HHS Public Access

Author manuscript

Cochrane Database Syst Rev. Author manuscript; available in PMC 2015 May 20.

Published in final edited form as:

Cochrane Database Syst Rev. ; (3): CD005555. doi:10.1002/14651858.CD005555.pub2.

Lens extraction for chronic angle-closure glaucoma

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Abstract

Background—Angle-closure glaucoma is characterized by obstruction to the outflow of aqueous humor and consequent rise in intraocular pressure. The obstruction may result from an anatomical predisposition of the eye or may be due to pathophysiologic processes in any part of the eye. The former is considered the primary form and the latter a secondary form of angle closure. Relative pupillary block obstructing free flow of aqueous from the posterior chamber of the eye to the anterior chamber is considered to be the most common mechanism of angle closure. Crowding of the angle is another mechanism, which often coexists with pupillary block. This can result from an anterior placement of the lens due to an increase in the thickness of the lens (as occurs with aging), anterior displacement by a posterior force (for example choroidal effusion), or laxity of the zonules.

Objectives—The objective of this review was to assess the effectiveness of lens extraction for chronic primary angle-closure glaucoma compared with other interventions for the condition in people without past history of acute-angle closure attacks.

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Conceiving the review: DSF, VSS
Designing the review: DSF, VSS
Coordinating the review: VSS
Undertaking manual searches: VSS, DSF
Screening search results: DSF, VSS
Organizing retrieval of papers: VSS
Screening retrieved papers against inclusion criteria: DSF, VSS
Appraising quality of papers: DSF, VSS
Abstracting data from papers: DSF, VSS
Writing to authors of papers for additional information: DSF, VSS
Providing additional data about papers: VSS
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Analysis of data: VSS, DSF
Interpretation of data: DSF, VSS
Writing the review: DSF, VSS
Performing previous work that was the foundation of current study: DSF

Declarations of interest

None known

Search methods—We searched CENTRAL (2005, Issue 3), MEDLINE (1950 to April 2006), EMBASE (1980 to April 2006), and LILACS (to August 2005). We searched the reference lists of included studies and used the Science Citation Index database.

Selection criteria—In the absence of any randomized trials we included non-randomized studies comparing lens extraction with other treatment modalities for chronic primary angle-closure glaucoma including, but not limited to, laser iridotomy, medications, and laser iridoplasty. We excluded studies with a case-series design.

Data collection and analysis—Two authors independently extracted data on methodological quality of the included studies, outcomes for the review, and study characteristics including participant characteristics, interventions, and sources of funding. Differences were resolved through discussion.

Main results—We found no randomized trials evaluating the effects of lens extraction as a treatment for chronic primary angle-closure glaucoma. Two non-randomized comparative studies included in the review have several methodological flaws including selection bias. While these studies and other non-comparative studies provide information on biological plausibility and treatment effect they do not provide proof of effectiveness. Also, they do not address the question of how primary lens extraction compares with other treatments for chronic primary angle-closure glaucoma.

Authors' conclusions—There is no evidence from good quality randomized trials or non-randomized studies of the effectiveness of lens extraction for chronic primary angle-closure glaucoma.

Plain language summary

Removal of the lens as a treatment for chronic primary angle-closure glaucoma

Chronic primary angle-closure glaucoma results in debilitating loss of vision. Lens extraction or removal of the lens in this condition is thought to improve drainage of aqueous humor from the eye. This review evaluated available evidence of effectiveness of lens extraction as a treatment for people with chronic primary angle-closure glaucoma. No randomized trials were found. Subsequently, as stated in the protocol for this review, two non-randomized trials were included. Both studies were of poor methodological quality. There is no published evidence of effectiveness of lens extraction as a treatment option for chronic primary angle-closure.

Background

Introduction

Aqueous humor is secreted in the posterior chamber of the eye, passes through the pupil into the anterior chamber and is drained through the trabecular meshwork. Angle-closure glaucoma (ACG) is characterized by obstruction to the outflow of aqueous humor and consequent rise in intraocular pressure (IOP). The obstruction may result from an anatomical predisposition of the eye or due to pathophysiologic processes in any part of the eye. The former is considered the primary form and the latter a secondary form of angle closure.

Epidemiology and pathogenesis

Primary angle-closure glaucoma (PACG) has variable prevalence in different parts of the world. Higher prevalence rates were reported in Eskimos of Canada and Greenland compared to white populations in Europe (Bankes 1968; Clemmesen 1971; Drance 1973; Hollows 1966). Recent studies in Asian countries including China, India, Singapore, Japan, and Taiwan as well as studies in South Africa and Mongolia, reported higher prevalence and incidence rates of PACG compared to those reported in studies of white populations (Chew 2001; Dandona 2000; Foster 1996; Foster 2000; Jacob 1998; Lai 2000; Okabe 1991; Salmon 1994; See 2004; Wang 2002; Zhao 1990). The reasons for these differences in prevalence across racial groups are not clearly understood.

