Do locally agreed guidelines for optometrists concerning the referral of glaucoma suspects influence referral practice?

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Abstract

Purpose To assess whether the issuing of local guidelines for glaucoma detection including a protocol for the referral of suspects can improve the quality and accuracy of referrals from optometrists.

Methods Universally agreed guidelines, which included a protocol for referring glaucoma suspects, were circulated to all optometrists in the catchment area of a major teaching hospital ophthalmic unit. Data on 207 new patients referred to one glaucoma clinic were collected from GOS18 forms and hospital records covering two 12 month periods spanning the guideline dissemination. Referral accuracy was calculated and the reasons for protocol violations and referral of normal individuals were determined. Where possible, data were compared with a similar study relating to referrals made to the same clinic in 1988 and 1993.

Results The mean (SD) intraocular pressure (IOP) at which optometrists referred patients was 22.5 (6.6) in 1997 and 21.9 mmHg (6.6) in 1998/9, both significantly less than in 1988. A statistically significant upward trend with time was found in the number of patients referred with an assessment of cup/disc ratio and in those with details of a visual field assessment. The overall 'true positive diagnosis' was 40% (42/105) in 1997 and 32.3% (33/102) in 1998/9 after the guidelines ($p = 0.32$), both of which were significantly lower than the 1988 rate of 56% (34/75) ($p = 0.03$ and 0.003). Fifty per cent of false positive referrals in both 1997 and 1998/9 were associated with an assessment by the optometrist of the optic disc(s) that was at variance with the ophthalmologist's. False positive visual fields were associated with 22% and 35% of non-true positive referrals in 1997 and 1998/9. Protocol violations were observed in 48% of referrals after the guidelines had been disseminated.

When the referral was both a false positive and the guideline protocol was not followed, 88% of violations were associated with IOP measurement in 1997 and 73% in 1998/9. The equivalent figures for visual field violations were 70% in 1997 and 76% in 1998/9. Normal individuals referred as suspects were significantly ($p = 0.001$) less likely to be referred on IOP grounds if their optometrist followed the referral protocol.

Conclusion Local dissemination of glaucoma screening guidelines with a protocol for referral did not appear to improve the diagnostic accuracy of optometrists in our area. Optometrists who follow the guidelines refer fewer normal individuals on IOP grounds, but false positive visual fields and optic disc interpretation difficulties remain a factor in such referrals. Additional strategies will be necessary to improve the quality and accuracy of referrals for suspect glaucoma by optometrists.

Key words Glaucoma, Guidelines, Optometrists, Protocol, Screening

In the UK, most glaucoma suspects are identified by optometrists, who perform various tests aimed at detecting the disease, and are then referred to the Hospital Eye Service (HES) via the patient's General Practitioner (GP). Glaucoma suspects constitute the second most common cause of referrals to the HES.¹ Several studies have been published reporting on aspects of the efficacy of such a system but, in spite of recent technological advances in glaucoma detection equipment, the system's 'predictive power of positive test' has not improved, with between 43% and 77.5% of referrals being false positives.¹⁻⁶

We had observed that, despite the International Glaucoma Association's desire that all three commonly employed screening

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tests (intraocular pressure (IOP), visual fields and optic disc assessment) be routinely applied, significant numbers of referrals were being received with suboptimal data on which to base priority.² In addition, guidelines from the College of Optometrists active during the time course of this study advocated that all those over the age of 40 years should have visual field analysis as part of a periodic eye examination.⁷

To our knowledge, there has been no study to examine whether the referral information delivered to the ophthalmologist from optometrists can be influenced by local guidelines and protocols. We report the effect of such an exercise undertaken in Nottingham Health District and compare referral accuracy rates in the late 1990s with those from the late 1980s and early 1990s.

