

# NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

## INTERVENTIONAL PROCEDURES PROGRAMME

### Interventional procedure overview of implantation of lens systems for advanced age-related macular degeneration

Age-related macular degeneration is an eye disorder that affects central vision that usually occurs later in life. The procedure involves removing the natural lens of the eye through a small incision at the front of the eye and implanting a combination of artificial lenses into the eye, with the aim of helping improve central vision.

#### Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

#### Date prepared

This overview was prepared in January 2008

#### Procedure name

- Implantation of lens systems for advanced age-related macular degeneration

#### Specialty societies

- Royal College of Ophthalmologists

#### Description

##### *Indications*

Advanced age-related macular degeneration.

Macular degeneration is an eye disorder that affects central vision. If it occurs later in life, it is described as age-related. Age-related macular degeneration (AMD) is the commonest cause of irreversible blindness in industrialised countries. It is associated with degeneration of the macula – a small area at the centre of the retina, responsible for central vision and for appreciation of fine detail and colour (see figure 1). There are two main types of AMD, the most common of which is atrophic or 'dry' macular degeneration. This dry form is characterised by thinning of the macular retina. It develops slowly, causing a gradual loss in central vision. The other type is neovascular or 'wet' AMD, which is characterised by the growth of new blood vessels behind the retina, causing retinal bleeding and scarring. The new vessels are described according to whether they can be seen clearly ('classic') or poorly ('occult') on fluorescein angiography. The onset and disease progression in wet AMD is much faster than in the dry form. Both types of AMD usually affect both eyes, although one may be affected before the other.

### ***Current treatment and alternatives***

Optical aids such as magnifying glasses may be helpful to patients with dry or wet AMD, for reading and other tasks involving fine detail. For wet AMD, treatment options greatly depend on the disease subtype and the location of lesions in relation to the fovea – the most central part of the macula. These may include laser photocoagulation, photodynamic therapy and intravitreal injections of anti-VEGF (vascular endothelial growth factor) agents. All these treatments may require several follow-up and treatment episodes. Other treatment options may include transpupillary thermotherapy, macular translocation surgery and radiotherapy. There is currently no treatment for dry AMD.

### ***What the procedure involves***

Implantation of lens systems for advanced AMD is usually done under local anaesthesia. The natural lens of the eye is removed through a small incision at the limbus (the area where cornea meets the sclera) and the new lens system inserted. The artificial lens systems can consist of a miniature telescope prosthesis or a combination of lenses, implanted either in the capsular bag of the native lens, or one in front of and one behind the iris. The exact technique for implantation varies according to the system being used. Generally, if a telescope prosthesis is used, a larger limbal incision may be required. Viscoelastic fluid is used during the implantation process to facilitate the insertion and is then removed by irrigation or aspiration. The eye then processes images according to which lens system is used. If a single lens is used, images in the treated eye are enlarged by the implanted lens system and focused on the macula, while the other eye is used for peripheral vision. If a system of two separate lenses is used, the lenses are rotationally aligned to deflect a magnified image away from the most damaged part of the macular and towards a less damaged area. After the implantation procedure, patients are usually required to undergo a period of visual rehabilitation.

## **Efficacy**

In a non-randomised comparative study of 217 patients, 66.7% (128/192) and 67.7% (130/192) of eyes with an implanted lens system had improvement of three or more lines in best-corrected distance visual acuity and best-corrected near visual acuity, respectively, at 1-year follow-up, compared with 12.5% (24/192) and 33.3% (64/192) of the fellow eyes without implants ( $p < 0.0001$ )<sup>1</sup>. The loss of two or more lines in best-corrected distance visual acuity was reported in 2.1% of implanted eyes and 8.9% of fellow eyes at 1 year ( $p = 0.005$ ). In a case series of 40 eyes, all patients had improved best-corrected distance visual acuity after a mean follow-up of 20 months<sup>2</sup>.

## **Safety**

In one study, 5% (11/217) of procedures had to be aborted because of complications (posterior capsule rupture, choroidal effusion, choroidal haemorrhage and zonular dehiscence). In addition, two eyes required the device to be removed 1 month after implantation because of condensation inside the telescope cylinder. Two patients in this study developed corneal decompensation and underwent device removal and corneal transplantation (more than 1 year after initial surgery)<sup>1</sup>. In another study, the implant was removed in 16.7% (6/36) of patients (three because of patient dissatisfaction, two because of condensation in the telescope and one because of diplopia)<sup>3</sup>. Other complications included development of increased intraocular pressure requiring treatment (28%, [57/206]), corneal oedema (25% [9/36], 7% [14/206]), hypopyon (11% [4/36]), iris sphincter erosion/iris prolapse (2.8% [1/36], 6% [12/206]), corneal abrasion (5% [11/206]), synechiae (6% [13/206], 19% [7/36]) and posterior capsule opacification (2.9% [1/35], 11% [4/36])<sup>1,3</sup>.

