

# Screening for diabetic eye disease by optometrists using slit lamps

**ABSTRACT**—Diabetic patients were screened for diabetic eye disease by hospital-based optometrists using a slit lamp with a 78-dioptres Volk lens. Visual acuity and intraocular pressure were also measured. Of 622 patients screened, 149 (24.0%) had background and 32 (5.1%) advanced retinopathy/maculopathy. The fundus was inadequately visualised in four (0.6%) patients. Following screening, 86 (13.8%) patients were referred to the ophthalmology clinic for appropriate treatment and follow up.

Hospital-based optometrists using a slit lamp offer a useful new method for screening for diabetic eye disease. They can identify previously unrecognised sight-threatening diabetic eye disease and important non-diabetic eye disease requiring intervention, and are relatively cheap. This method is ideally suited for rapid referral to the specialist. The results merit larger-scale studies both to confirm the effectiveness of this method and to assess whether hospital trained optometrists could perform screening in the community.

In 1990 the St Vincent declaration announced that diabetes services should aim to reduce the incidence of blindness as a result of diabetic eye disease by one-third over a period of five years [1]. The majority of blindness due to diabetes is preventable [2], and screening for diabetic retinopathy with early treatment can reduce the incidence of visual loss [3]. Unfortunately, a fully effective mechanism of screening has not yet been identified. Fundus photography, especially when housed in a mobile unit, can successfully identify previously unrecognised sight-threatening retinopathy [4–8], but concern has recently been expressed about the relatively low sensitivity ( $\leq 67\%$ ) of non-mydratric polaroid photography [9]. This raises the possibility of false negative reporting and the risk of missing patients with advanced diabetic retinopathy. The sensitivity of fundus photography can be improved by using mydriasis and 3-field photography [10], but this

increases the cost and slows down the screening service.

Alternative screening methods for diabetic eye disease need to be explored. Community-based optometrists have been used [11], but the sensitivity of this service has been as low as 48% [9]. We describe a completely new approach to screening for diabetic eye disease, in which hospital-based optometrists use slit lamp biomicroscopy.

## Patients and methods

Diabetic patients who were not thought to have retinopathy at their previous annual check one year earlier when examined by direct ophthalmoscopy, were referred from the general hospital diabetic clinic for hospital-based optometry screening. This was performed at a separate clinic visit by one of two hospital-based optometrists who had received standard optometry training, with further training in diabetic eye disease from the consultant ophthalmologist with a special interest in diabetes. Of 812 patients invited for screening, 622 attended (a non-attendance rate of 23.4%). Demographic patient details, treatment for diabetes, and history of glaucoma were obtained by questioning, and verified from the notes where possible.

Uncorrected and pinhole corrected distance visual acuities were assessed using a Snellen chart, near acuity with the Keeler Times near vision test, and intraocular pressure using Goldmann applanation tonometry. Subsequently, tropicamide (1%) and phenylephrine (2.5%) eye drops were instilled as a mydratric. Patients were examined using a slit lamp biomicroscope (Haag Streit) and a 78-dioptres Volk lens. Examination of the iris, lens, media and fundus was performed on each patient, and the findings recorded. Diabetic retinopathy and maculopathy were graded according to the early treatment diabetic retinopathy study (ETDRS) classification [12,13].

One hundred and three patients were examined using a slit lamp, first by the optometrist and then by the consultant ophthalmologist, both being unaware of each other's findings. Decisions about the results and the need for referral were recorded independently by the optometrist and ophthalmologist.

The cost of this method has been calculated from the salary scales for optometrists and clerical and nursing staff in 1994–95 figures, assuming sessions worked per week to be two, one and one, respectively.

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**Table 1.** Patients diagnosed as having diabetic retinopathy or maculopathy (total number screened = 622)

Form of retinopathy/maculopathy	Follow up arrangement after screening				
	No.	%	No.	%	
Background	149	24.0	Annual screening review:	97	65.1
			mild-moderate retinopathy		
			6-month screening review:	33	22.1
			moderate retinopathy		
			non-sight threatening maculopathy		
Refer ophthalmology clinic:			19	12.8	
			moderate retinopathy		
			non-sight threatening maculopathy		
			<i>Total</i>	149	100.0
Advanced	32	5.1	Ophthalmology clinic follow up:		
			severe/very severe pre-proliferative retinopathy	4	
			non-sight threatening maculopathy	6	
			<i>Total</i>	10	31.2
			Laser photocoagulation:		
			clinically significant maculopathy	13	
proliferative diabetic retinopathy	9				
			<i>Total</i>	22	68.8

Medication and hospital overheads (eg heating, cleaning) were included, but not depreciation on the slit lamp biomicroscope (cost about £2,000). This machine would be expected to last many years and is also used by many other ophthalmology clinics.

