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Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract (Review)

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Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

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A B S T R A C T

Background

Age-related cataract is a major cause of blindness and visual morbidity worldwide. It is therefore important to establish the optimal technique of lens removal in cataract surgery.

Objectives

To compare manual small incision cataract surgery (MSICS) and phacoemulsification techniques.

Search methods

We searched CENTRAL (which contains the Cochrane Eyes and Vision Group Trials Register) (*The Cochrane Library* 2013, Issue 6), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to July 2013), EMBASE (January 1980 to July 2013), Latin American and Caribbean Literature on Health Sciences (LILACS) (January 1982 to July 2013), Web of Science Conference Proceedings Citation Index - Science (CPCI-S) (January 1970 to July 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 23 July 2013.

Selection criteria

We included randomised controlled trials (RCTs) for age-related cataract that compared MSICS and phacoemulsification.

Data collection and analysis

Two authors independently 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). We collected data on these outcomes at three and 12 months after surgery. Complications such as posterior capsule rupture rates and other intra- and postoperative complications were also assessed. In addition, we examined cost effectiveness of the two techniques. Where appropriate, we pooled data using a random-effects model.

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Main results

We included eight trials in this review with a total of 1708 participants. Trials were conducted in India, Nepal and South Africa. Follow-up ranged from one day to six months, but most trials reported at six to eight weeks after surgery. Overall the trials were judged to be at risk of bias due to unclear reporting of masking and follow-up. No studies reported presenting visual acuity so data were collected on both best-corrected (BCVA) and uncorrected (UCVA) visual acuity. Most studies reported visual acuity of 6/18 or better (rather than 6/12 or better) so this was used as an indicator of good functional vision. Seven studies (1223 participants) reported BCVA of 6/18 or better at six to eight weeks (pooled risk ratio (RR) 0.99 95% confidence interval (CI) 0.98 to 1.01) indicating no difference between the MSICS and phacoemulsification groups. Three studies (767 participants) reported UCVA of 6/18 or better at six to eight weeks, with a pooled RR indicating a more favourable outcome with phacoemulsification (0.90, 95% CI 0.84 to 0.96). One trial (96 participants) reported UCVA at six months with a RR of 1.07 (95% CI 0.91 to 1.26).

Regarding BCVA of less than 6/60: there were only 11/1223 events reported. The pooled Peto odds ratio was 2.48 indicating a more favourable outcome using phacoemulsification but with wide confidence intervals (0.74 to 8.28) which means that we are uncertain as to the true effect.

The number of complications reported were also low for both techniques. Again this means the review is underpowered to detect a difference between the two techniques with respect to these complications. One study reported on cost which was more than four times higher using phacoemulsification than MSICS.

Authors' conclusions

On the basis of this review, removing cataract by phacoemulsification may result in better UCVA in the short term (up to three months after surgery) compared to MSICS, but similar BCVA. There is a lack of data on long-term visual outcome. The review is currently underpowered to detect differences for rarer outcomes, including poor visual outcome. In view of the lower cost of MSICS, this may be a favourable technique in the patient populations examined in these studies, where high volume surgery is a priority. Further studies are required with longer-term follow-up to better assess visual outcomes and complications which may develop over time such as posterior capsule opacification.

PLAIN LANGUAGE SUMMARY

Comparing two different techniques of removing cataracts

Cataract is a clouding of the lens in the eye, which most commonly occurs due to increasing age. This can only be treated with an operation, and the aim of this review was to assess two different surgical methods. The first, called manual small incision cataract surgery (MSICS) involves using instruments to remove the lens from the eye through a small incision. The second, phacoemulsification, involves using a high frequency ultrasound probe to fragment the lens, and this machine also removes the lens fragments from the eye.

We searched the literature in July 2013 and identified eight randomised controlled trials that compared these two techniques. These included a total of 1708 participants randomly allocated to MSICS or phacoemulsification. The studies were carried out in India, Nepal and South Africa.

Not all studies reported the outcomes of visual acuity that we aimed to assess, making it difficult to draw definite conclusions. Better uncorrected visual acuity was seen in the short term with phacoemulsification; however, there were no differences in best-corrected visual acuity (i.e. after correction with spectacles). There appeared to be no significant difference regarding uncorrected visual acuity between the two techniques at six months in the one trial that reported at that time point. There was a lack of long-term data (one year or more after surgery). Very few participants were reported to have poor visual outcomes or complications (such as posterior capsule rupture) from the surgery. The cost of phacoemulsification was documented in one study only, and this was more than four times the cost of MSICS.

In this setting, the two techniques appear to be comparable in terms of visual acuity outcomes and complications. However further studies with a longer follow-up period are needed to better assess these outcomes.

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SUMMARY OF FINDINGS FOR THE MAIN COMPARISON [*Explanation*]

Manual small incision cataract surgery (MSICS) compared with phacoemulsification for age-related cataract

Patient or population: people with age-related cataract
Settings: hospital
Intervention: manual small incision surgery
Comparison: phacoemulsification

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	**Corresponding risk**				
	Phacoemulsification	**MSICS**				
Good functional vision (presenting visual acuity 6/12 or better) 12 months after surgery	See comment					No study reported presenting visual acuity; few studies reported 6/12 outcomes; only one study reported at 12 months Seven studies reported best-corrected visual acuity (BCVA) of 6/18 or better at three months (pooled RR 0.99 (95% CI 0.98 to 1.01)) and three studies reported uncorrected visual acuity (UCVA) of 6/18 or better at three months (pooled RR in favour of phacoemulsification 0.90 (95% CI 0.84 to 0.96)
Poor visual outcome (best-corrected visual acuity worse than 6/60) 12 months after surgery	1 per 1000[1]	2 per 1000 (1 to 8)	OR: 2.48 (95% CI 0.74 to 8.28)	1250 (6)	⊕○○○ very low[2,3,4]	No data available at 12 months so data from three months follow-up used

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Posterior capsule opacification 12 months after surgery	See comments	494 (2)	⊕○○○ very low[4,5,6]	Posterior capsule opacification was reported in two studies. At six weeks no cases were observed in Gogate 2005a and at six months 20/46 MSICS versus 7/48 phacoemulsification cases were observed in Ruit 2007 (OR 2.98, 95% CI 1.39 to 6.37).
Other complications	See comments			No data on retinal detachment, glaucoma, cystoid macular oedema or corneal decompensation
Quality of life	See comments			No data reported
Costs	See comments			In the Ruit 2007 study, phacoemulsification cost USD 70 per case and MSICS cost USD 15 per case

*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; **RR:** Risk Ratio; **OR**: Odds Ratio

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.

1 Risk in phacoemulsification group ranged from 0 per 1000 to 25 per 1000 in the included studies; the median risk was 0. We have
   therefore estimated a low risk in the phacoemulsification group at 1 per 1000.
2 Downgraded for risk of bias: several items on risk of bias assessment not clearly reported.

3 Downgraded for imprecision: wide confidence intervals.
4 Downgraded for indirectness (not measured at 12 months).
5 Downgraded for inconsistency: only one study reported so not possible to assess.

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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. The density and location of the cataract determines the amount of vision affected. Initially, cataracts may not affect vision and if the cataract remains small or at the periphery of the lens, the visual changes may be minor. If the cataract forms in the area of the lens directly behind the pupil, vision may be significantly impaired. It is not thought to be reversible and surgery is currently the only treatment option. In the months or years after cataract surgery a small percentage of people will develop a condition called posterior capsular thickening which can be treated. A laser treatment, YAG laser capsulotomy, makes a small opening in the back of the lens capsule, which restores vision.

The World Health Organization (WHO) estimated from a recent global review of surveys that there are 37 million people worldwide who were blind in 2002 (Passolini 2004; Resnikoff 2004) and that age-related cataract remained the leading cause of blindness globally in 2002, as it was in 1990. Fifty per cent of total world blindness is thought to be due to cataract, with the majority of blinding cataract 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 (WHO 2005).

Description of the intervention

Phacoemulsification was first described in 1967 by Charles D. Kelman, an American ophthalmologist (1930 to 2004). It is the most commonly performed method of cataract extraction in the developed world and involves ultrasonic fragmentation of the crystalline lens. The incision is small (with a standard size of around 2.75 mm, but may range from 2.2 mm to 3.2 mm) which allows rapid visual rehabilitation postoperatively and low induced astigmatism. This technique requires a phacoemulsification machine which may cost GBP 20,000 to GBP 45,000 and has high disposable and maintenance costs. Phacoemulsification requires extensive surgical training, particularly the necessity to carry out a continuous capsulorhexis.

Manual small incision cataract surgery (MSICS) was first described by Blumenthal 1992. In Asia and Africa there has been a renewal of interest in this technique (Ruit 2000) as an alternative to phacoemulsification, because it is considerably less costly but has similar benefits of rapid visual recovery and reduced astigmatism (Yorston 2005). It involves a 6 mm to 6.5 mm scleral incision, just large enough to allow insertion of a 6 mm intraocular lens (IOL). There are various different techniques described for performing the capsulotomy in MSICS, for example, the can-opener method (Gogate 2005b), the continuous curvilinear capsulorhexis (Gogate 2003) and the endocapsular technique where the incision is from pupil margin to pupil margin. The lens is delivered into the anterior chamber, hydroextracted and aspirated. The posterior capsule of the lens is left intact. This technique is technically more difficult than a standard manual extracapsular extraction (ECCE). Figure 1 summarises the different types of cataract surgery.

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Figure 1.   Types of cataract surgery

Cataract surgery

Intracapsular extraction
Cataract is removed intact. Anterior chamber IOL can be implanted. Not usually used as a primary procedure.

Extracapsular extraction
Posterior capsule is left in place. Posterior chamber IOL is implanted in the capsular bag.

Large (12 mm) incision. Sutures required.

Small (< 6.5 mm) incision. No sutures required.

ECCE	PHACO-EMULSIFICATION	MSICS
The caractous lens is removed by expression and aspiration.	The cataractous lens is emulsified by ultrasound and aspirated.	The cataractous lens is removed manually.
Rigid IOL is inserted through the large incision.	Soft, foldable IOL can be rolled up and inserted through a very small incision.	Rigid, small diameter IOL is inserted through a small incision.
These IOLs cost between $2 and $3.	These IOLs are the most expensive type and cost over $30.	These IOLs cost between $2 and $3.

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

How the intervention might work

Cataract surgery consists of removing the lens of the eye and replacing it with an artificial lens called an intraocular lens. IOLs can be made from a range of materials, and can be 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 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 high-income countries.

From a global perspective phacoemulsification is too costly for many developing countries where there is the highest incidence of cataract blindness. Manual small incision cataract 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 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 method is no longer used as a primary procedure.

The cataract surgical techniques compared in these three reviews are:

1. MSICS and ECCE (Ang 2012);
2. Phacoemulsification and ECCE (Riaz 2010a);
3. MSICS and phacoemulsification (current review, published protocol Riaz 2010b).

O B J E C T I V E S

The aim of this review is to compare the effects of two types of cataract surgery: manual small incision cataract surgery (MSICS) and phacoemulsification.

Our secondary objective is to compare the costs of the two procedures as reported in included trials.

M E T H O D S

Criteria for considering studies for this review

Types of studies

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

Types of participants

We include trials where participants were people with age-related cataract.

Types of interventions

We include trials that compared MSICS with phacoemulsification, followed by implantation of a posterior chamber intraocular lens (IOL) in both techniques.