## **Literature review**

### **Rapid review of literature**

The medical literature was searched to identify studies and reviews relevant to implantation of lens systems for advanced AMD. Searches were conducted via the following databases, covering the period from their commencement to 31/01/2008: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches. (See appendix C for details of search strategy.)

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

**Table 1 Inclusion criteria for identification of relevant studies**

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising methodology.
Patient	Patients with age-related macular degeneration.
Intervention/test	Implantation of lens systems.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

### ***List of studies included in the overview***

This overview is based on one non-randomised comparative study and four case series <sup>1-5</sup>.

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

### ***Existing reviews on this procedure***

The Australia and New Zealand Horizon Scanning Network published a summary on implantable miniature telescopes for macular degeneration in August 2007 <sup>6</sup>. The report concluded that the procedure gave patients a significant improvement in their vision as reported to the Food and Drug Administration (FDA). There were, however, serious safety concerns and lack of data for the patients who did not benefit from the device implantation. Further evidence is required to fully assess whether the implantable miniature telescope will be worthy of clinical use.

### ***Related NICE guidance***

Below is a list of NICE guidance related to this procedure. Appendix B details the recommendations made in each piece of guidance listed below.

#### **Interventional procedures**

- Macular translocation for age-related macular degeneration. NICE interventional procedures guidance 48 (2004). Available from: [www.nice.org.uk/IPG048](http://www.nice.org.uk/IPG048)

- Radiotherapy for age-related macular degeneration. NICE interventional procedures guidance 49 (2004). Available from: [www.nice.org.uk/IPG049](http://www.nice.org.uk/IPG049)
- Transpupillary thermotherapy for age-related macular degeneration. NICE interventional procedures guidance 58 (2004). Available from: [www.nice.org.uk/IPG058](http://www.nice.org.uk/IPG058)

### **Technology appraisals**

- Guidance on the use of photodynamic therapy for age-related macular degeneration (2003). NICE technology appraisal guidance 68. Available from: [www.nice.org.uk/TA068](http://www.nice.org.uk/TA068)
- Ranibizumab and pegaptanib for age-related macular degeneration. NICE technology appraisal guidance (publication expected June 2008).

### **Clinical guidelines**

- None

### **Public health**

- None

**Table 2 Summary of key efficacy and safety findings on implantation of lens systems for advanced age-related macular degeneration**