## Results

Results are expressed as means  $\pm$  standard deviation, with ranges where appropriate. During the first 18 months of the service, 622 patients (332 men, (53.4%) and 290 women (46.6%)) were screened, of whom 135 (21.7%) were treated with insulin, 305 (49.0%) with tablets, and 182 (29.3%) by diet alone. The mean age was  $63.5 \pm 12.1$  years (range 21–88 years), and the duration since diagnosis of diabetes was  $8.4 \pm 7.9$  years (range 1–60 years).

### Optometrist examination

The optometrist identified 181 (29.1%) patients with diabetic retinopathy or maculopathy, and 22 (3.5%) of all patients screened received urgent laser photocoagulation (Tables 1 and 2). Cataracts were observed in 119 (19.1%) of patients screened, but associated with a visual acuity of 6/18 or worse in only 44 (7.1%). As a result of screening, early cataract surgery was recommended in eight patients, and YAG laser was used in two patients with post-capsular thickening subsequent to previous cataract extraction.

Two patients were noted to have rubeosis iridis, in

**Table 2.** Patients referred to the ophthalmology clinic (total number screened = 622)

Reason for referral	No.	%
Advancing retinopathy:		
requiring laser photocoagulation	22	3.5
requiring close follow up	29	4.7
Surgery (eg cataract, eyelid)	15	2.4
Glaucoma testing	11	1.8
Poor view of fundus	4	0.6
Other (eg detached retina)	5	0.8
<i>Total</i>	86	13.8

one of them associated with raised intraocular pressure which required urgent intervention. Raised intraocular pressure ( $\geq 25$  mmHg) was observed in 14 patients (2.3%) and a borderline intraocular pressure (22–24 mmHg) in a further 27 (4.3%). It was normal in 581 (93.4%) patients, and could not be measured in five (0.8%) of the patients screened.

Many patients had non-diabetic related eye disease. Drüsen were observed in 114 (18.3%) patients, but associated with visual acuity of 6/18 or worse in only 16 (2.6%). Active intervention was required for non-diabetic eye pathologies in 28 (4.5%) patients (Table 3).

Reappointment for early screening review at six months because of widespread background retinopathy



was required by 33 (5.3%) of the 622 patients screened. A further 86 (13.8%) were referred to the hospital ophthalmology clinic for a variety of reasons (Table 2). Only four (0.6%) patients were referred for a second opinion because of poor views of the fundus.

#### *Parallel examination by consultant ophthalmologist and optometrist*

Of the 103 patients examined in parallel by a consultant ophthalmologist and an optometrist, 57 (55.3%) had no retinopathy, 35 (34.0%) had background retinopathy and 11 (10.7%) retinopathy or maculopathy which required urgent referral, as judged by the ophthalmologist. Five patients referred by the optometrist for suspected intraretinal microvascular abnormality (IRMA) or new vessels had no pathology and required no further assessment (specificity: 87/92 (94.5%)), and one case of macular oedema was not referred (sensitivity: 10/11 (90.9%)). The correct diagnosis was made in 97 (94.1%) patients.

#### *Costing*

The cost of establishing the pilot study was £16 per patient screened, assuming that 10 patients were screened per session. The breakdown was as follows:

- optometrist salary: £8
- nursing time: £2
- clerical time: £2
- medication: £1
- hospital overheads per patient screened: £3.

This represents a cost of £390 per case identified of sight-threatening eye disease requiring laser photocoagulation. If hospital premises were not used and nursing input not utilised, the cost of the service would be reduced to £11 per patient screened. The marginal costs of setting up the service in a pre-existing eye clinic with an available optometrist do not include additional nurse time or hospital overheads. A slit lamp may need to be bought for screening purposes. At a cost of £2,000, this would increase the per patient screening cost by £0.20 or £0.05 if the slit lamp were used for two or eight sessions per week, respectively.