Relative pupillary block obstructing free flow of aqueous from the posterior chamber of the eye to the anterior chamber is considered to be the most common mechanism of angle closure, although some have postulated that other mechanisms (such as plateau iris configuration, choroidal expansion, and others) play a substantial role (Ho 2004; Ritch 2003; Tornquist 1958; Wand 1977). Relative pupillary block can be a consequence of a more anteriorly-placed lens coupled with a steeper anterior surface resulting in an increased area of contact between the lens and iris (Mapstone 1968). The raised pressure in the posterior chamber causes the iris to bow forwards, which occludes the angle of the eye and aqueous drainage through apposition. Synechiae or adhesions may develop in the long term, which can result in further damage to the trabecular meshwork and lead to elevated intraocular pressure (IOP).

Crowding of the angle is another mechanism of angle closure, which often coexists with pupillary block and can also cause ACG by itself. This results from an anterior placement of the lens due to either an increase in thickness or anterior displacement of the lens, anterior rotation of the ciliary body, or perhaps iris anatomical factors such as thickening of the peripheral iris.

Secondary ACG is an angle closure secondary to some pathologic process in the eye such as posterior synechiae, neovascularization, etc. Treatment for secondary angle-closure is usually focused on managing the underlying pathology.

In a retrospective chart review of patients younger than 40 years, angle closure was found to be more frequently associated with structural or developmental abnormalities than with relative pupillary block (Ritch 2003).

Presentation and diagnosis

Chronic PACG presents either asymptomatically or with symptoms that are a consequence of long-standing damage to the optic nerve due to raised IOP. Signs of chronic PACG include a narrow or closed angle along with disc cupping or nerve fiber layer defects, elevated IOP and visual field defects.

Treatment options

Many treatments have been suggested for the management of both acute and chronic forms of PACG. These include laser iridotomy, medications, laser iridoplasty, and surgical

procedures. The effectiveness of medical interventions is being addressed in a Cochrane review by Sankar 2006 and a Cochrane review on iridectomy is also underway. While traditional trabeculectomy is often used in ACG, others have proposed trabeculotomy/ gonioplasty as an alternative surgical approach. Finally, since the lens is clearly involved in the development of PACG, researchers have suggested that lens extraction alone may be adequate to treat some cases.

Rationale for a systematic review

Pupillary block and angle crowding, important mechanisms for the development of PACG, can be effectively managed by extraction of the lens. However, the effectiveness of lens extraction compared to other interventions for both chronic and acute PACG is unknown. This review proposes to examine systematically the evidence regarding the effectiveness of lens extraction as a treatment for chronic PACG.

Objectives

The objective of this review was to assess the effectiveness of lens extraction as a treatment modality for chronic primary angle-closure glaucoma (PACG) compared to other interventions for the condition in people without past history of acute-angle closure attacks.

Methods

Criteria for considering studies for this review

Types of studies—We planned to include randomized and quasi-randomized controlled trials in this review.

As per our protocol, failing to find any relevant randomized controlled trials we included prospective and retrospective non-randomized, comparative studies in an attempt to summarize the existing information on lens extraction for chronic primary angle-closure glaucoma (PACG). We excluded studies with a case-series design. There was no restriction based on language, date of publication or number of participants.

Types of participants—We included studies enrolling participants diagnosed with chronic PACG, to have been defined as gonioscopic evidence of angle closure in association with either glaucomatous optic neuropathy with or without visual field defects or elevated intraocular pressure ((IOP). For the purpose of this review we did not include persons with known symptomatic attacks in the past. Such persons may develop chronic disease but symptomatic patients may be substantially different from those with asymptomatic disease (Ang 2004). Where studies presented data on participants with chronic ACG with known symptomatic attacks in the past and those without, we attempted to procure data on the latter group. There were no restrictions with respect to age, gender, ethnicity, co-morbidities, use of adjunctive medications or the number of participants.

Types of interventions—We included studies that compared lens extraction with other treatment modalities for chronic PACG including, but not limited to, laser iridotomy, medications, and laser iridoplasty.

Types of outcome measures

Primary outcomes: The primary outcomes for this review were:

1. Proportion of participants with evidence of progression of visual field loss at different times of follow up. The main primary outcome was at one year of follow up. We planned to adopt the criteria in the included studies to define progression of visual field loss as measured using a validated method.
2. Mean change in IOP from baseline at one year and measured by any method. We also planned to report the mean change in IOP from baseline at different times of follow up. If the data on mean change from baseline and the standard deviation of change was not reported in the manuscript, and could not be obtained from the authors, we planned to analyze the final mean IOPs at one year and at different times of follow up.

Secondary outcomes: The secondary outcomes for this review were:

1. Mean change in depth of the anterior chamber from baseline in millimeters as measured by any method.
2. Number of medications to control IOP at six months, one year and at different times of follow up as reported in the included studies.
3. Gonioscopic findings in the participants – we planned to summarize the available information on examination of the angle, including angle width, from the included studies.
4. Visual acuity as reported in included studies.

