acuity did not state outcomes in a suitable format to include in our analysis.

Good functional vision

Uncorrected visual acuity

Chee 1999 reported UCVA of 6/12 or better at two months: this was achieved by 15/18 participants in the phacoemulsification group and 8/16 participants in the ECCE group (risk ratio (RR) 1.67, 95% confidence interval (CI) 0.98 to 2.84). MEHOX 2004 reported UCVA of 6/9 or better at three months: this was achieved by 83/237 (35%) phacoemulsification participants and 42/221 (19%) ECCE participants (RR 1.84, 95% CI 1.33 to 2.54). The pooled risk ratio was 1.81 (95% CI 1.36 to 2.41) (Analysis 1.1). Only one study (MEHOX 2004) reported UCVA of 6/9 or better at the 12-month time point: this was achieved by 87/224 (39%) participants in the phacoemulsification group and 42/215 (20%) in the ECCE group (RR 1.99, 95% CI 1.45 to 2.73) (Analysis 1.2).

Best corrected visual acuity

Four trials reported best corrected visual acuity of 6/12 or better at three months (Analysis 1.3) and one study at 12 months (Analysis 1.4). At three months there was a small benefit in favour of phacoemulsification (pooled RR 1.12, 95% CI 1.03 to 1.22). At 12 months the effect was smaller and uncertain (pooled RR 1.06, 95% CI 0.99 to 1.14).

Poor visual outcome

Poor visual acuity was reported in two trials with a lower incidence of poor BCVA in the phacoemulsification group (RR 0.33, 95% CI 0.20 to 0.55) (Analysis 1.5). In the George 2005 study a visual acuity of worse than 6/18 at six weeks was reported in 0/60 phacoemulsification participants and 5/52 ECCE participants (RR 0.08, 95% CI 0.0 to 1.4). In the MEHOX 2004 study, visual acuity worse than 6/9 was reported at three months in 17/237 phacoemulsification participants and 44/221 ECCE participants (RR 0.36, (95% CI 0.21 to 0.61).

At 12 months, BCVA worse than 6/9 was reported by MEHOX 2004 in 20/244 phacoemulsification participants and 31/215 ECCE participants (RR 0.62, 95% CI 0.36 to 1.05) (Analysis 1.6).

Additional visual outcome data

These studies included visual acuity data that were not in a suitable format for inclusion in our analysis.

Ravalico 1997 reported mean corrected decimal visual acuity at 30 days after surgery in the phacoemulsification group of 0.95 +/- 0.11 and the ECCE group of 0.92 +/- 0.10 (P value non-significant).

Stumpf 2006 reported an average corrected visual acuity at one, three and six months postoperatively. At the one and three-month time points, mean BCVA was better in the phacoemulsification group. The average decimal visual acuity was 0.83 in the phacoemulsification group and 0.68 in the ECCE group (P = 0.02) at one month and it was 0.86 in the phacoemulsification group versus 0.77 in the ECCE group (P = 0.04) at three months. However, at six months there was no significant difference between the two groups (0.87 in the phacoemulsification group, 0.81 in the ECCE group, P = 0.35).

Katsimpris 2004 reported BCVA as mean logMAR at 14 months and found a better average BCVA in the phacoemulsification group (0.3 logMAR units) compared to the ECCE group (0.5 logMAR units).

Secondary outcomes

Intraoperative complications

Posterior capsular rupture was reported in three studies (George 2005; Katsimpris 2004; MEHOX 2004) (Analysis 1.7). The overall rate was lower in the phacoemulsification group: 10/353 (2.8%) versus 17/335 (5.1%) in the ECCE group (Peto odds ratio (OR) 0.56, 95% CI 0.26 to 1.22). In most papers only a few events were reported, with the exception of Katsimpris 2004, however this is likely to reflect the nature of pseudoexfoliative cataracts in this study, which are recognised to have a higher surgical complication rate.

Iris prolapse was reported in only the MEHOX 2004 study, with a rate of 0/246 cases in the phacoemulsification group and 17/236 cases in the ECCE group (Peto OR 0.12, 95% CI 0.05 to 0.32).

Other intraoperative complications are tabulated here: Analysis 1.9.

Postoperative complications

Posterior capsule opacification was reported in two studies (Katsimpris 2004; MEHOX 2004) (Analysis 1.10) at 12 to 14 months with an overall rate of 17/292 (5.8%) in the phacoemulsification group and 40/279 (14.3%) in the ECCE group (Peto OR 0.38, 95% CI 0.22 to 0.66).

Retinal detachment was reported by MEHOX 2004 in 2/245 phacoemulsification cases and 0/232 ECCE cases (Peto OR 7.04, 95% CI 0.44 to 112.93) (Analysis 1.11).

Cystoid macular oedema was reported in two studies (Katsimpris 2004; MEHOX 2004) with an overall rate of 3/292 in the phacoemulsification group and 11/279 in the ECCE group (Peto OR 0.29, 95% CI 0.10 to 0.86) (Analysis 1.12).

Corneal endothelial cell loss was reported in four studies, however the data from Ravalico 1997 were not included in our analysis, since it could not be compared to other studies. Overall there was no significant difference between the two techniques in terms of percentage of endothelial cell loss (mean difference 1.00, 95% CI -0.88 to 2.89) (Table 2; Analysis 1.8).

Endophthalmitis rates were reported in only the MEHOX 2004 study with rates of 3/245 (1%) in the phacoemulsification group and 1/232 (0.4%) in the ECCE group.

Other complications are tabulated here: Analysis 1.14.

Quality of life

None of the studies reported quality of life.

Cost

Three studies reported the cost of cataract surgery in Brazil (Kara-Junior 2010), the UK (MEHOX 2004) and Malaysia (Rizal 2003).

- Kara-Junior 2010 reported a cost of surgery of USD 242.23 for phacoemulsification and USD 155.50 for ECCE.
- MEHOX 2004 reported a cost of GBP 359.89 for phacoemulsification and GBP 367.57 for ECCE. Costs for phacoemulsification and ECCE were similar up to six weeks

postoperatively, but following this time point ECCE incurred additional costs due to additional visits, spectacles and laser treatment to achieve a similar outcome.

- Rizal 2003 reported a cost of MYR 1978 for phacoemulsification and MYR 1664.46 for ECCE.

DISCUSSION

Summary of main results

The results are summarised in Summary of findings for the main comparison.

Our primary defined outcome was presenting visual acuity of 6/12 or better, and since no study reported this directly we report both uncorrected and best corrected visual acuity. Only four studies reported this outcome: at both the three-month and 12-month time point phacoemulsification gave superior results to ECCE both in terms of uncorrected and best corrected visual acuity, although for best corrected acuity the size of the effect was small.

We defined poor visual outcome as BCVA of less than 6/60: the three papers that included poor BCVA data reported worse than 6/9 and 6/18. The number of events in each group was small, making it difficult to draw conclusions. However, there were fewer events in the phacoemulsification group than the ECCE group at both the three-month (risk ratio 0.33, 95% CI 0.20 to 0.55) and 12-month time points (risk ratio 0.62, 95% CI 0.36 to 1.05).