Methods

Our hospital has been providing a consultant-led glaucoma service since 1986. A previous report,² which analysed glaucoma suspects referred by Nottinghamshire optometrists in 1988 and 1993, showed a significant increase in false positive referrals. Based on this study, guidelines for glaucoma detection, containing a protocol for glaucoma referral, were devised by the local glaucoma specialist (S.A.V.). The guidelines also took into consideration information from another earlier study that analysed the local optometric practice pattern of glaucoma screening.⁸

The local ophthalmic consultants first reviewed a draft of the guidelines and its protocol. It was then ratified and discussed with the local optometric committee and was presented to the 'Ophthalmic Working Group', a local policy body which contains representatives from ophthalmologists, trust and health authority managers, GPs, optometrists and public health physicians. Universal agreement was reached.

The guidelines covered aspects of IOP measurement, optic disc assessment and visual field performance and interpretation. The protocol allowed scenario-based referral. If the IOP was confirmed to be 35 mmHg or more or there were signs of acute angle closure, the patient could be referred directly to the eye casualty. All other patients should be referred via the patient's GP with data including IOP levels, optic disc features and visual field results. Patients could be referred on the basis of one of the following scenarios:

1. IOP alone (if measured > 25 mmHg on two visits).
2. Optic disc appearance alone if unequivocal glaucomatous excavation was identified by the optometrist (assumes a normal field).
3. Visual field alone, if defects were found to be repeatable on two separate occasions.
4. Optic disc asymmetry (vertical cup/disc ratio asymmetry of 0.2 or more) and IOP > 22 mmHg on two or more occasions (visual field normal).
5. Optic disc and visual field abnormalities (IOPs in the normal range).

6. 'Abnormal' IOP (> 22 mmHg on two separate visits), optic disc and visual field changes consistent with glaucoma.

The Health Authority distributed the guidelines (with the protocol) to all local practising optometrists in January 1998. We selected for analysis the records of patients referred during a period 12 months before circulation of the guidelines (1997) and a period of 12 months after (mid-1998 to mid-99). This allowed 6 months for 'post-guideline' practice to become established. Selection of patient records was similar to the method used in our previous study, which analysed referrals to the same clinic in 1988 and 1993,² but the number was increased to 120 from each 12 month period. Records from patients referred, other than those originating from our eye casualty department, were entered into the study if their records contained a GOS18 form or a copy of the optometrist's letter to the GP. Data from the suspects' GOS18 forms and from the clinic notes were then entered onto a database and analysed using two-tailed Student's *t*-tests and chi-squared tests where appropriate. For the purpose of this study the various diagnostic criteria remained identical to those previously described.² Briefly, a true positive referral was defined as a patient who was found to have 'treatable' disease (glaucoma, as defined as optic disc excavation associated with visual field loss of a nerve fibre bundle nature as defined in our previous publication,² or ocular hypertension with an IOP of 30 mmHg or more in either eye on two occasions).

Data obtained were then compared with similar data from referrals initiated in 1988 and 1993² where direct comparisons could be made.

For the 1997 and 1998/9 cohorts, referrals were deemed to follow the protocol if the basis for the referral could be assumed from the data provided by the referring optometrist. Referrals considered not to have followed the scenario-based protocol were analysed to identify which test(s) were responsible/missing from the data provided. For example, a referral based upon an IOP of 23 mmHg in one eye and 24 mmHg in the fellow eye with optic discs considered to be normal and without a visual field being performed would violate the protocol on IOP and field grounds.

Results

One hundred and five of the 120 case records were suitable for analysis from the 1997 cohort and 102 from the 1998/9 cohort. There was no significant difference between the number of men and women in the two cohorts (1997 and 1998/1999) with 56 of the 105 patients being female in 1997 and 54/102 in 1998/9.

The mean (SD) age of the patient was 64.7 years (14.2) in 1997 and 58.9 years (14.2) in 1998/9 ($p = 0.004$).

The mean IOP at which optometrists referred patients was slightly lower in 1998/9 at 21.9 mmHg (6.6) than in 1997 at 22.5 (6.6), but this difference was not statistically

significant. Both of these figures are significantly lower than in 1998 (25.1 mmHg (6.1), $p < 0.0005$) but similar to 1993 (22.4 mmHg (5.6)).