Adverse effects: We summarized adverse effects related to lens extraction reported in the included studies.

Quality of life measures: We planned to summarize quality of life outcomes reported in the included studies.

Follow up: There was no restriction based on length of follow up.

Search methods for identification of studies

Electronic searches—We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (which contains the Cochrane Eyes and Vision Group Trials Register) in *The Cochrane Library*, MEDLINE, EMBASE and LILACS. The searches were not restricted by language or date of publication.

See: Appendices for details of search strategies for the electronic databases.

Searching other resources—We searched the reference lists of included studies. We planned to contact the primary investigators of identified randomized trials for details of any additional trials not found by our electronic and manual searches. We used the Science Citation Index to search for references that cited the included studies.

We conducted a single search for randomized and non-randomized studies. On review of the reference lists of the retrieved papers and after conducting manual searches, we felt it was unnecessary to run additional searches with keywords on 'outcomes and angle-closure glaucoma' or 'outcomes and lens extraction' as stated in our protocol.

Data collection and analysis

Assessment of search results—Two authors independently assessed the titles and abstracts of all reports identified by the electronic and manual searches. Each report was labelled as (a) definitely exclude or (b) unsure or (c) definitely include. The full text of abstracts labelled as 'unsure' were re-assessed according to the inclusion criteria for this review. Differences between the two authors' assessments were resolved through discussion. Studies labelled as 'definitely exclude' were excluded from the review. Studies labelled as 'definitely include' were assessed for methodological quality.

Assessment of methodological quality—Two authors independently assessed the included studies for the following sources of systematic bias using forms that were developed for this purpose. The forms were developed based on criteria for validity of non-randomized studies discussed by Deeks 2003 and using an adaptation of the form developed by Zaza 2000. Randomized trials were to be assessed for methodological quality according to the guidelines in Section 6 of the *Cochrane Handbook for Systematic Review of Interventions* (Higgins 2005).

We assessed the included studies for different biases in the following manner.

Selection bias: Were the participants selected to different treatment groups in an unbiased fashion?

If the study had not adopted some method of random or quasi-random allocation of participants we examined the following:

- Were the criteria for allocation of participants to the treatment groups specified explicitly?
- Does the selection method adopted minimize the chance that participants with favorable outcomes were preferentially selected?
- Were the two groups comparable at baseline with respect to important prognostic factors?
- Were appropriate statistical methods used to adjust for the confounding factors?
- Were the factors adjusted for specified a priori?

Measurement of confounding factors in the participants was assessed for consistency.

Performance bias: We examined whether the intervention has been clearly defined as per a pre-specified protocol for prospective studies and whether the intervention was determined in an objective fashion (medical records etc.) rather than self-reporting in prospective and

retrospective studies. Further, we assessed whether the interventions were administered consistently to all participants.

Masking of participants and caregivers is not possible for the intervention under consideration and was not assessed, although masked measurement of intraocular pressure (IOP) and other outcomes was considered.

Attrition bias: The follow-up times and losses to follow up in each group were examined. We also evaluated any reasons for losses to follow up that were described to assess whether any differential losses were likely to have influenced the conclusion of the particular study.

Detection bias: For prospective study designs we examined masking of outcome assessors, standardization, pre-specification of methods used to assess the outcome and adherence to prespecified measurement protocol for the outcomes.

For retrospective studies we assessed whether explicit criteria stated a priori for identifying a clinical condition were used for inclusion of participants in the study. We also attempted to assess adherence to such criteria.

Data collection—Two authors independently extracted the data on primary and secondary outcomes onto paper data collection forms developed by the Cochrane Eyes and Vision Group. We resolved discrepancies through discussion. We planned to contact study authors for missing data. One author entered all data into RevMan 4.2 and verified it using the double-data entry facility.

Data synthesis—We did not conduct any data synthesis for this review. Due to the methodological variability and susceptibility to different kinds of bias, non-randomized studies eligible for inclusion in this review were not combined in a meta-analysis. Instead we present a tabulated and narrative summary of such studies.

Methods for updates to this review: If randomized trials are included in updates to this review we will use the following methods.

Assessment of methodological quality—For randomized studies, we will assess the method of randomization and allocation concealment. Allocation concealment will be graded as A (adequate), B (inadequate) or C (unclear). We will contact the primary investigators of trials classified as C (unclear) for clarification. We will also assess the trials for exclusions after randomization and reasons for any.

We will evaluate losses to follow-up and reasons for losses to follow-up. Randomized studies will also be assessed for analysis on an intention-to-treat basis (whether participants were analyzed in the group to which they were randomized). We will examine whether randomized participants for whom no outcome data were collected, and those who received only some or none of their allotted treatment, were included in the analysis. We will consider it to be an intention-to-treat analysis if all three criteria mentioned above are met. We will evaluate masking of outcome assessment to assess for detection bias.