Regarding complication rates, the three papers stated posterior capsule rupture rates (PCR). This was higher in the ECCE group than the phacoemulsification group, however these results may be skewed by the high complication rate in the Katsimpris 2004 paper which only included complicated cataracts in participants with pseudoexfoliation. If this paper is excluded from analysis, the PCR rates for the two techniques are approximately equal.

The rates of iris prolapse, cystoid macular oedema and posterior capsular opacification were also higher in the ECCE group than the phacoemulsification group. Regarding other complications, the event rate was too low to draw definite conclusions regarding the superiority of one technique over another.

Phacoemulsification surgical costs were higher than ECCE in two studies (Kara-Junior 2010; Rizal 2003). MEHOX 2004 reported similar costs for phacoemulsification and ECCE up to six weeks postoperatively, but following this time point ECCE incurred additional costs due to additional visits, spectacles and laser treatment to achieve a similar outcome. Therefore the overall cost of phacoemulsification was slightly lower than ECCE in this study.

Overall completeness and applicability of evidence

Collation of evidence from all studies was difficult, due to varying methods of outcome reporting. For example visual acuity was documented in seven studies as Snellen, mean logMAR and mean decimal visual acuity, which were measured at varying time points. There were relatively small numbers of events across all studies regarding complications and therefore it is difficult to draw overall conclusions. The severity of cataract varied across studies, with some studies only including hard or pseudoexfoliative cataracts, and others excluding these more complicated cataracts. This makes it difficult to apply the results regarding complication rates to all levels of difficulty of cataract surgery.

The 11 included studies were carried out in nine countries, ranging from teaching hospitals in developed countries to high-volume cataract centres in developing countries. Therefore the results from this review may be applicable to multiple settings.

Quality of the evidence

All studies included in this review were randomised controlled trials. The quality of evidence, however, was low or very low, and this was due to inconsistency of reporting outcome data. Due to the slow postoperative recovery of visual acuity with ECCE surgery, long-term visual outcome data are especially important when comparing phacoemulsification to ECCE. Comparing visual outcome data between these two techniques at a time point earlier than three months may therefore have limited value. Despite four studies having a follow-up period of 12 months or longer, there were few data on long-term visual outcomes and complications such as posterior capsule opacification in these studies.

Potential biases in the review process

No obvious biases were identified in the review process.

Agreements and disagreements with other studies or reviews

A study carried out in Pakistan found 80% of phacoemulsification and 54% of ECCE participants had a postoperative unaided visual acuity of 6/12 or better three months after surgery, and this trend is consistent with our results (Nangrejo 2011). A recent retrospective review of complications arising from 20,438 cases of phacoemulsification and 5736 cases of ECCE found a complication rate of 1.11% in the phacoemulsification group and 2.6% in the ECCE group. There were no statistically significant differences in the rate of endophthalmitis between the surgical techniques (Haripriya 2012). These findings are consistent with those of this review.

AUTHORS' CONCLUSIONS

Implications for practice

There was some evidence from one study that uncorrected visual acuity outcomes were better in the phacoemulsification group 12 months after surgery. Only four studies were incorporated into our analysis of visual acuity at up to 3 or 12 months, but data in three other included papers (which were not included in the analysis due to the method of recording visual acuity) supported these findings. Regarding complications, the numbers of events were small, however there appears to be a higher rate of posterior capsule rupture and also posterior capsule opacification in the ECCE group compared to the phacoemulsification group. It is difficult to determine a difference regarding other complications due to the low numbers involved.

Overall, phacoemulsification appears to give better visual outcomes and fewer complications than ECCE. The lower cost of ECCE in two out of three studies may favour ECCE where resources are limited. However, a greater number of outpatient postoperative visits associated with the ECCE group may indirectly increase the costs of this technique, as shown in the MEHOX 2004 study.

Implications for research

Future studies need to have standardised reporting of outcomes enabling data from different studies to be pooled, in particular a precise and reproducible method of reporting visual acuity. In the absence of a formal core outcome set for such trials, we suggest that the primary outcomes we have included in this review (presenting Snellen visual acuity 6/12 or better and best corrected visual acuity worse than 6/60) should be reported as a minimum. Future trials should also collect information on vision-related quality of life and cost utility. It should also be clearly stated whether one eye was operated on per participant or both eyes, and whether this decision was made prior to observing the outcome, as this may introduce bias.

Most of the trials included in this review had a relatively short follow-up period. We recommend a longer follow-up period, ideally 12 months or more. We recognise that this may be difficult in some populations but it is important especially with regard to complications such as posterior capsule opacification which may become visually significant over a longer time course.

ACKNOWLEDGEMENTS

The Cochrane Eyes and Vision Group (CEVG) created and executed the electronic searches. We thank Clare Gilbert, Catey Bunce, Daniel Gore and Richard Wormald for their comments on the protocol and/or review and Anupa Shah for editorial support. We would also like to thank Aeesha Malik for her work on the published protocol and earlier drafts of the review.

Richard Wormald (Co-ordinating Editor for CEVG) acknowledges financial support for his CEVG research sessions from the Department of Health through the award made by the National Institute for Health Research to Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology for a Specialist Biomedical Research Centre for Ophthalmology. The views expressed in this publication are those of the authors and not necessarily those of the Department of Health.

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Polack 2010
Polack S, Eusebio C, Mathenge W, Wadud Z, Rashid M, Foster A, et al. The impact of cataract surgery on activities and time-use: results from a longitudinal study in Kenya, Bangladesh and the Philippines. *PloS One* 2010;**5**(6): e10913.

Resnikoff 2004
Resnikoff S, Passolini D, Etyalale D, Kocur I, Pararajasegarm R, Pokharel GP, et al. Global data on visual impairment in the year 2002. *Bulletin of The World Health Organization* 2004;**82**(11):844–51.

RevMan 2012 [Computer program]
The Nordic Cochrane Centre, The Cochrane Collaboration. Review Manager (RevMan). Version 5.2. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2012.

Riaz 2006
Riaz Y, Mehta JS, Wormald R, Evans JR, Foster A, Ravilla T, et al. Surgical interventions for age-related cataract. *Cochrane Database of Systematic Reviews* 2006, Issue 4. [DOI: 10.1002/14651858.CD001323.pub2]

Riaz 2013
Riaz Y, de Silva SR, Evans JR. Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract. *Cochrane Database of Systematic Reviews* 2013, Issue 10. [DOI: 10.1002/14651858.CD008813.pub2]

References to other published versions of this review

Riaz 2010
Riaz Y, Malik ANJ, Evans JR. Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract. *Cochrane Database of Systematic Reviews* 2010, Issue 11. [DOI: 10.1002/14651858.CD008812]

