30 April 2018

3-year scoping report

Topic: Glaucoma referral and safe discharge: literature published since SIGN 144 was published in March 2015

1 Purpose of this report

Further research/evidence has been published since SIGN 144, Glaucoma and referral for safe discharge guideline was published in March 2015. The purpose of this report is to address the following objectives:

Objectives: provide the SIGN Guideline Programme Advisory Group (GPAG) with:

- **the key issues that could change practice or update/change a recommendation(s)**
- **the best timeframes for this update to be undertaken by the SIGN team**

Key issues identified from the scoping were:

- **optical coherence tomography (OCT) for anterior chamber assessment** (section 4.4, para 5)
- **OCT for disc analysis** (section 4.5)
- **the good practice point on referral of narrow angles based on Van Hericks** (section 4.4) cut off point

Timeframes for update: 3 years' time

2 Topic exploration

Topic: Glaucoma referral and safe discharge: literature published since SIGN 144 was published

Date of search: 30/08/17

Searched by: Hilda Emengo

Key concepts: suspect glaucoma, primary care, examination, assessment, test, referral, discharge

2.1 Summary of findings

The purpose of this topic exploration is to establish what evidence has been published since SIGN 144 (Glaucoma referral and safe discharge), and whether any sections of the guideline require updating. A rapid search of the literature was conducted, using a predefined list of resources. The search focused on secondary sources of evidence (evidence-based guidelines, systematic reviews and meta-analyses).

This summary only contains the results relating to the early identification, testing and referral of glaucoma patients from primary care. It does not contain information on the treatment and management of glaucoma.

2.1.1 Guidance

Reference	Information likely to be relevant	Relevant section
The American Academy of Ophthalmology (2016) Comprehensive Adult Medical Eye Evaluation	Recommended frequency of comprehensive medical eye examinations for adults who have risk factors for glaucoma, such as African Americans and Hispanics, by age group is as follows: under 40 years—every 1–2 years; 40 to 54 years—every 1–3 years; and 55 and older—every 1–2 years. (*moderate quality, strong recommendation)*	This may be relevant to section 7. SIGN 144 does not contain any recommendation based on risk factors associated with race

<table>
<tr>
<td>The Royal Australian College of General Practitioners (2016) Guidelines for preventive activities in general practice, 9th edition.</td>
<td>
Evidence supports screening people at higher risk for glaucoma. General practitioners (GPs) have an important role in identifying those at increased risk for glaucoma and referring them for testing. There is no consensus on the recommended frequency of screening for at-risk groups.

Table 12.1. Glaucoma: Identifying risk
<table>
<tr><th>Who is at risk?</th><th>What should be done?</th><th>How often?</th></tr>
<tr><td><u>Increased risk</u></td><td></td><td></td></tr>
<tr><td>Family history of glaucoma (first-degree relatives)
Caucasian and Asian patients aged ≥50 years
Patients of African descent aged ≥40 years</td><td>Refer for ocular examination 5–10 years earlier than the age of onset of glaucoma in the affected relative</td><td>Frequency of follow up determined by the individual patient’s eye assessment</td></tr>
<tr><td><u>Higher risk</u>
Patients aged >50 years with:
• diabetes
• myopia
• long-term steroid use
• migraine and peripheral vasospasm
• abnormal blood pressure (BP)
• history of eye trauma</td><td>Refer for examination of the optic nerve head (ophthalmoscopy), measurement of intraocular pressure (tonometry) and assessment of visual fields (perimetry)*</td><td>Frequency of follow up determined by the individual patient’s eye assessment</td></tr>
</table>
*This may be by an ophthalmologist or optometrist
BP, blood pressure
</td>
<td>This may be relevant to section 7 – monitoring of higher risk groups aged >50 years with abnormal BP, diabetes, long-term steroid use</td>
</tr>
</table>

