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NATIONAL GUIDELINES FOR MANAGEMENT OF GLAUCOMA

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Ophthalmic Services Unit
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P.O Box 30016
Nairobi 00100

Feedback and Enquiries: **Ophthalmicserviceske@gmail.com**

Cover photo
Assessment ofthe intraocular pressureat an outreach clinic. © *Dr Sheila Marco*

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NATIONAL GUIDELINES FOR THE

MANAGEMENT OF GLAUCOMA

IN KENYA

FOREWORD

Glaucoma, a disease that gradually affects the optic nerve, is the second leading cause of vision loss globally, and it continues to pose a challenge to the eye health professionals. In Kenya it is estimated that 4.3% of persons aged above 50 years have the glaucoma disease. The blindness caused by glaucoma is irreversible. We know that if diagnosed early, and with quality care, blindness due to glaucoma can be prevented. Comprehensive glaucoma care is one of the field in eye care requiring a lot of research to establish evidence for best practices especially for the Africa region.

These National guidelines for management of Glaucoma were developed after gathering evidence on the burden of glaucoma in the country and contributions by various experts in the region, and other stakeholders. The document demonstrates the the features of the disease, at different times of the natural history and outlines the best approach in a stepwise manner to the management by different health workers involved in care. It indicates what should be done in all stages of glaucoma treatment and at different level of care.

The document provides a person centred guide to care on what is feasible in Kenya taking into account the medical, socio-economic and psychological status of the glaucoma patient. Through these guidelines, we shall be able to identify patients with glaucoma in time and appropriately manage and as a result, reduce the blindness from glaucoma.

The development of these national glaucoma guidelines are in line with one of the items of the Big 4 National Agenda: Universal health coverage (UHC)that includes affordable quality healthcare for all. It will not be UHC without eye care and for that matter quality glaucoma care.

While much is unknown about Glaucoma, especially in the African race, the guidelines will need to be reviewed from time to time in order to adapt to the changing trends, technology and recent scientific evidence in tackling the disease.

These guidelines are a much needed resource and are recommended for use by all health workers to meet the felt need and demand for quality glaucoma care.

DR PATRICK AMOTH
Ag. DIRETOR GENERAL FOR HEALTH

ACKNOWLEDGEMENT

The national guidelines for management of glaucoma are a useful tool in the clinical care and management of glaucoma patients. The process of development of the guidelines involved extensive consultations among experts in the field and other stakeholders with experience from the medical and social background.

The Ministry of Health wishes to express gratitude to all who were involved in the process that led to the ultimate production of this impactful document.

We appreciate our well rehabilitated blind patients who though could not have their sight restored, inspired us on the need to set up standard best practices so that others may not reach to that situation. A good number of patients living with glaucoma, with some limitations also gave us the hope that with involvement of all the stakeholders, including the families, it is possible to achieve good outcomes of standard care.

We recognize the caregivers of glaucoma patients who are crucial in supporting the management of glaucoma patients. The wealth of experience and insights from individuals with clinical (ophthalmology), pharmacy, social and non-technical backgrounds greatly enhanced these guidelines, each taking a small part in the care which includes, available medications, councelling and psychosocial support needed by persons living with glaucoma. We appreciate and recognise the guidance and technical support from WHO Kenya country office especially in the process.

The process of developing these guidelines was guided by the Ministry of Health, Ophthalmic Services Unit in the directorate of health care Services, in close collaborations with the Division of Standards and quality Assurance. All this effort is appreciated besides contributions from other departments.

We thank all the team members of the Glaucoma Working Group of the College of Ophthalmology of Eastern, Central and Southern Africa (COECSA), contributors, reviewers, editors, designers and sponsors for their unforgettable role.

We anticipate as a result of these guidelines, we shall realise best care and outcome for persons living with glaucoma.

DR MICHAEL M. GICHANGI
HEAD: OPHTHALMIC SERVICES UNIT

LIST OF CONTRIBUTORS

	Contributor	Affiliation
1	Dr Michael Gichangi	Ophthalmic Services Unit
2	Prof Dan Kiage	Kisii Eye Hospital and Innovation Eye Centre
3	Dr Sheila Marco	University of Nairobi
4	Dr Faith Masila	PCEA Kikuyu Hospital Eye Unit
5	Dr Irene Makite	Tenwek Mission Hospital
6.	Dr NyawiraMwangi	Kenya Medical Training College
7	Dr Godfrey Nyaga	City Eye Hospital
8	Dr Morris Musyoki	Nakuru County Referral Hospital
9	Dr Judy Nderitu	Nyeri County Referral Hospital
10	Dr Steve Mukiri	University of Nairobi
11	Dr Cynthia Ogundo	Mbagathi County Referral Hospital
12	Dr Fredrick Korir	Lighthouse For Christ Eye Centre
14	Dr Sarah Sitati	Kenyatta National Hospital
15	Dr Hellen Roberts	Kwale Eye Centre
16	George Ohito	City Eye Hospital
17	Catherine Waigwe	Kenya Medical Training College
18	Zahra Rashid	Gertrude's Children's Hospital
19.	COECSA Regional Glaucoma Core Working Group	COECSA (listed)