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

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

Follow-up

Outcomes were measured at three months and one year after surgery. As studies may not report outcomes exactly at these time points, data collection was considered within the following time periods:
- three months: from four weeks to less than six 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 6, part of *The Cochrane Library*. www.thecochranelibrary.com (accessed 23 July 2013), Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid MEDLINE Daily, Ovid OLDMEDLINE (January 1946 to July 2013), EMBASE (January 1980 to July 2013), Latin American and Caribbean Health Sciences (LILACS) (January 1982 to July 2013), Web of Science Conference Proceedings Citation Index - Science (CPCI-S) (January 1970 to July 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 23 July 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. Duplicate records were removed, as were obviously irrelevant titles and abstracts. We obtained full-text copies of any report referring to definitely or possibly relevant trials. Multiple reports of the same study were linked together. We assessed these full-text reports for compliance of studies with eligibility criteria, and then assessed trials that met these criteria for methodological quality.

All studies that were excluded at this stage were documented and reasons for exclusion provided.

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. Any disagreements which could not be resolved were initially addressed by contacting the study authors, and if this was unsuccessful were reported in the review. Data were entered onto a spreadsheet, checked for accuracy by all review authors, and then cut and pasted into Review Manager 5 (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 as detailed in Chapter 8 of the *Cochrane Handbook for Systematic Reviews of interventions* (Higgins 2011). We considered the following parameters: sequence generation, allocation sequence concealment, masking (blinding), incomplete outcome data, selective outcome reporting and other potential sources of bias. We judged whether they were at high risk of bias, low risk of bias or unclear. 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 (i.e. post-operative 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. Corneal endothelial cell loss was reported as a continuous variable and was analysed using the mean difference. Currently the review does not include data on quality of life. In future updates this may become available. It may be reported as a continuous variable, in which case the mean difference will be used.

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Unit of analysis issues

In all studies included in this review, data were reported for one eye per person, although it was not always clear how the study eye was selected.

Dealing with missing data

We collected information on follow-up by treatment groups, and the reasons for missing data, although this was not always reported. The analyses in this review are based on available data and therefore assume that missing data are missing at random. We originally planned to investigate how reasonable this assumption is by doing a series of sensitivity analyses with different assumptions about the missing data using methods as set out by White 2008. However, data currently included in the review are sparse and we have therefore not done these sensitivity analyses for this initial version of the review.

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 are consistent, and thirdly by considering the I² value and Chi² test for heterogeneity (bearing in mind that the Chi² test has low power when the number of trials is small) (Higgins 2003).

Assessment of reporting biases

The main reporting biases that we planned to consider were publication bias and outcome reporting bias. Currently there are not enough trials included in the review to assess publication bias. In order to assess the possibility of outcome reporting bias we did a review outcome matrix using the ORBIT classification (Kirkham 2010).

Data synthesis

Where data were available, we pooled the results using a random-effects model if there were more than three studies, and a fixed-effect model if there were three or fewer studies. For data on complications, as the number of events was small, we used the Peto odds ratio (fixed-effect model). As a general rule, if there was substantial heterogeneity as defined above (Assessment of heterogeneity), we planned not to report a pooled estimate, depending on the size of studies and consistency of the effect estimates.

Subgroup analysis and investigation of heterogeneity

We did not plan or conduct any subgroup analyses.

Sensitivity analysis

We planned to do a sensitivity analysis excluding trials at high risk of bias and investigating the impact of missing data (see Dealing with missing data). However, currently there are not enough data to enable this.

Summary of findings table

We prepared a 'Summary of findings' table and assessed the quality of the body of evidence for each outcome using the GRADE approach as described in Chapter 12 of the *Cochrane Handbook for Systematic Reviews of interventions* (Schünemann 2011). This was done by one author (JE) and checked by the other authors.

RESULTS

Description of studies

Results of the search

The electronic searches yielded a total of 748 records (Figure 2). After deduplication we screened the title and abstract of 541 records. We excluded 523 records as not relevant to the scope of the review. We obtained full-text copies of 17 records for further investigation. We excluded eight studies, see Characteristics of excluded studies and included eight studies (nine reports) see Characteristics of included studies.

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Figure 2.   Results from searching for studies for inclusion in the review.

748 records identified through electronic database searching

↓

541 records after duplicates removed

↓

541 records screened by the authors → 524 records excluded by the authors as not relevant

↓

17 full-text articles assessed for eligibility → 8 full-text articles excluded, with reasons

↓

9 reports of 8 studies included in qualitative synthesis

↓

9 reports of 8 studies included in quantitative synthesis (meta-analysis)

Included studies

We included eight randomised controlled trials (RCTs) for analysis in this review (Cook 2012; George 2005; Ghosh 2010; Gogate 2005a; Gogate 2010; Ruit 2007; Singh 2009; Venkatesh 2010). See Characteristics of included studies for further details. All studies compared manual small incision cataract surgery (MSICS) with phacoemulsification. One trial had an additional extracapsular extraction (ECCE) arm (George 2005).

Participants: A total of 1708 people were included in these studies: 200 (Cook 2012); 124 (George 2005); 224 (Ghosh 2010); 400 (Gogate 2005a); 200 (Gogate 2010); 108 (Ruit 2007); 182 (Singh 2009); 270 (Venkatesh 2010).

Demographics: The average age of participants ranged from 56 to 68. Approximately equal numbers of women and men were enrolled (range percentage of women from 44.2% to 61%).

Location: Five of the included studies were conducted in India (George 2005; Ghosh 2010; Gogate 2005a; Gogate 2010; Venkatesh 2010), two in Nepal (Ruit 2007; Singh 2009) and one in South Africa (Cook 2012).

Outcomes: All eight studies evaluated Snellen visual acuity outcomes. Six studies reported visual acuity as their main outcome whereas George 2005 reported endothelial cell loss and surgery-induced astigmatism as their main outcome, and Ghosh 2010 reported macular thickness as the primary outcome. Postoperative complications were recorded in all studies.

Follow-up: Singh 2009 reported results on the first postoperative day only; George 2005; Gogate 2005a; Gogate 2010 and Venkatesh 2010 reported results at six weeks, Cook 2012 reported results at eight weeks; Ghosh 2010 and Ruit 2007 reported data up to six months postoperatively.

Excluded studies

See Characteristics of excluded studies table.

Risk of bias in included studies

Risk of bias is summarised in Figure 3 and Figure 4. See individual 'Risk of bias' tables for more detailed information on each study.

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

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

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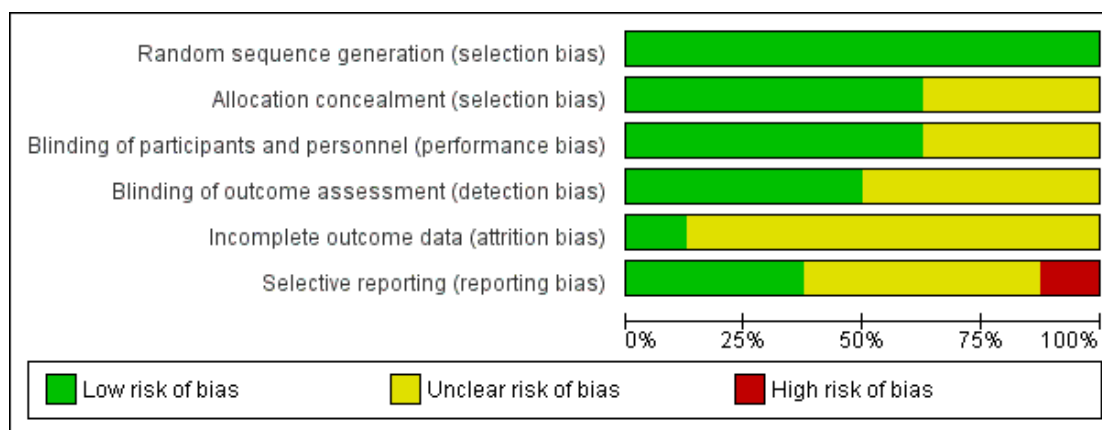
Allocation

All eight trials clearly stated how participants were allocated to each arm of the study. Five trials described using picking a ball or 'ballots' for assignment of treatment and surgeon (Cook 2012; Ghosh 2010; Gogate 2005a; Gogate 2010; Ruit 2007). Two studies used computer-generated random numbers (George 2005; Venkatesh 2010) and another study used a random number table (Singh 2009). Allocation concealment was described in five studies (Cook 2012; Ghosh 2010; Gogate 2005a; Gogate 2010; Venkatesh 2010).

Blinding

Performance bias

Five studies (Cook 2012; Ghosh 2010; Gogate 2005a; Gogate 2010; Venkatesh 2010) reported masking of participants to the nature of surgery.

Detection bias

Four studies reported that masking was carried out and that post-operative assessors were masked to the nature of surgery (Cook 2012; Ruit 2007; Singh 2009; Venkatesh 2010). However, obvious differences in postoperative appearance of the eye in each group may influence the ability to mask assessors.

Incomplete outcome data

Follow-up rates were variable between the included studies: 82.5% (Cook 2012); 91% (George 2005); 86% (Ghosh 2010); 93% (Gogate 2005a); 73% (Gogate 2010); 87% (Ruit 2007);100% (Singh 2009); 85% (Venkatesh 2010) respectively. Only Cook 2012 stated the reason for attrition, which was the distance needed to travel by participants living in rural areas.

Selective reporting

The only intraoperative complication described in George 2005 was posterior capsular rupture. Otherwise, a range of outcomes were reported in all other studies. Without access to the protocols for the studies it was difficult to assess this bias formally. However, we compiled an 'outcome reporting matrix' (Table 1) using the ORBIT classification (Kirkham 2010). We did not identify any cause for concern.

Other potential sources of bias

The level of surgical experience for each technique performed may be a source of bias. However, this would only be the case if there were imbalance between study groups in level of experience of the surgeon. In Cook 2012, 35% of phacoemulsification surgeries and 58% of MSICS surgeries were done by a team of five consultants. The remainder of surgery was done by 10 registrars, who were reported to be competent in the technique but had varying levels of experience. If the assumption is made that consultants were more experienced, this may be a potential source of bias in favour of MSICS outcomes.

In George 2005; Gogate 2005a; Ruit 2007 and Venkatesh 2010, all surgeons had comparable levels of experience. In Singh 2009 there was only one surgeon and it is not stated whether he had equal surgical experience of both techniques. In Ghosh 2010 there were two surgeons who performed equal amounts of surgery. In Gogate 2010 neither the number of surgeons nor the level of surgical experience is stated.

Effects of interventions

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

Primary outcomes

Visual outcomes

Good functional vision

We defined 'good functional vision' as presenting visual acuity of 6/12 or better. No studies reported presenting visual acuity so we report both uncorrected (UCVA) and best-corrected visual acuity (BCVA). Most studies reported outcomes of 6/18 or better, rather than 6/12 or better, so this outcome has been used as an indicator of good functional vision.

Uncorrected visual acuity (UCVA)

Five studies reported UCVA of 6/18 or better, with one study reporting this outcome at one day only (Singh 2009), two studies at six weeks (Gogate 2005a; Venkatesh 2010), one study at eight weeks (Cook 2012) and one study at six months (Ruit 2007).

At one day postoperatively, UCVA of 6/18 or better was found in 77.7% of participants in the MSCIS group and 68% of participants in the phacoemulsification group (P = 0.0655) (Singh 2009).

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At six weeks, Gogate 2005a reported UCVA of 6/18 or better in 133/187 (71%) of MSICS participants compared to 150/185 (81%) of phacoemulsification participants (risk ratio (RR) 0.88, 95% confidence interval (CI) 0.78 to 0.98). Venkatesh 2010 reported this outcome in 96/117 (82%) MSICS participants and 99/113 (88%) phacoemulsification participants (RR 0.94, 95% CI 0.84 to 1.04). At eight weeks, Cook 2012 reported this outcome in 63/85 (74%) MSICS participants and 69/80 (86%) phacoemulsification participants (RR 0.86, 95% CI 0.74 to 1.00). The pooled RR for this outcome was 0.90, (95% CI 0.84 to 0.96) which favours phacoemulsification (Analysis 1.1).