Study details	Key efficacy findings	Key safety findings	Comments																																				
<p>Hudson H (2006)<sup>1</sup></p> <p><b>Non-randomised comparative study (fellow eye controls)</b></p> <p>USA</p> <p>Study period: not stated</p> <p><b>n = 217 patients</b></p> <p>Population: patients with bilateral, end-stage AMD</p> <p>Mean age (years): 75.6 (range 55–93); Male: 52.5% (114/217)</p> <p>Inclusion criteria: age at least 55 years; bilateral BCDVA between 20/80 and 20/800 on ETDRS visual acuity chart– patients had to achieve at least a 5-letter improvement on chart with an external telescope in the eye scheduled for implantation.</p> <p>Technique: implantable fixed-focus telescopic device, x2.2 or x3 (IMT; VisionCare Ophthalmic Technologies).</p> <p><b>Follow-up: 12 months</b></p> <p>Disclosure of interest: none</p>	<p>3 or more lines improvement in BCDVA at 1 year:</p> <ul style="list-style-type: none"> <li>Implanted eye = 66.7% (128/192)</li> <li>Fellow eye = 12.5% (24/192), <math>p &lt; 0.0001</math></li> </ul> <p>3 or more lines improvement in BCNVA at 1 year:</p> <ul style="list-style-type: none"> <li>Implanted eye = 67.7% (130/192)</li> <li>Fellow eye = 33.3% (64/192), <math>p &lt; 0.0001</math></li> </ul> <p>Loss of 2 or more lines in BCDVA at 12 months:</p> <ul style="list-style-type: none"> <li>Implanted eye = 2.1%</li> <li>Fellow eye = 8.9%, <math>p = 0.005</math></li> </ul> <p><i>(actual numbers not given)</i></p> <p><b>Quality of life and functional outcomes (National Eye Institute Visual Function Questionnaire scores on scale of 0 [low] to 100 [maximum])</b></p> <table border="1" data-bbox="558 818 1104 1409"> <thead> <tr> <th></th> <th>Preoperative mean score (n = 206)</th> <th>12-month mean score (n = 192)</th> <th>P value</th> </tr> </thead> <tbody> <tr> <td>General health</td> <td>63.2</td> <td>58.7</td> <td>0.03</td> </tr> <tr> <td>General vision</td> <td>35.4</td> <td>50.3</td> <td>&lt;0.0001</td> </tr> <tr> <td>Near activities</td> <td>25.5</td> <td>37.3</td> <td>&lt;0.0001</td> </tr> <tr> <td>Distance activities</td> <td>34.3</td> <td>42.4</td> <td>&lt;0.0001</td> </tr> <tr> <td>Colour vision</td> <td>63.9</td> <td>67.2</td> <td>NS</td> </tr> <tr> <td>Social functioning</td> <td>49.3</td> <td>58.3</td> <td>&lt;0.0001</td> </tr> <tr> <td>Mental health</td> <td>39.8</td> <td>49.3</td> <td>&lt;0.0001</td> </tr> <tr> <td>Role</td> <td>37.4</td> <td>44.8</td> <td>0.0002</td> </tr> </tbody> </table>		Preoperative mean score (n = 206)	12-month mean score (n = 192)	P value	General health	63.2	58.7	0.03	General vision	35.4	50.3	<0.0001	Near activities	25.5	37.3	<0.0001	Distance activities	34.3	42.4	<0.0001	Colour vision	63.9	67.2	NS	Social functioning	49.3	58.3	<0.0001	Mental health	39.8	49.3	<0.0001	Role	37.4	44.8	0.0002	<p>5% (11/217) of procedures were aborted (7 posterior capsule rupture, 1 choroidal effusion, 2 choroidal haemorrhage, 1 zonular dehiscence). In addition, 2 eyes required device removal 1 month after implantation because of condensation inside the telescope cylinder.</p> <p>Loss of 2 or more lines in BCDVA or BCNVA at 12 months without a 2-line improvement in the other test distance = 5.2% (10/192).</p> <p>Corneal decompensation at 1 year = 1% (2/206) (both required device removal and corneal transplantation more than 1 year after initial surgery).</p> <p>Other adverse events/complications</p> <ul style="list-style-type: none"> <li>Inflammatory deposits on device = 21% (44/206)</li> <li>Pigment deposits on device = 10% (20/206)</li> <li>Guttae = 8% (16/206)</li> <li>Posterior synechiae = 6% (13/206)</li> <li>Increased intraocular pressure (IOP) within 7 days requiring treatment = 28% (57/206) (no further details were given)</li> <li>Increased IOP beyond 7 days requiring treatment = 3% (6/206)</li> </ul>	<p>IMT002 study.</p> <p>A total of 32 surgeons performed the procedure.</p> <p>1.8% (4/217) of patients were lost to follow-up.</p> <p>Analysis was discontinued for 10 eyes (7 because of patient death and 3 because of device removal).</p> <p>The authors comment that improvements in the fellow eye may be due to visual rehabilitation.</p> <p>Patients were not blinded to which eye was treated.</p> <p>The authors note that the implantation procedure is complex and careful patient selection with management of expectations is important.</p>
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Abbreviations used: AMD, age-related macular degeneration; BCDVA, best-corrected distance visual acuity; BCNVA, best-corrected near visual acuity; ETDRS, Early Treatment of Diabetic Retinopathy Study						
Study details	Key efficacy findings				Key safety findings	Comments
	difficulties					
	Dependency	37.2	48.3	<0.0001		
	Ocular pain	88.0	88.5	NS		
	Driving	2.1	1.9	NS		
	Peripheral vision	67.6	62.9	0.0009		
	Overall composite (excludes general health)	43.9	50.3	<0.0001		
					<ul style="list-style-type: none"> <li>• Corneal oedema within 30 days = 7% (14/206)</li> <li>• Iris prolapse = 6% (12/206)</li> <li>• Corneal abrasion = 5% (11/206)</li> <li>• Iritis beyond 30 days after implant = 4% (8/206)</li> <li>• Foreign body sensation = 3% (7/206)</li> <li>• Device removal = 3% (6/206)</li> </ul> <p>Less commonly reported adverse events included anterior chamber inflammation beyond 30 days (2.4%), corneal oedema beyond 30 days (1.0%) and device dislocation (1.0%).</p> <p>There were no reports of endophthalmitis or hypopyon.</p> <p>Endothelial cell density was reduced by 20% at 3 months and 25% at 1 year (this exceeded the 17% end point defined in the study protocol). There was significant correlation between postoperative endothelial cell density and the level of corneal oedema present on the first postoperative day, suggesting that endothelial damage occurred during surgery, rather than during the postoperative period.</p>	