Data synthesis—Data analysis will follow the guidelines set out in Section 8 of the *Cochrane Handbook for Systematic Review of Interventions* (Deeks 2005). We will calculate a summary risk ratio for dichotomous outcomes. The mean difference will be calculated for continuous outcomes. Standardized mean difference will be reported if outcomes are measured using different scales. We will attempt to quantify the proportion of variability within included randomized studies that is explained by heterogeneity using the I^2 statistic (Higgins 2002). If the I^2 statistic is greater than 50% we will consider it as substantial heterogeneity and will not combine the study results in a meta-analysis. Instead we will present the studies in a tabulated or narrative summary. We will examine funnel plot symmetry for evidence of other sources of heterogeneity. If there is no substantial heterogeneity as per the I^2 statistic we will combine the results of the included studies in a meta-analysis using a random-effects model. We will use a fixed-effect model if there are fewer than three studies.

Sensitivity analysis—Sensitivity analyses will be conducted to determine the impact of excluding randomized studies with lower methodological quality, excluding quasi-randomized studies, varying cut-off points for inclusion criteria and excluding unpublished studies and industry-funded studies.

Subgroup analysis—If the variability in effect estimates of the included studies explained by heterogeneity, as defined by I^2 statistic is greater than zero, we will explore the possible causes through subgroup analyses based on age of participants if adequate data are available.

Results

Description of studies

Our original electronic searches conducted in July 2005 yielded 195 titles and abstracts of which 17 studies appeared to be relevant and underwent review of the full articles. An updated search conducted in April 2006 yielded an additional 43 titles and abstracts but none were randomized trials.

Types of studies—No randomized trials were eligible for inclusion in the review. As per our protocol, we identified two non-randomized comparative studies that met the inclusion criteria. We excluded the remaining 15 studies which are listed in the ‘Characteristics of excluded studies’ table with reasons for exclusion. We searched the reference lists of the two studies and also the Science Citation Index for additional studies that cited them. Our manual searches identified 17 additional titles and abstracts, none of which were eligible for inclusion in the review. Thus, we included two studies in the review (Gunning 1998; Kubota 2003).

Types of participants—The two studies involved a total of 59 eyes of 48 patients. Gunning 1998 included participants diagnosed with subacute or chronic primary angle-closure glaucoma (PACG). Kubota 2003 included participants with glaucomatous optic neuropathy, a reproducible visual field defect and closed angle on indentation gonioscopy. The age of participants ranged from 47 to 84 years. Both studies included women and men.

Types of interventions—Gunning 1998 compared extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens (PCIOL) implantation with a standard, limbal-based trabeculectomy. Kubota 2003 evaluated ECCE with PCIOL versus additional goniosynechialysis procedure in patients with peripheral anterior synechiae in greater than two quadrants.

Types of outcomes—Both studies reported data on mean intraocular pressure (IOP) at final follow up (which was variable), visual acuity, visual field measurements, and postoperative anti-glaucoma medication use. Kubota 2003 commented on gonioscopic findings. Measurement of outcomes was variable in the two studies, as noted in the 'characteristics of included studies' table.

Risk of bias in included studies

The two included studies were non-randomized, retrospective, comparative studies. No explicit a priori inclusion or exclusion criteria were stated in either study. Other methodological discrepancies that could have influenced the validity of results in these studies, besides the selection bias due to lack of randomization, are summarized in the 'characteristics of included studies' table. Both studies included both eyes of some patients. However, both eyes of a patient may not be considered independent and thus analyses in both the studies suffer from unit of analysis error and failure to correct for possible cluster effects.

Effects of interventions

We did not conduct a meta-analysis for this review since we did not find any randomized trials and data from the included non-randomized studies were not adequate. We did not analyze results from Kubota 2003 since allocation, though non-randomized, did not take past history of acute attacks into consideration. Data from only a subgroup of patients without a past history of acute angle-closure was to be considered. Consequently only two patients were eligible in the extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens (PCIOL) and goniosynechialysis group, rendering any analyses unhelpful. Results are tabulated in Table 1 and Table 2 and are summarized below.

Visual field—Gunning 1998 used criteria discussed in Greve 1982 to classify visual field measurements and progression of visual field loss. In the ECCE with PCIOL group 5/22 eyes showed definite deterioration of visual field compared to 5/25 eyes in the trabeculectomy group (risk ratio (RR) 1.19; 95% confidence interval (CI) 0.40 to 3.56). Visual field data on participants without past history of acute attacks of angle closure were not available in Kubota 2003.

Mean change in intraocular pressure (IOP)—Mean IOP at final follow up alone was reported. Mean follow up was 52.4 months (range 15 to 90 months) in the ECCE with PCIOL group and 50.4 months (range 6 to 83 months) in the trabeculectomy group. Mean difference for IOP change (the difference in mean IOP change between the two groups) was −2.40 mm Hg (95% CI −7.36 to 2.56).