At six months, Ruit 2007 reported 41/46 (89%) of the MSICS group had UCVA of 6/18 or better compared with 40/48 (83%) of the phacoemulsification group (RR 1.07, 95% CI 0.91 to 1.26) (Analysis 1.2).

Best-corrected visual acuity (BCVA)

More studies reported BCVA (Analysis 1.3). At three months there was no difference between MSICS and phacoemulsification groups (pooled RR 0.99, 95% CI 0.98 to 1.01) (Analysis 1.3). One trial only reported at six months (Ruit 2007) with a RR of 1.0 (95% CI 0.94 to 1.06) (Analysis 1.4).

Poor visual outcome after surgery

We defined a poor outcome after surgery as BCVA of less than 6/60.

Six studies reported poor visual outcome data within three months postoperatively, with no cases in either group in three out of six studies. In total 8/617 MSICS cases and 3/606 phacoemulsification cases had BCVA worse than 6/60. With low numbers of events, the true estimate of effect is uncertain with a pooled Peto OR of 2.48 in favour of phacoemulsification and wide confidence intervals (95% CI 0.74 to 8.28; Analysis 1.5).

Ruit 2007 reported 1.9% of cases in both MSICS and phacoemulsification groups had BCVA worse than 6/18 at six months (Analysis 1.6).

Secondary outcomes

Intraoperative surgical complications

Posterior capsule rupture (PCR) was reported in all studies (Analysis 1.7). In most studies few cases of PCR were reported. The number of cases reported varied between studies from no events in either group (George 2005) to 10/100 in the MSICS and 4/100 in the phacoemulsification group (Cook 2012). Overall there was little evidence of any difference between the two intervention groups (Peto OR 1.07, 95% CI 0.63 to 1.83).

Five studies reported iridodialysis (Analysis 1.8). There were too few cases (seven) to detect any difference between MSICS and phacoemulsification (Peto OR 2.37, 95% CI 0.54 to 10.45). Two studies reported zonule dialysis (Gogate 2005a; Singh 2009) but again the number of cases (three) was low.

Three studies (Gogate 2005a; Gogate 2010; Ruit 2007) reported extension of capsulorrhexis during surgery (Analysis 1.9). This appeared to occur more commonly in the phacoemulsification group, but again the number of cases was low (six); Peto OR 0.26 (95% CI 0.05 to 1.30).

In Gogate 2005a, 2/199 cases allocated to the phacoemulsification groups were converted to MSICS; in Gogate 2010 this was 5/100 cases (three due to zonular dialysis and two due to posterior capsule tears), in Cook 2012 8/100 cases (due to hard nucleus) and in Venkatesh 2010 3/137 cases.

Postoperative inflammation was reported in three studies (11 cases in total) (Analysis 1.10). In the Ruit 2007 study, no events occurred in either group.

Postoperative complications

Early postoperative corneal oedema (occurring at day 1 to day 7) was reported in six studies (Analysis 1.11) with a total of 60/739 cases in the MSICS group and 93/737 cases in the phacoemulsification group. Overall there appeared to be more cases of early postoperative corneal oedema in the phacoemulsification group (Peto OR 0.58, 95% (CI) 0.41 to 0.83). In four studies, no events of corneal oedema were reported at three to six weeks (Analysis 1.12).

Posterior capsule opacification was reported in two studies (Analysis 1.13). At six weeks no cases were observed in Gogate 2005a, and at six months 20/46 MSICS versus 7/48 phacoemulsification cases were observed in Ruit 2007 (RR 2.98, 95% CI 1.39 to 6.37).

No significant difference between percentage endothelial cell loss was found between the two techniques (Analysis 1.14). George 2005 reported a 5.41% endothelial cell loss at six weeks in the phacoemulsification group, and 4.21% in the MSICS group (P = 0.855). Gogate 2010 reported a mean endothelial cell loss at one week of 16.1% in the phacoemulsification group, and 12.2% in the MSICS group (P = 0.06). At six weeks the percentage loss was 18.4% in the phacoemulsification group, and 17.7% in the MSICS group (P = 0.44).

Other reported findings

Surgically induced astigmatism (SIA)

This was reported in six studies (George 2005; Ghosh 2010; Gogate 2005a; Ruit 2007; Singh 2009; Venkatesh 2010).

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At one day postoperatively, Singh 2009 reported a mean induced astigmatism of 0.11 dioptre (D) (SD 0.74) for the phacoemulsification group and 0.09 (SD 0.82) for the MSICs group.

At six to eight weeks postoperatively, three studies reported a greater SIA in the MSICS groups: George 2005 (mean SIA 1.1 ± 0.95 D MSICS versus 0.77 ± 0.65 D phacoemulsification); Venkatesh 2010 (mean SIA 1.20 ± 0.36 D MSICS versus 0.8 ± 0.24 D phacoemulsification) and Cook 2012 (median SIA -1.50 D MSICS versus -1.00 D phacoemulsification). At this time point, Gogate 2005a found mean astigmatism was almost equal in the two groups (1.1 D phacoemulsification group versus 1.2 D MSICs group). They also found that 47/185 participants in the phacoemulsification group and 40/187 in the small incision group had no astigmatism at all.

At six months postoperatively, Ruit 2007 did not show any significant difference in keratometric astigmatism between the MSICS group (0.88 D) and the phacoemulsification group (0.70 D) (P = 0.12).

Cost evaluation and surgical time

In Ruit 2007, phacoemulsification cases took 15.5 minutes each on average (cost USD 70 per case), whereas MSICS cases took nine minutes per case on average (cost USD 15 per case). Surgical time was reported in two studies, and was shorter in the MSICS group in both. Singh 2009 reported surgical time was less than six minutes in 11.2% of phacoemulsification and 84.9% of MSICS cases. Venkatesh 2010 reported mean surgical time of 8.8 +/- 3.4 minutes in the MSICS group and 12.2 +/- 4.6 minutes in the phacoemulsification group.

DISCUSSION

Summary of main results

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

We defined a good visual outcome as presenting acuity of 6/12 or better. Presenting acuity was not reported by any trial and we have reported both best-corrected (BCVA) and uncorrected (UCVA) visual acuity. There was some evidence of a better visual outcome regarding UCVA at six weeks in participants in the phacoemulsification group versus the manual small incision cataract surgery (MSICS) group based on the results of three studies (Cook 2012; Gogate 2005a; Venkatesh 2010). However, there was no evidence of any difference in BCVA. Only one trial reported at longer time periods (six months), and found no difference in either corrected or uncorrected acuity.

We defined poor visual outcome as BCVA of less than 6/60. There were a small number of events reported in either group in any

study, so it is uncertain as to whether there are differences between the two groups with respect to poor visual outcome.

The number of complications reported were also low for both techniques. Again this means the review is currently underpowered to detect a difference between the two techniques with respect to these complications. Although most studies did not report postoperative corneal oedema, in the two studies that did there was some evidence that phacoemulsification caused more immediate postoperative oedema than MSICS. Further investigation is required to assess whether this effect is dependent on the setting in which the studies were conducted: for example, levels of cataract severity and degree of surgical experience may be possible explanations of this effect

No data were reported on quality of life. The cost of phacoemulsification was more than four times greater per case than MSICS (Ruit 2007).

Overall completeness and applicability of evidence

The outcomes reported by the included studies differed widely, making it difficult to collate evidence from all studies. Any conclusions must therefore be treated with caution due to the small numbers involved. The majority of studies were performed in India and Nepal in high output surgical units, and thus these results can not easily be applied to other settings, such as in developed countries. The one study carried out in South Africa concluded that the outcomes of phacoemulsification were better for UCVA, BCVA and astigmatism. However, this study involved 15 surgeons of varying experience, so the results may reflect surgical expertise rather than surgical technique.

We considered quite a number of secondary outcomes, and it is possible that some significant findings might have arisen due to chance. As the number of events was low we did not observe many statistically significant findings and we think it unlikely that the overall conclusions of the review are based on chance findings.

Quality of the evidence

Overall we graded the quality of the evidence as low or very low. All studies included were randomised controlled trials (RCTs). However, the level of evidence for many outcomes was downgraded due to lack of data reported in assessing risk of bias, imprecision (wide confidence intervals) and inconsistency (for example, if only one study reported the outcome and consistency could therefore not be assessed). The main risk of bias was a lack of reporting of the cause of incomplete outcome data in many studies. Also, most of the studies had a short follow-up period with the longest follow-up time of six months only reported in one study. Therefore more data regarding long-term visual outcomes are needed to draw conclusions about the two surgical techniques.

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Potential biases in the review process

We did not identify any obvious biases in the review process, although we did not have enough included studies (10 or more) to assess publication bias.

Agreements and disagreements with other studies or reviews

This review agrees with a recently published meta-analysis of six RCTs (Zhang 2013). Phacoemulsification was associated with improved uncorrected visual acuity compared to MSCIS, but both procedures resulted in similar best-corrected visual acuity.
A study comparing the cost of the two procedures (Muralikrishnan 2004) found MSICS to cost on average USD 17.03 per case, whereas phacoemulsification cost USD 25.55 per case. This study supports the finding that MSICS is less costly; however, their analyses included costs such as equipment, utilities, labour and materials in a very high volume setting, so the conclusions drawn are not directly comparable to the Ruit 2007 study.

AUTHORS' CONCLUSIONS

Implications for practice

On the basis of eight RCTs included in this review the only significant difference found was in UCVA at three months which favoured phacoemulsification, but there were no differences in BCVA at three months or in either outcome at six months. There was no difference found in poor visual outcomes and complications between these two techniques for cataract surgery. However, due to a lack of available data the review is currently underpowered to detect differences for rarer complications. The major advantage of MSICS over phacoemulsification was the lower cost of this technique .

Implications for research

To be able to draw more comprehensive conclusions, more studies comparing MSICS and phacoemulsification are required. These need to have standardised reporting of outcomes enabling data from different studies to be pooled. 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 visual acuity 6/12 or better and best corrected visual acuity worse than 6/60) should be reported as a minimum. However, as this review suggests that there may not be big differences in terms of visual outcome between these two interventions, future trials should collect information on vision-related quality of life and cost utility. 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

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Cook 2012

Methods	Parallel group randomised controlled trial 200 participants (200 eyes) randomised Follow-up: eight weeks
Participants	Age-related cataract in participants over 50 years **Exclusion criteria:** 1. People with early cataract (visual acuity better than 6/36) 2. People with coexistent glaucoma 3. People with corneal scar **Demographics:** M:F phacoemulsification 39:61; MSICS 33:67 Mean age: phacoemulsification 66.9 years, MSICS 68.8 years Black, coloured and white participants **Setting:** Groote Schuur Hospital, University of Cape Town, South Africa
Interventions	MSICS n = 100; phacoemulsification n = 100
Outcomes	1. UCVA at day 1 and week 8 2. BCVA at week 8 3. Refraction 4. Intraoperative and postoperative complication
Notes	Published data only Date conducted: not reported Funding sources: "Nil" Declarations of interest among the primary researchers: "Nil"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation to the two arms of the study was done using opaque sequentially numbered envelopes. The randomisation sequence allocation was generated by a research assistant who randomly selected and numbered sequential envelopes containing an instruction on the type of surgery to be done"
Allocation concealment (selection bias)	Low risk	"The envelopes were kept in the operating room, and the next numbered envelope was opened by the surgeon immediately prior

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		to the surgery"
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"The patients were not informed about the method of surgery that was used"
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The ophthalmic assistants and nurses who tested and recorded the post operative visual acuities were also masked to the surgery that was done"
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	80 participants in the phacoemulsification group, 85 participants in the MSICS group completed 8-week follow-up. "Eighteen per cent of our patients were lost to follow-up at eight weeks. Our patients are indigent people living both within the Cape Town Metropole and in more distant rural areas, and this loss to follow-up is difficult to control"
Selective reporting (reporting bias)	Low risk	None obvious.