Abbreviations used: AMD, age-related macular degeneration; BCDVA, best-corrected distance visual acuity; BCNVA, best-corrected near visual acuity; ETDRS, Early Treatment of Diabetic Retinopathy Study			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Orzalesi N (2007)<sup>2</sup></p> <p><b>Case series</b></p> <p>Italy</p> <p>Study period: not stated</p> <p><b>n = 40 eyes (35 patients)</b></p> <p>Population: patients with a stable central scotoma due to macular disease</p> <p>Mean age: not stated</p> <p>Exclusion criteria: pseudophakic in both eyes; visual acuity &gt;0.5 logMAR in fellow eye; no improvement in visual acuity using a simulator; corneal abnormalities; low endothelial cell count and/or shallow anterior chamber; experienced satisfactory improvement in visual performance after simply following preoperative visual training programme.</p> <p>Technique: IOL-Vip system consisting of two intraocular lenses.</p> <p><b>Mean follow-up: 20 months (range 7–35)</b></p> <p>Disclosure of interest: none stated</p>	<p>Patients with very poor preoperative visual acuity (<math>\leq 1.1</math> logMAR, n = 28):</p> <ul style="list-style-type: none"> <li>• Mean best reading magnification decreased from x11.6 to x3.5 (gain of x8.1)</li> <li>• Best reading distance increased from 2.66 cm to 8.21 cm (gain of 5.55 cm)</li> </ul> <p>Patients with relatively good preoperative visual acuity (<math>\leq 1.0</math> logMAR, n = 12):</p> <ul style="list-style-type: none"> <li>• Mean best reading magnification decreased from x3 to x1.3 (gain of x1.7)</li> <li>• Best reading distance increased from 8.87 cm to 21.46 cm (gain of 12.59 cm)</li> </ul> <p>All patients experienced a gain in BCDVA.</p> <p>The lens system was subjectively well tolerated and most patients retained or improved their mobility and orientation.</p>	<p>Mean procedure-related endothelial cell loss at end of follow-up = 7%</p> <p>3 of the first 5 cases developed a papillary block with increased intraocular pressure (managed by laser iridotomy). In all subsequent cases, preoperative iridotomy was performed.</p> <p>One patient developed anterior capsule fibrosis and posterior capsule clouding 6 months after phacoemulsification.</p> <p>There were no severe complications such as corneal oedema, iris and papillary changes, excess inflammation and/or sepsis, macular oedema, retinal detachment, glaucoma or intraocular lens displacement.</p>	<p>Consecutive cases.</p> <p>The authors note that the low optical magnifying power of the lens system allows maintenance of the peripheral visual field, thus making it suitable for monocular or binocular implantation.</p>