EXTERNAL REVIEWERS

1.	Dr Andrew White	Westmead Hospital/University of Sydney, AUSTRALIA
2.	Dr Karim Damji	Royal Alexandra Hospital/University of Alberta, CANADA
3.	Dr Bruce James	Stoke Mandeville Hospital, UNITED KINGDOM

COECSA REGIONAL GLAUCOMA CORE WORKING GROUP

1.	Prof Daniel. O. Kiage	CEO Kissi Eye Hospital-Kenya; kiaged@yahoo.com
2.	Dr Sheila A. Marco	Department of Ophthalmology University of Nairobi Kenya sheilamarco@yahoo.co.uk
3.	Dr Heiko Philippin	Tumaini University Kilimanjaro Christian Medical Centre Moshi, Tanzania Heiko.Philippin@lshtm.ac.uk
4.	Dr Abeba T. Giorgis	Department of Ophthalmology Addis Ababa University E-mail: abebatgiorgis@yahoo.com
5.	Dr Neema Daniel	Department of Ophthalmology Muhimbili Hospital Dar Es Salaam Tanzania neema10@yahoo.com

National Guidelines: Writing and Organising flow	
Dr Nyawira Mwangi	Kenya Medical Training College
Dr Faith Masila	PCEA Kikuyu Hospital Eye Unit

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

5FU	5-Fluorouracil
AC	Anterior Chamber
ACA	Anterior Chamber Angle
ALT	Argon Laser Trabeculoplasty
CCT	Central corneal thickness
CDR	Cup Disc ratio
COECSA	College of Ophthalmology of Eastern, Central and Southern Africa
CPC	Cyclophotocoagulation
CRVO	Central Retinal Vein Occlusion
D	Dioptres
dB	decibels
DDLS	Disc Damage Likelihood Scale
DLT	Diode Laser Trabeculoplasty
EACO	Eastern Africa College of Ophthalmologists
ECP	Endoscopic cyclophotocoagulation
FDT	Frequency Doubling Test
GAT	GoldmannApplanation Tonometry
GDx	Scanning Laser Polarimetry
GWG	Glaucoma Working Group
HFA	Humphrey Field Analyser
HRT	Heidelberg Retinal Tomography
ICE	Iridocorneal Endothelial Syndrome
ICO	International Council of Ophthalmology
IPL	Inner Plexiform Layer (IPL)
IOL	Intraocular lens
IOP	Intraocular pressure
ISNT	Inferior, Superior, Nasal, Temporal
***µ*m**	micrometres
mm	millimetres
mmHg	millimetres of mercury
MMC	Mitomycin C
MD	Mean Deviation
mDTC	Modified diurnal tension curve
mwmilliwatts	
mjmillijoules	
Nd:	YAG neodymium:yttrium-aluminum-garnet
NSAIDS	Non-steroidal anti-inflammatory drugs
NTG	Normal tension glaucoma
NVG	Neovascular glaucoma
OCT	Optical coherence tomography
ONH	Optic nerve head
PACS	Primary Angle Closure Suspect

PAC	Primary Angle Closure
PACG	Primary Angle Closure Glaucoma
PAS	Peripheral anterior synachiae
PCG	Primary Congenital Glaucoma
PGA	Prostaglandin analogue
PIPOH	Population, Intervention, Professionals, Outcome, Health care setting
POAG	Primary open angle glaucoma
QID	Every 6 hours
QOL	Quality of Life
RAPD	Relative Afferent Pupillary Defect
RNFL	Retinal nerve fibre layer
SICS	Small incision cataract surgery
SLT	Selective Laser Trabeculoplasty
TM	Trabecular Meshwork
VEGF	Vascular Endothelial Growth Factor
VR	Vitreo-retinal

INTRODUCTION

Glaucoma is a common sight-threatening disease, and it is the leading cause of irreversible blindness throughout the world.[1-3]It is chronic and progressive, and usually has no symptoms until at advanced stages when considerable loss of vision has occurred.[2]It disproportionately affects the black race.[1] Africa has a high prevalence of glaucoma with the commonest type being primary open angle glaucoma (POAG).[1, 4]A population-based study in Nakuru found the prevalence of glaucoma to be 4.3% in people aged 50 years and above.[5]The risk factors for POAG include African race, older age, high intraocular pressure (IOP), family history of glaucoma, type 2 diabetes mellitus, high myopia, and thin central corneal thickness.[2]