In 1998/9, 73.5% (75/102) of patients were sent with details of their cup/disc ratio assessment compared with 67.6% (71/105) in 1997 ($p = 0.28$). Fig. 1 shows an increasing tendency for optometrists to provide such data over an 11 year period in Nottingham. Both the 1997 and 1998/9 figures are significantly greater than those from 1993 ($p = 0.0004$ and $p < 0.0001$ respectively).

In 1997 61.9% (65/105) of patients were referred with data concerning their visual fields and this increased to 68.7% (70/102) in 1999, although the difference was not significant ($p = 0.24$). When the data from all four cohorts are analysed (Fig. 2), an increasing trend is seen. Although the 1997 figures do not quite reach statistical significance when compared with those from 1993 ($p = 0.07$), those from 1998/9 do ($p = 0.006$).

IOPs measured in the hospital clinic confirm that the patients are being referred at lower IOPs (all IOPs were taken between 9:00 and 12:00 hours in all four cohorts). In 1997 the mean of all IOPs at the first clinic visit was 20.9 mmHg (6.5). No significant difference was detected in the later cohort (mean 21.2 mmHg (5.9) in 1998/9; $p = 0.52$). The IOPs measured in the clinic in 1988 were significantly higher than in any of the subsequent years ($p < 0.0001$ for 1997 and 1998/9 and $p = 0.001$ for 1993). Interestingly, the mean IOP measured in the clinic in 1993 cohort (23.0 mmHg) was significantly higher than in 1997 ($p = 0.02$) and 1998/9 ($p = 0.02$).

The final clinic diagnoses for the 1997 and 1998/9 cohorts made after all the appropriate investigations are shown in Table 1.

Fig. 1. The percentage of patients referred with details of their cup/disc ratios in the four time periods.

Fig. 2. The percentage of patients referred with visual field results in the four time periods.

The overall 'true positive diagnosis' according to our previously published criteria (treatable disease) was 40% (42/105) in 1997. This decreased to 32.3% (33/102) after the guidelines, although the difference was not significant ($p = 0.32$). Both were, however, significantly lower than the positive referral rate of 56% in 1988 ($p = 0.03$ and 0.003 respectively). If glaucoma suspects are included as an 'appropriate referral', the 'inappropriate referrals' are effectively only the normals. In 1988 these numbered 3%, in 1993 23%,² in 1997 37% and in 1998/9 43%.

The false positive referrals (1997 and 1998/9 cohorts)

There were 63 'false positive' referrals in 1997 and 66 in 1998/9. Of the 41 patients deemed by the optometrist to have an abnormal disc in 1997, only 9 (21%) were considered suspicious in the clinic, with figures of 43 and 11 (26%) in 1998/9. Of the 18 patients referred with a defective field (in either eye) in 1997, only 4 (22%) were found to have a defect (not considered glaucomatous) in the clinic with figures of 24 and 1 (4%) in 1998/9.

An analysis of those patients whose final diagnosis was normal and whose referring optometrist had followed the guidelines for referral is shown in Table 2. A false positive field was recorded in 11 of 19 (58%) of those from 1997, and in 16 of 23 (70%) of those from

Table 1. Diagnoses for patients referred prior to (1997) and following (1998/9) the dissemination of the guidelines

Final diagnosis	1997 (n = 105)	1998-9 (n = 102)
True positives		
Glaucoma	39 (37.2%)	32 (31.4%)
Ocular hypertension (treated)	3 (2.8%)	1 (0.9%)
Ocular hypertension (not treated)	14 (13.3%)	18 (17.6%)
Suspicious disc	9 (8.6%)	7 (6.8%)
Other diagnosis	1 (0.9%)	
Normal	39 (37.2%)	44 (43.1%)

Table 2. Indications for referral of persons whose final diagnosis was normal by optometrists who followed the guidelines for referral

Reasons for referral	No. of persons	
	1997	1998/9
Raised IOP only	1	2
Suspicious disc only	5	5
Abnormal field only	0	4
Raised IOP + suspicious disc	2	0
Suspicious disc and abnormal field	9	10
Raised IOP and abnormal field	1	0
Raised IOP, suspicious disc + abnormal field	1	2
Total	19	23

IOP, intraocular pressure.