Abbreviations used: AMD, age-related macular degeneration; BCDVA, best-corrected distance visual acuity; BCNVA, best-corrected near visual acuity; ETDRS, Early Treatment of Diabetic Retinopathy Study			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Alio J (2004)<sup>3</sup></p> <p><b>Case series</b></p> <p>Spain</p> <p>Study period: not stated</p> <p><b>n = 40 eyes (40 patients)</b></p> <p>Population: patients with dry-type AMD</p> <p>Mean age: 77.1 years (range 61–87); male: 42.5% (19/40)</p> <p>Inclusion criteria: age &gt; 60 years; stable form of AMD; BCVA in selected eye not better than 20/80 or worse than 20/200; BCVA 20/80 or worse in fellow eye. Exclusion criteria: other eye disease; neurological disorder; immunosuppressive disease; extreme sensitivity.</p> <p>Technique: Intraocular miniaturised telescope with magnification of 3.0x (Vision Care Ophthalmic Technologies).</p> <p><b>Follow-up: 12 months</b></p> <p>Disclosure of interest: none</p>	<p><i>Distance visual acuity</i></p> <p>Mean line (ETDRS) in implanted eye:</p> <ul style="list-style-type: none"> <li>• Preoperative = 10.2 (n = 35)</li> <li>• 1 month postoperative = 8.1 (n = 29)</li> <li>• 6 months postoperative = 6.4 (n = 28)</li> <li>• 12 months postoperative = 6.8 (n = 23)</li> </ul> <p>Mean Snellen equivalent in implanted eye:</p> <ul style="list-style-type: none"> <li>• Preoperative = 20/209 (n = 35)</li> <li>• 1 month postoperative = 20/129 (n = 29)</li> <li>• 6 months postoperative = 20/87 (n = 28)</li> <li>• 12 months postoperative = 20/96 (n = 23)</li> </ul> <p>At 1 year, mean improvement for uncorrected distance visual acuity was 3.5 lines for implanted eye, and mean deterioration of fellow eye was 1.1 lines.</p> <p>Mean uncorrected distance visual acuity at 1 year:</p> <ul style="list-style-type: none"> <li>• Implanted eye = 0.6 logMAR</li> <li>• Fellow eye = 0.9 logMAR, p = 0.003</li> </ul> <p><i>Near visual acuity</i></p> <p>Mean line (ETDRS) in implanted eye:</p> <ul style="list-style-type: none"> <li>• Preoperative = 9.5 (n = 32)</li> <li>• 1 month postoperative = 8.3 (n = 23)</li> <li>• 6 months postoperative = 5.0 (n = 18)</li> <li>• 12 months postoperative = 5.1 (n = 16)</li> </ul> <p>Mean Snellen equivalent in implanted eye:</p> <ul style="list-style-type: none"> <li>• Preoperative = 180 (n = 32)</li> <li>• 1 month postoperative = 134 (n = 23)</li> <li>• 6 months postoperative = 63 (n = 18)</li> <li>• 12 months postoperative = 65 (n = 16)</li> </ul> <p>Mean uncorrected near visual acuity at 1 year:</p> <ul style="list-style-type: none"> <li>• Implanted eye = 0.4 logMAR</li> <li>• Fellow eye = 0.5 logMAR, p = not significant</li> </ul>	<p>Mean endothelial cell loss at 12 months = 34.5% (calculated for 10 eyes)</p> <p><i>Adverse effects and complications</i></p> <ul style="list-style-type: none"> <li>• Explantation because of patient dissatisfaction = 8.3% (3/36)</li> <li>• Bubbles inside telescope, requiring explantation = 5.6% (2/36)</li> <li>• Diplopia requiring explantation = 2.8% (1/36)</li> <li>• Hypopyon = 11.1% (4/36) (treated with topical steroids)</li> <li>• Intraoperative iris damage = 5.6% (2/36)</li> <li>• Intraoperative zonule rupture = 2.8% (1/36)</li> <li>• Iris sphincter erosion 6 months postoperatively = 2.8% (1/36)</li> <li>• Intraoperative vitreous bulge = 2.8% (1/36)</li> <li>• Corneal oedema = 25% (9/36)</li> <li>• Fibrin at pupil = 33.3% (12/36)</li> <li>• Synechias = 19.4% (7/36)</li> <li>• Hyphema = 11.1% (4/36)</li> <li>• Conjunctivitis = 5.6% (2/36)</li> <li>• Uveitis = 8.3% (3/36)</li> <li>• Cyclitic membrane (transient) = 2.8% (1/36)</li> <li>• Persistent pupillary cyclitic membrane = 2.8%</li> <li>• Persistent synechias = 5.6% (2/36)</li> <li>• Posterior capsular opacification = 11.1% (4/36)</li> </ul>	<p>An additional 21 cases were recruited to the study but did not complete study protocol up to 12-month follow-up. These patients were excluded (7 had insufficient data for follow-up, 7 were implanted with previous model, 4 were lost to follow-up and 3 patients were implanted with a x2.2 model rather than x3).</p> <p>The study narrative states that 40 eyes of 40 patients were included but distance visual acuity data is only presented for 35 eyes of 35 patients.</p>

Abbreviations used: AMD, age-related macular degeneration; BCDVA, best-corrected distance visual acuity; BCNVA, best-corrected near visual acuity; ETDRS, Early Treatment of Diabetic Retinopathy Study			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Agarwal A (2008)<sup>4</sup></p> <p><b>Case series</b></p> <p>India</p> <p>Study period: Jun–Dec 2006</p> <p><b>n = 6 eyes (6 patients)</b></p> <p>Population: patients with bilateral macular pathology and visual acuity worse than 20/200</p> <p>4 eyes had AMD, 1 eye each had myopic macular degeneration or macular dystrophy.</p> <p>Male: 83.3% (5/6)</p> <p>Inclusion criteria: patients with bilateral macular pathology; with distance or near visual acuity less than 20/200; cataract with nuclear sclerosis grade less than 2; no other ocular or systemic disease; vision improved when tested with x2.5 external telescope.</p> <p>Technique: Lipshitz macular implant (Optolight Vision Technology), which magnifies image on retina using a mirror telescope (x2.5).</p> <p><b>Follow-up: 6 months</b></p> <p>Disclosure of interest: none stated</p>	<p>The operated eyes gained a mean 3.66 lines in distance acuity at 6 months (the fellow eyes lost a mean 1.41 lines).</p> <p>Mean distance acuity in implanted eye (logMAR):</p> <ul style="list-style-type: none"> <li>• Preoperative = 1.47</li> <li>• 1 month postoperative = 0.96</li> <li>• 6 months postoperative = 0.94</li> </ul> <p>Mean near acuity in implanted eye (ETDRS score, logMAR):</p> <ul style="list-style-type: none"> <li>• Preoperative = 24.16</li> <li>• 1 month postoperative = 68.33</li> <li>• 6 months postoperative = 75.00</li> </ul> <p>The improvement in BCDVA and BVNVA at 6 months was statistically significant (<math>p = 0.014</math> for both).</p> <p>Quality-of-life questionnaire showed that the ability to read large print, count money and move independently was improved after surgery in most patients. The ability to read watches or clocks, dial the telephone and use a computer keyboard improved moderately in most patients. The ability to read small print improved slightly in most patients.</p> <p>Mean quality-of-life score:</p> <ul style="list-style-type: none"> <li>• Preoperatively = <math>11.16 \pm 1.72</math></li> <li>• Postoperatively = <math>4.5 \pm 0.83</math>, <math>p = 0.014</math></li> </ul>	<p>One patient lost lines at 1 week as a result of slight postoperative inflammatory reaction. This improved after 1 month.</p> <p>One patient had postoperative cystoid macular oedema that spontaneously resolved.</p> <p>All patients reported slight glare, especially in bright sunlight and while night driving. Two patients reported shadowing of images that occluded the unoperated eye; both patients adapted within 3 months of surgery.</p> <p>Mean change in endothelial count in operated eye = <math>-5.79\% \pm 4.07\%</math> cells/mm<sup>2</sup></p>	<p>The authors suggest that this implant can be used bilaterally because it provides enlarged central and normal peripheral vision.</p>