Visual acuity—Progression of visual acuity loss was defined as worsening by at least one Snellen line in Gunning 1998. There was just one eye with visual acuity worsening in ECCE with PCIOL group, resulting in wide confidence intervals. The risk ratio of visual acuity loss was 0.10 (95% CI 0.01 to 0.70) but ECCE with PCIOL would be expected to improve vision while trabeculectomy alone would not.

Postoperative anti-glaucoma medications—As with IOP this outcome was reported at final follow up. The difference in mean medications between the two groups was 0.78 (95% CI 0.32 to 1.24) favoring trabeculectomy. In other words, patients in the trabeculectomy group required fewer anti-glaucoma medications on average.

Gonioscopic findings—Gunning 1998 reported a before-after comparison of angle-width in the lens extraction group alone. Three of 7 eyes with 50% or more closed chamber angle before surgery improved to a “narrow angle”, defined in this study as “a very narrow chamber angle”, with lens extraction.

Complications—Complications reported in the two included studies are summarized in Table 3.

Discussion

Our search of multiple databases including CENTRAL did not identify a single randomized trial addressing this important clinical question. Furthermore, although we conducted an extensive search of the literature to identify non-randomized studies, the strategy we used has not been validated and shown to be 100% sensitive.

We identified two non-randomized comparative studies evaluating extracapsular cataract extraction (ECCE) with posterior chamber intraocular lens (PCIOL) implantation in chronic primary angle-closure glaucoma (PACG) eligible for inclusion in the review (Gunning 1998; Kubota 2003). Both studies suffered from methodological inadequacies that limit any conclusions that can be drawn from the findings, particularly the lack of random allocation. Kubota 2003 included patients with a past history of acute attacks, precluding any analyses on our part for this review.

The little information from these studies suggests no evidence of benefit with lens extraction in terms of progression of visual field loss and mean change in intraocular pressure (IOP). Results of analyses on visual acuity and postoperative anti-glaucoma medications in Gunning 1998 and Kubota 2003 are limited by the small number of patients analyzed. Further, both studies included both eyes of some of the patients resulting in a unit of analysis error.

Primary angle-closure glaucoma is due mainly to anatomic factors within the eye contributing to relative papillary block with narrowing of the anterior chamber angle resulting in obstruction to drainage of aqueous humor. As discussed under the ‘epidemiology and pathogenesis’ sections above, the lens contributes to angle obstruction through an independent mechanism as well, due to anterior location of the lens or increased lens thickness. Replacement of the lens with an intraocular lens was shown to result in an

increase in anterior chamber depth, widening of the angle and increase in anterior chamber angle depth by gonioscopic measurements in Gunning 1998 and using ultrasound biomicroscopy measurements in patients undergoing cataract surgery (Kurimoto 1997; Nonaka 2006; Pereira 2003). Similar findings were reported using Scheimpflug photography in PACG patients undergoing cataract extraction (Hayashi 2000). These findings support the biological plausibility of cataract extraction being beneficial to patients with chronic PACG as do other non-comparative studies discussed below. Presumably the main mechanism of glaucomatous optic nerve damage in PACG is elevation of IOP. If lens extraction is shown reliably to lower IOP in PACG as well as other procedures then the relative safety of cataract surgery might justify greater use of this treatment modality. Of course the ultimate goal of PACG treatment is to prevent additional damage to the optic nerve in order to slow or stop visual field progression. Future studies will want to assess the impact of treatments on both IOP and visual field.

Several non-comparative studies provide information supporting the role of lens extraction in chronic angle-closure glaucoma in relieving the pathophysiologic mechanisms leading to an elevation of IOP in such patients discussed in earlier sections of this review (Acton 1997; Gunning 1991; Hayashi 2001; Jacobi 2002; Wishart 1989). A more recent study reported similar findings in patients with the possibility of a reduced effect when peripheral anterior synechiae cover three-fourths or more of the angle (Euswas 2005). All patients in this study had a history of Nd-YAG laser peripheral iridotomy and had varying degrees of peripheral anterior synechiae. While such studies suggest feasibility of the procedure and biological plausibility of lens extraction in addressing the pathophysiologic mechanisms leading to an increased IOP in patients with chronic PACG, they do not provide evidence of effectiveness of the procedure. Also, none of these studies compared lens extraction with alternative treatment options for patients with PACG.

Our analyses do not provide adequate evidence on the effects of lens extraction as a therapeutic modality for patients with chronic PACG. Updates of this review will include any randomized trials conducted that meet eligibility criteria as per the ‘criteria for including studies in this review’ section above.

Authors’ conclusions

Implications for practice

There was not enough evidence to assess the superiority of lens extraction over any other means of controlling intraocular pressure (IOP) or visual field loss in patients with primary angle-closure glaucoma (PACG), although this approach seems biologically plausible. The benefits of cataract extraction on vision are known, and were not the primary focus of this review. Clinical practice decisions will have to be based on physician judgment given this lack of data in the literature.