The American Academy of Ophthalmology (2016). Primary Open-Angle Glaucoma Suspect	**Primary Open-Angle Glaucoma Suspect - Recommendations** A diagnosis for primary open-angle glaucoma (POAG) suspect is established by the presence of one of the following conditions: a consistently elevated intraocular pressure (IOP), a suspicious-appearing optic nerve, or abnormal visual field. Highlights of established risk factors for a POAG suspect diagnosis include an elevated IOP, family history of glaucoma or glaucoma suspect, thin central cornea, race, older age, myopia, and type 2 diabetes. The decision to treat a POAG suspect patient may depend on evidence of optic nerve changes, any visual field defect, level of IOP, and other associated risk factors. In the Ocular Hypertension Treatment Study (OHTS) overall, 90% to 95% of patients with ocular hypertension did not go on to develop glaucoma over 5 years, but treatment to reduce IOP also reduced the risk of developing POAG from 9.5% to 4.5%.4 A reasonable target for IOP reduction in a POAG suspect patient is 20%, based on the OHTS. Appropriate testing to evaluate and monitor patients with OAG includes gonioscopy, pachymetry, tonometry, perimetry, careful observation of the optic nerve, and ocular imaging. **COUNSELING AND REFERRAL** It is important to educate and engage patients in the management of their condition by providing oral and written take-home and online information. This may be especially true for patients who are primary open-angle glaucoma suspects, since some authors have shown that follow-up is poor in patients with this diagnosis. One reason for this was patients' perception that their disease was "not serious enough." Patients should be educated about their condition and its potential to lead to the blinding disease glaucoma, the rationale and goals of intervention, the status of their condition, and the relative benefits and risks of alternative interventions so that they can participate meaningfully in developing an appropriate plan of action. *(good quality, strong recommendation)* Patients should be encouraged to alert their ophthalmologist to physical or emotional changes that occur when taking glaucoma medications, if prescribed. *(good quality, strong recommendation)*	No new evidence identified

	The ophthalmologist should be sensitive to these problems and provide support and encouragement. Patients considering keratorefractive surgery should be informed about the possible impact laser vision correction has on reducing contrast sensitivity and decreasing the accuracy of IOP measurements. *(good quality, strong recommendation)*	
The American Academy of Ophthalmology (2016). Primary Open-Angle Glaucoma	**Gonioscopy** Gonioscopy is indicated when there is a suspicion of an angle-closure component, anterior chamber shallowing or anterior chamber angle abnormalities, or if there is an unexplained change in IOP. Gonioscopy may also be performed periodically.	No new evidence identified
BMJ Best Practice (2017) Angle-closure glaucoma	**Investigations** The optic nerve head should be investigated by slit-lamp examination or funduscopy, and may show typical changes of glaucoma such as a large optic cup and nerve fibre loss. Gonioscopy of both eyes should be performed in all patients in whom angle closure is suspected. Gonioscopy refers to the technique used for viewing the anterior chamber angle of the eye for evaluation of angle structures. Special contact lenses (gonioscopy lenses) overcome the problem of total internal reflection of light rays from the chamber angle, and allow visualisation of the angle using obliquely inclined mirrors. The angle can be closed even in the absence of any other symptoms or signs. If the clinician is uncertain about the gonioscopic findings, he/she can refer the patient for objective imaging of the angle via either ultrasound biomicroscopy or optical coherence tomography. Automatic testing of the visual field should be routinely done to assess the presence and extent of glaucomatous visual field loss. Objective quantitative assessment of optic nerve damage can be obtained by imaging machines such as Heidelberg retinal tomography, optical coherence tomography, and GDx nerve fibre analysis. It is usual for investigations and confirmation of the diagnosis to be completed before full treatment is initiated.	This may be of relevance to section 4.

Diagnostic tests - 1st test to order

Gonioscopy, examination of anterior chamber angle

- Definitive test for diagnosing angle closure.
- Gonioscopy of both eyes should be performed on all patients in whom angle closure is suspected. It should also be performed prior to instilling dilating medications to rule out eyes susceptible to angle closure.
- If angle closure is present, compression (indentation) gonioscopy with a four-mirror or similar lens is particularly helpful to differentiate between appositional (reversible) closure versus synechial (irreversible) angle closure, as well as allow for assessing the extent of peripheral anterior synechiae.
- It is also important for the detection of plateau iris and other specific anatomical configurations.
- It may be therapeutic in breaking the attack of acute angle closure.

