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# Interventions for age-related visual problems in patients with stroke (Review)

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# Interventions for age-related visual problems in patients with stroke

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## ABSTRACT

### Background

The prevalence of eye problems increases with age and, consequently, so does the level of visual impairment. As the incidence of stroke also increases with age, a significant proportion of stroke patients will have age-related visual problems. It is possible that the effect of interventions for age-related visual problems may differ in the population of stroke patients compared to the wider population of older people. The interaction between the problems arising directly from stroke and those arising directly from age-related visual problems will be complex. Interventions for age-related visual problems may also be affected by the presence of other stroke-related co-morbidities. Consequently, the nature and outcome of interventions for age-related visual problems may be different in patients with stroke.

### Objectives

The aim of this review is to determine if interventions for age-related visual problems improve functional ability following stroke.

### Search methods

We searched the Cochrane Stroke Group Trials Register (March 2011), the Cochrane Eyes and Vision Group Trials Register (December 2009) and nine electronic bibliographic databases including: the Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2011, Issue 1), MEDLINE (1950 to February 2011), EMBASE (1980 to February 2011), CINAHL (1982 to February 2011), AMED (1985 to February 2011) and PsycINFO (1967 to February 2011). We also searched reference lists and trials registers, handsearched journals and conference proceedings, and contacted experts.

### Selection criteria

Randomised trials in adults after stroke, where the intervention is specifically targeted at assessing, treating or correcting age-related visual problems, or improving the ability of the patient to cope with visual impairment. Primary outcome was functional ability in activities of daily living and secondary outcomes included functional ability in extended activities of daily living, visual acuity, visual field, visual function, balance, falls, depression and anxiety, discharge destination/residence after stroke, quality of life and social isolation, adverse events and death.

**Data collection and analysis**

Two review authors independently screened abstracts and planned to extract data and appraise trials. We planned that assessment of methodological quality would be undertaken for allocation concealment, blinding of outcome assessor, method of dealing with missing data and other potential sources of bias.

**Main results**

We considered 7357 titles, 460 abstracts and 85 full papers. We identified no studies for inclusion in this review.

**Authors' conclusions**

There are no implications for practice arising from this review. Evidence relating to the management of patients (from the general population) with age-related visual problems is available from other Cochrane reviews and is likely to be the best evidence available for making treatment decisions about individual patients. Subgroup analyses within these reviews to explore the effect of interventions for age-related visual problems in patients with stroke are recommended. We recommend that the objectives and selection criteria for this Cochrane review are amended and clarified prior to any future updates.

## PLAIN LANGUAGE SUMMARY

**Interventions for age-related visual problems in patients with stroke**

As people get older they are more likely to develop age-related visual problems (such as age-related macular degeneration, cataracts, glaucoma and diabetic retinopathy). As the incidence of stroke increases with age, a significant proportion of stroke patients will have age-related visual problems. This review aimed to determine if interventions for age-related visual problems improve functional ability following stroke. We were specifically interested in whether people with stroke responded differently from the general population when treated for age-related visual problems and also whether assessment and interventions for age-related visual problems could improve functional ability during stroke rehabilitation. After a complex search we identified no studies for inclusion in this review. Currently best evidence comes from a series of Cochrane reviews which evaluate the effect of specific interventions for different age-related visual problems (in the general population). We recommend that analyses are carried out within these reviews to explore the impact of these interventions on the subgroup of people with stroke. We encountered a number of methodological problems during this review, relating to selection criteria for including studies; we recommend that this is clarified before future updates of this review are carried out.

## BACKGROUND

The association between visual impairment and disability in activities of daily living is well established (Wolter 2006). The services available to patients with visual problems following stroke are presently inconsistent. We aim to provide an evidence base to facilitate the development of further research and promote best treatments for patients with visual problems following stroke.

We discussed the issues relating to systematic reviews of visual problems after stroke as a multidisciplinary group and formulated the key issues this proposed review seeks to address. We identified these as key issues for two main reasons.

1. Health professionals see many patients because of age-related visual problems on a background of stroke but there is little evidence to help them determine whether the treatment options for patients with age-related visual problems will be effective in patients with stroke. Treatments available for age-related visual problems potentially have an impact on many of the symptoms arising from stroke. The complexity of the relationship between these symptoms convinced our multidisciplinary group of the need for a systematic review specific to the population of patients with both age-related visual problems and stroke. Currently health professionals rely on evidence arising from subgroup analyses of systematic reviews of the wider population of patients with age-related visual problems.
2. Health professionals see many patients because of their stroke who also have age-related visual problems. Our multidisciplinary group has anecdotal reports that health professionals often fail to recognise or appreciate age-related visual problems and that failure to identify and address such problems can have a detrimental effect on stroke rehabilitation. These anecdotal reports suggests that very simple measures, such as ensuring patients wore their correct glasses during rehabilitation, could potentially have a significant impact on the outcome of rehabilitation. A prospective cohort study reported that over 90% of patients admitted to a stroke rehabilitation unit had previously been prescribed glasses; more than 25% of the sample did not have their glasses with them in hospital (Lotery 2000). Prospective cohort studies investigating presence of visual problems after stroke have also demonstrated that a large proportion of patients with stroke may also have ocular pathologies (Lotery 2000; Rowe 2009).

Many people with stroke will have stroke-related visual problems including visual field defects, eye movement disorders and visual perceptual problems (including visual neglect or inattention). There are a range of specific interventions and management strategies for these stroke-related visual problems which are the focus of other reviews. The emphasis of this review is on interventions for, and the management of, age-related visual problems in the population of patients with stroke and not on interventions for stroke-related visual problems.

The emphasis on age-related problems is highly relevant as the world population is recognised to be aging, with an increasing proportion of elderly people within the population. Figures from the United Nations (United Nations 2002) suggest that in the year 2000 in developed countries approximately 19.4% of the population was over 60 years (with 3.1% over 80 years). This is predicted to rise to 28.2% over 60 years (5.4% over 80 years) by 2025, and to 33.5% over 60 years (9.6% over 80 years) by 2050.

This review is one of a series of reviews supported by the Royal National Institute for the Blind (RNIB) in the UK. The aim of these reviews was to identify the evidence base for treatments of visual problems following stroke.

### Description of the condition

The prevalence of eye problems increases with age and, consequently, so does the level of visual impairment. According to the World Health Organization standard of classification, 6.2% of people in the age group 75 to 79 years are visually impaired. In the age group of 90 years and over, the figure increases to 36.9% (Evans 2004). Almost all age-related visual impairment is attributable to one of the following five problems (Evans 2004; Reidy 1998):

#### Age-related macular degeneration (AMD)

AMD is a degeneration of the central part of the retina. There is impairment of the oxygen and nutrient supply to the retinal cells leading to loss of central vision (dry AMD). Damage to retinal cells allows new vessels to grow in the retina (wet AMD). These vessels haemorrhage and the tissue swells, causing permanent scarring. This occurs at the most sensitive central part of the retina (the macula) resulting in significant decrease in fine or detailed vision. AMD is the most common cause of blind registration in the UK (Bunce 2008). Patients have reduced ability to perform activities of daily living that require good perception of detail: recognising faces, driving, reading, cooking and answering the telephone (Williams 1998). There is a loss of quality of life (Mitchell 2006) and levels of depression are doubled compared with contemporaries (Rovner 2002).

#### Uncorrected refractive error

The ability of the eye to focus light sharply on the retina alters in the presence of refractive error. The magnitude corresponds to the strength of lens prescription in a patient's glasses. Refractive error increases in irregularity (Asano 2005) as patients become more hyperopic, or long-sighted, with age (Wang 1994). It causes a general blurring of vision, but is eminently amenable to treatment.

#### Glaucoma

Damage to the optic nerve at the point where it exits the eye, often because of a rise in pressure within the eye, causes loss of retinal neurons and scotoma, or blind patches in the peripheral field of view. As the disease progresses, these patches, which are often arch-like in shape, enlarge, join and extend inwards to leave only a very small area of intact vision at the centre of the visual field. This affects patients' peripheral awareness and makes navigation and unaided mobility more difficult. The most severe functional disabilities occur in the areas of reading and driving (Green 2002), the latter becoming illegal in more severe cases.

#### Cataracts

This is a loss of transparency of the lens of the eye. The lens becomes progressively thicker, more opaque and less regular in internal structure, so that light travelling through the eye is bent in irregular ways. Cataracts primarily cause a loss of visual acuity and contrast sensitivity. As a result patients have difficulty with fine visual tasks, especially in poor lighting or at night time. They

have poorer perception of colour, greater sensitivity to glare and occasionally diplopia (double vision) (Stuen 2003).

#### Diabetic eye disease

This is a complication of diabetes, especially where blood sugar control is poor or the condition is long standing. Damage to the smallest blood vessels that supply the retina means they leak, haemorrhage and stop supplying blood efficiently, so that the retina is starved of oxygen. This can affect both central and peripheral vision. Vision may fluctuate significantly from day to day (Horowitz 2004). Depending on the type of diabetic eye disease, its effects are similar to those AMD and glaucoma patients experience.

Given that the incidence of stroke increases with age, a significant proportion of stroke patients have age-related visual problems (Wolter 2006). Poor visual acuity has a negative impact on rehabilitation of older people (Johansen 2003) and people with stroke (Jones 2006; Lotery 2000; Rowe 2009). Uncorrected visual impairment resulting from age-related visual problems causes difficulties with performing activities of daily living and mobility tasks (Wolter 2006). Untreated age-related visual problems following stroke can adversely affect quality of life (Jones 2006). Uncorrected refractive error is a common age-related visual problem. Using glasses addresses the problem, but there is evidence that following stroke this simple measure is often overlooked (Lotery 2000). Importantly, although vision loss is the third most common reason for requiring assistance with activities of daily living for those over 70 years of age, it is often overlooked when treating patients for other conditions (Warnecke 2003).

## Description of the intervention

There are a number of different treatment and management approaches available to patients with age-related visual problems. This review will consider any intervention that is specifically targeted at improving age-related visual problems, or improving the ability of patients to cope with such problems.

These interventions may include but are not limited to the following:

#### Environmental modification

This makes it easier for the patient to cope with age-related visual problems during everyday activities within the home (or immediate) environment. Examples include increased lighting, use of contrast, tactile enhancements and large print devices.

#### Activities of daily living training

This intervention aims to train a patient to cope with age-related visual problems. Examples include cooking, personal care and household chores.

#### Drugs

These generally aim to reduce or alleviate symptoms or slow the progression of a specific age-related visual problem. Examples include vascular endothelial growth factor (VEGF) inhibitors and intra-ocular pressure (IOP) lowering medication.