Abbreviations used: AMD, age-related macular degeneration; BCDVA, best-corrected distance visual acuity; BCNVA, best-corrected near visual acuity; ETDRS, Early Treatment of Diabetic Retinopathy Study			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Kaskaloglu M (2001)<sup>5</sup></p> <p><b>Case series</b></p> <p>Turkey</p> <p>Study period: 1999</p> <p><b>n = 3 eyes (3 patients)</b></p> <p>Population: patients with bilateral dry-type AMD and grade 1 nuclear sclerosis</p> <p>Ages (years): 68, 75 and 76; male: 33.3% (1/3)</p> <p>Inclusion criteria: age &gt; 60 years; stable form of AMD; BCVA in selected eye not better than 20/80 or worse than 20/200; BCVA 20/80 or worse in fellow eye. Exclusion criteria: other eye disease; neurological disorder; immunosuppressive disease; extreme sensitivity.</p> <p>Technique: Intraocular miniaturised telescope with magnification of 3.0x (Vision Care Ophthalmic Technologies).</p> <p><b>Follow-up: 18 months</b></p> <p>Disclosure of interest: none</p>	<p><b>Case 1</b> 18 months after implantation, BCNVA improved from A13 to A8. BCDVA improved from 20/200 to 20/100.</p> <p>The patient was better able to watch television with her operated eye but she could not adapt to the increased velocity of objects in her field of vision and preferred to use her unoperated eye. At the end of follow-up, the patient reported that the visual and functional aspects in the operated eye were better than preoperatively.</p> <p><b>Case 2</b> At 12 months, BCNVA improved from A10 to A9. BCDVA improved from 20/200 to 20/160.</p> <p>Numerous small bubbles were seen in the telescope at 2 months and were still present at 1 year. The implant was subsequently replaced with a conventional intraocular lens, after which distance visual acuity was 20/160 and near acuity was A9.</p> <p><b>Case 3</b> 18 months after implantation, BCNVA improved from A10 to A8. BCDVA improved from 20/80 to 20/50.</p> <p>The patient reported improvement in ability to orient around a table and identify faces. However, she could not read any better or climb/descend stairs. At the end of follow-up, she reported that visual and functional aspects of the operated eye were better than preoperatively.</p> <p>All 3 patients complained about the narrow field of view.</p>	<p>Case 1 developed mild anterior segment inflammation 2 and 6 months postoperatively that resolved with topical steroids and cycloplegics.</p>	<p>A total of 15 patients met the inclusion criteria for the study and 3 patients were willing to participate.</p>

### ***Validity and generalisability of the studies***

- There are several different systems available and the safety and efficacy may differ between them.
- Visual acuity outcomes reported in the literature vary in nature, and direct comparisons of reported efficacy between studies are made more difficult by this factor.
- None of the studies included randomised controls. One study used fellow eyes as the control group, but patients were not blinded as to which eye had been treated <sup>1</sup>.
- Most of the studies are small with limited follow-up.
- Two studies included only patients older than 60 years and one study included patients older than 55 years <sup>1, 3, 5</sup>. The remaining two studies did not specify an age limit in the inclusion criteria <sup>2, 4</sup>.

### **Specialist advisers' opinions**

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.