Glaucoma has serious impact on quality of life.[6-8] Patients with glaucoma may have difficulty with reading, walking, and driving. The effect is worse with worsening of glaucoma severity and when both eyes are affected. Glaucoma may cause rapid deterioration of vision. This leads to falls, accidents, depression, loss of independence and economic productivity. The cost of managing glaucoma (direct and indirect cost) is high, for the patient, family and society.[9]

Successful management of glaucoma requires early diagnosis, followed by lifelong monitoring and appropriate treatment.[2] Although there is no known cure for glaucoma, these strategies can prevent sight loss. In Kenya, as in other countries in sub-Sahara Africa, the prevention of blindness from glaucoma faces several challenges: low levels of awareness of glaucoma, late presentation, low coverage and affordability of glaucoma treatments, poor adherence to treatment approaches and erratic follow-up.[4, 5, 10]The lack of clinical guidelines for glaucoma contributes to these barriers.

Process of guideline development

The process of guideline development started with the formation of the Eastern Africa College of Ophthalmologists (EACO) Glaucoma Working Group in Kenya in 2009 prompted by recognition of the need to improve patient outcomes. This group conducted a literature review and subsequently developed an initial first draft. The recommendations in the guideline were adapted from evidence-based best practices in international guidelines such as the International Council of Ophthalmology (ICO) guidelines for glaucoma care.[8] This draft was later revised through an extensive consultative process involving glaucoma specialists within the College of Ophthalmology of Eastern, Central and Southern Africa (COECSA) that culminated in a COECSA draft. The national guidelines have been developed following the application of the Appraisal of Guidelines Research and Evaluation (AGREE) tool[11] to the COECSA draft and the ICO guidelines. The guidelines will be pilot-tested and thereafter officially launched.

Scope and purpose of the guidelines

The goal of these evidence-based guidelines is to improve the quality of care, and to contribute to the prevention of blindness from glaucoma through implementing best practices. The guidelines are to be used by eye care workers involved in glaucoma diagnosis and treatment. The guidelines should however not replace textbooks as source of more detailed information, nor should they discourage innovation in the day to day care of the patients. The final responsibility for decision making in the treatment of patient lies with the professionals involved in the care of glaucoma patients. The PIPOH summary (Table 1) outlines the scope of the guidelines. The guidelines are focused on POAG (the commonest type of glaucoma), clinicians should be vigilant on other types of glaucoma.

WTable 1: PIPOH summary

Parameter	Description
Population of interest	People at risk of glaucoma, glaucoma suspect or diagnosed with glaucoma. Every person over 35 years is at risk of glaucoma
Interventions	Case-finding, diagnosis, referral, treatment, monitoring
Professionals targeted	All cadres of eye care workers
Outcome expected	Early diagnosis; appropriate treatment; effective monitoring; preservation of visual function; improved quality of life
Health care setting	All static and outreach eye care settings

Figure 1: People at risk for glaucoma should be offered comprehensive evaluation to detect glaucoma early *© Prof Dan Kiage*

1 WHAT IS GLAUCOMA?

Glaucoma refers to a group of diseases characterized by a progressive, characteristic optic neuropathy and associated changes in the visual field.[2]Careful evaluation of the anterior chamber angle (ACA) using gonioscopy helps to distinguish the different categories of glaucoma. (Table 2 and Figure 2). The progression of optic nerve damage can be halted in most cases by lowering intraocular pressure.[8, 12, 13]

Table 2: Classification of Glaucoma

Primary glaucoma	a. Primary open angle glaucoma b. Normal-tension glaucoma, low-tension glaucoma c. Ocular hypertension d. Primary angle closure glaucoma: acute, subacute, chronic e. Plateau iris syndrome f. Mixed glaucoma
Secondary glaucoma	Secondary open angle and closed angle glaucoma
Childhood glaucoma	A. Primary Congenital Glaucoma (PCG) B. Glaucoma associated with systemic conditions C. Secondary paediatric glaucoma e.g. due to uveitis, ocular trauma, post infantile cataract surgery, retinoblastoma or retinopathy of prematurity