George 2005

Methods	Parallel group randomised controlled trial 124 participants (124 eyes) randomised by computer-generated random numbers Follow-up: six weeks
Participants	Primary diagnosis of nuclear sclerosis grade III or less **Exclusion criteria:** 1. Persons with other potential causes of decreased vision 2. Non-age-related cataracts 3. Cataract associated with glaucoma or retinal pathology 4. Phacodenesis **Demographics:** Gender M:F ratio 24:29 for MSICS, 27:33 for phacoemulsification groups. Mean age 58. 75 years for MSICs and 59.63 for phacoemulsification groups (no significant difference in the age or gender of all three groups) **Study setting:** Community ophthalmic care centre of a tertiary care eye hospital, Tamil Nadu, India
Interventions	MSICS n = 62; phacoemulsification n = 62 (ECCE group n = 62, not included in this review)
Outcomes	1. Mean endothelial cell loss 2. Cell density recorded as no of cells per square millimetre and as a percentage reduction 3. Mean surgically induced astigmatism (dioptres)

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	4. Mean prescribed cylindrical correction (dioptres) 5. Postoperative BCVA < 6/18 Participants were reviewed preoperatively, at one day, one week and six weeks postoperatively. Only results from the preoperative and six weeks postoperative visits were reported At six weeks all participants had visual acuity measured, refraction, slit lamp examination, keratometry, applanation tonometry, specular microscopy and dilated fundus examination The six-week follow-up was completed on 52/62 cases in the ECCE group, 53/62 cases in the MSICS group and 60/62 cases in the phacoemulsification group No subgroup analyses were performed.
Notes	Published data only Date conducted: not reported Funding sources: none specified Declarations of interest among the primary researchers: not mentioned

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) "Cases were separately randomized for each surgeon so that equal numbers of each technique were performed by each surgeon". (Page 294)
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Study does not document whether participants were aware/ informed of which intervention they were assigned to
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	"Independent observers performed refraction and keratometry in order to minimize bias". (Page 295) No mention of masking of outcome assessment
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The six-week follow-up was completed by 53/62 cases of MSICS and 60/62 cases of phacoemulsification The reasons for attrition were not stated

George 2005 (*Continued*)

Selective reporting (reporting bias)	Unclear risk	Primary outcomes implicit but neither outcomes or protocol clearly stated

Ghosh 2010

Methods	Parallel group randomised controlled trial 224 participants (224 eyes) randomised. "In each patient, the eye with more advanced cataract was included as study eye" (Page 103) Follow-up: six months
Participants	**Inclusion criteria:** Age 50 - 75 with age-related cataract **Exclusion criteria:** Fasting plasma glucose more than 126 mg/dl Any treatment history of diabetes History of previous eye surgery Present or past history of uveitis Ocular disease other than cataract History of significant eye trauma Axial length more than 26.5 mm People with 3+ or more flare (Standardization of Uveitis Nomenclature Working Group) on the 1st postoperative day were also excluded from study **Demographics:** Mean age: 62 +/- 6 SD years MSICS group; 61 +/- 6 SD Phacoemulsification group Males: 125 participants (55.8%) **Study setting:** Tertiary care hospital, Kolkata, West Bengal, India
Interventions	MSICS n = 112; phacoemulsification n = 112
Outcomes	1. BCVA 2. Mean macular thickness
Notes	Published data only Date conducted: April 2007 to April 2008 Funding sources: none specified Declarations of interest among the primary researchers: not mentioned

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Each patient was allocated to either MSICS or phacoemulsification group by drawing ballots from a sealed envelope". (Page 103)

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Ghosh 2010   *(Continued)*

Allocation concealment (selection bias)	Low risk	"Allocation to each surgeon was also performed during drawing of ballots, the two procedures being equally distributed among two surgeons (PNB, SG)". (Page 103)
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"The participating surgeons were not involved with the allocation procedure and were masked concerning the method of surgery until the patients were prepared on the table. The patients were masked to the allocation code until surgery was performed". (Page 103)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Details not stated in paper
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	"All patients completed the 1st-day and the 7th-day follow-up. In phacoemulsification group, 97 patients came for the 42nd-day follow-up and 94 patients completed the 180th-day follow-up. In MSICS group, 100 patients completed the 42nd-day follow-up and 99 came for the 180th-day follow-up". (Page 103) Reason for attrition not stated.
Selective reporting (reporting bias)	High risk	"Five patients in MSICS group (corneal oedema 1, iridodialysis 1, posterior capsular rupture 1, sulcus fixation IOL 1, 3+ flare 1) and nine patients in phacoemulsification group (corneal oedema 4, posterior capsular rupture 4, 3+ flare 1) were further excluded from the study because of various preoperative and postoperative complications necessitating alteration in management protocol". (Page 103) "The macular thickness of the five cases that were excluded for corneal oedema was evaluated on the 42nd and the 180th day after clearance of oedema. When these values along with the values of two patients with 3+ flare and five patients with capsular rupture were included in the analysis, the difference in CSMT between the two groups was still statistically significant". (Page 104)

Gogate 2005a *(Continued)*

Methods	Parallel group randomised controlled trial 400 participants (400 eyes) randomised Follow-up: six weeks	
Participants	Primary diagnosis: age-related cataract **Inclusion criteria**: Resident in region, willing and able to attend regular follow-up for one year **Exclusion criteria**: Combined surgical procedure Other causes of compromised vision (e.g. amblyopia, glaucoma, diabetic retinopathy, age-related macular degeneration) Axial length > 26.5 mm Age < 40 or > 90 Age/mobility would hinder follow-up Could not give informed consent **Demographics**: age 40 - 90, average age 68.1 phacoemulsification, and 60.7 for MSICs **Study setting:** HV Desai Eye hospital, Pune, India	
Interventions	MSICS n = 201; phacoemulsification n = 199	
Outcomes	Relevant outcomes: 1. VA at one week and six weeks 2. Intraoperative and postoperative complications 3. Final astigmatism at six weeks postoperative Adverse events: two phacoemulsification converted to MSICs Intervals of outcomes: one and six weeks Number of participants included in analysis: Phacoemulsification at one week follow-up = 192, at six weeks follow-up = 185 MSICs at one week follow-up = 191, at six weeks follow-up = 187	
Notes	Published data only Date conducted: July 2002 to December 2003. Funding sources: HV Desai hospital and Lakhani Trust Declarations of interest among the primary researchers: not mentioned	

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Allocation of participants: "Each patient was randomly allocated to 1 of the 2 groups by drawing ballots (from sealed envelopes) at the beginning of surgery, after the patient was placed on the operating table". (Page 870)

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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. The participating surgeons were not involved in the care of or the opening of the envelopes and were informed of the treatment assignment in the operating room immediately before surgery. The trial statistician who generated the allocation schedule in Hyderabad was not involved in the execution of the assignment. The trial manager opened the envelope in Pune and was not involved in the generation of the allocation schedule." (Page 870)
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"The patients were masked before, during, and after (during the follow-up) the surgical intervention regarding the surgical technique. The patients and the ophthalmologists in charge of the follow-up outcome assessment were masked to the treatment allocation code.". (Page 870)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	"The patients and the ophthalmologists in charge of the follow-up outcome assessment were masked to the treatment allocation code. However, the ophthalmologist examining the patient on follow-up would be able to determine the type of surgery". (Page 870)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No reasons for attrition were reported. 185/199 completed follow-up in the phacoemulsification group and 187/201 completed follow-up in the MSICs group
Selective reporting (reporting bias)	Unclear risk	None obvious.

Gogate 2010

Methods	Parallel group randomised controlled trial 200 participants randomised: it is most likely that one eye per person was enrolled in the trial; it was unclear how this eye may have been selected Follow-up: six weeks
Participants	Primary diagnosis: age-related cataract **Inclusion criteria**: Mature cataract

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	Cataract up to grade 4 hardness **Exclusion criteria**: Ocular comorbidity e.g. acute infection, severe inflammation, pre-existing corneal opacity, black cataract, non-age-related or complicated cataract, glaucoma, pseudoexfoliation, retinal pathology Pre-operative endothelial cell count < 2000 cells/mm2 Unable to consent **Demographics**: Gender 47.5% male, mean age 63.7 years for phacoemulsification and 62.7 for MSICs **Study setting:** Tertiary care centre, India
Interventions	MSICS n = 100; phacoemulsification n = 100
Outcomes	1. Endothelial cell count - Preoperatively, one week, and six weeks postoperatively 2. Difference in ECCE over time 3. Corrected distance VA at one and six weeks 4. Intra- and postoperative complications up to six weeks 5. Postoperative astigmatism Number of participants included in the analysis: at one week, phacoemulsification 92/100, MSICs 94/100. at six weeks phacoemulsification 71/100, MSICs 75/100 Adverse events were reported for both groups
Notes	Published data only Date conducted: not reported Funding sources: none specified Declarations of interest among the primary researchers: "no author has a financial or proprietary interest in any material or method mentioned" No correspondence with authors

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Ballots drawn from sealed envelopes at beginning of surgery used to randomly allocate each patient to phacoemulsification or SICS. There were 50 ballots for each of 4 surgeons; 25 ballots were for SICS and 25 for phacoemulsification. The randomization (allocation) schedule for each surgeon was generated using the EpiTable application (Epi Info, Centers for disease control) at the International Centre for Advancement and Rural Eye Care, L.V. Prasad Eye Institute, Hyderabad, India." (Page 248)

Gogate 2010 *(Continued)*

Allocation concealment (selection bias)	Low risk	"The allocation codes were sealed in sequentially numbered, opaque envelopes and kept by the study coordinator. The envelopes were opened 10 minutes before surgery. The participating surgeons were not involved in the care or opening the envelopes. If the surgeons performed a different technique or converted from phacoemulsification to SICS, the patients were analyzed on an intent to treat basis". (Page 248)
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"To minimize bias, patients were masked to the type of surgery". (Page 248)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	"Health workers interviewing patients were also unaware of the type of surgery the patients were to have. Surgeons were masked to the technique until 10 minutes before surgery. Optometrists and ophthalmologists examining the patient postoperatively were not masked to the type of surgery. A different set of ophthalmologists performed the postoperative follow-up and refractions". Page 248
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No explanation is given of why the attrition rate was relatively high "However, patients whose data were not available (lost to follow-up, data lost) did not differ from those whose data were available in preoperative variables (age, sex, preoperative acuity, cataract type, operating surgeon), intraoperative variables (type of surgery, surgery time, complications), or 1-week follow-up outcome measures". (Page 251) Missing data balanced in numbers across intervention groups. 71/100 participants analysed for phacoemulsification group and 75/100 analysed for MSICs group
Selective reporting (reporting bias)	Unclear risk	None obvious