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Chee 1999

Methods	Parallel-group randomised controlled trial Number randomised: 34 participants Unclear but likely that people were randomly allocated and 1 eye per person operated Length of follow-up 90 days
Participants	Country: Singapore Inclusion criteria: age-related cataract Exclusion criteria: diabetics Age, years: mean 63.1 Gender: 15 men, 19 women Ethnicity: Chinese and Malay
Interventions	Phacoemulsification (18 eyes) versus ECCE (16 eyes)
Outcomes	Postoperative inflammation measured at post-operative day 4, 8, 15, 30, 60, 90 with laser flare meter/slit lamp Snellen VA at 2 months
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Patients having cataract surgery were randomized to ECCE or phacoemulsification. " Page 1281 Details of randomisation procedure not stated
Allocation concealment (selection bias)	Unclear risk	Details not stated
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	"Also, to reduce bias, two surgeons performed both types of surgery" Page 1281 Not stated if participant masked to type of surgery
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	"1 independent postoperative observer (M. S.) was masked as to surgical procedure" Page 1281 (suture techniques different)
Incomplete outcome data (attrition bias) All outcomes	Low risk	There is no indication in the paper that any participants did not complete the full follow-up period

Chee 1999 (*Continued*)

Selective reporting (reporting bias)	Low risk	None obvious

Díaz-Valle 1998

Methods	Parallel-group randomised controlled trial Total number of participants: 60 1 eye per person included in the trial; unclear how the eye was selected for surgery Length of follow-up: 3 months
Participants	Country: Spain Inclusion criteria: age-related cataract Exclusion criteria: other ocular pathologies, high refractive defects, glaucoma, diabetes mellitus, and intraoperative or postoperative complications Age, years: mean 70.5 years +/- 7.6 (range 58 to 79 years) Gender: 27 men, 33 women
Interventions	Group1: phacoemulsification (20 eyes) Group 2: ECCE with planned continuous curvilinear capsulorhexis (20 eyes) Group3: ECCE with letterbox capsulotomy (20 eyes)
Outcomes	Endothelial permeability Endothelial cell loss Pachymetry
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No details stated in paper
Allocation concealment (selection bias)	Unclear risk	No details stated in paper
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	"All surgery was performed by the same surgeon." Page 952 No details regarding masking of surgeon, participants or other staff given
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not detailed in paper
Incomplete outcome data (attrition bias) All outcomes	Low risk	There is no indication in the paper that any participants did not complete the full follow-up period

Díaz-Valle 1998 (*Continued*)

Selective reporting (reporting bias)	Unclear risk	No details of intraoperative complications recorded in paper

George 2005

Methods	Parallel-group randomised controlled trial Number randomised: 186 participants Unclear but likely that people were randomly allocated and 1 eye per person operated Follow-up: 3 to 4 weeks (phaco), 8 weeks (ECCE)
Participants	Country: India Inclusion criteria: participant undergoing planned cataract surgery; otherwise normal preoperative examination; cataract < grade III Exclusion criteria: other potential causes of decreased vision; complicated cataracts; non age-related cataracts; phacodonesis; glaucoma or retinal pathology Age, years: phacoemulsification: 59.63 (SD 7.64) years, ECCE 57.85 (SD 8.01) years Gender: phacoemulsification 27 men, 33 women, ECCE 23 men, 29 women
Interventions	Phacoemulsification (62 eyes) versus ECCE (62 eyes) versus MSICS (62 eyes)
Outcomes	Surgically induced astigmatism Endothelial cell loss Snellen visual acuity
Notes	Published data only. No correspondence with authors Phacoemulsification - 5 mm incision rigid lens ECCE - can-opener capsulotomy

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Cases were randomized into three groups based on computer-generated random numbers. Randomization was carried out at the time of admission and used the hospital numbers (which were allotted at the time of the first hospital visit) for allocation into different groups". Page 294
Allocation concealment (selection bias)	Unclear risk	Not detailed in paper
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Study does not document whether participants or personnel were aware/informed of which intervention they were assigned to

George 2005 (*Continued*)

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	"Independent observers performed refraction and keratometry in order to minimize bias". Page 295
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The 6-week follow-up was completed by 52/62 cases of ECCE, 53/62 cases of MSICS and 60/62 cases of phacoemulsification The reasons for attrition were not stated
Selective reporting (reporting bias)	Low risk	None obvious

Kara-Junior 2010

Methods	Parallel-group randomised controlled trial Number randomised: 205 participants Each person only had 1 eye operated; it was not clear how the eye was selected Follow-up: 8 weeks
Participants	Country: Brazil Inclusion criteria: age 41 to 80 years, senile cataract, BCVA worse than 20/40 or logMAR 0.3 in better eye, participant living less than 100 km from hospital Exclusion criteria: presence of any physical or clinical restrictions besides visual problem, presence of any ocular disease that could contribute to decreased visual acuity, previous ocular surgery, amblyopia Age, years: phacoemulsification: mean 68.3 (SD 9) years, ECCE 69.1 (SD 8.5) years Gender: phacoemulsification: 35.3% men, ECCE 44.1% men
Interventions	Phacoemulsification (101 eyes) versus ECCE (104 eyes)
Outcomes	Governmental cost of participants undergoing phacoemulsification and ECCE Benefits after cataract surgery in productivity at work and motivation to seek work Social costs (for employers, participants, care givers and social security)
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	"The selected patients were randomly assigned to two groups" Page 2 Details of the method of randomisation are not stated
Allocation concealment (selection bias)	Unclear risk	Not detailed in paper

Kara-Junior 2010 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not detailed in paper
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not detailed in paper
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Only 17 participants in phacoemulsification group and 14 participants in ECCE group were employed, and the estimated social security costs per participant were based on these sample sizes only. (The remaining participants were retired, homemakers, seeking employment or not looking for a job)
Selective reporting (reporting bias)	Unclear risk	None related to defined outcomes (cost of surgery)

Katsimpris 2004

Methods	Randomised controlled trial Number randomised: 94 participants Each person only had 1 eye operated; it was not clear how the eye was selected Follow-up: mean 14 ± 6.2 months
Participants	Country: Greece Inclusion criteria: particpants with cataract in association with pseudoexfoliation; small pupil; small to moderate phacodonesis Exclusion criteria: partial or complete subluxation; vitreous present in anterior chamber Age, years: phacoemulsification: 77 (SD 5.3) years, ECCE 75.5 (SD 6.0)
Interventions	Phacoemulsification (47 eyes) versus ECCE (47 eyes)
Outcomes	Intraoperative zonular tears Capsular rupture Vitreous loss Corneal oedema LogMAR visual acuity Posterior capsule opacification Intraocular pressure spikes IOL decentration
Notes	Published data only. No correspondence with authors
Risk of bias	

Katsimpris 2004 (*Continued*)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not detailed in paper
Allocation concealment (selection bias)	Unclear risk	Not detailed in paper
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not detailed in paper
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not detailed in paper
Incomplete outcome data (attrition bias) All outcomes	Low risk	No details of any participant not completing follow-up
Selective reporting (reporting bias)	Low risk	None obvious

Landau 1999

Methods	Parallel-group randomised controlled trial Number randomised: 42 participants (21 to phacoemulsification, 21 to ECCE) Each person only had 1 eye operated; it was not clear how the eye was selected Follow-up: 1.5 to 2.5 years
Participants	Country: Sweden Inclusion criteria: participants with cataract Exclusion criteria: no other ocular disease Age, years: mean (range) 74.25 (68 to 82) years Gender: 11 men, 24 women (35 participants followed up)
Interventions	35 participants followed up Phacoemulsification (17 eyes) versus ECCE (18 eyes)
Outcomes	Ultrasound biomicroscopy examination of IOL haptic position Anterior chamber depth
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"At the preoperative examination the patients were randomly assigned to Group I