1998/9. Optic disc abnormalities were reported in 15 of 19 (79%) normals in 1997, and 17 of 23 (74%) normals in 1998/9. A similar analysis for those patients whose final diagnosis was normal and whose referring optometrist had *not* followed the guidelines for referral is shown in Table 3. A false positive field was recorded in only 1 of 21 (5% of those from 1997, and in 2 of 21 (10%) of those from 1998/9. Optic disc abnormalities were reported in 13 of 21 (62%) normals in 1997, and 11 of 21 (52%) normals in 1998/9.

In total, raised IOP was cited as a reason for referral in 38 of 42 (91%) normals referred by optometrists who had not followed the guideline protocol, but in only 9 of 42 (21%) normals whose optometrist had followed the protocol ($p = 0.001$).

Protocol violations

Even before the guidelines were distributed, 50 of 105 patients (47.6%) referred in 1997 were referred as per criteria to be laid down in our guideline protocol. In 1998/9, after the guidelines were disseminated, the optometrists referred 53 (52%) with data that followed the protocol ($p = 0.53$). The true positive rate in those referred according to the protocol was 44% (22/50) in 1997 and 34% (18/53) in 1998/9 ($p = 0.29$). The true positive rate in those not referred according to the protocol was similar at 40% (22/55) in 1997 and 33% (16/49) in 1998/9.

Table 3. Indications for referral of persons whose final diagnosis was normal by optometrists who had not followed the guidelines for referral

Reasons for referral	No. of persons	
	1997	1998/9
IOP only	7	8
Suspicious disc only	1	2
Abnormal field only	0	0
Raised IOP + suspicious disc	11	7
Suspicious disc and abnormal field	0	0
Raised IOP and abnormal field	0	1
Raised IOP, suspicious disc + abnormal field	1	2
Shallow AC	1	1
Total	21	21

AC, anterior chamber; IOP, intraocular pressure.

When the referral was both a false positive and the guideline protocol was not followed (33 patients in both 1977 and 1998/9), 29 (88%) were associated with violations of IOP measurement protocol in 1997, compared with 24 (73%) in 1998/9. The equivalent figures for visual field violations were 23 (70%) in 1997 and 25 (76%) in 1998/9. It was rare for optometrists not to make a comment on the optic discs in this subgroup (2 (6%) in 1997 and 1 (3%) in 1998/9). In 10 cases (30%) in 1997 and 8 (24%) in 1998/9, the protocol was violated on IOP grounds alone, with the equivalent figures for fields being 4 (12%) and 9 (27%).

Discussion

There have been a number of studies over the last 15 years that have analysed the accuracy of optometric referrals. They have reported a wide variation in true positive rates depending, in part, on the criteria used for the ophthalmologist's diagnosis. The following selection is representative.

In a 12 month retrospective analysis of glaucoma referrals to one consultant's clinic, Clearkin and Harcourt⁹ found 32.3% of 34 patients had glaucoma (defined as 'cupping' and field loss with or without raised IOP) and a further 12% had optic hypertension (OH) or suspect discs. Harrison *et al.*¹ identified glaucoma in 22.5% of 147 patients referred by optometrists and GPs. Their diagnosis was also based on glaucomatous field loss and disc cupping with or without raised IOP. However, a total of 80% of their referrals had confirmed or borderline glaucoma and OH. Sheldrick *et al.*³ found that 31.5% of 213 referrals from optometrists had glaucoma. Their criteria for a positive diagnosis were an IOP of 21 mmHg or more combined with a field defect typical of glaucoma. They found an additional 22.5% of their referrals had confirmed OH but did not report how many required treatment. Brittain *et al.*,⁵ in a 6 month prospective study, diagnosed glaucoma in 43.2% of their 95 referrals with a further 21% classified as 'suspects'. Diagnostic criteria for each subgroup were, unfortunately, not stated in this report.