Ruit 2007

Methods	Parallel group randomised controlled trial 108 participants randomised: it is most likely that one eye per person was enrolled in the trial; it was unclear how this eye may have been selected Follow-up: six months
Participants	Primary diagnosis: decreased visual acuity due to cataract **Exclusion criteria:** Other ocular disease **Demographics:** Median age 65.8 years (phacoemulsification) 63.8 years (MSICS) **Study setting:** Outreach microsurgical eye clinic, Nepal
Interventions	MSICS n = 54; phacoemulsification n = 54
Outcomes	Outcomes: 1. Operation time 2. Surgical complications intraoperatively and postoperatively 3. UCVA and BCVA 4. Astigmatism 5. Central corneal thickness and keratometry 6. Cost of equipment and consumables Intervals at which outcomes assessed: Postoperative days one and five, three and six weeks, three and six months Adverse events were reported for each intervention Number of participants included in analysis: 100% follow-up for each intervention at day one postoperatively phacoemulsification 86%; MSICs 85% follow-up at six months
Notes	Published data only Date conducted: May 2005 Funding sources: none specified Declarations of interest among the primary researchers: "The authors indicate no source of funding or financial conflict of interest" No correspondence with investigators

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Patients who were cleared for cataract surgery were assigned randomly by picking a ball from a bag that contained one white ball and one black ball. A white ball assigned the patient to phacoemulsification with a foldable IOL, which was performed by one of the authors (D.C.), who is a clinical professor at the University of California, San Francisco. A black ball assigned the pa-

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Ruit 2007 *(Continued)*

		tient to sutureless manual SICS, which was performed by another author (S.R.), director of the Tilganga Eye Center in Nepal. After each random assignment, the following patient was assigned automatically to the alter- native procedure". (Page 33)
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Surgeons were not masked since each surgeon performed a different technique Not mentioned if participants were masked
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"All postoperative visual acuities and refractions were obtained by ophthalmic assistants who were masked to the treatment group and had not been involved in the pre-operative portion of the study." (Page 34)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Cause of attrition rate not known: "Because of the nature of the outreach cataract screening process and the poor and remote setting where most patients reside, we were unable to determine the reasons that eight patients in the manual SICS group and six patients in the phacoemulsification group were lost to follow-up". (Page 35). 48/54 patients analysed for phacoemulsification group and 46/54 analysed for MSICS group
Selective reporting (reporting bias)	Unclear risk	None obvious

Singh 2009

Methods	Parallel group randomised controlled trial 182 participants randomised: it is most likely that one eye per person was enrolled in the trial; it was unclear how this eye may have been selected Follow-up: immediate postoperative (before discharge) only
Participants	**Inclusions criteria:** People with immature senile cataracts (defined as nucleus sclerosis up to 2+, cortical cataract 2+ and posterior sub-capsular cataract of any grade) **Exclusion criteria:** All other types of cataracts were excluded. **Demographics:** Mean age 58.2 years (phacoemulsification), 58.7 years (MSICS) **Study setting:**

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Singh 2009 *(Continued)*

	Biratnagar Eye Hospital, Nepal
Interventions	MSICS n = 89; phacoemulsification n = 93
Outcomes	1. Postoperative uncorrected visual acuity on the first postoperative day 2. Surgery-induced astigmatism 3. Intraoperative and postoperative complications 4. Surgical time
Notes	Published data only Date conducted: May 2007 to June 2007 Funding sources: none Declarations of interest among the primary researchers: "none"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomization was done with the help of random number tables". (Page 96)
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Not reported
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"However, the visual acuity recording person was not aware of the study and masking could be achieved". (Page 96)
Incomplete outcome data (attrition bias) All outcomes	Low risk	There is no indication in the paper that any participant did not complete the follow-up period (one day)
Selective reporting (reporting bias)	Low risk	None obvious

Venkatesh 2010

Methods	Parallel group randomised controlled trial 270 participants randomised: it is most likely that one eye per person was enrolled in the trial; it was unclear how this eye may have been selected Follow-up: six weeks
Participants	**Inclusion criteria:** Participants between 35 years and 70 years of age with white cataract that obscured fundus visualisation and whose pupils dilated to at least 5.0 mm **Exclusion criteria:**

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Venkatesh 2010 (*Continued*)

	Subluxated cataracts and cataracts clearly caused by trauma Additional exclusion criteria Coexisting glaucoma Corneal pathology Uveitis Poor pupil dilation (!5.0 mm) Other known pathology that could impair visual potential People that were unable to attend the follow-up visits or give informed consent **Demographics:** M:F phacoemulsification group 57:76; 51:86 MSICS group Mean age: 56 +/- 9.3 years phacoemulsification group; 56.6 +/- 9.5 years MSICS group **Setting:** Aravind Eye Hospital, Pondicherry, India
Interventions	MSICS n = 137; phacoemulsification n = 133
Outcomes	1. Rate of intraoperative and postoperative complications 2. BCVA 3. Corneal astigmatism 6 weeks postoperatively 4. Surgical time
Notes	Published data only Date conducted: September 2007 to April 2008 Funding sources: none specified Declarations of interest among the primary researchers: "no author has a financial or proprietary interest in any material or method mentioned"

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The randomization (allocation) schedule was generated by a DOS-based software program at Lions Aravind Institute for Community Ophthalmology". (Page 1850)
Allocation concealment (selection bias)	Low risk	"The allocation codes were sealed in opaque numbered envelopes that were opened by the operating room staff". (Page 1850)
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"Patients were not informed about the method of surgery to which they were assigned". (Page 1850)
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The evaluating independent investigator (an ophthalmologist who was not a study surgeon) and the examining refractionist

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Venkatesh 2010   *(Continued)*

		who assessed uncorrected (UDVA) and corrected (CDVA) distance visual acuities were also masked to the identity of the operating surgeon and the method of surgery". (Page 1850)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	"Two hundred thirty of 270 patients (85. 2%) completed the 6-week follow-up". (Page 1851). No explanation given for attrition rate
Selective reporting (reporting bias)	Low risk	None obvious

BCVA: best-corrected visual acuity
ECCE: extracapsular extraction
MSICS: manual small incision cataract surgery
UCVA: uncorrected visual acuity
VA: visual acuity

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

Study	Reason for exclusion
Cai 2008	Participants were not randomised to interventions
Centurion 1999	All participants underwent phacoemulsification
Centurion 2005	Retrospective study
Chanis 1993	No direct comparison
Elkady 2009	The study reported on microincision cataract surgery (MICS) versus microcoaxial phacoemulsification
Goel 2012	Cataract surgery with implantation of endocapsular supporting devices
Parmar 2006	This was a study of per-operative contamination of the anterior chamber
Reddy 2007	Non-standard interventions were used

DATA AND ANALYSES

Comparison 1. MSICS versus phacoemulsification

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Good functional vision at 3 months (uncorrected acuity)	3	767	Risk Ratio (M-H, Random, 95% CI)	0.90 [0.84, 0.96]
2 Good functional vision at 12 months (uncorrected acuity)			Other data	No numeric data
3 Good functional vision at 3 months (best-corrected acuity)	6	1223	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.98, 1.01]
4 Good functional vision at 12 months (best-corrected acuity)			Other data	No numeric data
5 Poor visual outcome at 3 months (best-corrected acuity worse than 6/60)	6	1223	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.48 [0.74, 8.28]
6 Poor visual outcome at 12 months (best-corrected acuity worse than 6/60)			Other data	No numeric data
7 Posterior capsular rupture	8	1708	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.07 [0.63, 1.83]
8 Iridodialysis	5	1114	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.37 [0.54, 10.45]
9 Capsulorhesis extended	3	708	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.26 [0.05, 1.30]
10 Postoperative inflammation	3	732	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.19 [0.36, 3.93]
11 Corneal oedema postoperatively	6	1476	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.58 [0.41, 0.83]
12 Corneal oedema 3 to 6 weeks	4		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
13 Posterior capsule opacification	2		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
14 Endothelial cell loss	2		Mean Difference (IV, Fixed, 95% CI)	Totals not selected

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

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

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

Study or subgroup	MSICS n/N	Phacoemulsification n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
Cook 2012 (1)	63/85	69/80		21.1 %	0.86 [0.74, 1.00]
Gogate 2005a (2)	133/187	150/185		37.6 %	0.88 [0.78, 0.98]
Venkatesh 2010 (3)	96/117	99/113		41.3 %	0.94 [0.84, 1.04]
Total (95% CI)	**389**	**378**		**100.0 %**	**0.90 [0.84, 0.96]**

Total events: 292 (MSICS), 318 (Phacoemulsification)
Heterogeneity: Tau² = 0.0; Chi² = 1.07, df = 2 (P = 0.58); I² =0.0%
Test for overall effect: Z = 3.02 (P = 0.0026)
Test for subgroup differences: Not applicable

0.1 0.2 0.5 1 2 5 10
Favours phaco   Favours MSICS
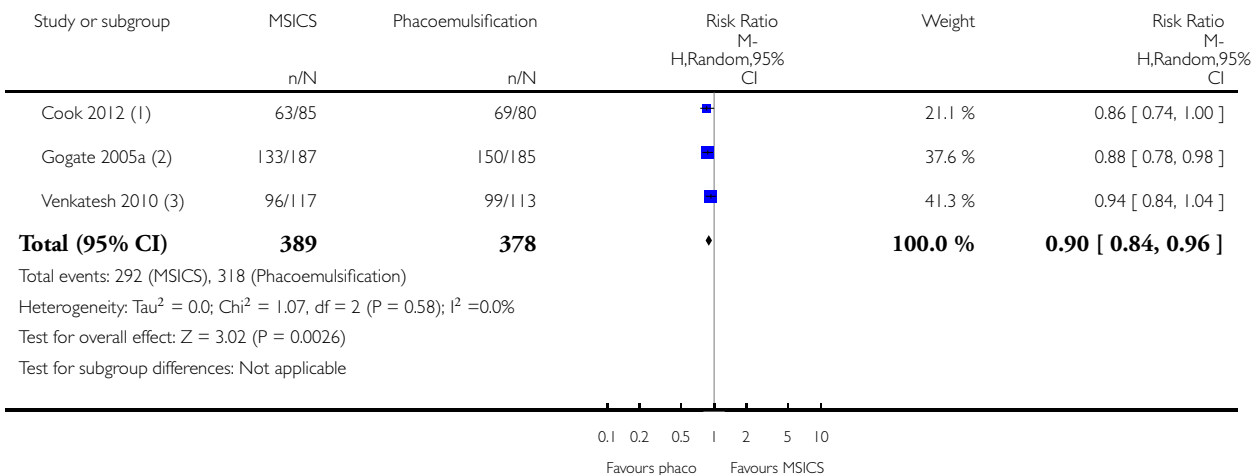
(1) 6/18 or better, 8 weeks follow-up

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

(3) 6/18 or better, 6 weeks follow-up

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

Good functional vision at 12 months (uncorrected acuity)

Study	
Ruit 2007	At 6 months: MSICS: 41/46 Phacoemulsification: 40/48 Risk ratio: 1.07 (95% CI 0.91 to 1.26)

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Analysis 1.3.   Comparison 1 MSICS versus phacoemulsification, Outcome 3 Good functional vision at 3 months (best-corrected acuity).