Landau 1999 (*Continued*)

		or Group II by a computer generated randomisation schedule". Page 394
Allocation concealment (selection bias)	Unclear risk	Not stated in paper
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"The patients were unaware of the surgical technique used". Page 394
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All UBM examinations were performed by one of the authors who was unaware of the surgical technique used for cataract extraction". Page 395
Incomplete outcome data (attrition bias) All outcomes	Low risk	"Two patients died before the start of the UBM study and five declined to be examined by UBM". Page 395
Selective reporting (reporting bias)	Low risk	None obvious

Laurell 1998

Methods	Randomised controlled trial Number randomised: 42 participants Follow-up: 2 years
Participants	Country: Sweden Inclusion criteria: participants enrolled for cataract surgery; age 64 to 82 years Exclusion criteria: pseudoexfoliation syndrome; small pupils (< 5 mm post dilatation); glaucoma; uveitis; dark brown irides; diabetes; treatment with eye drops or anti-inflammatory drugs Age, years: phacoemulsification: median 73 years, range 65 to 82, ECCE: range 64 to 79 Gender: phacoemulsification 62% women, ECCE 67% women
Interventions	Phacoemulsification (21 eyes) versus ECCE (21 eyes)
Outcomes	Operation time Blood-aqueous barrier reaction (3 months) Laser flare meter in anterior chamber (2 years) Snellen visual acuity (3 months) Corneal thickness (at 3 months)
Notes	Envelope capsulotomy for ECCE Published data only. No correspondence with authors
Risk of bias	

Laurell 1998 (*Continued*)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"randomly assigned to phacoemulsification (group I) or ECCE (group II) by a computer generated randomisation schedule thus the allocation was not dependent on characteristics of the eye" Page 574
Allocation concealment (selection bias)	Low risk	"The patients were not informed about the surgical method". Page 574
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not stated in paper
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"the analyst was not aware of the surgical method at the time of calculation of diffusion coefficients". Page 575
Incomplete outcome data (attrition bias) All outcomes	High risk	Not all visual acuity data reported for all participants "One patient in group II died between the three months and one year examinations. In group I the BAB measurements of one participant were discarded because fine pseudoexfoliations were found after the patient had entered the study. the other drop-outs were due to patients unavailable for follow up". Page 575
Selective reporting (reporting bias)	Unclear risk	No details of intraoperative complications recorded in paper

MEHOX 2004

Methods	Randomised controlled trial (2 centres) Number randomised: 500 participants (251 participants randomised to phacoemulsification, 249 to ECCE) Each person only had 1 eye operated, "*The choice of eye in those with bilateral cataracts was as in routine clinical practice, and was independent of the allocated surgical treatment-that is, was made before randomisation*." Length of follow-up: 1 year
Participants	Country: UK Inclusion criteria: consenting participant; age-related cataract; resident in the region; willing and able to attend regular follow-up Exclusion criteria: hard, highly brunescent cataracts; eye disorders that may compromise vision (e.g. amblyopia, glaucoma, diabetic retinopathy, macular degeneration); high my-

	opes (axial length > 26.5 mm) Age, years: mean 72, range 40+ years Gender: (of people with complete data): phacoemulsification 91 men, 132 women, ECCE 97 men, 113 women
Interventions	Phacoemulsification (244 participants received the allocated treatment) versus ECCE (232 participants)
Outcomes	439 participants completed trial, 433 participants had complete data Snellen visual acuity Astigmatism Capsule rupture/vitreous loss Capsule opacity at 1 year Endothelial cell loss
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"The unit of randomisation was the individual patient, with only one eye considered for cataract surgery. The randomisation was stratified by surgeon with blocks of size four and six". Page 825
Allocation concealment (selection bias)	Low risk	"The allocation codes were sealed in sequentially numbered opaque envelopes, and placed in the care of the trial manager in each study centre. The participating surgeons were not involved in the care of or opening of the envelopes, and were informed of the treatment assignment in theatre immediately before surgery. The trial statistician who generated the allocation schedules was not involved in execution of the assignment". Page 825
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"As in many surgical trials, complete masking was not possible. The patients and the optometrists in charge of the follow up outcome assessments were masked to the treatment allocation code". Page 825
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"optometrists in charge of the follow up outcome assessments were masked to the treatment allocation code. The optometrists examining the patient, however,

MEHOX 2004 (*Continued*)

		could not be masked to the size and location of the surgical incision, which indicated the type of surgery". Page 825
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	"similar numbers were lost in the two treatment groups, and the reasons for loss-mainly problems with attendance due to change of residence or death-were similar in the two groups". Page 828
Selective reporting (reporting bias)	Low risk	None obvious

Ravalico 1997

Methods	Parallel-group randomised controlled trial Number randomised: 40 participants People were randomly allocated to treatment and likely (but not clearly stated) that 1 eye per person operated Follow-up: mean 30 days
Participants	Country: Italy Inclusion criteria: participants scheduled for cataract surgery Exclusion criteria: high refractive defects (> 4.0 dioptres); other ocular pathologies; diabetes mellitus; intraoperative or postoperative complications Age, years: phacoemulsification mean 62.9 (SD 6.2) (range 60 to 70), ECCE: mean 63.7 (SD 6.7) years
Interventions	Phacoemulsification (20 eyes) versus ECCE (20 eyes)
Outcomes	Mean endothelial cell density Coefficient of variation in cell size Pachymetry Endothelial cell pump function and permeability coefficient Mean decimal visual acuity
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Forty patients scheduled for cataract surgery were divided by randomization numbers into two groups of 20 patients each". Page 1001
Allocation concealment (selection bias)	Unclear risk	No details stated in paper

Ravalico 1997 (*Continued*)

Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	"All ECCE and phacoemulsification procedures were performed by the same surgeon." Page 1001 No details regarding masking of participants or other staff given
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No details stated in paper
Incomplete outcome data (attrition bias) All outcomes	Low risk	"No patient dropped out of the study". Page 1001
Selective reporting (reporting bias)	Unclear risk	No details of intraoperative complications recorded in paper

Rizal 2003

Methods	Parallel-group randomised controlled trial Number randomised: 60 participants Unclear but likely that people were randomly allocated and 1 eye per person operated Follow-up: 2 months
Participants	Country: Malaysia Inclusion criteria: age over 40, BCVA of 6/60 or better with symptoms of cataract Exclusion criteria: senile dementia, frailty or deformity, have a past history of eye injury, undergoing any major surgery within the study period, anxious participants who require general anaesthesia, participants with cerebral vascular accident causing significant visual loss. Participants with glaucoma, maculopathy, difficult pupillary dilation, media opacity such as vitreous haemorrhage and any central corneal opacity of 3 mm diameter Age, years: range 45 to 94 years Gender: phacoemulsification 12 men, 18 women, ECCE 12 men, 18 women Ethnicity: Malay, Chinese, Indian
Interventions	Phacoemulsification (30 eyes) versus ECCE (30 eyes)
Outcomes	Cataract surgery cost
Notes	Published data only. No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Using a computer generated randomisation table, they were subjected to either ECCE or PEA". Page 381