Result - trabecular meshwork is not visible in angle closure, because the peripheral iris is in contact with it

Slit-lamp examination

- The best method of examining the optic disc is with the slit lamp combined with a high magnification posterior pole lens. The anterior chamber depth should be noted and the size of the phakic lens.

Result - shallow anterior chamber; and signs of glaucoma: large optic cup, narrowing of the neuroretinal rim, splinter haemorrhage, nerve fibre loss

Automatic static perimetry

- Identifies the presence, and quantifies the amount, of glaucomatous visual field loss during initial diagnosis and subsequently during follow-up care.

Result - visual field defects

	Other tests to consider **Ultrasound biomicroscopy** • Can be ordered for objective documentation of angle closure when findings during physical examination (gonioscopy) are not clear. • Useful for demonstrating specific aetiologies for angle closure such as plateau iris or supraciliary body fluid and for demonstrating dynamic changes in the angle during light and dark, and after other provocative tests and after treatment. **Result - closed angle; occludability of the angle in the dark versus light; plateau iris or supraciliary body fluid** **Anterior segment optical coherence tomography (of angle)** • Can be ordered for objective documentation of angle closure when findings during physical examination (gonioscopy) are not clear. • Useful for demonstrating dynamic changes in the angle during light and dark. • Less capable of defining specific aetiologies for angle closure due to inability to image behind the iris. **Result - closed angle; occludability of the angle in the dark versus light** **Evaluation of the optic nerve head by fundoscopy** **Result - may show typical changes of glaucoma such as a large optic cup and nerve fibre loss** **Retinal optical coherence tomography** • Can be used to assess loss of nerve tissue in and around the optic nerve objectively and quantitatively. **Result - quantifies neural tissue in and around the optic nerve**	

Heidelberg's retinal tomography

- Can be used to assess loss of nerve tissue in and around the optic nerve objectively and quantitatively.
- Presents this in relation to a nomogram derived from healthy eyes.

Result - quantifies neural tissue in and around the optic nerve

GDx nerve fibre analyser

- Can be used to assess loss of nerve tissue in and around the optic nerve objectively and quantitatively.

Result - quantifies neural tissue in and around the optic nerve

Diagnostic criteria

Acute angle-closure attacks

- Presence of at least 2 of the following symptoms: ocular or periocular pain, nausea and/or vomiting, an antecedent history of intermittent blurring of vision with haloes.
- Presenting intra-ocular pressure (IOP) >21 mmHg.
- Presence of at least 3 of the following signs: conjunctival injection, corneal epithelial oedema, mid-dilated unreactive pupil, and shallow anterior chamber.

Chronic angle-closure attacks

Developed for the use in prevalence surveys. It identifies 3 stages in the natural history of angle closure:

- Primary angle-closure suspect: an 'occludable angle', with normal IOP, optic disc, and visual field, without evidence of peripheral anterior synechiae (PAS).
- Primary angle-closure: an 'occludable angle' with either raised IOP and/or primary PAS. Optic disc and field normal.
- Primary angle-closure glaucoma: primary angle closure with evidence of glaucomatous damage to optic disc and visual field.