Mr V Chong, Mr B Moriarty, Mr R Newsom, Mr A Tufail (Royal College of Ophthalmologists)

- There are a number of systems available. Some systems are minor variations of existing procedures but others (IMT and IOL-Vip) are much more involved than standard intraocular lens implantation and have different safety and efficacy profiles.
- The comparator would be standard cataract surgery with conventional intraocular lens implantation followed by postoperative prescription and training in the use of low vision aids and eccentric fixation training.
- Theoretical adverse effects include corneal endothelial cell loss, corneal decompensation, corneal oedema, macula oedema, infection, retinal detachment and falls due to failure to adapt. One adviser commented that there are additional risks associated with implantation of a lens system

compared with standard cataract surgery. These include the possibility of increased corneal endothelial cell loss; the risk of glaucoma may be higher; pupil block acute glaucoma requiring iridotomy; the implant may hamper the ability to detect peripheral retinal disease; removal of the implant if the patient cannot adapt to using alternate eyes for different tasks.

- Reported adverse events include corneal endothelial cell loss.
- Key efficacy outcomes include near and distance visual acuity, reading speed and improved navigational vision.
- Patient selection and preoperative and postoperative visual rehabilitation are important.
- A prospective multicentre study on the implantable miniature telescope is underway, sponsored by VisionCare Ophthalmic Technologies Inc. The study started in November 2007, the estimated completion date is July 2009 and estimated enrolment is 75 patients.

## **Issues for consideration by IPAC**

- None other than those described above.

## References

1. Hudson HL, Lane SS, Heier JS et al. (2006) Implantable miniature telescopes for the treatment of visual acuity loss resulting from end-stage age-related macular degeneration: 1-year results. *Ophthalmology* 113: 1987–2001.
2. Orzalesi N, Pierrottet CO, Zenoni S et al. (2007) The IOL-Vip system. A double intraocular implant for visual rehabilitation of patients with macular disease. *Ophthalmology* 114: 860–5.
3. Alio JL, Mulet EM, Ruiz-Moreno JM et al. (2004) Intraocular telescopic lens evaluation in patients with age-related macular degeneration. *Journal of Cataract and Refractive Surgery* 30: 1177–89.
4. Agarwal A, Lipshitz I, Jacob S et al. (2008) Mirror telescopic intraocular lens for age-related macular degeneration. Design and preliminary clinical results of the Lipshitz macular implant. *Journal of Cataract and Refractive Surgery* 34: 87–94.
5. Kaskaloglu M, Uretmen O, Yagci A (2001) Medium-term results of implantable miniaturized telescopes in eyes with age-related macular degeneration. *Journal of Cataract and Refractive Surgery* 27: 1751–5.
6. Adelaide Health Technology Assessment on behalf of National Horizon Scanning Unit (HealthPACT and MSAC), 'Implantable miniature telescope for macular degeneration. Horizon Scanning Technology Prioritising Summary' [online]. Available from: [www.horizonscanning.gov.au](http://www.horizonscanning.gov.au)

## Appendix A: Additional papers on implantation of lens systems for advanced age-related macular degeneration not included in summary table 2

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients /follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Garcia-Feijoo J, Duran-Poveda S, Cuina-Sardina R et al. (2001) Ultrasound biomicroscopy of an implantable miniaturized telescope. Archives of Ophthalmology 119: 1544–5.	n = 2	Both patients had subjective visual improvement. In one patient, one of the haptics was placed in the sulcus rather than the capsular bag and so the telescope was not optimally positioned. One of the most important preoperative factors should be the depth of the anterior chamber.	Larger studies are included.
Garfinkel RA, Berinstein DM, Frantz R (2006) Treatment of choroidal neovascularization through the implantable miniature telescope. American Journal of Ophthalmology 141: 766–7.	n = 1	At 6-month follow-up, the patient had retinal haemorrhage with an area of subretinal fluid temporal to the macular atrophy. The patient underwent focal laser photocoagulation through the telescope without complication.	Case report.

## Appendix B: Related NICE guidance for implantation of lens systems for advanced age-related macular degeneration

Guidance	Recommendation
Interventional procedures	<p data-bbox="755 510 1349 604"><i>Macular translocation for age-related macular degeneration. NICE interventional procedures guidance 48 (2004)</i></p> <p data-bbox="755 638 1365 800">1.1 Current evidence on the safety and efficacy of macular translocation does not appear adequate for this procedure to be used without special arrangements for consent and for audit or research.</p> <p data-bbox="755 806 1341 869">1.2 Clinicians wishing to undertake macular translocation should take the following action.</p> <ul data-bbox="755 875 1312 1171" style="list-style-type: none"> <li data-bbox="755 875 1268 938">• Inform the clinical governance leads in their Trusts.</li> <li data-bbox="755 945 1312 1106">• Ensure that patients understand the uncertainty about the procedure's safety and efficacy and provide them with clear written information. Use of the Institute's <i>Information for the Public</i> is recommended.</li> <li data-bbox="755 1113 1289 1171">• Audit and review clinical outcomes of all patients having macular translocation.</li> </ul> <p data-bbox="755 1178 1284 1339">Publication of safety and efficacy outcomes will be useful in reducing the current uncertainty. The Institute may review the procedure upon publication of further evidence.</p> <p data-bbox="755 1383 1349 1478"><i>Radiotherapy for age-related macular degeneration. NICE interventional procedures guidance 49 (2004)</i></p> <p data-bbox="755 1493 1377 1860">1.1 Current evidence shows radiotherapy for age-related macular degeneration to have little efficacy. There are also concerns about its safety. It is suitable for use only within good quality research studies approved by a research ethics committee, specifying the dose of radiation used and with explicit patient consent. Publication of safety and efficacy outcomes will be useful in reducing the current uncertainty. The Institute is not undertaking further investigation at present.</p>