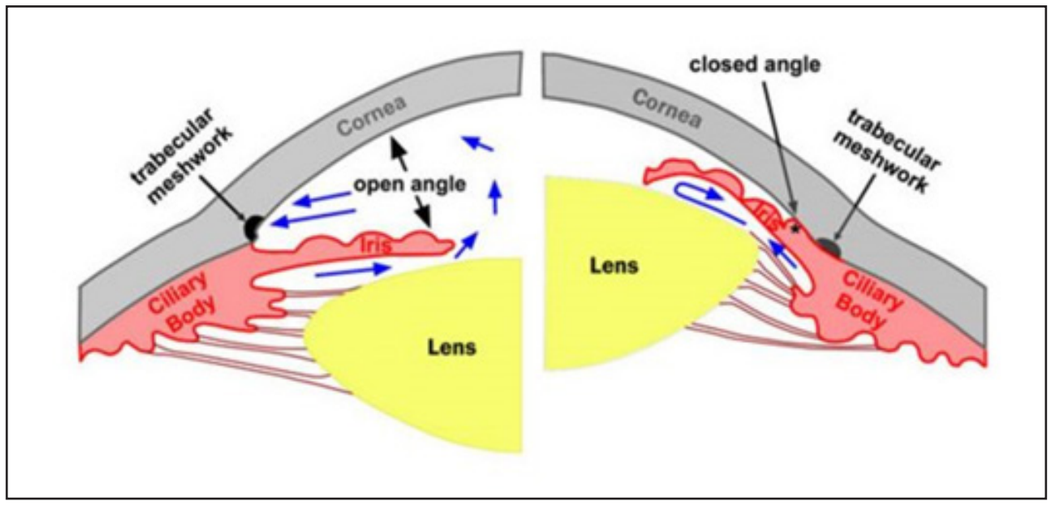


Figure 2: Open and closed angle glaucomahttps://eyeswidebay.com.au/

1.1 Primary Open Angle

1.1.1 Primary open-angle glaucoma

Primary open-angle glaucoma (POAG) is a progressive, chronic optic neuropathy in adults with open angles and associated visual field defects.[13]It is the most common type of glaucoma in Kenya. Intraocular pressure (IOP) is a major risk factor among other currently unknown factors. There are generally no symptoms of POAG until very late in the disease when central vision is threatened.[14]

The anterior chamber angle is open and the aqueous drainage structures look normal on gonioscopic examination. POAG is generally bilateral, but asymmetry of the disc findings is common. The diagnosis is based on characteristic appearance of the optic nerve head (see Table 3) and/or visual field defect.[14, 15]Documented progression of these disc findings confirms the diagnosis of glaucoma. Thus more than one visit for clinical evaluation may be required before a diagnosis is made. Patients with risk factors (Table 4) require a comprehensive glaucoma evaluation.

Table 3: Signs of glaucomatous optic neuropathy

Signs of glaucomatous optic neuropathy

- Enlargement of the optic disc cup with thinning of the neuroretinal rim, particularly at the inferior and superior poles.
- Diffuse or focal loss (notch) of the retinal nerve fibre layer (RNFL)
- Haemorrhages may be found on the disc margin.
- Peripapillary atrophy
- Nasal shift of vessels
- Slit like pores (instead of round in shape) in the lamina cribrosa

Table 4: Risk factors for POAG

Risk factors associated with POAG

- Age > 35years
- High IOP
- African race
- Family history of glaucoma
- Myopia greater than -4 diopters.
- Thin cornea <520μm
- Lower mean diastolic ocular perfusion pressure (diastolic BP minus IOP< 55 mm Hg)
- Migraine
- Raynaud's phenomenon
- Obstructive sleep apnea
- Pseudoexfoliation syndrome
- Pigment dispersion syndrome
- Cardiovascular disease

Recommendation: Risk factors

Patients with two or more risk factors should be examined further for glaucoma.

1.1.2 Normal Tension Glaucoma

In normal tension glaucoma (NTG), the intraocular pressure constantly remains within the normal range during the development and progression of glaucomatous optic neuropathy (Table 5).[2, 15-17]It is a subset of primary open angle glaucoma (POAG). As it is quite difficult to establish that IOPs are within the norma range, repeated tonometry is useful. This includes a modified diurnal tension curve (mDTC), which consists of four to five IOP measurements during working hours. These measurements can be taken at 8 a.m., 10 a.m., 12 noon, 2 p.m., and 4 p.m. An alternative pattern would be 9 a.m, 11 a.m, 1 p.m and 3 p.m.

NTG is a progressive disease although the worsening of the visual fields and optic disc may not manifest for several years. A diagnosis of NTG should be made on the **basis of optic nerve and visual field changes in the absence of any known cause for nerve damage, along with diurnal IOP measurements.** Central corneal thickness (CCT) measurements should be taken, as Goldmann applanation tonometry (GAT) can be artificially low in patients with thin corneas.[15]

Table 5: Definition of normal tension glaucoma

Criteria for Normal Tension Glaucoma[17]

1. A mean IOP without treatment less than or equal to 21 mm Hg on diurnal testing, with no measurement greater than 24 mm Hg
2. Open anterior chamber angles, as determined through gonioscopy
3. Absence of any secondary cause for a glaucomatous optic neuropathy (i.e., trauma, topical steroid use, or uveitis)
4. Typical optic disc damage with glaucomatous cupping and loss of neuroretinal rim
5. Visual field defect compatible with the glaucomatous cupping
6. Progression of glaucomatous damage

Recommendation: Confirmation of Normal Tension Glaucoma

Patients with glaucomatous optic nerve changes and normal pressure, without any obvious reason for nerve damage, should have IOP measured at different times of the day and central corneal thickness be measured.