BMJ Best Practice (2016) Open-angle glaucoma	**Screening** Screening is important because glaucoma often progresses without symptoms. About 50% of cases are undetected. Once identified, current treatments can stave off disease progression and eventual blindness in many cases. Screening consists of routine, dilated eye examinations with measurement of the optic disc and visual fields. Screening is especially important for high-risk patients (patients with first-degree relative with glaucoma or certain ethnicities: e.g., African-Caribbeans). Simply checking the intra-ocular pressure is not an adequate screening technique for glaucoma. **Screening based on risk stratification** Patients who have a first-degree relative with glaucoma and black patients should be screened at the following frequencies: • Between ages 20 and 29 years, every 3 to 5 years • Between ages 30 and 64 years, every 2 to 4 years • From age 65 years onwards, every 1 to 2 years. White patients (without a first-degree relative with glaucoma) should be screened at the following frequencies: • Between ages 20 and 29 years, at least once • Between ages 30 and 39 years, at least twice • Between ages 40 and 64 years, every 2 to 4 years • From age 65 years onwards, every 1 to 2 years. Patients suspected to have glaucoma based on history and examination should then receive further testing. **Secondary prevention** Primary relatives of affected patients should have a dilated ophthalmic examination.	This may be of relevance to section 7. The SIGN guideline does not contain any recommendation based on risk factors associated with race

	<u>Diagnostic tests - 1st test to order</u> **Tonometry** • Most common, accurate, and most expensive method is Goldmann tonometry. A topical anaesthetic is placed on the patient's eye while the patient is sitting at the slit lamp. • A small, sterile cone makes contact with the cornea, and the clinician looks through the lamp for an image of two aligned crescents before determining the reading on the dial. Specifically, the Goldmann procedure underestimates pressures in patients with thin corneas and overestimates them in patients with thick corneas. • The I-Care is a portable method of intra-ocular pressure measurement. This does not require anaesthesia and has single-use probes. Another method entails use of the Tono-Pen, a portable device also used with a topical anaesthetic and a sterile cover. It is repeatedly placed on the cornea and beeps when producing a digital readout. If a slit lamp is unavailable or the patient is young and/or unco-operative, these methods are particularly useful. Both methods have the risk of imprecision. • The most basic tonometer is the pneumotonometer. A blast of air on the cornea measures the rate of fluid rebound. A pressure readout results. No eye drops are needed. **Result: intra-ocular pressure elevated if above normal range: 10 mmHg and 21 mmHg** **Direct ophthalmoscopy** • Inexpensive, portable device, providing retinal and optic disc visualisation and cup-to-disc ratio with magnification. • Shines and reflects this light onto the eye interior, providing clear visualisation of the retina and optic disc. • Can determine the presence of flame haemorrhages around the optic disc, found in late disease. **Result: cup-to-disc ratio over 0.6 may be suspicious of glaucoma as is asymmetry of greater than 0.2 between the two eyes; visualisation of optic disc and retina quality; flame haemorrhages in late disease**	The section on diagnostic tests may be of relevance to section 4.

	Indirect ophthalmoscopy • Portable device providing a 3-dimensional appearance of the retina and diagnostic optic disc cupping or indentation. • Reflections from the retina at the superior and inferior poles of the optic disc are usually bright in healthy eyes, but are quite dull in glaucoma. **Result: cup-to-disc ratio over 0.6 may be suspicious of glaucoma as is asymmetry of greater than 0.2 between the two eyes; 3-dimensional view of retina and optic disc cupping** **Slit-lamp biomicroscopy** • This is the most frequent method used by ophthalmologists. It allows for assessment of the cornea, anterior chamber, and drainage angle. Intra-ocular pressure can also be measured. Fundal examination, looking at the optic disc, can also be facilitated using the slit lamp. **Result: cornea should be clear, anterior chamber should be deep, and drainage angle should be open** **Visual field testing** • Is both manual and automated. It should be performed on all patients. • Scotomas with either an elevated intra-ocular pressure or an enlarged cup-to-disc ratio have high sensitivity and specificity. • First-time test takers often perform worse than those on subsequent examination. • The patient's alertness influences results; therefore, new scotomas are always confirmed by repeating the test on a different day. • By the time of disease detection, 50% of the nerve fibre layer may be damaged. **Result: scotomas indicating loss of the nerve fibre layer**	