Rizal 2003 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	Not detailed in paper
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not detailed in paper
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not detailed in paper
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not detailed in paper
Selective reporting (reporting bias)	Unclear risk	No details of intraoperative complications recorded in paper

Stumpf 2006

Methods	Randomised controlled trial Number randomised: 41 eyes in 39 participants Follow-up: 180 days
Participants	Country: Brazil Inclusion criteria: senile cataract with hard cataract, possibility of return examinations for at least 6 months Exclusion criteria: presence of ocular pathology, prior eye surgery in the eye studied, diabetes mellitus, participants who were unable to do 6 months postoperative follow-up Age, years: 54 to 88 Gender: 12 men, 27 women
Interventions	Phacoemulsification (20 eyes) versus ECCE (21 eyes)
Outcomes	Decimal VA at 1, 3 and 6 months Endothelial cell loss Pachymetry
Notes	Published data only (paper translated from Portuguese original). No correspondence with authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Participants were randomised using a ballot system. "The patients were randomly divided by lot into two groups". Page 492

Stumpf 2006 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	Not detailed in paper
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not detailed in paper
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not detailed in paper
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants completed 6-month follow-up period
Selective reporting (reporting bias)	Unclear risk	No details of intraoperative complications recorded in paper

BCVA: best corrected visual acuity
ECCE: extracapsular cataract extraction
IOL: intraocular lens
MSICS: manual small incision cataract surgery
SD: standard deviation
UBM: ultrasound biomicroscopy
VA: visual acuity

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Arriaga 2002	Not a RCT
Balent 2001	Not strictly a RCT. "Patients were randomly assigned to any surgeon's table as soon as the table emptied"
Bellucci 1995	Study in people with small pupils
Bovet 1992	Not a RCT
Bovet 1994	Not a RCT
Bömer 1995	Surgical technique was not randomly allocated
Cavallini 1996	Not a RCT
Dam-Johansen 1993	Not a RCT

(*Continued*)

Dowler 2000	Participants were diabetic therefore may not have had age-related cataract
Egger 1994	Not a RCT
Geerling 2000	Not a RCT
Grinbaum 2003	Not a RCT
Honda 1995	Not a RCT
Kim 1996	Study of intraocular pressure change only
Lagreze 1996	Participants only randomly allocated to phacoemulsification, not to ECCE
Li 2005	Not a RCT
Liu 1995	Not a RCT
Liu 2003a	Not a RCT
Liu 2003b	Not a RCT
Loo 2004	Not a RCT
Lupidi 1994	Not a RCT
Ma 2000	Not a RCT
Matheu 1997	Does not compare phacoemulsification and ECCE
Moulick 2009	Not a RCT
Muralikrishnan 2004	Not a RCT
Müller-Jensen 1996	Not a RCT
Okinami 1994	Not a RCT
Ram 2001	Not a RCT
Sun 2010	Not a RCT
Watson 1992	Not a RCT
Yasuyoshi 1995	Not a RCT

ECCE: extracapsular cataract extraction
RCT: randomised controlled trial

Characteristics of studies awaiting assessment *[ordered by study ID]*

Durovic 2004

Methods	
Participants	
Interventions	
Outcomes	
Notes	Awaiting translation

Trnavec 1997

Methods	
Participants	
Interventions	
Outcomes	
Notes	Awaiting translation

DATA AND ANALYSES

Comparison 1. Phacoemulsification versus ECCE

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Good functional vision at 3 months (uncorrected acuity)	2	492	Risk Ratio (M-H, Fixed, 95% CI)	1.81 [1.36, 2.41]
2 Good functional vision at 12 months (uncorrected acuity)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
3 Good functional vision at 3 months (best corrected acuity)	4	645	Risk Ratio (M-H, Random, 95% CI)	1.12 [1.03, 1.22]
4 Good functional vision at 12 months (best corrected acuity)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
5 Poor visual outcome at 3 months (best corrected acuity 6/60 or worse)	3	604	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.20, 0.55]
6 Poor visual outcome at 12 months (best corrected acuity 6/60 or worse)	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
7 Capsular rupture	3	688	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.56 [0.26, 1.22]
8 % corneal endothelial cell loss	3	605	Mean Difference (IV, Fixed, 95% CI)	1.00 [-0.88, 2.89]
9 Other intraoperative complications			Other data	No numeric data
10 Posterior capsule opacification	2	571	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.38 [0.22, 0.66]
11 Retinal detachment	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
12 Cystoid macular oedema	2	571	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.29 [0.10, 0.86]
13 Iris prolapse	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
14 Other complications			Other data	No numeric data

Analysis 1.1. Comparison 1 Phacoemulsification versus ECCE, Outcome 1 Good functional vision at 3 months (uncorrected acuity).

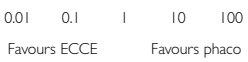
Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 1 Good functional vision at 3 months (uncorrected acuity)

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Chee 1999 (1)	15/18	8/16		16.3 %	1.67 [0.98, 2.84]
MEHOX 2004 (2)	83/237	42/221		83.7 %	1.84 [1.33, 2.54]
Total (95% CI)	**255**	**237**		**100.0 %**	**1.81 [1.36, 2.41]**

Total events: 98 (Phacoemulsification), 50 (ECCE)
Heterogeneity: $Chi^2 = 0.11$, df = 1 (P = 0.74); $I^2 = 0.0\%$
Test for overall effect: Z = 4.10 (P = 0.000041)
Test for subgroup differences: Not applicable



(1) 6/12 or better, 2 months follow-up

(2) 6/9 or better, 3 months follow-up

Analysis 1.2. Comparison 1 Phacoemulsification versus ECCE, Outcome 2 Good functional vision at 12 months (uncorrected acuity).

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 2 Good functional vision at 12 months (uncorrected acuity)

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
MEHOX 2004 (1)	87/224	42/215		1.99 [1.45, 2.73]

(1) 6/9 or better

Analysis 1.3. Comparison 1 Phacoemulsification versus ECCE, Outcome 3 Good functional vision at 3 months (best corrected acuity).

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 3 Good functional vision at 3 months (best corrected acuity)

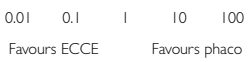
Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
Chee 1999 (1)	17/18	15/16		18.9 %	1.01 [0.85, 1.19]
George 2005 (2)	60/60	47/52		36.0 %	1.11 [1.01, 1.22]
Laurell 1998 (3)	16/21	9/20		2.6 %	1.69 [0.99, 2.91]
MEHOX 2004 (4)	220/237	177/221		42.6 %	1.16 [1.08, 1.25]
Total (95% CI)	**336**	**309**		**100.0 %**	**1.12 [1.03, 1.22]**

Total events: 313 (Phacoemulsification), 248 (ECCE)

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 5.42$, df = 3 (P = 0.14); $I^2 = 45\%$

Test for overall effect: Z = 2.54 (P = 0.011)

Test for subgroup differences: Not applicable



(1) 6/12 or better, 2 months follow-up

(2) 6/12 or better, 6 weeks follow-up

(3) better than 6/6, 3 months follow-up

(4) 6/9 or better, 3 months follow-up

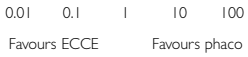
Analysis 1.4. Comparison 1 Phacoemulsification versus ECCE, Outcome 4 Good functional vision at 12 months (best corrected acuity).