#### Surgery

Surgery aims to reduce or alleviate a specific age-related visual problem. Examples include cataract extraction, vitrectomy, laser photocoagulation and photo-dynamic therapy.

#### Visual aids and equipment

These work by correcting an age-related visual problem (e.g. correcting a refractive error), or helping the patient cope with the age-related visual problem (e.g. magnifying objects). Examples include magnifiers, telescopes, closed-circuit television (CCTV) and absorptive lenses.

#### Assessment and screening interventions

These work by identifying a patient's age-related visual problems and initiating appropriate referral or treatments. These might include standardised visual assessments, screening and referral for visual assessment and intervention.

## How the intervention might work

There is substantial evidence of the effect of each of these interventions in populations with age-related visual problems. It is beyond the scope of this review to address the specific methods by which each of the many individual interventions may work in the population of older people with age-related visual problems. This review focuses on how specific interventions may work in the population of patients with stroke. It is possible that the effect of interventions for age-related visual problems may differ in the population of stroke patients compared with the wider population of older people. The interaction between the problems arising directly from stroke and those arising directly from age-related visual problems will be complex. Interventions for age-related visual problems may also be affected by the presence of other stroke-related co-morbidities. Consequently, the nature and outcome of interventions for age-related visual problems may be different in patients with stroke.

The aim of this review is to determine the effects and impact of interventions in stroke patients with age-related visual problems. Determining these effects will help healthcare clinicians make treatment decisions for this patient group with complex needs. It is not the aim of this review to compare the effect of treatments between people with age-related visual problems and stroke and people with age-related visual problems only.

We are unaware of any research in this area. However, the following are examples of how stroke may alter intervention for age-related visual problems and its result.

#### Environmental modification

Patients with a variety of stroke-related problems, including motor, cognitive and sensory problems, could potentially benefit from environmental modification in order to improve their functional ability and independence in activities of daily living. Environmental modification may also benefit age-related visual problems by removing possible trip hazards and aiding safe movement and activity. Environmental modification may therefore have several benefits for stroke patients with age-related visual problems, improving their function, activities of daily living and mobility, and reducing the risk of adverse events such as falls.

### Activities of daily living training

Activities of daily living training is an intervention commonly offered to improve function associated with age-related loss of vision. Similarly, patients with complex problems following stroke can benefit from such training. It has the potential to be particularly beneficial as it may help address the complex and holistic needs of patients with both stroke and age-related visual problems.

### Pharmacological interventions

Vision has been identified as important to the success of physical rehabilitation. Drugs which preserve the visual field may be of significant benefit when it comes to achieving functioning and independence in activities of daily living goals after stroke. Non-compliance with drug therapy (failure of a patient to take medication as it is prescribed by a health professional) is known to adversely affect patients with glaucoma in general populations (Patel 1995). Non-compliance with drug therapy regimes in patients with complex problems and needs after stroke may also adversely affect outcomes. Education and awareness among ward or rehabilitation unit staff must be effective to ensure drug therapy is continued during inpatient episodes.

### Surgery

While arguably the physical effects of surgery ought to be similar in the population of older people and the population of stroke patients, there are some specific important issues which may impact on the benefits of a surgical intervention. For example, do patients with mobility or perceptual problems following stroke have the ability to care for themselves adequately post-surgery? What is the impact of the post-surgical care on the mobility, functioning and well-being of a patient with stroke? Such questions pose themselves particularly where recovery from surgery may require bed rest in a prone position. If patients are unable to administer essential eye drops, due to upper limb, cognitive or perceptual problems, surgical intervention may remove the need for eye drops and improve independence, functional ability and quality of life. Indeed, there is a case for surgical intervention with conditions such as glaucoma where compliance with drug therapy is poor (Patel 1995).

### Visual aids and equipment

Many visual aids used to assist with age-related visual problems are hand-held and may therefore be difficult to handle for those with upper limb problems. Learning to use visual aids and equipment may require intact cognitive processing, and patients with cognitive difficulties following stroke may be unable to acquire such new skills. Thus, while health professionals tend to encourage the use of visual aids and equipment to assist patients with age-related visual problems, certain subgroups of patients with stroke may not benefit fully from such aids and equipment.

### Assessment and screening interventions

Appropriate assessment and screening may help encourage patients with stroke to participate more effectively in rehabilitation after stroke. For example, screening and ensuring that patients wear appropriate glasses for their needs during therapy may affect rehabilitation (Freeman 1988). This may be particularly important for patients with speech or cognitive problems who are unable to ensure that they wear the correct glasses (MacDiarmid 2007). Thus, very simple and low-cost screening may be particularly effective in improving rehabilitation outcomes in stroke patients with age-related eye problems.

## Why it is important to do this review

Age-related visual problems in older people are extremely common and diverse in nature. They can result in wide-ranging functional difficulties that adversely affect rehabilitation should a person also have a history of stroke. There are a wide variety of treatment and rehabilitation options for age-related visual problems and, while there is a large group of patients who have both stroke and age-related visual problems, we lack evidence of the effectiveness of interventions on functional ability. There is one recently published review of the literature relating to age-related visual problems in stroke (Wolter 2006). This review provides a broad overview of the literature relating to visual problems after stroke, but does not provide a rigorous, systematic analysis of outcomes of treatment interventions for age-related visual problems.

A high-quality systematic review of the existing evidence base is essential in order to determine the effectiveness of any treatment or management approaches for stroke patients with age-related visual problems . This will also facilitate appropriate planning and prioritisation of future primary research.

While other reviews address interventions aimed at stroke-related visual problems, such as visual field defects, eye movement disorders and visual perceptual problems (neglect, inattention), this review may include participants who have co-existing age-related and stroke-related visual problems, but the emphasis of the review is on the effect of interventions targeting the age-related visual problems of stroke patients.

# OBJECTIVES

## Research question

Do interventions for age-related visual problems improve functional ability following stroke?

## Specific objectives

1. To determine whether, in stroke patients with age-related visual problems:
   a. environmental modification is more effective than control, placebo or no intervention in improving functional ability in activities of daily living;
   b. activities of daily living training is more effective than control, placebo or no intervention in improving functional ability in activities of daily living;
   c. pharmacological interventions are more effective than control, placebo or no intervention in improving functional ability in activities of daily living;
   d. surgical interventions are more effective than control, placebo or no intervention in improving functional ability in activities of daily living;
   e. vision aids and equipment interventions are more effective than control, placebo or no intervention in improving functional ability in activities of daily living;
   f. assessment and screening interventions are more effective than control, placebo or no intervention in improving functional ability in activities of daily living.

2. To determine whether, in stroke patients with age-related visual problems:
   a. environmental modification is more effective than control, placebo or no intervention in improving secondary outcomes;
   b. activities of daily living training is more effective than control, placebo or no intervention in improving secondary outcomes;
   c. pharmacological interventions are more effective than control, placebo or no intervention in improving secondary outcomes;
   d. surgical interventions are more effective than control, placebo or no intervention in improving secondary outcomes;
   e. vision aids and equipment are more effective than control, placebo or no intervention in improving secondary outcomes;
   f. assessment and screening are more effective than control, placebo or no intervention in improving secondary outcomes.
3. To explore the relationship between patient characteristics and the effect of interventions aimed at improving functional abilities in activities of daily living, using subgroup analysis.
4. To make specific recommendations for future research into the effectiveness of interventions for age-related visual disorders in patients with stroke, based on a knowledge of the existing evidence base.

# METHODS

## Criteria for considering studies for this review

### Types of studies

Randomised controlled trials (RCT) and randomised controlled cross-over trials (we planned to analyse the first phase as a parallel-group trial).

### Types of participants

Adult participants (over 18 years of age) after stroke (using the World Health Organization (WHO) definition of stroke or a clinical definition if not specifically stated, i.e. signs and symptoms persisting longer than 24 hours). We did not limit participants to patients who have age-related visual problems as we anticipated that some interventions such as routine visual assessment may be aimed at the whole population of stroke patients. However, we also planned to include studies that only included stroke patients who have age-related visual problems such as AMD, diabetic retinopathy, glaucoma, cataracts and vascular problems. We planned to accept a clinical diagnosis of AMD, cataract, glaucoma or diabetic retinopathy. We planned to document the method of diagnosing the condition; the extent of visual acuity, visual field and other visual function loss and planned subgroup analysis to investigate the effect of no loss, partial loss or severe loss in each category. We excluded studies that included participants who have age-related visual problems but no stroke. We planned to include studies with participants who have stroke-related visual problems, assuming that the intervention is one that is specifically targeted at age-related vision problems. We planned to document the presence or absence and extent of stroke-related visual problems.

### Types of interventions

We planned to include any intervention that is specifically targeted at assessing, treating or correcting age-related visual problems, or improving the ability of the patient to cope with visual impairment. We anticipated that interventions would include: visual assessment and screening, visual aids and equipment (glasses, lighting, magnifiers, CCTV), surgery (e.g. cataract removal), drugs (e.g. for glaucoma and macular degeneration), training in activities of daily living and environmental modifications.

We planned to compare interventions with a no treatment, placebo or control intervention. We anticipated the following specific comparisons.

1. Environmental modification versus no treatment, placebo, control or usual care.
2. Activities in daily living training versus no treatment, placebo, control or usual care.
3. Pharmacological interventions versus no treatment, placebo, control or usual care.
4. Surgical interventions versus no treatment, placebo, control or usual care.
5. Visual aids and equipment versus no treatment, placebo, control or usual care.
6. Assessment and screening intervention versus usual care.

We classified interventions that use laser treatment as surgery for the purposes of this review.

### Types of outcome measures

If possible, we planned to assess outcome at the end of the intervention period and at a follow-up point (ideally six months after the completion of the intervention). Some of the interventions, such as long-term use of pharmacological interventions or visual aids, will not have an endpoint; in these cases we planned to assess outcome at a follow-up point after the start of the intervention (ideally six months after the start of the intervention).

#### *Primary outcomes*

##### Functional ability in activities of daily living

We included studies using the following validated scales: Barthel Activities of Daily Living (ADL) Index (Mahoney 1965), Functional Independence Measure (FIM) (Smith 1990), Modified Rankin Scale, Katz Index of Activities of Daily Living (Katz 1963) and Rehabilitation Activities Profile. If a study reported more than one of these functional ability scales, we planned to use the scale listed earliest in this list.

#### *Secondary outcomes*

##### Functional ability in extended activities of daily living

Nottingham Extended Activities of Daily Living scale, Lawton Instrumental Activities of Daily Living, Frenchay Activities Index (Holbrook 1983), Rivermead ADL Score.