2.1.2 Reviews

Reference	Information likely to be relevant	Relevant section
Michelessi et al (2015)	**Main results** We included 106 studies in this review, which analysed 16,260 eyes (8353 cases, 7907 controls) in total. Forty studies (5574 participants) assessed GDx, 18 studies (3550 participants) HRT, and 63 (9390 participants) OCT, with 12 of these studies comparing two or three tests. Regarding study quality, a case-control design in 103 studies raised concerns as it can overestimate accuracy and reduce the applicability of the results to daily practice. Twenty-four studies were sponsored by the manufacturer, and in 15 the potential conflict of interest was unclear. Comparisons made within each test were more reliable than those between tests, as they were mostly based on direct comparisons within each study. The Nerve Fibre Indicator yielded the highest accuracy (estimate, 95% confidence interval (CI)) among GDx parameters (sensitivity: 0.67, 0.55 to 0.77; specificity: 0.94, 0.92 to 0.95). For HRT measures, the Vertical Cup/Disc (C/D) ratio (sensitivity: 0.72, 0.60 to 0.68; specificity: 0.94, 0.92 to 0.95) was no different from other parameters.With OCT, the accuracy of average RNFL retinal thickness was similar to the inferior sector (0.72, 0.65 to 0.77; specificity: 0.93, 0.92 to 0.95) and, in different studies, to the vertical C/D ratio. Comparing the parameters with the highest diagnostic odds ratio (DOR) for each device in a single HSROC model, the performance of GDx, HRT and OCT was remarkably similar. At a sensitivity of 0.70 and a high specificity close to 0.95 as in most of these studies, in 1000 people referred by primary eye care, of whom 200 have manifest glaucoma, such as in those who have already undergone some functional or anatomic testing by optometrists, the best measures of GDx, HRT and OCT would miss about 60 cases out of the 200 patients with glaucoma, and would incorrectly refer 50 out of 800 patients without glaucoma. If prevalence were 5%, e.g. such as in people referred only because of family history of glaucoma, the corresponding figures would be 15 patients missed out of 50 with manifest glaucoma, avoiding referral of about 890 out of 950 non-glaucomatous people. Heterogeneity investigations found that sensitivity estimate was higher for studies with more severe glaucoma, expressed as worse average mean deviation (MD): 0.79 (0.74 to 0.83) for MD < -6 db versus	This review was published in 2015 - the search carried out was about two months more recent than that of the SIGN guideline. The information could be relevant to 4.5.4. Note conclusions of the study and limitations due to case-control studies included. Overall, the findings of the review is not likely to have a significant impact on the conclusions of section 4.5.4

	0.64 (0.60 to 0.69) for MD _ -6 db, at a similar summary specificity (0.93, 95% CI 0.92 to 0.94 and, respectively, 0.94; 95% CI 0.93 to 0.95; P < 0.0001 for the difference in relative DOR). **Authors' conclusions** The accuracy of imaging tests for detecting manifest glaucoma was variable across studies, but overall similar for different devices. Accuracy may have been overestimated due to the case-control design, which is a serious limitation of the current evidence base. We recommend that further diagnostic accuracy studies are carried out on patients selected consecutively at a defined step of the clinical pathway, providing a description of risk factors leading to referral and bearing in mind the consequences of false positives and false negatives in the setting in which the diagnostic question is made. Future research should report accuracy for each threshold of these continuous measures, or publish raw data.	
Porciatti and Ventura 2017	The findings and summary section of the review states that: While the pattern electroretinogram (PERG) technique has been in use since the 1980's, only recently PERG methods have been developed with skin electrodes and automated analysis that expand the PERG application in the clinical setting. The PERG may be altered at stages of glaucoma that precede losses of visual field and optic nerve tissue. PERG alterations may be progressive and reversible after IOP lowering. PERG alterations may be inducible in susceptible eyes of patients at risk of glaucoma.	The PERG technique was not mentioned in the SIGN guideline. Not certain of its relevance