	<p><i>Transpupillary thermotherapy for age-related macular degeneration. NICE interventional procedures guidance 58 (2004)</i></p> <p>1.1 Current evidence on the safety and efficacy of transpupillary thermotherapy for age-related macular degeneration does not appear adequate for this procedure to be used without special arrangements for consent and for audit or research.</p> <p>1.2 Clinicians wishing to undertake transpupillary thermotherapy for age-related macular degeneration should take the following action.</p> <ul style="list-style-type: none"> <li>• Inform the clinical governance leads in their Trusts.</li> <li>• Ensure that patients understand the uncertainty about the procedure's safety and efficacy and provide them with clear written information. Use of the Institute's <i>Information for the Public</i> is recommended.</li> <li>• Audit and review clinical outcomes of all patients having transpupillary thermotherapy for age-related macular degeneration.</li> </ul> <p>1.3 Publication of safety and efficacy outcomes will be useful in reducing the current uncertainty. The Institute may review the procedure upon publication of further evidence.</p>
Technology appraisals	<p><i>Guidance on the use of photodynamic therapy for age-related macular degeneration. NICE technology appraisal guidance 68 (2003)</i></p> <p>1.1 Photodynamic therapy (PDT) is recommended for the treatment of wet age-related macular degeneration for individuals who have a confirmed diagnosis of <b>classic with no occult</b> subfoveal choroidal neovascularisation (CNV) (that is, whose lesions are composed of classic CNV with no evidence of an occult component) and best-corrected visual acuity 6/60 or better. PDT should be carried out only by retinal specialists with expertise in the use of this technology.</p> <p>1.2 PDT is not recommended for the treatment of people with <b>predominantly classic</b> subfoveal CNV (that is, 50% or more of the entire area of the lesion is classic CNV but some occult CNV is present) associated with wet age-related macular degeneration, except as part of ongoing</p>

	<p>or new clinical studies that are designed to generate robust and relevant outcome data, including data on optimum treatment regimens, long-term outcomes, quality of life and costs.</p> <p>1.3 The use of PDT in <b>occult</b> CNV associated with wet age-related macular degeneration was not considered because the photosensitising agent (verteporfin) was not licensed for this indication when this appraisal began. No recommendation is made with regard to the use of this technology in people with this form of the condition.</p> <p>1.4 Patients currently receiving treatment with PDT could experience loss of well-being if their treatment is discontinued at a time they did not anticipate. Because of this, all NHS patients who have begun a course of treatment with PDT at the date of publication of this guidance should have the option of continuing to receive treatment until their clinical condition indicates that it is appropriate to stop.</p>
Clinical guidelines	None
Public health	None

## Appendix C: Literature search for implantation of lens systems for advanced age-related macular degeneration

Database	Date searched	Version searched
Cochrane Library	30/01/08	Issue 1, 2008
CRD databases (DARE & HTA)	30/01/08	Issue 1, 2008
Embase	30/01/08	1980 to 2008 Week 04
Medline	30/01/08	1950 to January Week 3 2008
Premedline	30/01/08	January 29, 2008
CINAHL	30/01/08	1982 to December Week 1 2007
British Library Inside Conferences	30/01/08	-
NRR	30/01/08	-
Controlled Trials Registry	30/01/08	-

### Search strategy used in Medline

The search strategy was adapted for use in the databases above

1	(implant\$ adj3 telescop\$).tw.
2	((prosth\$ or precision) adj3 telescop\$).tw.
3	((optical or visual or telescop\$) adj3 prosthe\$ adj3 device\$).tw.
4	(miniatur\$ adj3 telescop\$).tw.
5	(intraocular adj3 (magnif\$ or len\$) adj3 (implant\$ or system)).tw.
6	(galilean adj3 telescop\$).tw.
7	imt.tw.
8	lens implantation, intraocular/
9	miniaturization/
10	or/1-9
11	Macular Degeneration/
12	((macul\$ or retin\$) adj3 (degener\$ or disease\$)).tw.
13	maculopath\$.tw.

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14	or/11-13
15	animals/
16	humans/
17	15 not (15 and 16)
18	10 and 14
19	18 not 17