Implications for research

There is no evidence of effects of lens extraction in chronic PACG from well-conducted randomized controlled trials. Trials comparing lens extraction (with or without goniosynechialysis) with trabeculectomy for patients in whom pupillary block is alleviated

with either iridotomy or surgical peripheral iridectomy will help clinical decision making. Comparisons with medical therapy, laser iridotomy and laser iridoplasty will also be of interest. Since patients with a history of acute attacks of angle-closure may be substantially different from those with asymptomatic disease, stratification by this variable should be adopted in studies including both types of patients. Though most forms of therapy for glaucoma are aimed at controlling IOP, adequate data on visual field changes using validated methods and validated definitions, visual acuity, vision-related quality of life and economic outcomes will help in evaluating different interventions for this condition appropriately.

Acknowledgments

We thank Karen Blackhall, Trials Search Co-ordinator for CEVG, for devising and running the electronic searches. We thank Zbys Fedorowicz, Suzanne Brodney-Folse and Jennifer Burr for their comments on the protocol for this review. We thank the CEVG editorial base and Kay Dickersin for their guidance in designing the protocol. We acknowledge comments on an earlier draft of this review from Katherine Henshaw, Roberta Scherer, Jennifer Burr and Barbara Hawkins.

Sources of support

Internal sources

- Brown University, USA
- Johns Hopkins University, USA

External sources

- Contract N-01-EY2-1003, National Eye Institute, National Institutes of Health, USA

Appendices

1 CENTRAL search strategy used for Issue 3, 2005

#1GLAUCOMA ANGLE-CLOSURE

#2(glaucoma* near angle* near closure*)

#3(#1 or #2)

#4LENS IMPLANTATION INTRAOCULAR

#5CATARACT EXTRACTION

#6CAPSULORHEXIS

#7PHACOEMULSIFICATION

#8LENS CRYSTALLINE su

#9(lens* or cataract*)

#10(extract* or remov* or operat* or aspirat* or surg*)

#11(#9 and #10)

#12(#4 or #5 or #6 or #7 or #8 or #11)

#13(#3 and #12)

2 MEDLINE search strategy used from 1950 to April 2006

#1 explode “Glaucoma-Angle-Closure”/all SUBHEADINGS in MIME,MJME

#2 ((glaucoma* near angle* near closure*) in TI)or((glaucoma* near angle* near closure*) in AB)

#3 #1 or #2

#4 explode “Lens-Implantation-Intraocular”/all SUBHEADINGS in MIME,MJME

#5 explode “Cataract-Extraction”/all SUBHEADINGS in MIME,MJME

#6 explode “Capsulorhexis-”/all SUBHEADINGS in MIME,MJME

#7 explode “Phacoemulsification-”/all SUBHEADINGS in MIME,MJME

#8 explode “Lens-Crystalline”/surgery in MIME,MJME

#9 (((lens* or cataract*) near (extract* or remov* or operat* or aspirat* or surg*)) in TI)or(((lens* or cataract*) near (extract* or remov* or operat* or aspirat* or surg*)) in AB)

#10 #4 or #5 or #6 or #7 or #8 or #9

#11 #3 and #10

3 EMBASE search strategy used from 1980 to April 2006

#1 exp Closed Angle Glaucoma/

#2 (glaucoma$ adj3 angle$ adj3 closure$).ab,ti.

#3 #1 or #2

#4 exp Lens Implantation/

#5 exp Cataract Extraction/

#6 exp CAPSULORHEXIS/

#7 exp PHACOEMULSIFICATION/

#8 exp LENS/

#9 su.fs.

#10 #8 and #9

#11 ((lens$ or cataract$) adj5 (extract$ or remov$ or operat$ or aspirat$ or surg$)).ab,ti.

#12 #4 or #5 or #6 or #7 or #10 or #11

#13 #3 and #12

4 LILACS search strategy used on 3 August 2005

(glaucoma$ AND angle$ AND closure$) [Words] and (extract$ or remov$ or operat$ or aspirat$ or surg$) [Words]

References to studies

Included studies

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Excluded studies

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Table 1

Summary of outcomes – visual field and visual acuity

Outcome	Study ID	Lens extraction	Trabeculectomy	Relative Risk(95%CI)
Progression of visual field loss	Gunning 1998	Number of eyes with outcome – 5; Total number of eyes – 21	Number of eyes with outcome – 5; Total number of eyes – 25	1.19 (0.4 to 3.56)
Progression of visual acuity loss	Gunning 1998	Number of eyes with outcome – 1; Total number of eyes – 21	Number of eyes with outcome – 12; Total number of eyes – 25	0.1 (0.01 to 0.7)