2.1.3 Summaries

Reference	Information likely to be relevant	Relevant section
Dynamed (2016) Open-angle glaucoma	**Consultation and referral** • if diagnosis in question or refractory to treatment, consider referral to glaucoma specialist • patients with substantial visual impairment or blindness can be referred for and encouraged to use appropriate vision rehabilitation and social services (AAO Level A-III) **Evaluation** • Primary open-angle glaucoma (POAG) and POAG suspect are usually asymptomatic early in the disease course, and patients typically are identified through screening or based on abnormal findings on an eye examination. • To assess for POAG and POAG suspect, perform a comprehensive eye examination initially and also on a regular basis. • Consider a diagnosis of POAG suspect if there is a consistently elevated intraocular pressure (IOP), a suspicious-appearing optic nerve, abnormal nerve fiber layer on optical coherence tomography (OCT), disc hemorrhage, or an abnormal visual field. • Diagnose open angle-glaucoma if there is progressive optic neuropathy in ≥ 1 eye characterized by acquired typical structural damage to the optic nerve and open anterior chamber angle as measured by gonioscopy. • Severity of POAG is based on standard automated perimetry. o Mild - normal visual field o Moderate - visual field abnormalities in 1 hemifield that are not within 5 degrees of fixation of patient's gaze on a static point o Severe - visual field abnormalities in both hemifields and/or loss within 5 degrees of fixation in ≥ 1 hemifield	Some of the information could be relevant to section 7 – monitoring of at risk groups eg persons with diabetes

	o Indeterminate - definite optic disc or retinal nerve fiber layer abnormalities consistent with glaucoma, inability of patient to perform visual field testing, unreliable/uninterpretable visual field test results, or visual fields not yet performed • Exclude other causes of optic disc abnormalities, retinal abnormalities, central nervous system abnormalities, and elevated IOP. **Likely risk factors** • diabetes o **diabetes associated with increased risk of glaucoma** ▪ based on systematic review of observational studies ▪ systematic review of 47 observational studies evaluating association between diabetes and risk of glaucoma in 2,981,342 persons ▪ 21 studies evaluated risk of open-angle glaucoma and 8 studies evaluated risk of overall glaucoma ▪ all results limited by significant heterogeneity ▪ compared to patients without diabetes, diabetes associated with ▪ increased risk of glaucoma (relative risk 1.48, 95% CI 1.29-1.71) in analysis of 29 studies ▪ increased intraocular pressure (mean difference 0.18 mm Hg, 95% CI 0.09-0.27 mm Hg) in analysis of 10 studies	
Dynamed (2016) Angle-closure glaucoma	**Testing overview** • intraocular pressure (IOP) measurement o Goldmann applanation tonometry is standard technique o numerous other options available	This may be of relevance to section 4.

- measure IOP preferably using a contact applanation method (typically Goldmann tonometry) before gonioscopy (postpone measuring central corneal thickness until resolution of acute attack) (AAO Level A-III)

- visual field evaluation
  - preferably by automated static threshold perimetry (AAO Level A-III)
  - careful manual combined kinetic and static threshold testing (for example, Goldmann visual fields) is an acceptable alternative to automated perimetry when either patient cannot perform test reliably or it is unavailable (AAO Level A-III)
  - repeat confirmatory visual field examinations may be required before changing management if new glaucomatous defect apparent (AAO Level A-II)
- gonioscopy of both eyes (AAO Level A-III)

Other diagnostic testing

- visual field test (especially measurement of light sensitivity at locations in central 30 degrees of vision)
  - techniques for visual field testing
    - Humphrey Field Analyzer (computerized static perimetry test)
      - uses computer software program (Guided Progression Analysis) to determine visual field progression (defined as a deterioration > 95% CI in pattern deviation at same ≥ 3 locations on 3 consecutive visual field tests)
    - Goldman (manual kinetic perimetry)
    - frequency-doubling technology (portable)
    - Damato campimetry
      - **Damato campimetry might detect visual field loss (level 2 [mid-level] evidence)**
        - based on diagnostic cohort study

- 178 eyes with ocular diseases assessed for visual field loss by Damato campimetry with Humphrey automated perimetry as reference standard
- reduced visual field in 81 eyes, normal visual field in 67, inconclusive results in 30
- detection of visual field loss with Damato campimetry had
  - 81% sensitivity
  - 72% specificity