##### Visual acuity

Snellen and LogMAR chart or equivalents.

#### Visual field

Data from visual field plots: we planned to include measures of the size or depth, or both, of the visual field loss and descriptions of type of visual field loss.

#### Visual function

We included contrast sensitivity data.

#### Balance

Berg Balance Scale (Berg 1989)), Functional Reach (Duncan 1990), Get Up and Go Test (Mathias 1986), Standing Balance Test, Step Test or other standardised balance measure. We would not include measures of weight distribution or postural sway during standing, as it is not possible for us to establish the relationship between ability to maintain balance and these outcomes.

#### Falls

Number of reported falls, Falls Efficacy Scale (Tinetti 1990).

#### Depression and anxiety

Hospital Anxiety and Depression Scale, Beck Depressive Inventory, General Health Questionnaire, Geriatric Depression Scale.

#### Discharge destination or residence after stroke

Dichotomous variable: discharged to previous place of residence, i.e. place of residence prior to stroke or discharged to alternative destination.

#### Quality of life and social isolation

EQ5D, Health-Related Quality of Life Scale, Quality of Well Being Scale, SF36.

#### Adverse events

Any reported adverse events excluding falls and deaths.

#### Death

## Search methods for identification of studies

See the 'Specialized register' section in the Cochrane Stroke Group module.

### Electronic searches

We searched the Cochrane Stroke Group Trials Register (3 March 2011), the Cochrane Eyes and Vision Group Trials Register (December 2009) and the following electronic bibliographic databases:

- MEDLINE (1950 to February 2011) (Appendix 1);
- The Cochrane Central Register of Controlled Trials (CENTRAL) 2011 Issue 1, part of *The Cochrane Library*. www.thecochranelibrary.com (accessed February 2011) (Appendix 2);
- EMBASE (1980 to February 2011) (Appendix 3);
- CINAHL (1982 to February 2011) (Appendix 4);
- AMED (1985 to February 2011);
- PsycINFO (1967 to February 2011);
- Dissertations & Theses (PQDT) database (1861 to February 2011);
- British Nursing Index (1985 to February 2011);
- PsycBITE (Psychological Database for Brain Impairment Treatment Efficacy, www.psycbite.com) (February 2011).

### Searching other resources

In an effort to identify further published, unpublished and ongoing trials, we:

1. searched the following registers of ongoing trials:
   - ClinicalTrials.gov (http://clinicaltrials.gov/) (February 2010);
   - Current Controlled Trials (www.controlled-trials.com) (February 2010);
   - Trials Central (www.trialscentral.org) (February 2010);
   - Stroke Trials Registry (www.strokecenter.org/trials/) (February 2010);
   - Health Service Research Projects in Progress (wwwcf.nlm.nih.gov/hsr_project/home_proj.cfm) (February 2010);
   - National Eye Institute Clinical Studies Database (http://clinicalstudies.info.nih.gov/cgi/protinstitute.cgi?NEI.0.html) (February 2010);
2. handsearched the following journals and conference proceedings:
   - *Australian Orthoptic Journal* (1959 to 2010);
   - *British Orthoptic Journal* (1939 to 2003);
   - *British and Irish Orthoptic Journal* (2004 to 2010);
   - International Strabismological Association (ISA) (1966 to 2010);
   - International Orthoptic Association (IOA) (www.liverpool.ac.uk/orthoptics/research/search.htm) (1967 to 2008);
   - Proceedings of Association for Research in Vision and Ophthalmology (www.arvo.org) (1969 to 2010);
   - Proceedings of the European Strabismological Association (ESA) (1969 to 2009);
3. performed citation tracking using Web of Science Cited Reference Search for all included studies;
4. searched the reference lists of included trials and review articles about vision after stroke;
5. contacted experts in the field (including authors of included trials and excluded studies identified as possible preliminary or pilot work).

We searched for trials in all languages and arranged translation of trials published in languages other than English.

## Data collection and analysis

One review author (CH) ran all the electronic searches, downloaded references into bibliographic software and removed duplicates. One review author (CH) excluded any titles which were obviously not related to stroke and vision. We obtained the abstracts for any references related to stroke and vision. Two review authors (CH and AP) independently considered each of these abstracts, excluded any studies which were clearly not RCTs or cross-over trials, and excluded any studies where the intervention was clearly not aimed at an age-related visual problem. We resolved any disagreements between review authors through discussion. We obtained the full papers for any studies included at this stage.

### Selection of studies

Two review authors (CH and AP) independently applied the selection criteria, considering and documenting the types of studies, types of participants, intervention, comparisons of intervention and outcome measures. Each review author classified each study as one to include or exclude. If there was disagreement between these two review authors, they reached consensus through discussion involving a third review author.

We planned to list any excluded studies that included participants with age-related visual problems and stroke in the Characteristics of excluded studies table, with the reason for exclusion. We did not list studies that were excluded because they included participants who had stroke-related visual problems (i.e. visual field defect, eye movement disorders, visual perceptual problems) but not age-related visual disorders, unless the two review authors agreed that there was a clear reason to do so.

### Data extraction and management

We planned to use a pre-designed form to extract data from the included studies. Two review authors planned to document the following independently.

- Methods: study design, method of randomisation.
- Participants: number of participants, inclusion criteria. We planned to document the type of age-related visual problem and the method of diagnosis. We planned to record the country of origin of participants.
- Interventions: description of interventions given to each treatment group including, if relevant, the duration, intensity, frequency or dose. We planned to classify the type of intervention as visual aids and equipment, surgery, drugs, activities of daily living training, environmental modification or assessment and screening. We planned to classify the type of control as no treatment, placebo, control or standard care. We planned to document the professional background of the person providing the intervention (e.g. occupational therapist, orthoptist).
- Outcomes: we planned to document the primary and secondary outcomes relevant to this review. Where a study had used a number of different methods of measuring the same outcome, we will planned to note the outcome to be used for any subsequent analysis.
- Notes: we planned to document any important confounding variables. If a study included more than two intervention groups, we planned to note the method of including these groups in any subsequent analysis.

In addition, the review authors planned to independently document, if data allowed, the following demographics of the included participants: age, gender, place of residence, type of stroke, side of stroke, time since stroke, presence of stroke-related visual field loss or eye movement disorder, initial functional ability and previous assessments or interventions for age-related visual problems.

The review authors planned to resolve any data extraction discrepancies through discussion.

### Assessment of risk of bias in included studies

We planned to assess risk of bias using The Cochrane Collaboration's 'Risk of bias' tool, as described in Chapter 8 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011), and by answering the following questions for each included study and documenting this within 'Risk of bias' tables.

#### *Was allocation adequately concealed?*

Studies with adequate concealment would include those which have used central randomisation at a site remote from the study; computerised allocation, in which records are in a locked readable file that can be accessible only after entering patient details; and the drawing of opaque envelopes. Studies with inadequate concealment would include those using an open list or table of random numbers, open computer systems or drawing of non-opaque envelopes. Studies with unclear concealment would include those with no or inadequate information in the report.

#### *Was knowledge of the allocated intervention adequately concealed from the outcome assessor?*

We would consider studies adequately concealed if the outcome assessor was masked and the report does not identify any unmasking. We would consider studies inadequately concealed if the outcome assessor was not masked or where the report clearly identifies that unmasking occurred during the study. We would document concealment as unclear if a study does not state whether or not an outcome assessor was masked or there is insufficient information to judge.

#### *Were incomplete outcome data adequately addressed?*

Studies adequately addressing incomplete outcome data would have: no missing outcome data; missing outcome data which are unlikely to be related to true outcome; missing outcome data which are balanced in numbers across intervention groups with similar reasons for missing data across groups; a reported effect size (difference in means or standardised difference in means) among missing outcomes which are insufficient to have clinical relevance to observed effect size; or missing data which have been imputed using appropriate methods. Studies inadequately addressing incomplete outcome data would either have: missing outcome data which are likely to be related to true outcome with either imbalance in numbers or reasons for missing data across intervention groups; a reported effect size (difference in means or standardised difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size; as-treated analysis done with substantial departure of the intervention received from that assigned at randomisation. We would document the addressing of incomplete outcome data as unclear if there is insufficient reporting to allow assessment, or if this is not addressed in the report.

#### *Was the study apparently free of other problems that could put it at a high risk of bias?*

We would assess a study as not free of bias if it has at least one important risk of bias such as a potential source of bias related to the specific study design used; an extreme baseline imbalance; a claim to have been fraudulent; or some other problem. If there is insufficient information or the information provided is unclear, we would document the risk of other bias as unclear.

We planned to produce a 'Risk of bias' summary figure to illustrate the potential biases within each of the included studies.

### Measures of treatment effect

For dichotomous variables, we planned to calculate the treatment effect using a fixed-effect model and reported as Peto odds ratios (OR) with 95% confidence intervals (CI). For continuous data, we planned to calculate the treatment effect using standardised mean differences (SMD) and 95% CI where studies used different scales for the assessment of the same outcome. We planned to use mean differences (MD) and 95% CI where studies had all used the same method of measuring outcome.

### Unit of analysis issues

The primary outcome of functional ability in activities of daily living, and secondary outcomes of functional ability in extended activities of daily living, visual acuity, visual field and visual function data, balance, falls, depression/anxiety, and quality of life and social isolation comprise either ordinal data from measurement scales, count data or continuous data, and we planned to analyse these as continuous variables.

Where reported outcomes have a scale where a lower value is indicative of a better outcome (e.g. count of number of falls, scale of depression/anxiety) we planned to multiple the reported values by -1, so that in all analyses a higher value will be indicative of a better outcome.

If studies report change values and the baseline value is available, we planned to calculate the value at follow-up (change value - baseline value). If studies reported change values and the baseline value is available, we planned to use these data in meta-analyses, but planned sensitivity analyses to investigate the effect of including these data.

We planned to analyse discharge destination, adverse events and death as dichotomous variables.

### Dealing with missing data

If an included study does not report a particular outcome, we planned not to include that study in the analyses of that outcome. If an included study has missing data (e.g. reports means but not standard deviations for the follow-up data) we planned to take logical steps to enter an assumed value. Such steps may have included estimating a standard deviation based on a reported standard error, or estimating a follow-up standard deviation based on a baseline value. We planned to do sensitivity analyses to investigate the effect of entering assumed values.