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

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

Study or subgroup	MSICS n/N	Phacoemulsification n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
Cook 2012 (1)	73/85	75/80		2.1 %	0.92 [0.83, 1.02]
George 2005 (2)	52/53	60/60		8.1 %	0.98 [0.93, 1.03]
Ghosh 2010 (3)	100/100	97/97		35.8 %	1.00 [0.98, 1.02]
Gogate 2005a (4)	184/187	182/185		24.6 %	1.00 [0.97, 1.03]
Gogate 2010 (5)	73/75	70/71		9.3 %	0.99 [0.94, 1.03]
Venkatesh 2010 (6)	115/117	112/113		20.2 %	0.99 [0.96, 1.02]
Total (95% CI)	**617**	**606**		**100.0 %**	**0.99 [0.98, 1.01]**

Total events: 597 (MSICS), 596 (Phacoemulsification)

Heterogeneity: Tau² = 0.00; Chi² = 6.06, df = 5 (P = 0.30); I² =17%

Test for overall effect: Z = 0.82 (P = 0.41)

Test for subgroup differences: Not applicable

```
     0.1  0.2  0.5   1    2    5   10
      Favours phaco      Favours MSICS
```
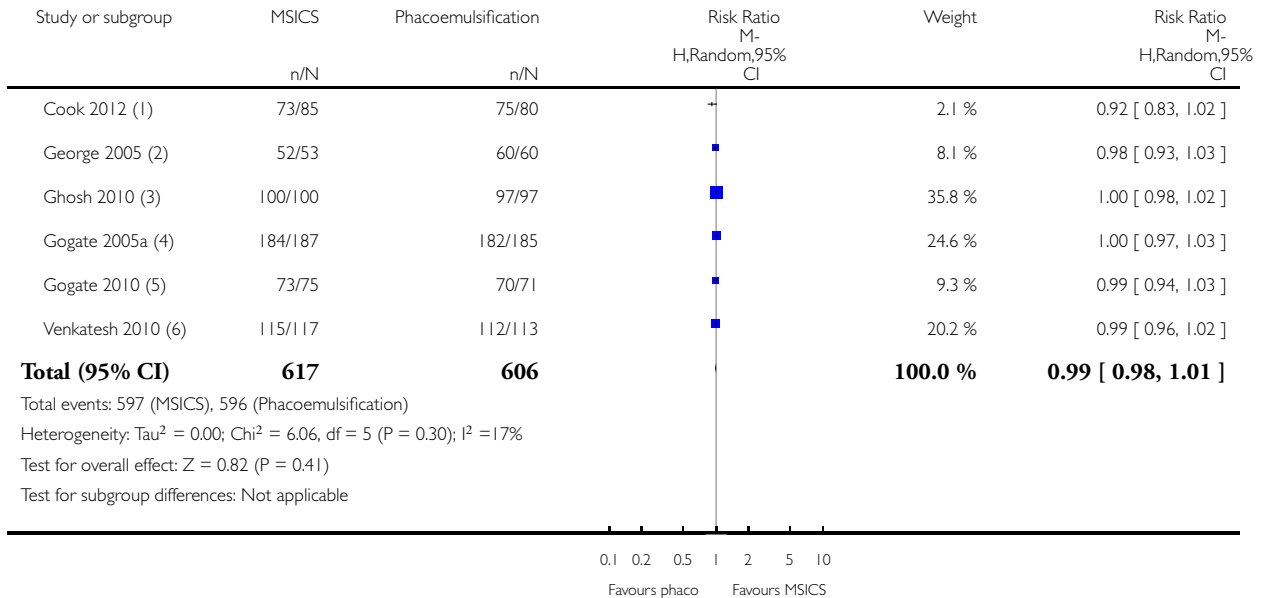
(1) 6/18 or better, 8 weeks follow-up
(2) better than 6/18, 6 weeks follow-up
(3) 6/12 or better, 6 weeks follow-up
(4) 6/18 or better, 6 weeks follow-up
(5) 6/18 or better, 6 weeks follow-up
(6) 6/18 or better, 6 weeks follow-up

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

Good functional vision at 12 months (best-corrected acuity)

Study	
Ruit 2007	At 6 months: MSICS: 45/46 Phacoemulsification: 47/48 Risk ratio: 1.0 (95% CI 0.94 to 1.06)

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Analysis 1.5. Comparison 1 MSICS versus phacoemulsification, Outcome 5 Poor visual outcome at 3 months (best-corrected acuity worse than 6/60).

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

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

Study or subgroup	MSICS n/N	Phacoemulsification n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
Cook 2012 (1)	7/85	2/80		81.1 %	3.02 [0.79, 11.54]
George 2005 (2)	1/53	0/60		9.4 %	8.43 [0.17, 428.18]
Ghosh 2010 (3)	0/100	0/97			Not estimable
Gogate 2005a (4)	0/187	1/185		9.5 %	0.13 [0.00, 6.75]
Gogate 2010 (5)	0/75	0/71			Not estimable
Venkatesh 2010 (6)	0/117	0/113			Not estimable
Total (95% CI)	**617**	**606**		**100.0 %**	**2.48 [0.74, 8.28]**

Total events: 8 (MSICS), 3 (Phacoemulsification)

Heterogeneity: Chi² = 2.59, df = 2 (P = 0.27); I² =23%

Test for overall effect: Z = 1.47 (P = 0.14)

Test for subgroup differences: Not applicable

```
        0.01   0.1    1    10   100
        Favours MSICS      Favours phacoe
```
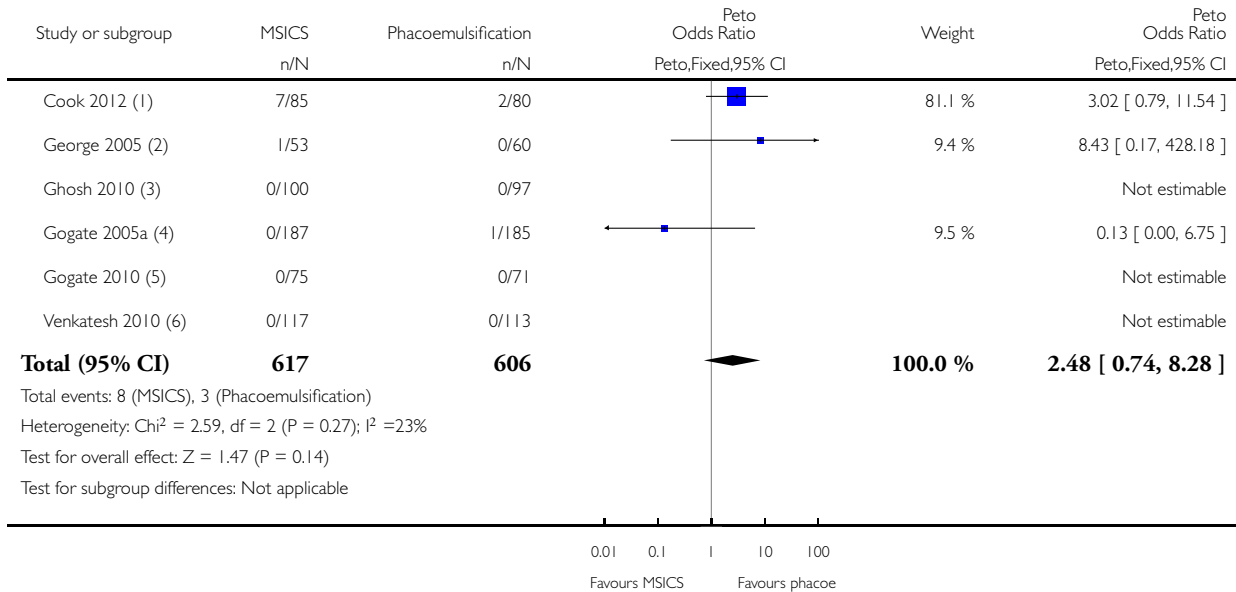
(1) worse than 6/60, 8 weeks follow-up

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

(3) all patients achieved BCVA 6/12 or better, 6 weeks follow-up

(4) worse than 6/60, 6 weeks follow-up

(5) worse than 6/60, 6 weeks follow-up

(6) Follow-up: 6 weeks

Analysis 1.6. Comparison 1 MSICS versus phacoemulsification, Outcome 6 Poor visual outcome at 12 months (best-corrected acuity worse than 6/60).

Poor visual outcome at 12 months (best-corrected acuity worse than 6/60)

Study	
Ruit 2007	At six months: BCVA < 6/18 1.9% participants in both groups

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Analysis 1.7. Comparison 1 MSICS versus phacoemulsification, Outcome 7 Posterior capsular rupture.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

Outcome: 7 Posterior capsular rupture

Study or subgroup	MSICS n/N	Phacoemulsification n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
Cook 2012	10/100	4/100		24.4 %	2.50 [0.85, 7.39]
George 2005	0/62	0/62			Not estimable
Ghosh 2010	1/112	4/112		9.2 %	0.29 [0.05, 1.73]
Gogate 2005a	12/201	7/199		33.8 %	1.72 [0.68, 4.31]
Gogate 2010	4/100	6/100		17.8 %	0.66 [0.18, 2.34]
Ruit 2007	0/54	1/54		1.9 %	0.14 [0.00, 6.82]
Singh 2009	0/89	2/93		3.7 %	0.14 [0.01, 2.25]
Venkatesh 2010	2/137	3/133		9.2 %	0.65 [0.11, 3.78]
Total (95% CI)	**855**	**853**		**100.0 %**	**1.07 [0.63, 1.83]**

Total events: 29 (MSICS), 27 (Phacoemulsification)
Heterogeneity: Chi² = 9.42, df = 6 (P = 0.15); I² =36%
Test for overall effect: Z = 0.26 (P = 0.80)
Test for subgroup differences: Not applicable

```
        0.01   0.1    1    10    100
      Favours MSICS      Favours phaco
```

Analysis 1.8.   Comparison 1 MSICS versus phacoemulsification, Outcome 8 Iridodialysis.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract
Comparison: 1 MSICS versus phacoemulsification
Outcome: 8 Iridodialysis

Study or subgroup	MSICS	Phaco	Peto Odds Ratio	Weight	Peto Odds Ratio
	n/N	n/N	Peto,Fixed,95% CI		Peto,Fixed,95% CI
Ghosh 2010	1/112	0/112		14.3 %	7.39 [0.15, 372.38]
Gogate 2005a	2/201	2/199		57.0 %	0.99 [0.14, 7.08]
Gogate 2010	1/100	0/100		14.3 %	7.39 [0.15, 372.38]
Ruit 2007	0/54	0/54			Not estimable
Singh 2009	1/89	0/93		14.3 %	7.73 [0.15, 389.87]
Total (95% CI)	**556**	**558**		**100.0 %**	**2.37 [0.54, 10.45]**

Total events: 5 (MSICS), 2 (Phaco)

Heterogeneity: Chi^2 = 1.75, df = 3 (P = 0.63); I^2 =0.0%

Test for overall effect: Z = 1.14 (P = 0.26)

Test for subgroup differences: Not applicable

```
        0.01    0.1     1     10    100
        Favours MSICS      Favours phaco
```

Analysis 1.9.   Comparison I MSICS versus phacoemulsification, Outcome 9 Capsulorhesis extended.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

Outcome: 9 Capsulorhesis extended

Study or subgroup	MSICS	Phaco	Peto Odds Ratio	Weight	Peto Odds Ratio
	n/N	n/N	Peto,Fixed,95% CI		Peto,Fixed,95% CI
Gogate 2005a	0/201	2/199		33.4 %	0.13 [0.01, 2.14]
Gogate 2010	1/100	2/100		49.8 %	0.51 [0.05, 4.96]
Ruit 2007	0/54	1/54		16.8 %	0.14 [0.00, 6.82]
Total (95% CI)	**355**	**353**		**100.0 %**	**0.26 [0.05, 1.30]**

Total events: 1 (MSICS), 5 (Phaco)

Heterogeneity: Chi^2 = 0.67, df = 2 (P = 0.72); I^2 =0.0%

Test for overall effect: Z = 1.64 (P = 0.10)

Test for subgroup differences: Not applicable

0.01   0.1   1   10   100

Favours MSICS   Favours phaco

Analysis 1.10. Comparison 1 MSICS versus phacoemulsification, Outcome 10 Postoperative inflammation.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