1.2 Ocular hypertension

Ocular hypertension (OHT) is a term reserved for eyes in which the IOP lies above the normal population range, the optic nerve and visual field show no signs of glaucomatous damage, and there is no ocular co-morbidity. The upper limit for "normal" IOPs is considered to be 21 mmHg in patients with CCT within normal range.

It is likely that only approximately 10% of individuals with persistent OHT will convert to POAG over a ten-year period.[18] Risk factors for the conversion of OHT to POAG can be divided into ocular and systemic (Table 6).[19]

Table 6: Risk factors for conversion of OHT to glaucoma

Risk factors for conversion from OHT to glaucoma [18,19]

A. Ocular risk factors

- Level of the IOP - the greater the IOP the greater the risk
- Large vertical cup/disc ratio > 0.7 (indicating reduced neuroretinal rim area/volume)
- Cup/disc (C/D) ratio asymmetry >0.2
- Visible or previously documented disc haemorrhage
- Retinal nerve fibre layer defect in the absence of clinical optic nerve head changes
- Thinner than average central corneal thickness
- Pseudoexfoliation syndrome
- Pigment dispersion syndrome
- High pattern standard deviation on visual field testing

B. Systemic risk factors

- Increasing age
- Family history
- Individuals of black African origin

Recommendation: Intraocular Pressure and Glaucoma

An intraocular pressure above 21mmHg does not mean that the patient has glaucoma. Glaucoma refers to a group of diseases characterized by a progressive, characteristic optic neuropathy and associated changes in the visual field. The diagnosis of glaucoma requires fundoscopy and a visual field evaluation if possible. Patients with ocular hypertension who at a high risk for conversion to glaucoma should have treatment initiated with medication and/or laser trabeculoplasty.

1.3 Primary open angle glaucoma Suspect

A POAG glaucoma suspect has a normal open angle on gonioscopy and meets one of the criteria in Table 7.[20] Presence of two or more of the criteria points to the diagnosis of POAG, especially in the presence of other risk factors for POAG.

Table 7: Definition of glaucoma suspect

Definition of a glaucoma suspect.[20]

A glaucoma suspect is defined as an adult who has one of the following findings in atleast one eye;

A. An optic nerve or nerve fibre layer defect suggestive of glaucoma.
(enlarged cup-disc ratio, asymmetric cup-disc ratio of >0.2, notching or narrowing of the neuroretinal rim, a disc haemorrhage, or suspicious alteration in the nerve fibre layer)

B. A visual field abnormality consistent with glaucoma

C. An elevated lOP greater than 21 mm Hg.

Recommendation

All persons who are considered a glaucoma suspect need an initial comprehensive eye examination to rule out or confirm glaucoma, and subsequently annual eye examinations (or more frequently if necessary). The importance for regular follow up needs to be emphasized with these persons.

1.4 Primary Angle-Closure

1.4.1 Primary angle-closure

In primary angle-closure (PAC), the IOP is raised due to appositional or synechial closure of the angle secondary to pupillary block.[2, 21]The mechanism of the pupillaryblock must be in the context of normal anatomical structures. On clinical examination, the peripheral anterior chamber appearsshallow (e.g. by Van Herrick), and minimal to no angle structures are seen ongonioscopy. In primary angle-closure glaucoma, relativepupillary block and plateau iris are the main angle-closure mechanisms.

Primary angle-closure glaucoma with relative pupillary block can be subdivided into the acute angle closure (AAC), intermittent angle closure (IAC) and the chronic angle closure (CAC) type. The stages of primary angle-closure glaucoma (PACG) with relative pupillary block are summarized in Table 8.[21, 22]

Table 8: Stages of Primary Angle Closure

Stages of Primary angle closure[21, 22]

(1) Primary angle closure suspect (PACS)

- An eye in which appositional contact between the peripheral iris and posterior trabecular meshwork is noted by gonioscopy with dim lighting. This is an angle in which >270° of the trabecular meshwork cannot be seen. This is also referred to as an occludable angle.
- Normal IOP
- No peripheral anterior synechiae (PAS)
- No evidence of glaucomatous optic neuropathy

(2) Primary angle closure (PAC)

- An eye with an occludable drainage angle and features indicating that trabecular obstruction by the peripheral iris has occurred.
- The optic disc does not have glaucomatous damage.
- Raised IOP
- ± PAS

(3) Primary angle closure glaucoma (PACG)

- An eye with an occludable drainage angle and features indicating that trabecular obstruction by the peripheral iris has occurred
- Raised IOP
- The optic disc has glaucomatous damage.