### Assessment of heterogeneity

We planned to determine heterogeneity using the $I^2$statistic. If the $I^2$ statistic was greater than 50% we would consider this to be substantial heterogeneity. If the $I^2$ statistic was less than or equal to 50% we would use a fixed-effect meta-analysis. If the $I^2$ statistic was greater than 50%, we would explore the individual trial characteristics to identify potential sources of heterogeneity, using pre-planned subgroup analyses. Where there is substantial heterogeneity, we would perform meta-analysis using both fixed-effect and random-effects modelling to assess sensitivity to the choice of modelling approach. If we find non-identical results, we would report the most conservative outcome.

### Assessment of reporting biases

We attempted to avoid reporting biases by using a comprehensive search strategy which included searching for unpublished studies and searching trials registers. We planned to carry out sensitivity analyses to explore the effect of publication type.

### Data synthesis

We planned that two review authors would independently extract data from the included trials. One review author would enter the data into the Review Manager software, RevMan 5.1 (RevMan 2011) and the other review author would check the entries. They would resolve any disagreements through discussion, with reference to the original report.

### Subgroup analysis and investigation of heterogeneity

We intended to explore heterogeneity by subgroup analyses to investigate the effect of:

- age (under 60 years, 60 years and over);
- gender (male, female);
- time after stroke (less than three months, less than six months, more than six months);
- type of age-related visual problems (macular degeneration, refractive error, cataracts, glaucoma, diabetic retinopathy);
- visual services/intervention received prior to stroke (e.g. regular eye assessment);
- severity of visual acuity loss (mild, moderate, severe);
- extent of visual field loss (absent, partial, severe);
- other visual function loss (presence, absence);
- side of stroke (left, right);
- presence of visual field loss after stroke (presence, absence);
- presence of eye movement disorders (presence/absence);
- presence of visual inattention/neglect (presence, absence);
- level of motor impairment (mild, moderate, severe);
- level of cognitive impairment (mild, moderate, severe);
- type of treatment (e.g. for surgery - cataract extraction for cataract, vitrectomy in diabetic retinopathy; for visual aids - stand magnifiers, telescopes; for assessment/screening - by orthoptist, occupational therapist, doctor).

We planned to use an established method for subgroup analyses (Deeks 2001).

### Sensitivity analysis

We intended to carry out sensitivity analysis to explore the effect of the following methodological features.

- Allocation concealment. We planned to reanalyse data, excluding trials with inadequate or unclear allocation concealment.
- Masking of outcome assessor. We planned to reanalyse data, excluding trials without or with unclear masking of outcome assessor.
- Missing outcome data. We planned to reanalyse the data, excluding trials with inadequate or unclear methods of dealing with missing outcome data.

- Other bias. We planned to reanalyse the data, excluding trials assessed as having other bias, or where it was unclear as to whether they have other bias.
- Type of intervention. We planned to reanalyse data, excluding trials where the classification of the type of intervention was uncertain.
- Publication type (peer-reviewed journal, conference abstract/ proceedings, doctoral dissertation). We planned to reanalyse data including only those trials from peer-reviewed journals.

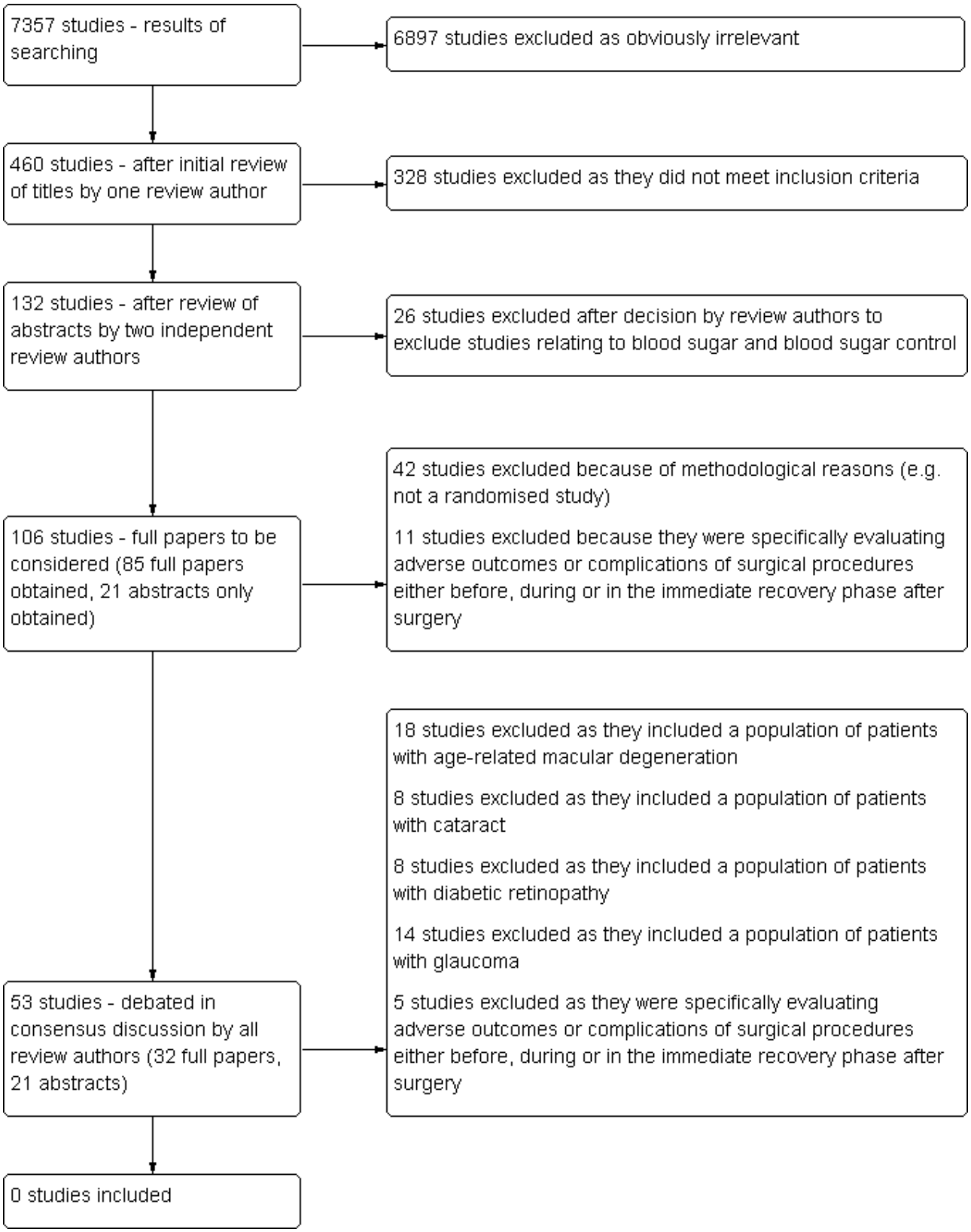
# RESULTS

## Description of studies

### Results of the search

The results of the search are summarised in Figure 1.

**Figure 1. Flow diagram illustrating the results of searching**




Our search strategy identified 7357 titles in the main databases. After elimination of duplicates and obviously irrelevant studies we were left with 1034 'possibly relevant' abstracts which covered all topics in this series of reviews. Four hundred and-sixty related to

age-related visual problems: we obtained these 460 abstracts and two review authors (CH and AP) evaluated their inclusion according to the criteria described in the protocol. At least one of the two review authors assessed 132 abstracts as 'include' or 'unsure'.

Twenty-six of these 132 abstracts were reports of studies specifically relating to blood sugar or blood sugar control. Discussion amongst the review authors led to the decision to exclude all of these studies, as these were focused on interventions to prevent visual problems which were beyond the scope of this review. This left 106 studies which we aimed to consider after viewing the full paper. We obtained the full paper of 85 of these and two review authors (CH and AP) met to discuss the inclusion of these 85 studies. The remaining 21 of the 106 studies we held abstracts for (and the intention at this stage was to continue to pursue full papers for these studies).

We excluded 53 of the 85 studies (full papers): 42 because of methodological reasons (e.g. not a randomised study) and 11 because they were specifically evaluating adverse outcomes or complications of surgical procedures either before, during or in the immediate recovery phase after surgery, and consequently did not have appropriate outcome measures.

We were unsure about the inclusion or exclusion of the remaining 32 studies (full papers). Twenty-four of these 32 studies were randomised controlled trials evaluating interventions in populations of people with age-related macular degeneration (12 studies), cataract (two studies), diabetic retinopathy (six studies) or glaucoma (four studies). We considered it possible that these studies could contain a sub-population of stroke patients. Discussion amongst the review authors led to the decision to exclude all these studies (see Discussion for further details of this decision). We had questions relating to the methods of the other eight of these 32 studies (e.g. they were not clearly randomised controlled trials) but, as all these studies either included the population of people with age-related macular degeneration (three studies) or glaucoma (three studies) or were evaluating adverse outcomes or complications of surgery (two studies), we also excluded all eight of these studies (in line with previous decisions made by the review authors).

In light of the decisions made to exclude studies evaluating the adverse outcomes or complications of surgical procedures and studies containing populations of people with age-related macular degeneration, cataract, diabetic retinopathy or glaucoma, rather than obtain the full papers of the remaining 21 studies which we were still pursuing, we re-evaluated the abstracts from these studies. We then excluded all 21 of these studies. This decision was made as the studies were evaluating surgical procedures (three studies) or included populations of people with age-related macular degeneration (three studies), cataract (six studies), diabetic retinopathy (two studies) or glaucoma (seven studies).

Therefore, we identified no studies for inclusion in this review.

### Included studies

We did not include any studies in this review.

### Excluded studies

We considered 106 studies and discussed them in detail (85 full papers and 21 abstracts). Of the 85 full papers we excluded 42 because of methodological or design reasons (e.g. not a randomised study). These are not listed in the Characteristics of excluded studies table. We excluded 11 studies because they were evaluating adverse outcome or complications of surgical procedures (Ahmed 2002; Akman 2004; Corke 1999; Jacobi 2000; Lira 2001; Morel 2006; Nicholson 2000; Ozdemir 2004; Schein 2000; Thompson 1986; Yuen 2007). Twenty-four were RCTs which were limited to one specific population of patients with age-related visual problems:

- 12 included a population of patients with age-related macular degeneration (Boyer 2009; Brown 2009; Busbee 2005; Ciulla 2002; Heier 2006; Lai 2009; Michels 2005; Pulido 2006; Regillo 2008; Reichel 2007; Rosenfield 2006; Slakter 2006);
- two included a population of patients with cataracts (Harwood 2005; Uusitalo 1999);
- six included a population of patients with diabetic retinopathy (DIRECT study 2008a; DIRECT study 2008b; DX-Retinopathy study 2006; MDR study 2005; PKS-DRS study 2005; READ-2 study 2009);
- four included a population of patients with glaucoma (Abdollahi 2002; García-Sánchez 2004; Pfeiffer 2002; Walters 1998).