#### **Discussion**

This is the first study to demonstrate the routine use of slit lamp biomicroscopes by hospital optometrists to screen for diabetic retinopathy in a clinical setting. This method has reliably identified previously unrecognised diabetic retinopathy and maculopathy. Important non-diabetic related eye disease, such as glaucoma, cataract and other treatable pathologies were also identified. There was a low technical failure

**Table 3.** Eye disease identified other than retinopathy or maculopathy (total number screened = 622)

Eye pathology	No.	%	No. needing intervention
Cataract	119	19.1	9
Raised intraocular pressure	14	2.3	9
Drüsen	114	18.3	0
Basal cell carcinoma on eyelid	3	0.5	3
Age-related macular degeneration	3	0.5	0
Cholesterol embolus	2	0.3	1
Detached retina	1	0.2	1
Central retinal vein occlusion	1	0.2	0
Entropion	1	0.2	1
Lattice degeneration	1	0.2	1
Raised macula with decreased visual acuity	1	0.2	1
Sac washout	1	0.2	1
Fundal naevi	1	0.2	0
Branch retinal artery occlusion	1	0.2	0
Capsular thickening	1	0.2	1
<b>Total</b>			<b>28</b>

rate, with only four (0.6%) of the 622 screened patients referred to the ophthalmology clinic because of poor view of the fundus. The cost of the service was similar to other screening methods [14–16]. Use of hospital optometrists allows an intensified training programme to be used because there are few hospital optometrists, and this also makes it easier to perform ongoing audit.

This screening service was based within the hospital, not in the community, with the advantage that patients can be—and were—immediately referred to the consultant ophthalmologist and urgent problems quickly dealt with. Travelling distances to the hospital are not extensive in a densely populated inner city setting such as North Liverpool; thus, the majority of patients were not seriously inconvenienced. Non-diabetic related eye pathology was identified in a clinically significant number of patients, with 6.7% of them receiving some form of urgent treatment (laser, surgery or other: see table 2)—but nearly half of these not for diabetic retinopathy or maculopathy. It is likely that much of the non-diabetic eye pathology would have been missed in the standard diabetic clinic and with other screening methods. Also, patients did not have to attend for additional general ophthalmology clinic appointments, which is advantageous for the patient and helps reduce patient waiting times.

About 23% of patients did not attend their screening appointments, a figure comparable to the 15–47% failure to attend rate for our own general diabetic clinic and the reported rates in the literature [17–19].



It would be possible for hospital-based optometrists to screen patients in the community, which might improve uptake and also reduce screening costs. Hospital optometrists could negotiate use of community optometrists' equipment for screening, or the service could be located in large health centres (some general practitioners already possess slit lamps).

Community-based optometrists have been used to screen for diabetic eye disease. Small studies have indicated that this may be quite effective [11,20], but a larger study demonstrated a sensitivity of only 48% [9]. Thus, although a few community optometrists may be able and well motivated, there appear to be limitations to their widespread use. The hospital-based optometrists in this study achieved a high level of screening sensitivity, although admittedly in a relatively small number of patients. Their intensive training and the use of slit lamps instead of ophthalmoscopy may partly explain the better sensitivities achieved by hospital optometrists compared with community optometrists [9]. One or two of the former could screen most diabetic patients within a district and, by so doing, maintain their skills and accuracy.

The sensitivity of direct ophthalmoscopy, even if performed by a trained ophthalmologist, has recently been shown to be only 67% compared to the reference standard of slit lamp biomicroscopy examination [10]. This may no longer be considered sufficiently sensitive for screening; other screening methods, within both hospital and community, may have to be used in the future. Combined ophthalmoscopy and retinal photography can improve screening sensitivity [21], but hospital optometrists using a slit lamp constitute a useful alternative method for screening for diabetic eye disease. As this does not require examination by two techniques, it may be quicker, more convenient and easier to organise. The sensitivity results from our study of this method are sufficiently encouraging to justify a larger-scale trial to examine its sensitivity and specificity. The slit lamp also has the advantage of detecting retinal thickening, which should make it easier to detect maculopathy, and may offer an advantage over fundus photography.

The low technical failure rate of 0.6% associated with the slit lamp biomicroscope is significantly less than that reported for fundus photography, in which 7–34% of films are unreadable [4,6–8,16]. As a result, the number of patients requiring re-examination is much less than with fundus photography, reducing the cost and inconvenience of recall.

The cost of hospital-based optometry screening is similar to mobile fundus photography [22–24]. If the screening service were based in the community, the cost of screening would be similar to the cheapest estimates of mobile fundus photography (about £10–11) [22–24]. The cost of treating diabetic eye disease (eg with laser photocoagulation), which would not have been identified other than by screening, should be compared to the much greater financial

cost [25] of supporting a blind person in the community, and the much lower quality of life that would result.

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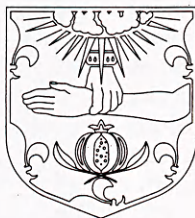
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