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 4 Good functional vision at 12 months (best corrected acuity)

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
MEHOX 2004 (1)	204/224	184/215		1.06 [0.99, 1.14]



(1) 6/9 or better

Analysis 1.5. Comparison 1 Phacoemulsification versus ECCE, Outcome 5 Poor visual outcome at 3 months (best corrected acuity 6/60 or worse).

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 5 Poor visual outcome at 3 months (best corrected acuity 6/60 or worse)

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Chee 1999 (1)	0/18	0/16			Not estimable
George 2005 (2)	0/60	5/52		11.4 %	0.08 [0.00, 1.40]
MEHOX 2004 (3)	17/237	44/221		88.6 %	0.36 [0.21, 0.61]
Total (95% CI)	**315**	**289**		**100.0 %**	**0.33 [0.20, 0.55]**

Total events: 17 (Phacoemulsification), 49 (ECCE)
Heterogeneity: Chi^2 = 1.07, df = 1 (P = 0.30); I^2 =6%
Test for overall effect: Z = 4.23 (P = 0.000024)
Test for subgroup differences: Not applicable

(1) worse than 6/12, 2 months follow-up

(2) 6/18 or worse, 6 weeks follow-up

(3) worse than 6/9, 3 months follow-up

Analysis 1.6. Comparison 1 Phacoemulsification versus ECCE, Outcome 6 Poor visual outcome at 12 months (best corrected acuity 6/60 or worse).

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 6 Poor visual outcome at 12 months (best corrected acuity 6/60 or worse)

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
MEHOX 2004 (1)	20/224	31/215		0.62 [0.36, 1.05]

(1) worse than 6/9

Analysis 1.7. Comparison 1 Phacoemulsification versus ECCE, Outcome 7 Capsular rupture.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 7 Capsular rupture

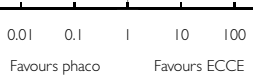
Study or subgroup	Phacoemulsification n/N	ECCE n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
George 2005	0/60	0/52			Not estimable
Katsimpris 2004	2/47	8/47		35.5 %	0.26 [0.07, 0.98]
MEHOX 2004	8/246	9/236		64.5 %	0.85 [0.32, 2.23]
Total (95% CI)	**353**	**335**		**100.0 %**	**0.56 [0.26, 1.22]**

Total events: 10 (Phacoemulsification), 17 (ECCE)

Heterogeneity: $Chi^2 = 1.97$, df = 1 (P = 0.16); $I^2 = 49\%$

Test for overall effect: Z = 1.46 (P = 0.15)

Test for subgroup differences: Not applicable

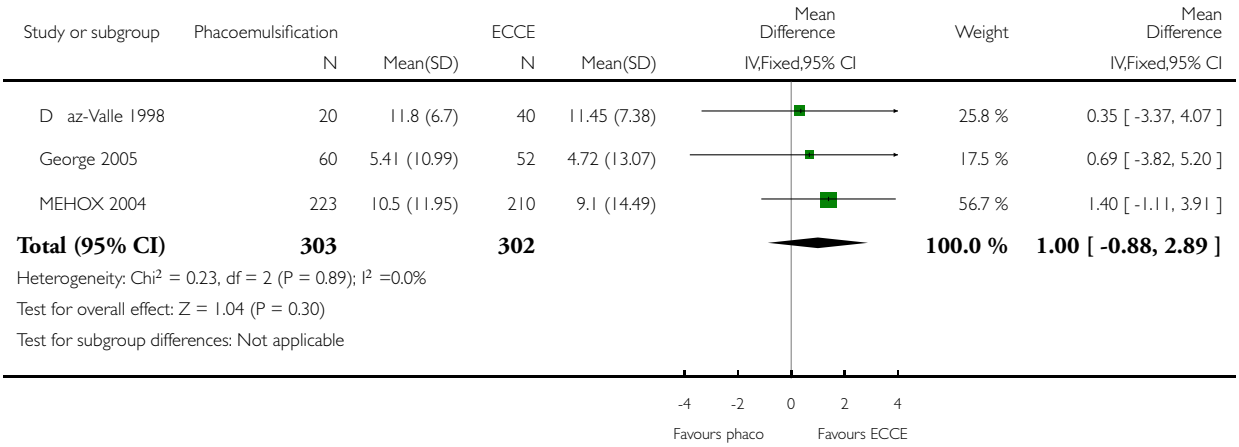


Analysis 1.8. Comparison 1 Phacoemulsification versus ECCE, Outcome 8 % corneal endothelial cell loss.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 8 % corneal endothelial cell loss



Analysis 1.9. Comparison 1 Phacoemulsification versus ECCE, Outcome 9 Other intraoperative complications.

Other intraoperative complications

Study	**Complication**	**Result**
Katsimpris 2004	Vitreous loss	Phacoemulsification: 2/47 (4%), ECCE: 8/47 (17%)
Landau 1999	IOL haptic located in capsular bag	Phacoemulsification: 18/18 (100%), ECCE: 10/17 (59%)
MEHOX 2004	Choroidal haemorrhage Iris torn or emulsified Other “minor” difficulties including: - anterior chamber collapse or bleed - anterior capsule tear - incomplete capsulorhexis	Phacoemulsification: 1/246 (0.4%), ECCE: 1/236 (0.4%) Phacoemulsification: 2/246 (1%), ECCE: 5/236 (2%) Phacoemulsification: 6/246 (2%), ECCE: 16/236 (7%)

Analysis 1.10. Comparison 1 Phacoemulsification versus ECCE, Outcome 10 Posterior capsule opacification.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 10 Posterior capsule opacification

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
Katsimpris 2004 (1)	5/47	18/47		35.7 %	0.23 [0.09, 0.58]
MEHOX 2004 (2)	12/245	22/232		64.3 %	0.50 [0.25, 1.01]
Total (95% CI)	**292**	**279**		**100.0 %**	**0.38 [0.22, 0.66]**

Total events: 17 (Phacoemulsification), 40 (ECCE)

Heterogeneity: $Chi^2 = 1.76$, df = 1 (P = 0.18); $I^2 = 43\%$

Test for overall effect: Z = 3.41 (P = 0.00065)

Test for subgroup differences: Not applicable

(1) At 14 months

(2) Laser capsulotomy

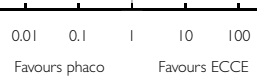
Analysis 1.11. Comparison 1 Phacoemulsification versus ECCE, Outcome 11 Retinal detachment.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 11 Retinal detachment

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Peto Odds Ratio Peto,Fixed,95% CI	Peto Odds Ratio Peto,Fixed,95% CI
MEHOX 2004	2/245	0/232		7.04 [0.44, 112.93]



Analysis 1.12. Comparison 1 Phacoemulsification versus ECCE, Outcome 12 Cystoid macular oedema.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 12 Cystoid macular oedema

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
Katsimpris 2004	1/47	8/47		62.4 %	0.18 [0.05, 0.72]
MEHOX 2004	2/245	3/232		37.6 %	0.63 [0.11, 3.68]
Total (95% CI)	**292**	**279**		**100.0 %**	**0.29 [0.10, 0.86]**

Total events: 3 (Phacoemulsification), 11 (ECCE)

Heterogeneity: Chi^2 = 1.19, df = 1 (P = 0.27); I^2 =16%

Test for overall effect: Z = 2.24 (P = 0.025)

Test for subgroup differences: Not applicable

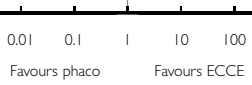
Analysis 1.13. Comparison 1 Phacoemulsification versus ECCE, Outcome 13 Iris prolapse.