We excluded eight studies because, although we originally had questions relating to the methods, we later agreed that these were evaluating adverse outcome or complications of surgical procedures or limited to one specific population of patients with age-related visual problems:

- two evaluated surgical procedures (Arraes 2006; Joussen 2009);
- three included a population of patients with age-related macular degeneration (Antoszyk 2008; MPS 1994; Siddiqui 2006);
- three included a population of patients with glaucoma (Anderson 2003; Erb 2005; Jampel 2005).

Following decisions made pertaining to the exclusion of studies evaluating adverse outcome or complications of surgical procedures, or limited to one specific population of patients with age-related visual problems, we reconsidered the abstracts of the 21 studies for which we had not obtained full papers. We excluded all these 21 studies because:

- three evaluated surgical procedures (Frezzotti 1982; Maze 1995; Unknown 2003);
- three included a population of patients with age-related macular degeneration (Koester 2006; Unknown 2001; Unknown 2006);
- six included a population of patients with cataract (Assia 1998; Davis 1989; Manabe 1994; Manners 1996; Patel 1998; Xu 2009);
- two included a population of patients with diabetic retinopathy (Kal 2006; Mikami 1985);
- seven included a population of patients with glaucoma (Bojic 1993; Caramazza 1999; Fleck 1991; Geijssen 1990; Kolomoitseva 1994; Ritch 2005; Valimaki 1999).

Note: we have not checked whether any individual references identified in the searches relate to the same study. It is therefore possible that some of our references to 'studies' in fact relate to the same clinical trial. As these are all excluded from the review we did not view this to be important.

### Risk of bias in included studies

We did not include any studies in this review.

### Effects of interventions

We found no evidence relating to the effect of interventions for age-related visual problems in the population of people with stroke.

## DISCUSSION

### Summary of main results

Following extensive and comprehensive searching, we identified no studies which evaluated the effect of interventions for age-related visual problems in the population of people with stroke. The searching identified:

- no studies which only included stroke patients;
- no studies which explicitly stated that stroke patients were included as a subgroup of patients with an age-related problem;
- 24 studies which might include stroke patients as a subgroup of patients with an age-related problem (either age-related macular degeneration, cataract, diabetic retinopathy or glaucoma). Following discussion amongst review authors, we excluded these studies from the review.

We were not explicit in our protocol as to whether or not we would include studies which had a subgroup of stroke patients as part of a larger trial of an intervention for a specific age-related visual problem. All review authors debated whether to:

- exclude all studies which might include stroke patients as a subgroup of patients with age-related visual problem, or
- contact the authors of all the studies which might include stroke patients and ask if they included stroke patients, and whether data were available for this subgroup.

The review authors unanimously agreed that these studies should all be excluded. The key reasons for this were as follows.

- Age-related visual problems (for the general population) are well covered by Cochrane systematic reviews (there are 14 Cochrane reviews relating to age-related macular degeneration (AMD); eight for cataract; five for diabetic retinopathy; 12 for glaucoma - see Table 1). If there was to be subgroup analysis for stroke patients, the review authors felt that this should most correctly be within these condition-specific Cochrane reviews (although none of them do currently include subgroup analysis of patients with stroke).

- Our search strategy was designed to identify studies specific to 'stroke' and 'age-related visual problems'. This search strategy was not designed to identify all trials to do with AMD, cataract, diabetic retinopathy or glaucoma. Subsequently, further extensive searching would be required if studies which might include stroke patients as a subgroup were to be included.
- Managing the subgroup analyses that would arise from the inclusion of condition-specific randomised controlled trials (RCTs) which had subgroups of stroke patients within this stroke review would be very difficult as there could potentially be a really wide range of interventions and conditions, making the information difficult to synthesise and to access.
- To make a clinical decision about the treatment of an age-related visual problem in a patient who also has stroke, the best - and most comprehensive - evidence to look at is arguably always going to be the Cochrane review specific to that visual problem.

### Potential biases in the review process

As there are no studies included in this review, any potential biases arise from the methods of searching and selection of studies. There are two key areas which may potentially have introduced bias into this review.

#### Decision to exclude RCTs which might include stroke patients as a subgroup of patients with age-related visual problems

We failed to recognise adequately that our proposed research questions and search strategy would identify RCTs designed to evaluate the effects of interventions to treat or prevent specific age-related visual problems which may potentially include subgroups of patients with stroke. We failed to develop a protocol designed to explicitly deal with such RCTs. As a result, the decision as to whether to include or exclude RCTs we identified which might include stroke patients as a subgroup had to be made with knowledge of the search results. Knowledge of the potential workload and time implications which would have been associated with inclusion of these studies may have biased the opinions of the review authors who made this decision. However, the decision was unanimously agreed by all 11 review authors, only two of whom (AP and CH) would have been directly affected by the increased workload had the studies been included. We feel that the arguments made for exclusion of this group of studies are strong and valid, and we are confident that this was the correct decision.

#### Decision not to pursue full papers or further information from authors for some studies

At the time of the decision relating to the exclusion of RCTs which might include stroke patients as a subgroup we were still pursuing full papers to enable us to assess 21 studies, and had questions relating to the design of eight studies. After the decision was made to exclude the RCTs which might include stroke patients, we decided to reappraise the available abstracts or titles, or both, of these 29 studies rather than to continue pursuing full papers. This led to the exclusion of all 29 studies. Arguably we ought to have obtained the full papers for these studies. However, we felt that the selection criteria had been sufficiently clarified to enable us to reapply the selection criteria based on the limited information available on these studies. We are confident that we have not, as a result of lack of information, excluded any studies which met the inclusion criteria.

#### Clinical relevance of review questions

As this review has resulted in a complex and time-consuming search process which has not identified any relevant studies we feel it is appropriate to consider the clinical relevance of the questions addressed in this review. This is important in order to make decisions about the future of this Cochrane review - specifically whether time ought to be spent regularly updating the searches.

The issues that this review sought to address arose from discussions amongst a multidisciplinary group of clinicians and are described in the Background section. The first issue related to whether clinicians could apply the evidence base for specific age-related visual problems to the population of patients who also

had stroke. We acknowledged that currently health professionals rely on evidence arising from subgroup analyses of systematic reviews of the wider population of patients with age-related visual problems, but argued that the complexity of the relationship between these problems justified the need for a systematic review specific to the population of patients with both age-related visual problems and stroke. In retrospect we now accept that this argument was largely erroneous and we recognise that evidence arising from subgroup analyses of systematic reviews specific to particular age-related visual problems is likely to provide the most robust evidence. We also recognise that such subgroup analyses will be most effectively synthesised and made accessible within Cochrane reviews relating to those specific age-related conditions. Nevertheless, our motivation for pursuing this question arose largely out of a clinical interest in the potential impact of interventions for age-related visual problems on outcomes which are particularly relevant to people with stroke, such as functional activities of daily living and ability to participate successfully in rehabilitation. We believe this remains a clinically relevant and patient-centred research question, and urge authors of Cochrane reviews relating to age-related visual problems to consider subgroup analysis to explore the effect of co-morbid conditions including stroke and to include patient-centred outcomes such as activities of daily living, depression, anxiety, discharge destination and quality of life.

The second issue which this review sought to address related more specifically to whether health professionals adequately identified and addressed age-related visual problems in patients with stroke. This included specific issues such as whether health professionals ensured that patients had and used appropriate corrective glasses during rehabilitation. Although we found no randomised clinical trials addressing this issue we believe that this remains a clinically relevant question, which was successfully addressed within the search strategy for this review. However, as the specific clinical relevance of this question arguably relates to interventions which stroke health professionals are likely to deliver (rather than interventions which eye-care professionals, such as ophthalmologists and optometrists, are qualified to deliver) we propose that the interventions originally identified as relevant to this review are too broad, as they include pharmacological and surgical interventions which would need specialist eye-care professionals to deliver. Consequently, we propose that for future updates of this review the interventions covered should be reduced to assessment and screening strategies to identify patients with age-related visual problems and appropriate interventions to compensate or substitute for the presence of age-related visual problems such as environmental modifications, activities of daily living training, vision aids and equipment interventions. We propose that the review objectives and inclusion criteria are amended accordingly prior to any future updates.

# AUTHORS' CONCLUSIONS

## Implications for practice

There are no implications for practice arising from this review. Evidence relating to the management of patients (from the general population) with age-related visual problems is available from other Cochrane reviews, and is likely to be the best evidence available for making treatment decisions about individual patients. Health professionals will have to use clinical judgement and expertise to determine the possible impact of treatment for any age-related visual problem in an individual who has had a stroke.

## Implications for research

### Are randomised controlled trials required?

Randomised controlled trials (RCTs) are required to determine the effect of interventions delivered by health professionals working within stroke-care settings to improve the identification or management of age-related visual problems. We propose that these should address the impact of interventions including environment modification, activities of daily living training, vision aids and equipment interventions, and assessment and screening interventions, and include outcomes relevant to functional activities of daily living.

### Are other primary research studies required?

Other primary research studies may be required in preparation for well-designed RCTs.

### Are further systematic reviews required?

We recommend that future updates of Cochrane systematic reviews addressing specific interventions for age-related visual problems and low vision rehabilitation should consider subgroup analysis to explore the effect of the intervention on the population of people with stroke. We also recommend that these reviews consider patient-centred outcomes such as functional activities of daily living and quality of life.

We recommend that the objectives and selection criteria for this Cochrane review are amended and clarified prior to any updates of this review. We also propose that for future updates the searching is, in the first instance, restricted to updates from the Cochrane Central Register of Controlled Trials (CENTRAL), and more extensive searching is only performed when we have evidence of active research in this field.

# ACKNOWLEDGEMENTS

We would like to thank Brenda Thomas and Marion Kelt for their help in developing the search strategy.