Outcome: 10 Postoperative inflammation

Study or subgroup	MSICS	Phaco	Peto Odds Ratio	Weight	Peto Odds Ratio
	n/N	n/N	Peto,Fixed,95% CI		Peto,Fixed,95% CI
Ghosh 2010	1/112	1/112		18.4 %	1.00 [0.06, 16.09]
Gogate 2005a	5/201	4/199		81.6 %	1.24 [0.33, 4.65]
Ruit 2007	0/54	0/54			Not estimable
Total (95% CI)	**367**	**365**		**100.0 %**	**1.19 [0.36, 3.93]**

Total events: 6 (MSICS), 5 (Phaco)

Heterogeneity: Chi² = 0.02, df = 1 (P = 0.89); I² =0.0%

Test for overall effect: Z = 0.29 (P = 0.77)

Test for subgroup differences: Not applicable

```
        0.01    0.1     1      10     100
        Favours MSICS       Favours phaco
```

Analysis 1.11. Comparison 1 MSICS versus phacoemulsification, Outcome 11 Corneal oedema postoperatively.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

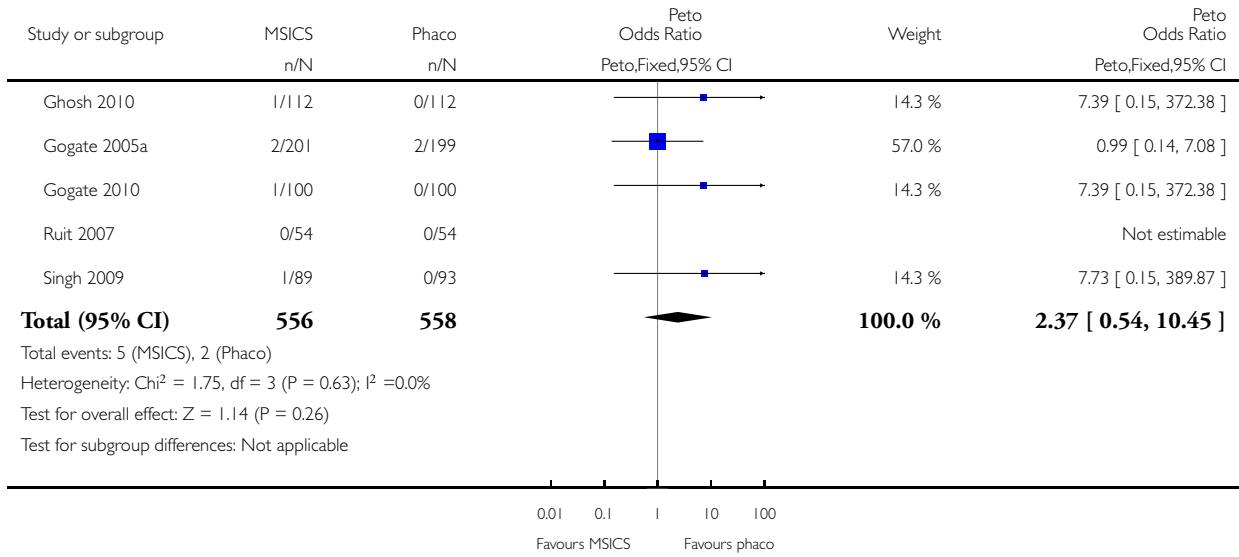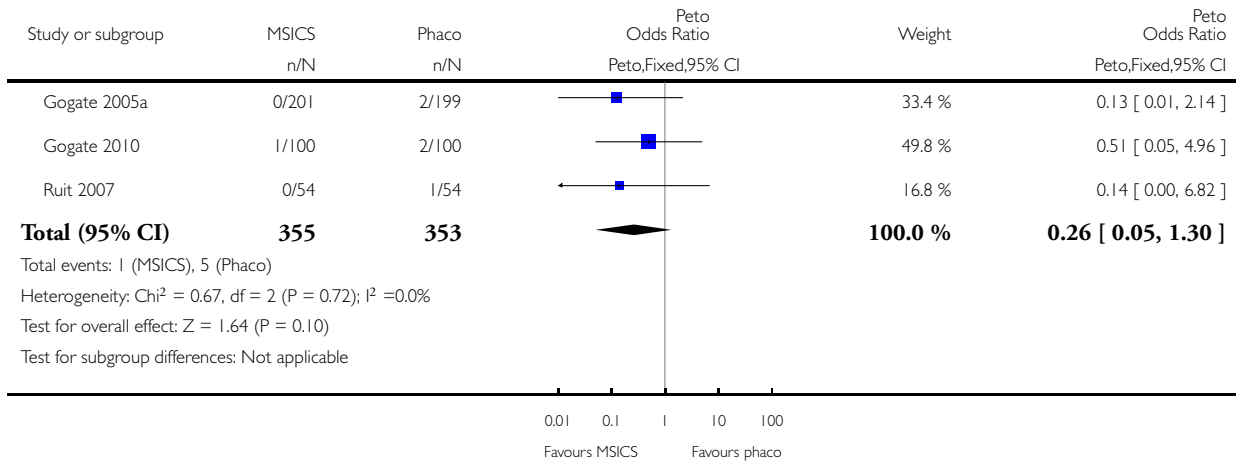Comparison: 1 MSICS versus phacoemulsification

Outcome: 11 Corneal oedema postoperatively
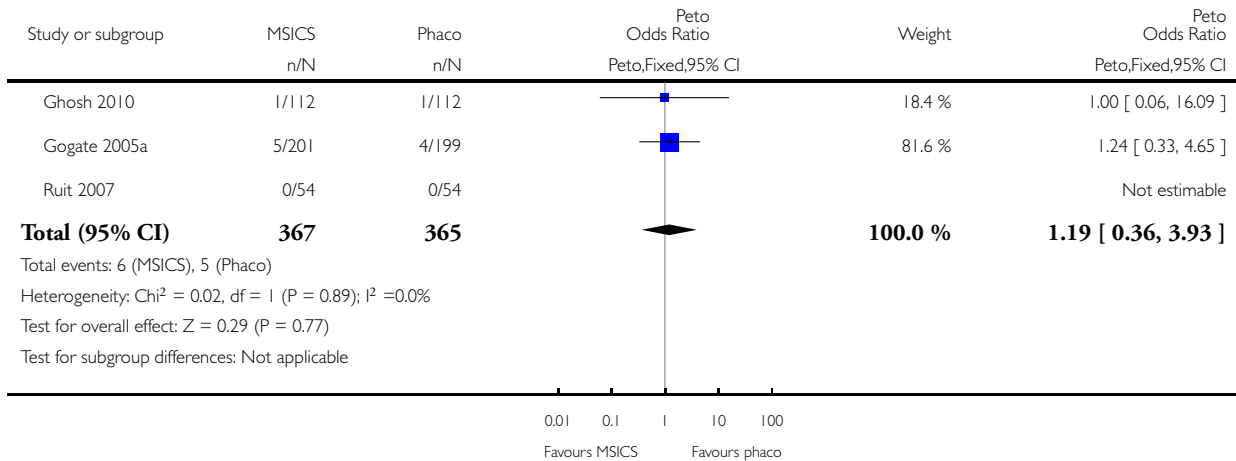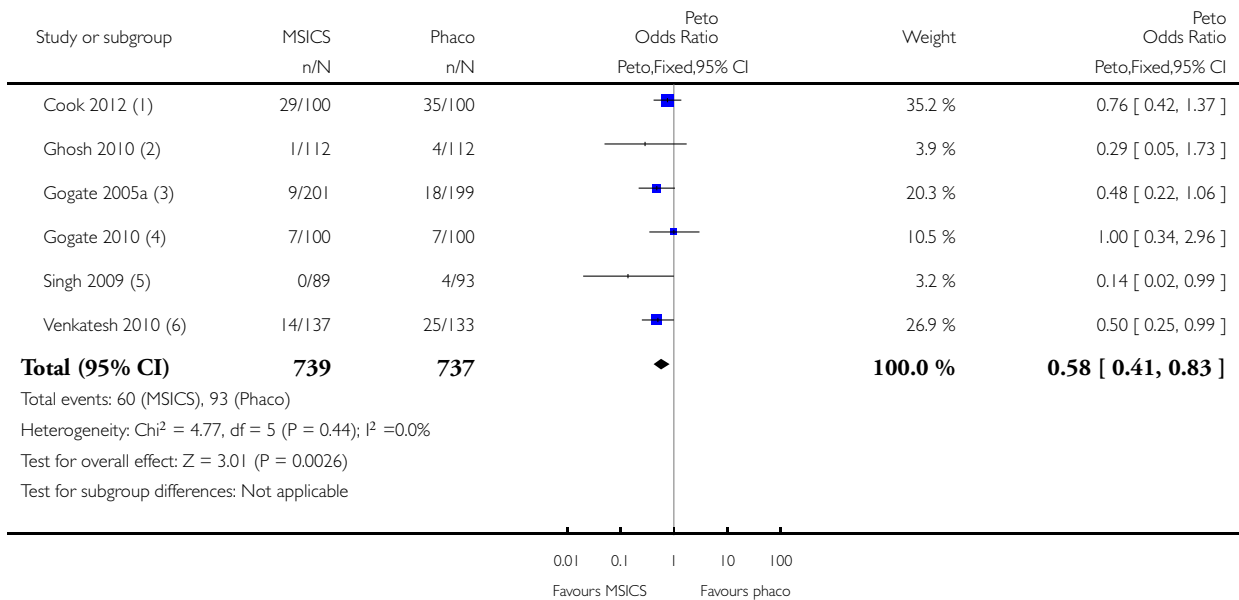
Study or subgroup	MSICS n/N	Phaco n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
Cook 2012 (1)	29/100	35/100		35.2 %	0.76 [0.42, 1.37]
Ghosh 2010 (2)	1/112	4/112		3.9 %	0.29 [0.05, 1.73]
Gogate 2005a (3)	9/201	18/199		20.3 %	0.48 [0.22, 1.06]
Gogate 2010 (4)	7/100	7/100		10.5 %	1.00 [0.34, 2.96]
Singh 2009 (5)	0/89	4/93		3.2 %	0.14 [0.02, 0.99]
Venkatesh 2010 (6)	14/137	25/133		26.9 %	0.50 [0.25, 0.99]
Total (95% CI)	**739**	**737**		**100.0 %**	**0.58 [0.41, 0.83]**

Total events: 60 (MSICS), 93 (Phaco)

Heterogeneity: Chi^2 = 4.77, df = 5 (P = 0.44); I^2 =0.0%

Test for overall effect: Z = 3.01 (P = 0.0026)

Test for subgroup differences: Not applicable

```
        0.01   0.1    1    10    100
        Favours MSICS      Favours phaco
```

(1) Follow-up: first day after surgery, corneal oedema decreasing visual acuity

(2) Follow-up: first day after surgery

(3) Follow-up: first day after surgery

(4) Follow-up: first day after surgery

(5) Follow-up: one week after surgery

(6) Follow-up: first day after surgery, "significant" corneal oedema

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Analysis 1.12. Comparison 1 MSICS versus phacoemulsification, Outcome 12 Corneal oedema 3 to 6 weeks.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