- intraocular pressure (IOP) measurement
  - one-time use contact lens (Triggerfish) FDA approved to help practitioners identify the best time of day to measure a patient's intraocular pressure
  - American Academy of Ophthalmology (AAO) recommends measurement of IOP preferably using a contact applanation method (typically Goldmann tonometry) before gonioscopy (postpone measuring central corneal thickness until resolution of acute attack) (AAO Level A-III)
  - Goldmann applanation tonometry is standard[1]
  - other tonometry options include
    - transpalpebral tonometry
      - pressure phosphene tonometry (PPT)
        - technique
          - pressure phosphene tonometer applied through closed eyelid without topical anesthetic
          - pressure applied until patient experiences pressure phosphene (a subjective impression of bright central area surrounded by dark ring with outer bright halo)

	▪ evidence for diagnostic accuracy conflicting ▪ **PPT and Goldmann applanation tonometry may be similarly accurate for intraocular pressure (IOP) measurement** ▪ based on cohort study ▪ 192 eyes of 100 consecutive patients measured with PPT and Goldmann applanation tonometer in random order ▪ comparing PPT and Goldmann applanation tonometer ▪ for all patients, mean IOP statistically similar (correlation coefficient 0.71) ▪ for separate group of 14 eyes with IOP > 19 mm Hg, mean IOP statistically similar (correlation coefficient 0.73) ▪ **PPT and Goldmann applanation tonometry may not similarly identify patients with increased IOP** ▪ based on cohort study ▪ 137 patients taught to do 5 self-measurements of IOP using PPT and had Goldmann applanation tonometry measurements performed ▪ for patients with Goldmann pressure ≥ 22 mm Hg, sensitivity of PPT 18% ▪ TGDc-01 transpalpebral tonometry using handheld device that provides quantitative readout of IOP ▪ other forms of corneal tonometry	

	▪ Perkins tonometry (hand-held device allows measurement at arms' length) ▪ dynamic contour tonometry (direct transcorneal measurement of IOP using contour matching) ▪ electronic indentation (measures changes in corneal indentation pulse) ▪ rebound tonometry (magnetized probe bounced off cornea) ▪ pneumotonometry (assesses changes in IOP caused by rhythmic filling of intraocular vessels) o review of different methods for measurement of IOP can be found in Curr Opin Ophthalmol 2008 Mar;19(2):122 o comparison studies include Eur J Ophthalmol 2009 Sep-Oct;19(5):783, Acta Ophthalmol Scand 2007 May;85(3):272 full-text • gonioscopy o gonioscopy is contact lens-like instrument containing a mirror placed on cornea to view internal junction of base of iris with trabecular meshwork(1) o AAO recommends gonioscopy of both eyes for evaluation of (AAO Level A-III)(3) ▪ angle anatomy ▪ appositional closure ▪ presence of peripheral anterior synechiae	

2.2 Concluding remarks

The rapid literature search identified some secondary evidence published since SIGN 144. The likely impact of the evidence identified on the guideline has been highlighted.

3 Consultation

3.1 Specialist review

This topic exploration was reviewed by a small working, of group members responsible for developing SIGN 144, who were asked to comment primarily on the comprehensiveness and accuracy of the summary of findings (*see section 4*) and whether there is sufficient new evidence to warrant an update/ refresh of the guideline. There was engagement with the wider optometry community (n= 76) at the NHS Education for Scotland (NES) optometry conference in October 2017 to discuss key issues relating to the guideline update and timeframes. Further consultation, with a small working group with additional expertise, to consider the key issues and the NICE guideline (glaucoma in adults for people with suspected or diagnosed chronic open angle glaucoma or with ocular hypertension) published after the initial scoping was completed and finally consultation with the full membership of the original guideline group was carried out. After careful consideration of the key issues identified above and their potential to change practice/recommendations, it was concluded that SIGN 144 would not require updating at this stage.

3.2 Conclusion

No update to this guideline is currently required. The ideal timeframes for consideration of an update and review of the key issues above would be in 3 years' time.