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# CHARACTERISTICS OF STUDIES

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

| Study | Reason for exclusion |
|---|---|
| Abdollahi 2002 | Design: RCT<br>Population: glaucoma |
| Ahmed 2002 | Study evaluates adverse outcome or complications of surgical procedure |
| Akman 2004 | Study evaluates adverse outcome or complications of surgical procedure |
| Anderson 2003 | Design: secondary analysis of RCT<br>Population: glaucoma |
| Antoszyk 2008 | Design: follow-up data from RCT<br>Population: AMD |
| Arraes 2006 | Design: unclear (translation required)<br>Intervention: surgery<br>Outcomes: safety |
| Assia 1998 | Design: unclear (further information required) |

| Study | Reason for exclusion |
|---|---|
| | Population: cataract<br>Notes: abstract only |
| Bojic 1993 | Design: RCT (more information required)<br>Population: glaucoma<br>Notes: abstract only |
| Boyer 2009 | Design: RCT<br>Population: AMD |
| Brown 2009 | Design: RCT<br>Population: AMD |
| Busbee 2005 | Design: RCT<br>Population: AMD |
| Caramazza 1999 | Design: RCT (more information required)<br>Population: glaucoma<br>Notes: abstract only, translation required |
| Ciulla 2002 | Design: RCT<br>Population: AMD |
| Corke 1999 | Study evaluates adverse outcome or complications of surgical procedure |
| Davis 1989 | Design: RCT<br>Population: cataract<br>Notes: abstract only |
| DIRECT study 2008a | Design: RCT<br>Population: diabetic retinopathy |
| DIRECT study 2008b | Design: RCT<br>Population: diabetic retinopathy |
| DX-Retinopathy study 2006 | Design: RCT<br>Population: diabetic retinopathy |
| Erb 2005 | Design: unclear (requires translation)<br>Population: glaucoma |
| Fleck 1991 | Design: RCT<br>Population: glaucoma<br>Notes: abstract only |

| Study | Reason for exclusion |
|---|---|
| Frezzotti 1982 | Design: unsure (more information required)<br>Intervention: surgery<br>Notes: no abstract, more information required |
| García-Sánchez 2004 | Design: RCT<br>Population: glaucoma |
| Geijssen 1990 | Design: unsure (more information required)<br>Population: glaucoma<br>Notes: no abstract, more information required |
| Harwood 2005 | Design: RCT<br>Population: cataract |
| Heier 2006 | Design: RCT<br>Population: AMD |
| Jacobi 2000 | Study evaluates adverse outcome or complications of surgical procedure |
| Jampel 2005 | Design: review of RCT data<br>Population: glaucoma |
| Joussen 2009 | Design: unclear - does this include a report of a RCT?<br>Intervention: surgery |
| Kal 2006 | Design: unclear (unlikely to be RCT)<br>Population: diabetes<br>Notes: no abstract, more information required |
| Koester 2006 | Design: unclear (more information required)<br>Population: AMD<br>Notes: abstract only |
| Kolomoitseva 1994 | Design: unclear (more information required)<br>Population: glaucoma<br>Notes: abstract only |
| Lai 2009 | Design: RCT<br>Population: AMD |
| Lira 2001 | Study evaluates adverse outcome or complications of surgical procedure |
| Manabe 1994 | Design: unclear (more information required)<br>Population: cataract |

| Study | Reason for exclusion |
|---|---|
| | Notes: abstract only |
| Manners 1996 | Design: RCT<br>Population: cataract<br>Notes: abstract only |
| Maze 1995 | Design: unsure (more information required)<br>Intervention: surgery<br>Notes: no abstract, more information required |
| MDR study 2005 | Design: RCT<br>Population: diabetic retinopathy |
| Michels 2005 | Design: RCT<br>Population: AMD |
| Mikami 1985 | Design: unsure (more information required)<br>Population: diabetic retinopathy<br>Notes: no abstract, more information required |
| Morel 2006 | Study evaluates adverse outcome or complications of surgical procedure |
| MPS 1994 | Design: RCT. Unclear relating to eligibility criteria for people with stroke (were they excluded?)<br>Population: AMD |
| Nicholson 2000 | Study evaluates adverse outcome or complications of surgical procedure |
| Ozdemir 2004 | Study evaluates adverse outcome or complications of surgical procedure |
| Patel 1998 | Design: RCT<br>Population: cataract<br>Notes: abstract only |
| Pfeiffer 2002 | Design: RCT<br>Population: glaucoma |
| PKS-DRS study 2005 | Design: RCT<br>Population: diabetic retinopathy |
| Pulido 2006 | Design: RCT<br>Population: AMD |
| READ-2 study 2009 | Design: RCT<br>Population: diabetic retinopathy |
| Regillo 2008 | Design: RCT |

| Study | Reason for exclusion |
|---|---|
| | Population: AMD |
| Reichel 2007 | Design: RCT<br>Population: AMD |
| Ritch 2005 | Design: review<br>Population: glaucoma<br>Notes: abstract only |
| Rosenfield 2006 | Design: RCT<br>Population: AMD |
| Schein 2000 | Study evaluates adverse outcome or complications of surgical procedure |
| Siddiqui 2006 | Design: possibly reports 2 RCTs<br>Population: AMD |
| Slakter 2006 | Design: RCT<br>Population: AMD |
| Thompson 1986 | Study evaluates adverse outcome or complications of surgical procedure |
| Unknown 2001 | Design: report of 2 RCTs (more information required)<br>Population: AMD<br>Notes: abstract only |
| Unknown 2003 | Design: report of RCT (more information required)<br>Intervention: surgery (laser)<br>Notes: abstract only |
| Unknown 2006 | Design: unclear (more information required)<br>Population: AMD<br>Notes: abstract only |
| Uusitalo 1999 | Design: RCT<br>Population: cataract |
| Valimaki 1999 | Design: unsure (more information required)<br>Population: glaucoma<br>Notes: no abstract, more information required |
| Walters 1998 | Design: RCT<br>Population: glaucoma |
| Xu 2009 | Design: unclear |

| Study | Reason for exclusion |
|---|---|
| | Population: cataract<br><br>Notes: abstract only |
| Yuen 2007 | Study evaluates adverse outcome or complications of surgical procedure |

AMD: age-related macular degeneration
RCT: randomised controlled trial

## ADDITIONAL TABLES

**Table 1. Summary of Cochrane reviews of age-related visual problems**

| Cochrane review | Age-related visual problem | Intervention studied |
|---|---|---|
| Eandi 2008 | AMD | Macular translocation |
| Reddy 2006 | AMD | Antiangiogenic therapy with interferon alfa |
| Evans 2008 | AMD | Antioxidant vitamin and mineral supplements for prevention |
| Wormald 2007 | AMD | Photodynamic therapy |
| Gehlbach 2009 | AMD | Statins |
| Vedula 2008 | AMD | Antiangiogenic therapy with anti-vascular endothelial growth factor |
| Evans 2006 | AMD | Antioxidant vitamin and mineral supplements for slowing the progression |
| Evans 1999 | AMD | Ginkgo biloba extract |
| Virgili 2007 | AMD | Laser photocoagulation |
| Parodi 2009 | AMD | Laser treatment of drusen to prevent progression |
| Giansanti 2009 | AMD | Submacular surgery |
| Casparis 2009 | AMD | Surgery for cataracts |
| Geltzer 2007 | AMD | Surgical implantation of steroids with antiangiogenic characteristics |
| Evans 2010 | AMD | Radiotherapy |
| Fedorowicz 2011 | Cataract | Day care versus in-patient surgery |
| Leyland 2006 | Cataract | Multifocal versus monofocal intraocular lenses |
| Sivaprasad 2004 | Cataract | Non-steroidal anti-inflammatory agents after cataract surgery |
| Alhassan 2008 | Cataract | Peribulbar versus retrobulbar anaesthesia for cataract surgery |
| Keay 2009 | Cataract | Routine preoperative medical testing for cataract surgery |

**Table 1. Summary of Cochrane reviews of age-related visual problems** *(Continued)*

| | | |
|---|---|---|
| Davison 2007 | Cataract | Sub-tenon's anaesthesia versus topical anaesthesia for cataract surgery |
| Do 2008 | Cataract | Surgery for post-vitrectomy cataract |
| Riaz 2006 | Cataract | Surgical interventions |
| Smith 2011 | Diabetic retinopathy | Anti-vascular endothelial growth factor |
| Parravano 2009 | Diabetic retinopathy | Antiangiogenic therapy with anti-vascular endothelial growth factor |
| Grover 2008 | Diabetic retinopathy | Intravitreal steroids for macular edema |
| Lopes 2008 | Diabetic retinopathy | Pentoxifylline |
| Lopes 2008a | Diabetic retinopathy | Vitamin C and superoxide dismutase |
| Law 2007 | Glaucoma | Acupuncture |
| Minckler 2006 | Glaucoma | Aqueous shunts |
| Kirwan 2009 | Glaucoma | Beta radiation for glaucoma surgery |
| Sycha 2010 | Glaucoma | Interventions for normal tension glaucoma |
| Wilkins 2005 | Glaucoma | Intraoperative mitomycin C for glaucoma surgery |
| Rolim 2007 | Glaucoma | Laser trabeculoplasty |
| Friedman 2006 | Glaucoma | Lens extraction |
| Vass 2007 | Glaucoma | Medical interventions |
| Burr 2004 | Glaucoma | Medical versus surgical interventions |
| Sena 2010 | Glaucoma | Neuroprotection |
| Wormald 2001 | Glaucoma | Post-operative 5-fluorouracil |
| Hatt 2006 | Glaucoma | Screening for prevention of optic nerve damage |

AMD: age-related macular degeneration

# APPENDICES

## Appendix 1. MEDLINE search strategy

To avoid duplication of effort we designed broad search strategies for the major databases sensitive enough to cover the scope of a series of three Cochrane reviews of interventions for different visual disorders following stroke. We devised the following search strategy, using a combination of controlled vocabulary (MeSH) and free-text terms, for MEDLINE and modified it to suit other databases.

### MEDLINE (Ovid)

1. cerebrovascular disorders/ or exp basal ganglia cerebrovascular disease/ or exp brain ischemia/ or exp carotid artery diseases/ or exp intracranial arterial diseases/ or exp intracranial arteriovenous malformations/ or exp "intracranial embolism and thrombosis"/ or exp intracranial hemorrhages/ or stroke/ or exp brain infarction/ or vasospasm, intracranial/ or vertebral artery dissection/
2. (stroke or poststroke or post-stroke or cerebrovasc$ or brain vasc$ or cerebral vasc$ or cva$ or apoplex$ or SAH).tw.