Review: Phacoemulsification with posterior chamber intraocular lens versus extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens for age-related cataract

Comparison: 1 Phacoemulsification versus ECCE

Outcome: 13 Iris prolapse

Study or subgroup	Phacoemulsification n/N	ECCE n/N	Peto Odds Ratio Peto,Fixed,95% CI	Peto Odds Ratio Peto,Fixed,95% CI
MEHOX 2004	0/246	17/236		0.12 [0.05, 0.32]



Analysis 1.14. Comparison 1 Phacoemulsification versus ECCE, Outcome 14 Other complications.

Other complications

Study	**Complication**	**Result**
Chee 1999	"Complications"	None reported
George 2005	Mean induced astigmatism in dioptres (SD)	Phacoemulsification (n = 60): 0.77 (0.65), ECCE (n = 52): 1.77 (1.65)
Katsimpris 2004	Corneal oedema (no time point stated) Transient IOP spike IOL decentration	Phacoemulsification: 22/47 (47%), ECCE: 35/47 (74%) Phacoemulsification: 4/47 (9%), ECCE: 14/47 (30%) Phacoemulsification: 0/47 (0%), ECCE: 2/47 (4%)
Landau 1999	Complications	Phacoemulsification: 0/18 (0%), ECCE: 0/17 (0%)
Laurell 1998	Median diffusion coefficient for fluorescein leakage through the BAB at 3 months	Phacoemulsification (n = 18): 8.58, ECCE (n = 17): 14.34
MEHOX 2004	Endophthalmitis	Phacoemulsification: 3/245 (1%), ECCE: 1/232 (0.4%)

ADDITIONAL TABLES

Table 1. Outcome reporting matrix

	Chee 1999	**Diaz-Valle 1998**	**George 2005**	**Kara-Junior 2010**	**Katsimpris 2004**	**Landau 1999**	**Laurell 1998**	**MEHOX**	**Ravalico 1997**	**Rizal 2003**	**Stumpf 2006**
Review outcomes											
Presenting VA >= 6/12	√	H	H	H	H	H	C	√	C	H	H
BCVA < 6/60	F	H	√	H	C	H	C	√	C	H	C
Capsular rupture with or without vit-	F	H	√	H	√	F	H	√	H	H	H

Table 1. Outcome reporting matrix (*Continued*)

reous loss											
Iris prolapse	F	H	H	H	H	F	H	√	H	H	H
Postoperative inflammation	√	H	H	H	H	H	H	H	H	H	H
Posterior capsule opacification	H	H	H	H	√	H	H	√	H	H	H
Retinal detachment	H	H	H	H	H	H	H	√	H	H	H
Glaucoma	H	H	H	H	H	H	H		H	H	H
Cystoid macular oedema	H	H	H	H	√	H	H	√	H	H	H
Corneal endothelial cell loss	H	√	√	H	H	H	H	√	H	H	H
Corneal decompensation	H	H	H	H	H	H	H	H	H	H	H
Quality of life	I	I	I	√	I	I	I	I	I	I	I
Other outcomes (list other outcomes reported)		Change in corneal thickness	Mean induced astigmatism	Cost, number of days off work	Zonular dialysis, corneal oedema, transient IOP spike, IOL decentra-	IOL haptic located in capsular bag, "complications"	Operating time, corneal thickness, diffusion coefficient	Choroidal haemorrhage, endophthalmitis, other "minor"	Corneal thickness	Operation time, cost	Operation time, corneal thickness

Table 1. Outcome reporting matrix (*Continued*)

					tion		for fluorescein leakage through BAB	difficulties, cost			

√ Reported and included in review.
Other codes see Appendix 9.
BAB: blood-aqueous barrier
BCVA: best corrected visual acuity
IOL: intraocular lens
VA: visual acuity

Table 2. Corneal thickness

Díaz-Valle 1998	Mean change in corneal thickness (µm) - at 3 months	Phacoemulsification (n = 20): 5 ECCE (n = 20 CCC, n = 20 letterbox) 24 and 15
Laurell 1998	Mean increase in corneal thickness (µm) - at day 3	Phacoemulsification (n = 20): 29 ECCE (n = 20): 29
Laurell 1998	Mean increase in corneal thickness (µm) - 3 months	Phacoemulsification (n = 19): -4 ECCE (n = 20): 3
Ravalico 1997	Corneal thickness (% increase) - at 7 days	Phacoemulsification (n = 20): 2.1 ECCE (n = 20): 6.4
Ravalico 1997	Corneal thickness (% increase) - at 30 days	Phacoemulsification (n = 20) 0.8: ECCE (n = 20): 4.8
Ravalico 1997	Mean (SD) change in corneal thickness - at 7 days	Phacoemulsification (n = 20) 11.6 (10.5): ECCE (n = 20): 34.7 (12.5)
Ravalico 1997	Mean (SD) change in corneal thickness - at 30 days	Phacoemulsification (n = 20) 4.7 (10.3): ECCE (n = 20) : 26.3 (12.2)
Stumpf 2006	Mean corneal thickness increase - 1 month	Phacoemulsification (n = 20):7 ECCE (n = 21): 7
Stumpf 2006	Mean corneal thickness increase - 3 months from baseline	Phacoemulsification (n = 20): 0 ECCE (n = 21): 1
Stumpf 2006	Mean corneal thickness increase - 6 months from baseline	Phacoemulsification (n = 20): 3 ECCE (n = 21): 5

APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor Cataract
#2 MeSH descriptor Cataract Extraction
#3 MeSH descriptor Lens, Crystalline
#4 MeSH descriptor Lenses, Intraocular
#5 MeSH descriptor Lens Implantation, Intraocular
#6 intraocular lens* or intra ocular lens* or IOL*
#7 (#1 OR #2 OR #3 OR #4 OR #5 OR #6)
#8 MeSH descriptor Phacoemulsification
#9 pha?oemulsif*
#10 phaco or phako
#11 (#8 OR #9 OR #10)
#12 extracapsular near/2 cataract
#13 extra capsular near/2 cataract
#14 ECCE
#15 (#12 OR #13 OR #14)
#16 (#7 AND #11 AND #15)