Recommendation

Gonioscopy (preferably with the ability to perform corneal compression) is important in the evaluation of glaucoma and should be part of the initial workup of a glaucoma patient. It should be repeated if the pressure is unstable or increasing over time.

1.5 Secondary Glaucoma

Glaucoma in which elevated intraocular pressure is caused by other ocular diseases, systemic diseases, or drug use is termed as secondary.[9] It can be either open or closed angle. There are various types of secondary glaucoma that can result as a complication of many ocular and orbital diseases, trauma, surgical interventions or drugs administration.[13] Examples of secondary glaucoma that are frequently encountered by ophthalmic practitioners include glaucoma associated with uveitis, trauma, steroid use, foreign body in the eye, cataract surgery, vitreo-retinal surgery, corneal transplant, intraocular tumours, neovascular and pigmentary glaucoma.

Recommendation:

Patient evaluation must include a comprehensive evaluation of current and past systemic and ocular morbidity.

1.6 Childhood Glaucoma

Figure 3: Buphthalmos©Prof. Dan Kiage

Glaucoma in the paediatric age group can be divided into roughly 3 subtypes: congenital; associated with systemic conditions (e.g. neurofibromatosis); or secondary paediatric glaucoma (e.g. secondary to uveitis, trauma, retinoblastoma or retinopathy of prematurity).Symptoms of paediatric glaucoma include sensitivity to light (photophobia), tearing (epiphora) and cloudy cornea (corneal oedema).[23, 24]

Signs of paediatric glaucoma include buphthalmos (enlarged globe, “big eye”); photophobia and tearing; corneal oedema; breaks in Descemet’s membrane (Haab’s striae); increased intraocular pressure and abnormal optic nerve cupping.[23, 24]

Recommendation: Detection of Childhood Glaucoma

Early identification and referral to a specialized centre are imperative for a good prognosis of congenital glaucoma. A baby presenting with tearing (epiphora), fear of light (photophobia), cloudy or large cornea (corneal oedema or buphthalmos) requires careful assessment for childhood glaucoma.

2. INITIAL AND FOLLOW-UP ASSESSMENT OF PATIENTS FOR GLAUCOMA

The initial assessment helps in identifying the risk factors for glaucoma, making an appropriate diagnosis, and planning a comprehensive management strategy.[8, 25, 26]

2.1 Patient History

Include the following aspects in the history:
Table 9: History-taking in glaucoma

TAKING HISTORY IN GLAUCOMA	
Domain	**Comments**
Date of birth	• Consider age of onset e.g. congenital, juvenile, adult glaucoma • Younger patients will have longer exposure to the disease and its treatment.
Gender	• Women are more prone to PACG
Race	• Blacks and Latinos/Hispanics are more at risk of developing POAG vs Caucasians. • Asians, Inuits are more prone to PACG.
Occupation and social history	• Is the patient still working, retired, studying? • How will the glaucoma affect their occupation? • Socioeconomic status and ability to afford medications, attend for follow-up visits, geographic location • Drug use eg marijuana, IV drug use
Chief complaint	• Visual blurring especially in one eye? • Haloes around lights in angle closure • Pain (aching) in one or both eyes • Reduced visual field e.g. bumping into people, falls, driving accidents
Current medication and allergies (ocular and systemic)	• Is the patient on glaucoma medication? What types? • Some medications eg ethambutol or isoniazid can mimic glaucomatous optic neuropathy; others eg with anticholinergic or with sympathomimetic action can precipitate angle closure • History of steroid use by any route. • Use of systemic beta blockers (in which case topical beta blockers may not significantly lower IOP) • Use of anti-coagulants (may factor into pathogenesis or surgical treatment decision) • Allergies to sulphur (oral and topical Carbonic Anhydrase Inhibitors should be avoided) and to previous glaucoma medications • Any complimentary/alternative medications or therapies
Ocular history	• Myopia increases risk of POAG, hyperopia increases risk of PACG • History of trauma, uveitis, red eye (secondary glaucoma) • Previous ocular surgery e.g. glaucoma surgery, intraocular surgery (can cause secondary glaucoma), refractive surgery