3.3 Outcome

The recommendation to the Guideline Programme Advisory Group is that no update is required and to add SIGN 144 to the programme in July 2020 for scoping/update. This time scale would allow the scoping to be completed, a working group to potentially meet and consider any new evidence and the possibility of engagement with the wider optometry community via the annual NES conference early October, as appropriate.

4 Decision

The recommendation was ratified by the Guideline Programme Advisory Group on 14 February 2018.

This guideline was **revalidated** in April 2018 and will be considered for review in three years. Any updates to the guideline in the interim period will be noted on the SIGN website: www.sign.ac.uk

Annex 1: Search results

Resource	Results (post 2014)
SIGN	Updating the current guideline SIGN 144 (2015): Glaucoma referral and safe discharge http://www.sign.ac.uk/assets/sign144.pdf
NICE	0 identified
Guidelines International Network (GIN)	1 German guideline in development (guideline will be published in German) Association of Scientific Medical Societies AWMF (DE) (March 2018): Assessment of risk factors for the occurrence of open-angle glaucoma: http://www.g-i-n.net/library/international-guidelines-library/guidelines/awmf-de/bewertung-von-risikofaktoren-fur-das-auftreten-des-offenwinkelglaukoms-s2e-ll-dog
ECRI	0 identified
Dynamed	Dynamed (2016) Open-angle glaucoma: https://www.dynamed.com/topics/dmp~AN~T114157/Open-angle-glaucoma Dynamed (2016) Angle-closure glaucoma: https://www.dynamed.com/topics/dmp~AN~T901114/Angle-closure-glaucoma
BMJ Best Practice	BMJ Best Practice (2017) Angle-closure glaucoma http://bestpractice.bmj.com/best-practice/monograph-pdf/372.pdf

	BMJ Best Practice (2016) Open-angle glaucoma http://bestpractice.bmj.com/best-practice/monograph-pdf/373.pdf
Cochrane Library	*Cochrane reviews* • Michelessi M, Lucenteforte E, Oddone F, Brazzelli M, ParravanoM, Franchi S, Ng SM, Virgili G. Optic nerve head and fibre layer imaging for diagnosing glaucoma. Cochrane Database of Systematic Reviews 2015, Issue 11. Art. No.: CD008803. DOI: 10.1002/14651858.CD008803.pub2. http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD008803.pub2/epdf
Medline/Embase	A rapid search for systematic reviews/meta-analyses on squamous cell carcinoma was run in Medline (2013-2017). • Porciatti and Ventura. The PERG as a Tool for Early Detection and Monitoring of Glaucoma. Curr Ophthalmol Rep (2017) 5:7–13. DOI 10.1007/s40135-017-0128-1 https://link.springer.com/content/pdf/10.1007%2Fs40135-017-0128-1.pdf
Other (references in articles identified)	The American Academy of Ophthalmology (2016) Comprehensive Adult Medical Eye Evaluation: http://ac.els-cdn.com/S0161642015012695/1-s2.0-S0161642015012695-main.pdf?_tid=26209ad8-8c99-11e7-96a9-00000aacb35f&acdnat=1503997685_1b1dd23047d89b425c54158b3894fec4 The Royal Australian College of General Practitioners (2016) Guidelines for preventive activities in general practice, 9th edition: http://www.racgp.org.au/your-practice/guidelines/redbook/12-glaucoma/

	The American Academy of Ophthalmology (2016). Primary Open-Angle Glaucoma Suspect http://ac.els-cdn.com/S0161642015012786/1-s2.0-S0161642015012786-main.pdf?_tid=88fbdc1a-8c9b-11e7-bedf-00000aab0f26&acdnat=1503998710_4e583de0f8e90d9c3f3b1210899a53ee The American Academy of Ophthalmology (2016). Primary Open-Angle Glaucoma http://ac.els-cdn.com/S0161642015012762/1-s2.0-S0161642015012762-main.pdf?_tid=03ff8804-8ca0-11e7-9555-00000aacb362&acdnat=1504000634_2c3f412ff08469f12f62d1af9cc62ee3