Appendix 2. MEDLINE (OvidSP) search strategy

1. randomized controlled trial.pt.
2. (randomized or randomised).ab,ti.
3. placebo.ab,ti.
4. dt.fs.
5. randomly.ab,ti.
6. trial.ab,ti.
7. groups.ab,ti.
8. or/1-7
9. exp animals/
10. exp humans/
11. 9 not (9 and 10)
12. 8 not 11
13. exp cataract/
14. cataract extraction/
15. exp lens crystalline/
16. exp lenses intraocular/
17. lens implantation intraocular/
18. (intraocular lens$ or intra ocular lens$ or IOL$).tw.
19. or/13-18
20. phacoemulsification/
21. pha?oemulsif$.tw.
22. (phaco or phako).tw.
23. or/20-22
24. (extracapsular adj2 cataract$).tw.
25. (extra capsular adj2 cataract$).tw.
26. ECCE.tw.
27. or/24-26
28. 19 and 23 and 27
29. 12 and 28

The search filter for trials at the beginning of the MEDLINE strategy is from the published paper by Glanville et al (Glanville 2006).

Appendix 3. EMBASE.com search strategy

1. exp randomized controlled trial/
2. exp randomization/
3. exp double blind procedure/
4. exp single blind procedure/
5. random$.tw.
6. or/1-5
7. (animal or animal experiment).sh.
8. human.sh.
9. 7 and 8
10. 7 not 9
11. 6 not 10
12. exp clinical trial/
13. (clin$ adj3 trial$).tw.
14. ((singl$ or doubl$ or trebl$ or tripl$) adj3 (blind$ or mask$)).tw.
15. exp placebo/
16. placebo$.tw.
17. random$.tw.
18. exp experimental design/
19. exp crossover procedure/
20. exp control group/
21. exp latin square design/
22. or/12-21
23. 22 not 10
24. 23 not 11
25. exp comparative study/
26. exp evaluation/
27. exp prospective study/
28. (control$ or prospectiv$ or volunteer$).tw.
29. or/25-28
30. 29 not 10
31. 30 not (11 or 23)
32. 11 or 24 or 31
33. exp cataract/
34. exp cataract extraction/
35. exp lens/
36. exp lens implant/
37. exp lens implantation/
38. (intraocular lens$ or intra ocular lens$ or IOLS).tw.
39. or/33-38
40. exp phacoemulsification/
41. pha?oemulsif$.tw.
42. (phaco or phako).tw.
43. or/40-42
44. exp extracapsular cataract extraction/
45. (extracapsular adj2 cataract$).tw.
46. (extra capsular adj2 cataract$).tw.
47. ECCE.tw.
48. or/44-47
49. 39 and 43 and 48
50. 32 and 49

Appendix 4. LILACS search strategy

cataract$ and phaco$ or phako$ and extracapsular or extra capsular or ECCE

Appendix 5. Web of Science CPCI-S search strategy

#8 #3 and #6 and #7
#7 TS= (extracapsular or extra capsular or ECCE)
#6 #4 or #5
#5 TS=(phaco or phako)
#4 TS=(phacoemulsification or phakoemulsification)
#3 #1 OR #2
#2 TS=(intraocular lens* or intra ocular lens* or IOL*)
#1 TS=cataract*

Appendix 6. *meta*Register of Controlled Trials search strategy

cataract AND phacoemulsification

Appendix 7. ClinicalTrials.gov search strategy

cataract AND phacoemulsification

Appendix 8. ICTRP search strategy

phacoemulsification = Condition AND extracapsular or extra capsular or ECCE = Intervention

Appendix 9. ORBIT classification

The Outcome Reporting Bias In Trials (ORBIT) study classification system for missing or incomplete outcome reporting in reports of randomised trials as given in Kirkham 2010.

Description		Level of reporting	Risk of bias
Clear that the outcome was measured and analysed			
A	Trial report states that outcome was analysed but only reports that result was not significant (typically stating P > 0.05)	Partial	High risk
B	Trial report states that outcome was analysed but only reports that result was significant (typically stating P < 0.05)	Partial	No risk

(*Continued*)

C	Trial report states that outcome was analysed but insufficient data were presented for the trial to be included in meta-analysis or to be considered to be fully tabulated	Partial	Low risk
D	Trial report states that outcome was analysed but no results reported	None	High risk
Clear that the outcome was measured			
E	Clear that outcome was measured but not necessarily analysed. Judgement says likely to have been analysed but not reported because of non-significant results	None	High risk
F	Clear that outcome was measured but not necessarily analysed. Judgement says unlikely to have been analysed but not reported because of non-significant results	None	Low risk
Unclear whether the outcome was measured			
G	Not mentioned but clinical judgement says likely to have been measured and analysed but not reported on the basis of non-significant results	None	High risk
H	Not mentioned but clinical judgement says unlikely to have been measured at all	None	Low risk
Clear that the outcome was not measured			
I	Clear that outcome was not measured	NA	No risk

CONTRIBUTIONS OF AUTHORS

Conceiving the review: YR

Designing the review: YR, JE

Co-ordinating the review: YR, JE

Data collection for the review:

- Designing electronic search strategies: Cochrane Eyes and Vision Group editorial base

- Undertaking manual searches: YR

- Screening search results: YR, SdeS

- Organising retrieval of papers: YR

- Screening retrieved papers against inclusion criteria: YR, SdeS

- Appraising quality of papers: YR, JE, SdeS

- Extracting data from papers: YR, JE, SdeS

- Writing to authors of papers for additional information: YR, SdeS

- Obtaining and screening data on unpublished studies: YR

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Analysis of data: YR, JE, SdeS

Interpretation of data:

- Providing a methodological perspective: JE

- Providing a clinical perspective: YR, SdeS

- Providing a policy perspective: YR, SdeS

Writing the review: YR, JE, SdeS

Performing previous work that was the foundation of the current study: YR, JE

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- Sightsavers, UK.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The primary visual acuity (VA) outcomes for this review were presenting VA of 6/12 or better, or a best corrected VA of worse than 6/60. None of the papers documented presenting VA, and therefore we report both uncorrected and best-corrected VA.

NOTES

The original published Cochrane review 'Riaz Y, Mehta JS, Wormald R, Evans JR, Foster A, Ravilla T, Snellingen T. Surgical interventions for age-related cataract. *Cochrane Database of Systematic Reviews* 2006, Issue 4. Art. No.: CD001323. DOI: 10.1002/14651858.CD001323.pub2' has been divided into three smaller reviews each using the same outcome measures as the original review but only comparing two surgical methods within each review. The interventions being compared are ECCE, MSICS and phacoemulsification. Intracapsular extraction (ICCE) is no longer included in the reviews as this technique is no longer used as a primary procedure.

INDEX TERMS

Medical Subject Headings (MeSH)

*Lenses, Intraocular; Cataract Extraction [adverse effects; *methods]; Clinical Protocols; Phacoemulsification [adverse effects; *methods]; Posterior Eye Segment [injuries]; Randomized Controlled Trials as Topic

MeSH check words

Aged; Aged, 80 and over; Humans; Middle Aged