3. ((brain$ or cerebr$ or cerebell$ or intracran$ or intracerebral) adj5 (isch?emi$ or infarct$ or thrombo$ or emboli$ or occlus$)).tw.
4. ((brain$ or cerebr$ or cerebell$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage$ or hemorrhage$ or haematoma $ or hematoma$ or bleed$)).tw.
5. hemiplegia/ or exp paresis/
6. (hemipleg$ or hemipar$ or paresis or paretic).tw.
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp eye/
9. exp visually impaired persons/
10. exp ocular physiological processes/ or exp diagnostic techniques, ophthalmological/
11. Optometry/ or Orthoptics/
12. eye diseases/ or vision disorders/ or eye manifestations/ or blindness/ or diplopia/
13. vision, binocular/ or vision, monocular/ or exp visual acuity/ or visual fields/ or vision, low/ or perimetry/ or ophthalmology/ or vision screening/
14. exp eye diseases, hereditary/ or exp eye hemorrhage/ or exp lacrimal apparatus diseases/ or exp lens diseases/ or exp ocular hypertension/ or exp ocular hypotension/ or exp ocular motility disorders/ or exp optic nerve diseases/ or exp orbital diseases/ or exp pupil disorders/ or exp refractive errors/ or exp retinal diseases/ or exp blindness, cortical/ or exp hemianopsia/ or exp vitreoretinopathy, proliferative/ or exp vitreous detachment/ or scotoma/
15. abducens nerve/ or oculomotor nerve/ or trochlear nerve/
16. (nystagmus or smooth pursuit or saccades or depth perception or stereopsis or gaze disorder$ or retinal or retinopathy or macular degeneration or glaucoma or cataract$ or ophthalmol$ or optic nerve).tw.
17. (intranuclear ophthalmoplegia or parinaud's syndrome or weber's syndrome or skew deviation or conjugate deviation or (one adj3 half syndrome)).tw
18. ((visual$ or vision or eye or eyes or eyesight or sight) adj5 (problem$ or disorder$ or impair$ or disabilit$ or loss or disease$ or defect $ or manifestation$ or screening or test$ or examination$)).tw.
19. (hemianop$ or blindness or low vision or refractive errors or vitreoretinopathy or vitreous detachment or scotoma or diplopia or optometr$ or ocular or orthoptic$).tw.
20. (oscillopsia or visual tracking or fresnel prism$).tw
21. ((III or IV or VI or third or fourth or sixth) adj3 nerve palsy).tw
22. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21
23. 7 and 22
24. Randomized Controlled Trials as Topic/
25. random allocation/
26. Controlled Clinical Trials as Topic/
27. control groups/
28. clinical trials as topic/ or clinical trials, phase i as topic/ or clinical trials, phase ii as topic/ or clinical trials, phase iii as topic/ or clinical trials, phase iv as topic/
29. double-blind method/
30. single-blind method/
31. Placebos/
32. placebo effect/
33. cross-over studies/
34. Multicenter Studies as Topic/
35. Therapies, Investigational/
36. Drug Evaluation/
37. Research Design/
38. Program Evaluation/
39. evaluation studies as topic/
40. randomized controlled trial.pt.
41. controlled clinical trial.pt.
42. (clinical trial or clinical trial phase i or clinical trial phase ii or clinical trial phase iii or clinical trial phase iv).pt.
43. multicenter study.pt.
44. (evaluation studies or comparative study).pt.
45. random$.tw.
46. (controlled adj5 (trial$ or stud$)).tw.
47. (clinical$ adj5 trial$).tw.
48. ((control or treatment or experiment$ or intervention) adj5 (group$ or subject$ or patient$)).tw.
49. (quasi-random$ or quasi random$ or pseudo-random$ or pseudo random$).tw.
50. ((multicenter or multicentre or therapeutic) adj5 (trial$ or stud$)).tw.
51. ((control or experiment$ or conservative) adj5 (treatment or therapy or procedure or manage$)).tw.
52. ((singl$ or doubl$ or tripl$ or trebl$) adj5 (blind$ or mask$)).tw.
53. (coin adj5 (flip or flipped or toss$)).tw.
54. latin square.tw.

55. versus.tw.
56. (cross-over or cross over or crossover).tw.
57. placebo$.tw.
58. sham.tw.
59. (assign$ or alternate or allocat$ or counterbalance$ or multiple baseline).tw.
60. controls.tw.
61. (treatment$ adj6 order).tw.
62. or/24-61
63. 23 and 62
64. exp child/ or exp infant/
65. (neonat$ or child or children or childhood or juvenile or infant or toddler).tw
66. exp neoplasms/
67. (cancer$ or carcinoma$ or tumor$ or tumour$ or neoplasm$).tw
68. case reports.pt or case report$.tw
69. 64 or 65 or 66 or 67 or 68
70. 63 not 69
71. limit 70 to humans

## Appendix 2. The Cochrane Central Register of Controlled Trials (CENTRAL) search strategy

1. MeSH descriptor Cerebrovascular Disorders, this term only
2. MeSH descriptor Basal Ganglia Cerebrovascular Disease explode all trees
3. MeSH descriptor Brain Ischemia explode all trees
4. MeSH descriptor Carotid Artery Diseases explode all trees
5. MeSH descriptor Intracranial Arterial Diseases explode all trees
6. MeSH descriptor Intracranial Arteriovenous Malformations explode all trees
7. MeSH descriptor Intracranial Embolism and Thrombosis explode all trees
8. MeSH descriptor Intracranial Hemorrhages explode all trees
9. MeSH descriptor Stroke explode all trees
10. MeSH descriptor Brain Infarction explode all trees
11. MeSH descriptor Vasospasm, Intracranial, this term only
12. MeSH descriptor Vertebral Artery Dissection, this term only
13. stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* or cerebral vasc* or cva* or apoplex* or SAH
14. (brain* or cerebr* or cerebell* or intracran* or intracerebral) near/5 (isch?emi* or infarct* or thrombo* or emboli* or occlus*)
15. (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) near/5 (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*)
16. MeSH descriptor Hemiplegia, this term only
17. MeSH descriptor Paresis explode all trees
18. hemipleg* or hemipar* or paresis or paretic 1735
19. (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18)
20. MeSH descriptor Eye explode all trees
21. MeSH descriptor Visually Impaired Persons explode all trees
22. MeSH descriptor Ocular Physiological Processes explode all trees
23. MeSH descriptor Diagnostic Techniques, Ophthalmological explode all trees
24. MeSH descriptor Optometry explode all trees
25. MeSH descriptor Orthoptics explode all trees
26. MeSH descriptor Eye Diseases, this term only
27. MeSH descriptor Vision Disorders, this term only
28. MeSH descriptor Eye Manifestations, this term only
29. MeSH descriptor Blindness, this term only
30. MeSH descriptor Diplopia explode all trees
31. MeSH descriptor Vision, Binocular, this term only
32. MeSH descriptor Vision, Monocular, this term only
33. MeSH descriptor Visual Acuity explode all trees
34. MeSH descriptor Visual Fields, this term only
35. MeSH descriptor Vision, Low, this term only

36. MeSH descriptor Perimetry, this term only
37. MeSH descriptor Ophthalmology, this term only
38. MeSH descriptor Vision Screening, this term only
39. MeSH descriptor Eye Diseases, Hereditary explode all trees
40. MeSH descriptor Eye Hemorrhage explode all trees
41. MeSH descriptor Lacrimal Apparatus Diseases explode all trees
42. MeSH descriptor Lens Diseases explode all trees
43. MeSH descriptor Ocular Hypertension explode all trees
44. MeSH descriptor Ocular Hypotension explode all trees
45. MeSH descriptor Ocular Motility Disorders explode all trees
46. MeSH descriptor Optic Nerve Diseases explode all trees
47. MeSH descriptor Orbital Diseases explode all trees
48. MeSH descriptor Pupil Disorders explode all trees
49. MeSH descriptor Refractive Errors explode all trees
50. MeSH descriptor Retinal Diseases explode all trees
51. MeSH descriptor Blindness, Cortical explode all trees
52. MeSH descriptor Hemianopsia explode all trees
53. MeSH descriptor Vitreoretinopathy, Proliferative explode all trees
54. MeSH descriptor Vitreous Detachment explode all trees
55. MeSH descriptor Scotoma, this term only
56. MeSH descriptor Abducens Nerve, this term only
57. MeSH descriptor Oculomotor Nerve, this term only
58. MeSH descriptor Trochlear Nerve, this term only
59. nystagmus or smooth pursuit or saccades or depth perception or stereopsis or gaze disorder* or retinal or retinopathy or macular degeneration or glaucoma or cataract* or ophthalmol* or optic nerve
60. intranuclear ophthalmoplegia or parinaud's syndrome or weber's syndrome or skew deviation or conjugate deviation
61. one near/3 half syndrome
62. (visual* or vision or eye or eyes or eyesight or sight) near/5 (problem* or disorder* or impair* or disabilit* or loss or disease* or defect* or manifestation* or screening or test* or examination*)
63. hemianop* or blindness or low vision or refractive errors or vitreoretinopathy or vitreous detachment or scotoma or diplopia or optometr* or ocular or orthoptic*
64. oscillopsia or visual tracking or fresnel prism*
65. III or IV or VI or third or fourth or sixth near/3 nerve palsy
66. (#20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65)
67. (#19 AND #66)
68. MeSH descriptor Infant explode all trees
69. MeSH descriptor Child explode all trees
70. neonat* or child or children or childhood or juvenile or infan* or toddler
71. MeSH descriptor Neoplasms explode all trees
72. cancer* or carcinoma* or tumor* or tumour* or neoplasm*
73. (#68 OR #69 OR #70 OR #71 OR #72)
74. (#67 AND NOT #73)

## Appendix 3. EMBASE search strategy

1. cerebrovascular disease/ or basal ganglion hemorrhage/ or cerebral artery disease/ or cerebrovascular accident/ or stroke/ or exp carotid artery disease/ or exp brain hematoma/ or exp brain hemorrhage/ or exp brain infarction/ or exp brain ischemia/ or exp cerebrovascular malformation/ or exp intracranial aneurysm/ or exp occlusive cerebrovascular disease/ or stroke unit/ or stroke patient.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
2. (stroke or poststroke or post-stroke or cerebrovasc$ or brain vasc$ or cerebral vasc$ or cva$ or apoplex$ or SAH).tw.
3. ((brain$ or cerebr$ or cerebell$ or intracran$ or intracerebral) adj5 (isch?emi$ or infarct$ or thrombo$ or emboli$ or occlus$)).tw.
4. ((brain$ or cerebr$ or cerebell$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage$ or hemorrhage$ or haematoma $ or hematoma$ or bleed$)).tw.