REVIEW OF SYSTEMS IN A GLAUCOMA PATIENT	
System	Comment
Endocrine System	• Diabetes Mellitus (Associated with increased risk of POAG, and neovascular glaucoma)
	• Pituitary tumours for compressive optic neuropathy
	• Thyroid disease (hyper or hypothyroid)
Respiratory System	• Asthma, chronic obstructive airway disease are contraindications for use of beta blockers
	• Sleep apnea (risk factor for development of POAG)
Cardiovascular System	• Heart block, bradycardia contraindications for use of beta blockers
	• Systemic hypertension (nocturnal hypotension can increase glaucoma progression, systemic beta blockers can mask increased IOP)
	• History of blood loss or profound hypotension – this can lead to an optic nerve change that mimics glaucoma
	• History of vascular disorders
Ocular family history	• Family history of glaucoma; if known age of onset and severity (i.e did person loose vision
Central Nervous System	• History of intracranial tumour, head injury, cerebrovascular accident for optic atrophy
	• Mental health status of patient (compliance with medication and follow up)
Musculoskeletal System	• Arthritis can prevent proper instillation of drops
Genito-urinary System	• Renal stones may be a contraindication for use of acetazolamide.
Pregnancy and lactation	• Discussion on benefits versus risk of treatment approaches

2.2 Examination

Ocular examination is important to confirm the diagnosis and type of glaucoma. The examination should be comprehensive and should include: Visual acuity measurement, Pupillary reaction, Anterior segment examination, IOP measurement, Gonioscopy, Central Corneal Thickness, ONH and RNFL examination and rest of fundus examination.[2, 8, 26]

Table 10: Ocular Examination in glaucoma

EXAMINATION OF A PATIENT WITH GLAUCOMA	
Examination	Comments
Best corrected visual acuity	• Important in assessing the amount of functional damage.
	• Patients with tunnel vision can still have normal visual acuity.
External examination	• Cavernous haemangioma, dilated episcleral veins, conjunctival injection may give a hint on the aetiology of the glaucoma.
Assessment of ocular motility, strabismus	• Sensory strabismus or amblyopia can change treatment options.
Pupillary reaction (relative afferent pupillary defect)	• An RAPD can be picked in the eye with more advanced disease. • A mid dilated unreactive pupil can be seen in acute angle closure glaucoma, or absolute glaucoma • A distorted pupil may indicate an intraocular foreign body, a membrane (e.g. ICE syndrome), or PAS
Slit lamp bio-microscopy	• Anterior segment should be thoroughly examined before and after dilatation. • Assess for causes of Secondary glaucomae.g. due to uveitis, neovascular glaucoma, pseudo-exfoliation, pigment dispersion and acute angle closure

IOP and time of measurement	• Goldmannapplanation tonometry is the gold standard in taking IOP. Document method used.
Central Corneal Thickness	• Physiologically thin central cornea: underestimation of IOP (true IOP higher than what is measured) • Physiologically thick central cornea: overestimation of IOP (true IOP lower than what is measured) • Note method used as optical and ultrasonic give different readings (optical is typically less than ultrasonic)
Assessment of anterior chamber angle	• Van Herrick test • Gonioscopy to check angle opening, meshwork pigmentation, any other abnormalities, iris contour
Dilated examination of Lens	• Assessment of intumescent lens, pseudoexfoliation, microspherophakia, etc.
Bio-microscopy of ONH and RNFL	• Detection of structural glaucomatous changes
Objective disc documentation such as diagrams, photography, imaging	• Important for follow-up to detect progression
Fundus examination	• E.g. assess for diabetic retinopathy, maculopathy, any other diseases causing reduction of vision

Figure 4: Patient examination

https://www.wgweek.net/activity/screening-event-36/

2.2.1 Intraocular Pressure Measurement

The "normal" range of IOP is roughly 10–20 mm Hg. There is a circadian rhythm to aqueous flow and this can result in IOP fluctuations of 2–5 mm Hg in normal circumstances, and much wider fluctuations in POAG, therefore a single IOP reading does not give a true picture of the diurnal range. [26-29]Goldmann applantion tonometry (GAT) is the reference standard for tonometry.