Table 2

Summary of outcomes – intraocular pressure and anti-glaucoma medications

Outcome	Study ID	Lens extraction	Trabeculectomy	Mean diff. (95% CI)
Mean change in intraocular pressure	Gunning 1998	Number of eyes in group – 21 Mean – 11.84 Standard deviation – 7.25	Number of eyes in group – 25 Mean – 14.24 Standard deviation – 9.86	−2.4 (−7.36 to 2.56)
Number of postoperative anti-glaucoma medications	Gunning 1998	Number of eyes in group – 21 Mean – 1.3 Standard deviation – 0.8	Number of eyes in group – 25 Mean – 0.52 Standard deviation – 0.8	0.78 (0.32 to 1.24)

Table 3

Table of complications

Type of complication	Lens extraction (22)	Trabeculectomy (25)
Gunning 1998		
Early IOP elevation	10	0
Persistent IOP elevation leading to trabeculectomy	1	0
Pre-pupillary fibrin and posterior synechiae	5	0
Wound dehiscence	1	0
CRVO	1	0
Choroidal detachment	0	9
Flat AC	0	2
Peripheral iris-cornea touch	0	10
Transient hypotony	0	2
Hyphema	0	1
Lens extraction group in Gunning 1998 included 22 eyes and trabeculectomy group included 25 eyes		
Posterior capsule rupture was reported in 1 of 11 eyes treated with lens extraction in Kubota 2003		

CRVO: Central Retinal Vein Occlusion
AC: Anterior chamber
IOP: Intraocular pressure

Characteristics of included studies

Gunning 1998		
Methods	Type of study: Retrospective cohort study. Were the criteria for allocation of participants to the treatment and control groups explicitly reported? No. Criteria were not clearly defined. The authors do not explain how participants were allocated to treatment arms. Can the above criteria be explicitly related to the outcome? Yes. Patient selection could have influenced the outcome if some with a presumed better prognosis were allocated into one arm over another. Was there evidence of a consecutive sample or a clearly defined patient population or some other method to minimize the chance that clinicians preferentially selected patients with favorable outcomes or that patients with better outcomes volunteered? No evidence. No information on how patients were selected to receive the two interventions. How were the controls selected? Not explained. Was the control group representative of the underlying population? Unclear: Cannot tell from the publication. Were appropriate statistical/ case-mix methods used to adjust for confounding factors? Sample size was small, and the authors report that age, preoperative IOP, and number of preoperative ocular hypotensive medicines were not statistically significantly different. Residual confounding may have existed. There was no adjustment in the analyses. Were the factors adjusted for in the analyses, specified a priori? No adjustments were made. Was the measurement of the confounding factors in the participants consistently adequate? No. The gonioscopic appearance at baseline should have been included. Also, there is no report on the consistency of gonioscopic measurements. Was consistency achieved in allocation, administration of treatments and recording of the treatments? Unclear. Was the treatment/intervention confirmed in an objective way and not determined exclusively by self reports? Yes. The intervention was a surgical procedure. Was outcome assessment conducted in a masked fashion (if the study was prospective)? Unclear. Were criteria/protocols for outcome assessment standardized and/or pre-specified? Were there deviations from the protocol? Unclear. Was the method of outcome assessment valid? Unclear. Was outcome assessed in the same way in both groups? No – IOP assessment in lens extraction group was preceded by an oral carbonic anhydrase inhibitor and it is not clear if the IOP in this group was also obtained from diurnal curves. Losses to follow-up and reasons for loss to follow-up: controls: 0. Cases: 1 eye, which needed filtration surgery was not analyzed.	
Participants	Country: The Netherlands. Study period: 1987 to 1994. Age: Mean (SD) was 66.5 (9.7) years in lens extraction group and 64.6 (11.9) years in trabeculectomy group. Gender: 61% in lens extraction group and 79% in trabeculectomy group were females. Inclusion criteria: no explicit inclusion criteria reported. Patients in lens extraction group were selected based on gonioscopic appearance as evaluated by a single author. Patients in the control group underwent trabeculectomy during the same period. Exclusion criteria: no explicit exclusion criteria mentioned. Equivalence of baseline characteristics: baseline age appears lower in controls but difference was not statistically significant. Similar in preoperative IOP values. One patient in lens extraction group had 20/200 visual acuity pre-operatively while 5 patients in trabeculectomy group had preoperative visual acuity of 20/200 or worse.	
Interventions	Cases or Intervention 1 or Cases: extracapsular cataract extraction with posterior chamber intraocular lens (PCIOL). Subconjunctival steroids and pilocarpine ointment were given after the surgical procedure. Number of participants (eyes): 18 (22) Control or Intervention 2: trabeculectomy with postoperative 5-Fluorouracil administered in 6 eyes. Number of participants (eyes): 19 (25) Length of follow up: Planned: not stated. Actual: lens extraction group, range 15 to 90 months; trabeculectomy group, range 11 to 83 months.	
Outcomes	Primary outcome as defined in the study: no explicit primary outcome stated a priori. Main results were focused on mean IOP. Measurement of primary outcome in the study: not clearly reported. Secondary outcomes as defined in the study: best-corrected visual acuity; postoperative anti-glaucoma medication use; visual field and gonioscopic findings. Measurement of secondary outcomes in the study: visual acuity was measured using Snellen charts, no information on measurement of visual field. Goldmann 3-mirror goniolens was used to evaluate the angle. Intervals at which outcome assessed: no specific intervals reported. Reported information on cost of interventions: none. Reported information on quality of life: none.	
Notes		
Risk of bias table		
Item	Authors' judgement	Support for judgement
Kubota 2003		
Methods	Type of study: retrospective cohort study. Were the criteria for allocation of participants to the treatment and control groups explicitly reported? Yes, those with broad PAS in two or more quadrants had combined procedures.	