5. hemiparesis/ or hemiplegia/ or paresis/
6. (hemipleg$ or hemipar$ or paresis or paretic).tw.
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp eye/ or exp eye disease/ or exp visual disorder/
9. exp visual system examination/ or eye examination/ or exp vision test/
10. exp ophthalmology/ or orthoptics/ or exp visual system/ or exp visual system function/ or depth perception/
11. exp visual aid/
12. abducens nerve/ or oculomotor nerve/ or trochlear nerve/
13. (nystagmus or smooth pursuit or saccades or depth perception or stereopsis or gaze disorder$ or retinal or retinopathy or macular degeneration or glaucoma or cataract$ or ophthalmol$ or optic nerve).tw.
14. (intranuclear ophthalmoplegia or parinaud's syndrome or weber's syndrome or skew deviation or conjugate deviation or (one adj3 half syndrome)).tw.
15. ((visual$ or vision or eye or eyes or eyesight or sight) adj5 (problem$ or disorder$ or impair$ or disabilit$ or loss or disease$ or defect $ or manifestation$ or screening or test$ or examination$)).tw.
16. (hemianop$ or blindness or low vision or refractive errors or vitreoretinopathy or vitreous detachment or scotoma or diplopia or optometr$ or ocular or orthoptic$).tw.
17. (oscillopsia or visual tracking or fresnel prism$).tw.
18. ((III or IV or VI or third or fourth or sixth) adj3 nerve palsy).tw.
19. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20. 7 and 19
21. Randomized Controlled Trial/
22. Randomization/
23. Controlled Study/
24. control group/
25. clinical trial/ or phase 1 clinical trial/ or phase 2 clinical trial/ or phase 3 clinical trial/ or phase 4 clinical trial/ or controlled clinical trial/
26. Crossover Procedure/
27. Double Blind Procedure/
28. Single Blind Procedure/ or triple blind procedure/
29. latin square design/
30. Parallel Design/
31. placebo/
32. Multicenter Study/
33. experimental design/ or experimental study/ or quasi experimental study/
34. experimental therapy/
35. drug comparison/ or drug dose comparison/
36. drug screening/
37. Evaluation/ or "Evaluation and Follow Up"/ or evaluation research/ or clinical evaluation/
38. Methodology/
39. "types of study"/
40. research subject/
41. Comparative Study/
42. random$.tw.
43. (controlled adj5 (trial$ or stud$)).tw.
44. (clinical$ adj5 trial$).tw.
45. ((control or treatment or experiment$ or intervention) adj5 (group$ or subject$ or patient$)).tw.
46. (quasi-random$ or quasi random$ or pseudo-random$ or pseudo random$).tw.
47. ((multicenter or multicentre or therapeutic) adj5 (trial$ or stud$)).tw.
48. ((control or experiment$ or conservative) adj5 (treatment or therapy or procedure or manage$)).tw.
49. ((singl$ or doubl$ or tripl$ or trebl$) adj5 (blind$ or mask$)).tw.
50. (coin adj5 (flip or flipped or toss$)).tw.
51. latin square.tw.
52. versus.tw.
53. (cross-over or cross over or crossover).tw.
54. placebo$.tw.
55. sham.tw.
56. (assign$ or alternate or allocat$ or counterbalance$ or multiple baseline).tw.
57. controls.tw.
58. (treatment$ adj6 order).tw.
59. or/21-58
60. 20 and 59
61. exp child/ or exp newborn/
62. (neonat$ or child or children or childhood or juvenile or infant or toddler).tw.

63. exp Neoplasm/
64. (cancer$ or carcinoma$ or tumor$ or tumour$ or neoplasm$).tw.
65. case report/ or case study/
66. 61 or 62 or 63 or 64 or 65
67. 60 not 66
68. limit 67 to human

## Appendix 4. CINAHL search strategy

1. MH "Cerebrovascular Disorders+" or MH "stroke patients" or MH "stroke units"
2. TI ( stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* ) or AB ( stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* )
3. TI ( brain* or cerebr* or cerebell* or intracran* or intracerebral ) or AB ( brain* or cerebr* or cerebell* or intracran* or intracerebral )
4. TI ( ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus* ) or AB ( ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus* )
5. S3 and S4
6. TI ( brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachmoid ) or AB ( brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid )
7. TI ( haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed* ) or AB ( haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed* )
8. S6 and S7
9. MH "Hemiplegia"
10. TI ( hemipleg* or hemipar* or paresis or paretic ) or AB ( hemipleg* or hemipar* or paresis or paretic
11. S1 or S2 or S5 or S8 or S9 or S10
12. MH "Eye+" or MH "Rehabilitation of Vision Impaired+" or MH "Optometry" or MH "Eye Diseases+"
13. MH "Visual Acuity+" or MH "Perimetry+" or MH "Ophthalmology+" or MH "Vision Screening+" or MH "Ocular Physiology+"
14. TI ( orthoptics or vision, monocular or vision, binocular ) or AB ( orthoptics or vision, monocular or vision, binocular )
15. TI ( vitreous detachment or hemianopsia or hemianopia or quadrantanopia ) or AB ( vitreous detachment or hemianopsia or hemianopia or quadrantanopia )
16. MH "Abducens Nerve" or MH "oculomotor nerve" or MH "troclear nerve" or MH "optic nerve" or MH "nystagmus, pathologic
17. TI ( smooth pursuit or saccades or gaze disorder* or retinal or retinopathy or ophthalmol* ) or AB ( smooth pursuit or saccades or gaze disorder* or retinal or retinopathy or ophthalmol*)
18. TI ( hemianop* or blindness or low vision or refractive errors or vitreoretinopathy or vitreous detachment or scotoma or diplopia or optometry* or ocular or orthoptic* ) or AB ( hemianop* or blindness or low vision or refractive errors or vitreoretinopathy or vitreous detachment or scotoma or diplopia or optometry* or ocular or orthoptic* )
19. TI ( oscillopsia or visual tracking or fresnel prism* ) or AB ( oscillopsia or visual tracking or fresnel prism* )
20. TI ( intranuclear ophthalmoplegia or parinaud's syndrome or weber's syndrome or skew deviation or conjugate deviation ) or AB ( intranuclear ophthalmoplegia or parinaud's syndrome or weber's syndrome or skew deviation or conjugate deviation )
21. TI ( visual* or vision or eye or eyes or eyesight or sight ) or AB ( visual* or vision or eye or eyes or eyesight or sight )
22. TI ( problem* or disorder* or impair* or disability* or loss or disease* or defect* or manifestation* or screening or test* or examination* ) or AB ( problem* or disorder* or impair* or disability* or loss or disease* or defect* or manifestation* or screening or test* or examination* )
23. 21 and S22
24. TI ( third or fourth or sixth ) or AB ( third or fourth or sixth )
25. AB nerve palsy or TI nerve palsy
26. S24 and S25
27. S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S23 or S26
28. S11 and S27
29. (MH "Random Assignment") or (MH "Random Sample+")
30. (MH "Crossover Design") or (MH "Clinical Trials+") or (MH "Comparative Studies")
31. (MH "Control (Research)") or (MH "Control Group")
32.(MH "Factorial Design") or (MH "Quasi-Experimental Studies") or (MH "Nonrandomized Trials")
33. (MH "Placebo Effect") or (MH "Placebos") or (MH "Meta Analysis")
34. (MH "Community Trials") or (MH "Experimental Studies") or (MH "One-Shot Case Study") or (MH "Pretest-Posttest Design+") or (MH "Solomon Four-Group Design") or (MH "Static Group Comparison") or (MH "Study Design")
35. (MH "Clinical Research") or (MH "Clinical Nursing Research")
36. PT clinical trial
37. PT systematic review
38. TI random* or AB random*
39. TI ( singl* or doubl* or tripl* or trebl* ) or AB ( singl* or doubl* or tripl* or trebl* )
40. TI ( blind* or mask* ) or AB ( blind* or mask*)
41. S39 and S40

42. TI ( crossover or cross-over or placebo* or control* or factorial or sham ) or AB ( crossover or cross-over or placebo* or control* or factorial or sham )
43. TI ( clin* or intervention* or compar* or experiment* or preventive or therapeutic ) or AB ( clin* or intervention* or compar* or experiment* or preventive or therapeutic )
44. TI trial* or AB trial*
45. S43 and S44
46. TI ( counterbalance* or multiple baseline* or ABAB design ) or AB ( counterbalance* or multiple baseline* or ABAB design )
47. TI ( meta analysis* or metaanlaysis or meta-anlaysis or systematic review* ) or AB ( meta analysis* or metaanlaysis or meta-anlaysis or systematic review* )
48. S29 or S30 or S31 or S32 or S33 or S34 or S35 or S36 or S37 or S38 or S41 or S42 or S45 or S46 or S47
49. S28 and S48

## CONTRIBUTIONS OF AUTHORS

Alex Pollock led this review, provided methodological expertise, acted as a second review author and wrote the final review.
Christine Hazelton ran searches, identified relevant studies, acted as first review author and provided content expertise.

Clair Henderson, Baljean Dhillon, Heather Orr, Katrina Livingstone, Frank A Munro, Fiona Rowe, Uma Shahani, Jayne Angilley and Peter Langhorne provided additional content expertise, read and commented on drafts, and acted as additional review authors where there was uncertainty or disagreement.

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Alex Pollock has received project grant funding to support a body of work relating to visual problems after stroke. The grant funding primarily supports the salary for a research assistant, who is working on a series of reviews and surveys related to visual problems after stroke. The grant funding was awarded by the Royal National Institute for Blind people (RNIB).

Christine Hazelton's post as research assistant on this review is funded by RNIB Scotland.

Clair Henderson works for RNIB, which is the leading organisation in the UK supporting blind and partially sighted people.

Fiona Rowe was Chief Investigator for Vision In Stroke (VIS) study which reported data in relation to age-related visual impairment in stroke. The VIS study was completely unfunded research work.

The work presented here represents the view of the authors and not necessarily those of the funding bodies.

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### Internal sources

- No sources of support supplied

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  Funded this review, and employs Clair Henderson
- Chief Scientist Office, Scottish Government, UK.

  The Nursing, Midwifery and Allied Health Professions Research Unit, which is funded by the Chief Scientist Office in Scotland employs Alex Pollock

## DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The protocol was not clear as to whether RCTs of interventions for specific age-related visual problems which may potentially include subgroups of patients with stroke should be included or excluded. Review authors made the decision to exclude these studies. This decision is documented and described within the review.

The protocol was not clear as to whether RCTs of interventions relating to blood sugar and blood sugar control, which may prevent the development of age-related visual problems, should be included or excluded. The review authors made the decision to exclude these studies as they related to the prevention of age-related visual problems rather than the treatment of age-related visual problems.

## INDEX TERMS

### Medical Subject Headings (MeSH)

Activities of Daily Living; Age Factors; Stroke [*complications]; Vision Disorders [*therapy]

### MeSH check words

Aged; Humans