In a large prospective survey by Tuck and Crick,⁶ glaucoma referrals from various optometrist practices, representative of England and Wales, were analysed over a 4 month period. A diagnosis of glaucoma was subsequently made in 40.2% of 704 referrals with another 31.5% being graded as 'suspect' by the ophthalmologist. As the study involved many ophthalmologists, it is very probable that the diagnostic criteria were not uniform.

At the time of writing, in the most recent retrospective study other than from our unit, Newman *et al.*⁴ found glaucoma in 43% of 82 optometric referrals with a further 19.5% with a diagnosis of OH. Their diagnosis of glaucoma was independent of IOP and included as positive those with disc excavation without established field loss. To our knowledge, our study reports the first sequential analysis of optometric glaucoma suspect referrals to the same clinic over an 11 year period. In 1997 the referred cohort contained significantly older patients

than in 1993 and 1998/9, but not 1988. The reasons for this 'blip' are unclear but it may be associated with the reintroduction of free tests for the over-60s (April 1999) if younger individuals were deferring their visit to an optometrist hoping for a relaxation of the fees which eventually occurred.

During the whole of the study period, our diagnostic parameters for true positives have not altered, although the method of visual field analysis was different in 1988 (Friedmann) from that utilised during the 1990s (Humphrey). For a study of this nature we feel our definition of positive referrals (treatable disease) is practical and has remained consistent. The diagnosis of glaucoma was independent of IOP for all four cohorts and OH was treated if the IOP measured 30 mmHg or above on two visits to the clinic or at a lower level when other ophthalmic risk factors were present (such as cup/disc ratio asymmetry). It might be considered that our definition of a true positive is rather strict considering the contents of the guidelines for referral. However, even if all the 'non-normal' patients are defined as appropriate referrals, this still leaves approximately 2 in 5 referrals as being inappropriate – a proportion which has not decreased following dissemination of the guidelines (Table 1).

Our study has demonstrated a sustained reduction in the IOP at which optometrists are referring glaucoma suspects, with recent clinic IOPs at significantly lower levels than both the late 1980s and early 1990s. By inference, therefore, increasingly large numbers of patients are being referred primarily on the basis of optic disc and/or visual field abnormalities.

In our two most recent cohorts, the percentage of false positive referrals associated with a non-substantiated abnormal assessment of the optic disc has remained constant following the guidelines (50%). However, those associated with an abnormal field at the optometrist (but later found to be normal in clinic) increased from 22% to 35% in less than 2 years.

The College of Optometrists' guideline advice on best practice suggests an optic disc and visual field assessment should be performed on all patients at risk of developing glaucoma⁷ (essentially all those aged 40 years and over). If those referred are representative of those screened, optometrists in Nottingham appear to be well on their way to achieving this target. This clearly represents a major change in practice, as routine perimetry was only performed by a small percentage of optometrists as little as 10 years ago¹⁰ with only 8% of optometrists doing so for patients over 40.¹¹

It has been suggested that increasing the utilisation of routine visual field testing in optometric practice has been responsible (in part) for the reduced predictive power of a positive referral from optometrists.^{2,4} Our protocol was designed in an attempt to reduce what we considered to be poor-quality referrals. An integral part of this was the agreement that field defects detected in an otherwise normal eye should be verified prior to referral. It appears that repeating an 'abnormal' visual field does not necessarily avoid an inappropriate referral of a

normal patient (Table 2), but it is our impression that careful interpretation of the available data might well do as the two 'abnormal' fields were often dissimilar.