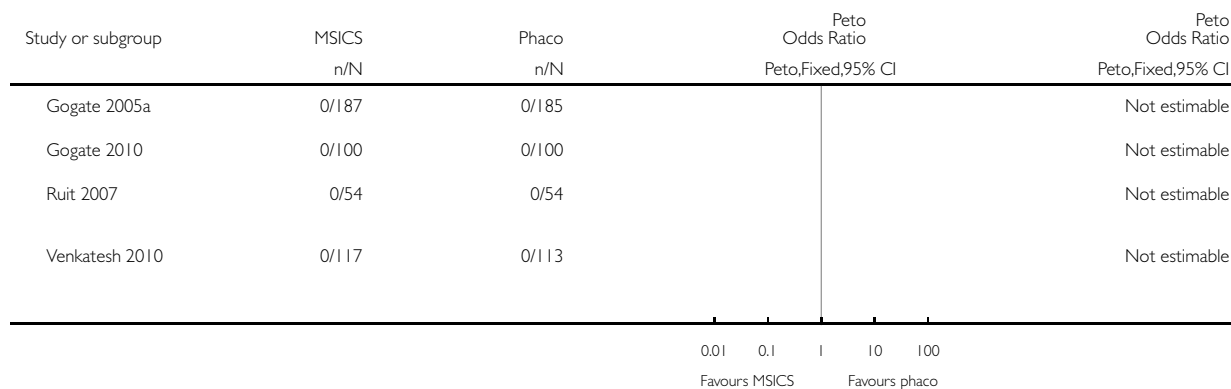Comparison: 1 MSICS versus phacoemulsification

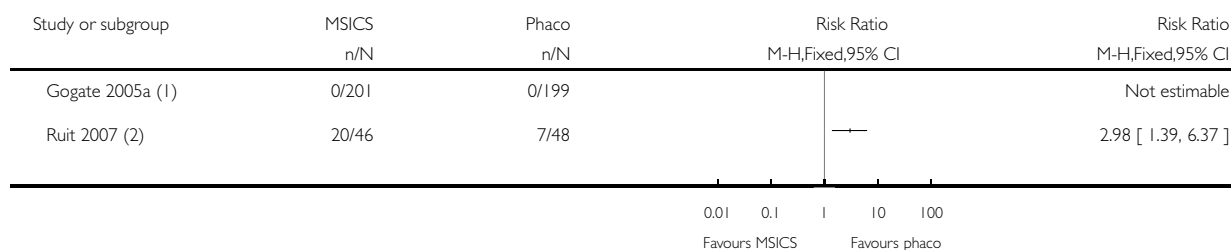Outcome: 12 Corneal oedema 3 to 6 weeks

Study or subgroup	MSICS	Phaco	Peto Odds Ratio	Peto Odds Ratio
	n/N	n/N	Peto,Fixed,95% CI	Peto,Fixed,95% CI
Gogate 2005a	0/187	0/185		Not estimable
Gogate 2010	0/100	0/100		Not estimable
Ruit 2007	0/54	0/54		Not estimable
Venkatesh 2010	0/117	0/113		Not estimable

0.01 0.1 1 10 100

Favours MSICS   Favours phaco

Analysis 1.13. Comparison 1 MSICS versus phacoemulsification, Outcome 13 Posterior capsule opacification.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

Outcome: 13 Posterior capsule opacification

Study or subgroup	MSICS	Phaco	Risk Ratio	Risk Ratio
	n/N	n/N	M-H,Fixed,95% CI	M-H,Fixed,95% CI
Gogate 2005a (1)	0/201	0/199		Not estimable
Ruit 2007 (2)	20/46	7/48		2.98 [1.39, 6.37]

0.01 0.1 1 10 100

Favours MSICS   Favours phaco
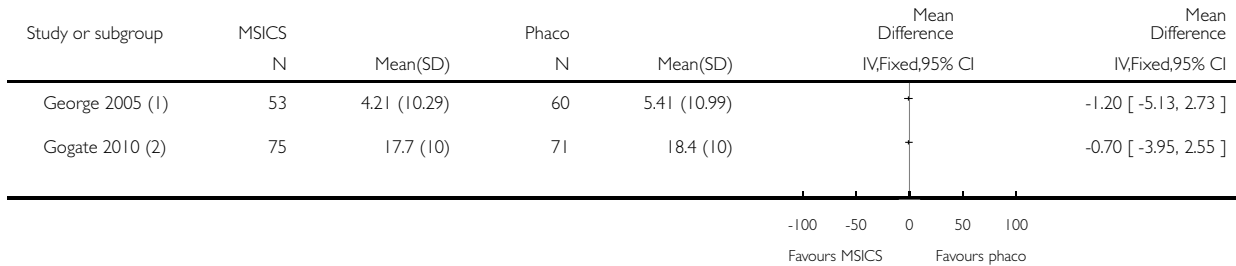
(1) Follow-up: six weeks
(2) Follow-up: six months

Analysis 1.14. Comparison 1 MSICS versus phacoemulsification, Outcome 14 Endothelial cell loss.

Review: Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract

Comparison: 1 MSICS versus phacoemulsification

Outcome: 14 Endothelial cell loss

Study or subgroup	MSICS N	Mean(SD)	Phaco N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
George 2005 (1)	53	4.21 (10.29)	60	5.41 (10.99)		-1.20 [-5.13, 2.73]
Gogate 2010 (2)	75	17.7 (10)	71	18.4 (10)		-0.70 [-3.95, 2.55]

-100 -50 0 50 100

Favours MSICS   Favours phaco

(1) Percentage reduction over 6 weeks
(2) Percentage mean cell loss, SD estimated

ADDITIONAL TABLES

Table 1. Outcome reporting matrix

	George 2005	Gogate 2005	Gogate 2010	Ruit 2007	Singh 2009	Cook 2012	Venkatesh 2011	Ghosh 2010
Review outcomes								
Presenting VA ≥ 6/12	H	✓	H	✓	I	✓	✓	H
BCVA < 6/60	F	✓	✓	F	I	✓	✓	✓
Capsular rupture with or without vitreous loss	✓	✓	✓	✓	✓	✓	✓	✓
Iris prolapse	H	H	H	✓	H	H	H	H
Postoperative inflammation	H	✓	H	✓	✓	H	H	✓

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Table 1. Outcome reporting matrix (*Continued*)

Posterior capsule opacification	H	✓	H	✓	H	H	H	H
Retinal detachment	H	H	H	H	H	H	H	H
Glaucoma	F	H	H	H	H	H	H	H
Cystoid macular oedema	H	H	H	H	H	H	H	✓
Corneal endothelial cell loss	✓	H	✓	H	H	H	H	H
Corneal decompensation	H	H	H	H	H	H	H	H
Quality of life	I	I	I	I	I	I	I	I
Other outcomes (list other outcomes reported)	Astigmatism	Capsulorhexis extended, Iridodialysis, zonule dialysis, Descemet tear, conversion to MSICS, Astigmatism	Capsulorhexis extended, Conversion to MSICS, Iridodialysis, retained cortex, decentred IOL	Capsulorhexis extended, Minor hyphaema, cost effectiveness, Astigmatism	Zonule dialysis, surgical time, Astigmatism	"Other complications", corneal oedema at day 1, median astigmatism	Corneal oedema at day 1 and 6 weeks, astigmatism, surgical time	Macular thickness

✔ Reported and included in review

F: Clear that outcome was measured but not necessarily analysed. Judgment says unlikely to have been analysed but not reported because of non-significant results (low risk of bias)

H: Not mentioned but clinical judgment says unlikely to have been measured at all (low risk of bias)

I: Clear that outcome was not measured (no risk)

For other categories see Kirkham 2010

Manual small incision cataract surgery (MSICS) with posterior chamber intraocular lens versus phacoemulsification with posterior chamber intraocular lens for age-related cataract (Review)

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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 manual near/3 small near/3 incision near/3 cataract*
#13 MISICS or SICS
#14 MeSH descriptor Capsulorhexis explode all trees
#15 continuous near/3 curvilinear near/3 capsulor*hexis
#16 continuous near/3 circular near/3 capsulor*hexis
#17 CCC or CCS
#18 can opener near/5 capsulotom*
#19 endocapsular
#20 (#12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19)
#21 (#7 AND #11 AND #20)

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. (manual adj3 small adj3 incision adj3 cataract$).tw.
25. (MISICS or SICS).tw.

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26. capsulorhexis/
27. (continuous adj3 curvilinear adj3 capsulorhexis).tw.
28. (continuous adj3 circular adj3 capsulorhexis).tw.
29. (continuous adj3 curvilinear adj3 capsulor?hexis).tw.
30. (CCC or CCS).tw.
31. (can opener adj5 capsulotom$).tw.
32. endocapsular.tw.
33. or/24-32
34. 19 and 23 and 33
35. 12 and 34

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 (OvidSP) 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$.tw.
42. (phaco or phako).tw.
43. or/40-42
44. (manual adj3 small adj3 incision adj3 cataract$).tw.
45. (MISICS or SICS).tw.
46. capsulorhexis/
47. (continuous adj3 curvilinear adj3 capsulorhexis).tw.
48. (continuous adj3 circular adj3 capsulorhexis).tw.
49. (continuous adj3 curvilinear adj3 capsulor?hexis).tw.
50. (CCC or CCS).tw.
51. (can opener adj5 capsulotom$).tw.
52. endocapsular.tw.
53. or/45-52
54. 39 and 43 and 53
55. 32 and 54

Appendix 4. LILACS search strategy

cataract$ and phaco$ or phako$ and manual small incis$ or MISICS or SICS or capsulorhexis or capsulorrhexis

Appendix 5. Web of Science CPCI-S search strategy

#17 #3 and #6 and #16
#16 #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15
#15 TS=can opener capsulotom*
#14 TS=(CCC or CCS)
#13 TS=(continuous circular capsulorrhexis)
#12 TS=(continuous circular capsulorhexis)
#11 TS=(continuous curvilinear capsulorrhexis)
#10 TS=(continuous curvilinear capsulorhexis)
#9 TS=capsulorhexis
#8 TS=(MISICS or SICS)
#7 TS=(manual small incision)
#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 manual or MISICS or SICS or capsulorhexis or capsulorrhexis = Intervention

C O N T R I B U T I O N S   O F   A U T H O R S

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:

- Screening search results: YR, JE, SdeS

- Organising retrieval of papers:

- Screening retrieved papers against inclusion criteria: YR, SdeS

- Appraising quality of papers: YR, SdeS, JE

- Extracting data from papers: YR, SdeS, JE

- Writing to authors of papers for additional information: YR

- Providing additional data about papers: SdeS, YR

- Obtaining and screening data on unpublished studies: SdeS, YR

Data management for the review:

- Entering data into Review Manager 5: JE, YR, SdeS

- Checking data entered into Review Manager 5: YR, JE, SdeS

Analysis of data: JE

Interpretation of data:

- Providing a methodological perspective: JE

- Providing a clinical perspective: YR, SdeS

- Providing a policy perspective: YR, SdeS

Writing the review: YR, SdeS, JE

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

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DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- Sightsavers, UK.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Primary outcome "presenting visual acuity 6/12 or better"

No study reported presenting visual acuity so we report both uncorrected and best-corrected acuity. Most studies reported 6/18 or better outcomes and we have used this to indicate 'good functional vision'.

Unit of analysis

The main unit of analysis issue is 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). However, in the event this was not necessary.

Assessment of reporting biases

The main reporting biases that we planned to consider were publication bias and outcome reporting bias. Currently there are not enough trials included in the review to assess publication bias. When there are enough trials (10 or more) we will do a funnel plot to see if small studies report different effects, one explanation for which could be publication bias

Sensitivity analysis

We planned to do a sensitivity analysis excluding trials at high risk of bias and investigating the impact of missing data. However, currently there are not enough data to enable this.

'Summary of findings' tables

This was not specified in the protocol.

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N O T E S

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.

I N D E X   T E R M S

Medical Subject Headings (MeSH)

*Lenses, Intraocular; Age Factors; Cataract Extraction [*methods]; Lens Implantation, Intraocular [*methods]; Phacoemulsification [methods]; Posterior Eye Segment; Randomized Controlled Trials as Topic; Visual Acuity

MeSH check words

Humans