	Can the above criteria be explicitly related to the outcome? Yes, the presence of PAS may be associated with worse IOP outcome. Was there evidence of a consecutive sample or a clearly defined patient population or some other method to minimize the chance that clinicians preferentially selected patients with favorable outcomes or that patients with better outcomes volunteered? No. How were the controls selected? The indication for an additional goniosynechialysis procedure was a broad peripheral synechiae of more than 2 quadrants observed by intraoperative Swan gonioscopy. Was the control group representative of the underlying population? Unclear. Were appropriate statistical/case-mix methods used to adjust for confounding factors? No factors adjusted for in the analysis. Were the factors adjusted for in the analyses specified a priori? None adjusted for. Was the measurement of the confounding factors in the participants consistently adequate? Unclear. Was consistency achieved in allocation, administration of treatments and recording of the treatments? Unclear. Was the treatment/intervention confirmed in an objective way and not determined exclusively by self reports? Yes, treatment was surgery. Was outcome assessment conducted in a masked fashion (if the study was prospective)? No attempt at masking outcome assessment described. Were criteria/protocols for outcome assessment standardized and/or pre-specified? Were there deviations from the protocol? No criteria described. Was the method of outcome assessment valid? Unclear, method of measurement of outcomes including IOP not described. Was outcome assessed in the same way in both groups? Unclear. Losses to follow-up and reasons for loss to follow-up: controls – none reported, but not clear if sample was consecutive. Cases – none reported, but not clear if sample was consecutive.	
Participants	Country: Japan. Study period: April 1998 to March 2001. Age: Mean (SD) age of all patients was 67.7 (8.8) years. Gender: 67% of all patients were women. Inclusion criteria: PACG was defined as GON, reproducible VF defect, closed angle on indentation. Also write "patients with a closed angle who had a history of raised IOP were included in the study." Not sure if this means patients without VF defect and GON were included. Exclusion criteria: secondary angle-closure glaucoma. Equivalence of baseline characteristics: unclear	
Interventions	Cases or Intervention 1 or Cases: phacoemulsification and intraocular lens replacement. Number of participants (eyes): 9 (11) Control or Intervention 2: phacoemulsification and intraocular lens replacement and goniosynechialysis. Number of participants (eyes): 2 (2) Length of follow up: planned: Not stated. Actual: 13.8 (7.2) months, range 6 to 36 months	
Outcomes	Primary outcome as defined in the study: no primary outcome was specified a priori. IOP was reported. Measurement of primary outcome in the study: not reported. Secondary outcomes as defined in the study: number of postoperative medications, visual acuity, complications. Measurement of secondary outcomes in the study: visual acuity measured using Snellen charts. Intervals at which outcome assessed: during routine follow-up for surgery, 1 week, 2 weeks, 1 month, 2 months, 3 months and 6 months postoperatively. Reported information on cost of interventions: none. Reported information on quality of life: none.	
Notes		
Risk of bias table		
Item	Authors' judgement	Support for judgement

PACG – primary angle-closure glaucoma
IOP – intraocular pressure
SD – standard deviation
PCIOL – posterior chamber intraocular lens
GON – glaucomatous optic neuropathy
VF – visual field
PAS – peripheral anterior synechiae

Characteristics of excluded studies

Acton 1997	
Reason for exclusion	Non-comparative study
Ge 2000	
Reason for exclusion	Non-comparative study
Greve 1988	
Reason for exclusion	Non-comparative study
Gunning 1991	
Reason for exclusion	Non-comparative study
Hayashi 2000	
Reason for exclusion	Non-comparative study
Hayashi 2001	
Reason for exclusion	Non-comparative study
Jacobi 2001	
Reason for exclusion	Non-comparative study
Jacobi 2002	
Reason for exclusion	Non-comparative study
Ko 2004	
Reason for exclusion	Non-comparative study
Mori 1993	
Reason for exclusion	Non-comparative study
Reibaldi 1992	
Reason for exclusion	Non-comparative study
Satoh 2003	
Reason for exclusion	Non-comparative study
Steuhl 1992	
Reason for exclusion	Non-comparative study
Yamagami 1994	
Reason for exclusion	Non-comparative study
Yang 1997	
Reason for exclusion	Non-comparative study

Characteristics of studies awaiting classification

Characteristics of ongoing studies