Our guidelines also gave advice concerning the common causes of non-contact tonometry false positives, based upon research data.^{12,13} It was encouraging to see how few inappropriate referrals (normals) were associated with IOP measurement when optometrists followed the guideline protocol compared with those who did not (21% vs 91%; Tables 2, 3). We do not know how many normal individuals the former group of optometrists would have referred if they had not followed the protocol, but the results suggest that our protocol may reduce the number of inappropriate referrals that rely heavily on IOP. However, difficulties in optic disc assessment appear to be associated with a high percentage of normals referred as suspects by optometrists who do and do not follow the guidelines (Tables 2, 3). The low percentage of false positive fields found in normals referred by optometrists who did not follow the guideline protocol was due primarily to the small number of visual fields performed in these patients prior to referral.

Were there other reasons why our efforts were unsuccessful in altering referral practice? We were assured that the documentation had been distributed to all optometrists currently registered with the health authority, but it is possible that it did not reach all of its target audience.

It is interesting to note that nearly 50% of our referrals were 'following' our protocol, prior to its dissemination. This may reflect the fact that the originating author of the guidelines (S.A.V.) has been proactive in local postgraduate activities involving the local optometric association over the previous 14 years. It would be interesting to determine how many referrals from optometrists elsewhere would be classed as 'following the protocol' during the same time period.

A large countrywide study performed a decade ago determined that the true positive referral rate is higher from optometrists who routinely perform more than one type of diagnostic test.⁶ This may have been the case when this study was performed, as it may have reflected the possibility that the optometrists who performed multiple tests on each patient were more interested in glaucoma and therefore inherently better at identifying glaucoma than others who performed just one. In the absence of additional training in results interpretation, increasing the number of tests per patient by *all* optometrists might be expected to increase the overall false positive rate dramatically, whilst adding only a few true positives because of the low prevalence of undetected disease (1.4%).¹⁴

The Nottingham optometrists have not been able to improve their predictive power of a positive (PP+ve) referral in the late 1990s over and above that which prevailed in 1993. Indeed, it is interesting to note that all the PP+ve rates in the 1990s were significantly lower than that found in 1988. This is also true even if we consider all patients with confirmed OH and suspicious

discs as appropriate referrals. It is also of concern that the number of normal individuals referred as glaucoma suspects has continued to rise through the 1990s from 23% in 1993 to 43% in 1998/9. Our protocol did not allow us to identify the origin of the referrals for confidentiality reasons but it is our impression that optometrists divide into those who refer with detailed, appropriate data and those from whom referrals consistently fall below our standard.

We recognise that our assessments of accuracy, particularly in relation to optic disc assessment, relate to a comparison of the optometrist's 'opinion' with our own, and that there could conceivably be cases in this series where another group of glaucoma specialists would pronounce differently on some of the 'suspicious' discs we defined as being normal. Harper *et al.*¹⁵ found that selected optometrists performed well against ophthalmologists when assessing stereopair photographs of optic discs. We are currently investigating whether this is also the case for *in vivo* assessments, as it is our impression that many optometrists under- or overestimate the cup/disc ratio on glaucoma referrals.

Working to guidelines and having a scenario-based protocol for referral, simplifies the decision-making process for those referring and those receiving the referrals. It also allows meaningful audit and facilitates feedback, so necessary for the continued improvement of the screening process. In addition it permits effective prioritisation of referrals by a hard-pressed hospital service, thus reducing the chance that individuals will suffer irrevocable damage whilst waiting to be seen by an ophthalmologist.

It has been calculated that the most cost efficient mode of screening for glaucoma in optometric practice is to perform all three tests routinely on the over-40s, or to perform tonometry and disc assessment routinely with visual field analysis only for high-risk groups.¹⁶ If the former is to increase in prevalence towards 100%, strict adherence to protocols may be necessary to avoid excessive referrals, or some form of secondary screening system (perhaps utilising optometrists with additional training and expertise¹⁷) may need to be introduced.

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