Table 11: Methods of IOP measurement

TABLE 11: A SUMMARY OF METHODS OF IOP MEASUREMENT	
TONOMETER	COMMENT
Goldmannapplanation tonometer (GAT)/	
Perkins tonometer	Gold standard for IOP measurement.For use where available such as referral centres and county hospitals.
Schiotz tonometer	Uses indentation tonometry. IOP readings are lower than GAT.IOP could be higher due to supine position
Air puff non-contact tonometry	Useful in screening. Good correlation with GAT within normal IOP range.
Tonopen	Within normal IOP range, there is good correlation with GAT. However, it underestimates GAT IOPs in the higher range and overestimates in the lower range.
ICare Rebound Tonometer	Can measure IOP without use of topical anaesthesia and is useful for screening and for children. IOPs are comparable with GAT over a reasonable range. It is recommended for most facilities where GAT is not available such as peripheral health facilities.
Pascal dynamic counter tonometer	Digital output of IOP and a graphic output of ocular pressure pulse. Less prone to errors based on neutralizing corneal rigidity.
Digital (finger) tonometry	Useful when IOPs are normal, very high e.g. in acute angle closure, post corneal graft, keratoprosthesis, or very low e.g. ciliary body shutdown. It is used in conjunction with tonometry and not on its own

Table 12: Factors that affect IOP levels

Factor	Comment
Central corneal thickness (CCT)	• Africans have an average CCT of 530-535 microns. • GAT is most accurate at a central corneal thickness (CCT) of 520 μm • Important in management of ocular hypertension and normotensive glaucoma
IOPs artificially low	• Using the "white light" and no flourescein • Insufficient fluorescein in tear film • Illumination not bright enough • Conductingrepeated measures within a few minutes • During accommodation • After PRK, LASIK or other procedure thinning cornea • During systemic blood pressure drop. • Corneal oedema
IOPs artificially high	• Excessive fluorescein in tear film • Eyelid pressure on globe from blepharospasm, lid retraction • Digital pressure on globe to hold lids apart • Obese patient • Patient straining to reach chin/forehead rest • Patient breath-holding • Patient wearing constricting clothing around neck (tight shirt collar or tie for men)

Miscellaneous difficulties in taking GAT IOPs	• Dry eye • Hair lying across cornea distorting mires • Lens-corneal apposition • Corneal abnormalities (scars, graft, oedema, keratoconus) • High corneal astigmatism (> 4D) • Small palpebral aperture • Nystagmus • Head tremor

Recommendation

GoldmannApplanationTonometry is the gold standard for IOP measurement and it should be done correctly. An outline of the procedure is provided in the appendix

2.2.2 Anterior chamber angle assessment

Assessment of the anterior chamber (AC) is essential in all patients suspected to be having glaucoma.[30] It is important to document whether the angle is open or closed, presence of new vessels, tumours, cysts, foreign bodies, blood and peripheral anterior synaechiae as this will determine the management of the patient. Table 13 summarises the different techniques used for AC assessment. Use the methods available in your facility.

Table 13: Technique for ACA assessment

ANTERIOR CHAMBER (AC) ANGLE ASSESSMENT	
Technique	**Comments**
Oblique flashlight test	• Useful when slit lamp and gonio-lenses are unavailable
	• Useful in screening, as it can estimate a shallow AC (“eclipse sign”) from anterior bowing of iris producing a nasal shadow
Van Herrick Technique	• Useful when gonio-lenses are unavailable
	• Estimating the peripheral anterior chamber depth by comparing it with adjacent corneal thickness.
	• Useful in screening for angle closure
	• The presence of a positive Van Herrick Test and raised IOP is highly specific for angle closure, but gonioscopy is still required for confirmation.
	• Can be used in post-operative glaucoma cases to assess depth of AC
Gonioscopy	• Can be indirect using the Goldmann, Zeiss, Posner and Sussman lenses or direct using the Koeppe, Barkan and Swan-Jacobs lenses.
Ultrasound Bio-microscopy	• Aids in visualization of the iris, posterior chamber, lens zonules and ciliary body.
	• Can be useful in diagnosing causes of pupillary block especially when the media is not clear.
Anterior Segment OCT	• Non-invasive procedure useful in documenting anterior segment structures. However, it does clearly image structures posterior to iris

Van Herrick Grading should be recorded as follows:

Table 14: Van Herrick Grading

VAN HERRICK GRADING SYSTEM	
Grade	**Description**
0	Iridocorneal contact (absent peripheral AC)
I	Peripheral AC depth between iris and endothelium is less than a ¼ corneal thickness (occludable)
II	The AC depth is = ¼ of the corneal thickness
III	The AC depth is ¼ to ½ of corneal thickness (non-occludable)
IV	The AC depth is > or = to the corneal thickness

2.2.3 Gonioscopy

Gonioscopy should be done at the initial examination for any glaucoma suspect or glaucoma patient. It is also indicated when there is suspicion of angle closure by Van Herrick test, shallow AC, unexplained change in IOP, proliferative Diabetic Retinopathy, CRVO and prior to considering laser trabeculoplasty. Document the following findings: how open the angle is in each quadrant, degree of trabecular meshwork pigmentation (0=no pigment to 4=heavy uniform pigment), and iris configuration (concave, flat or convex).

If the meshwork is not easily visualized, then compression gonioscopy is important to determine if there is appositional or synechial closure.

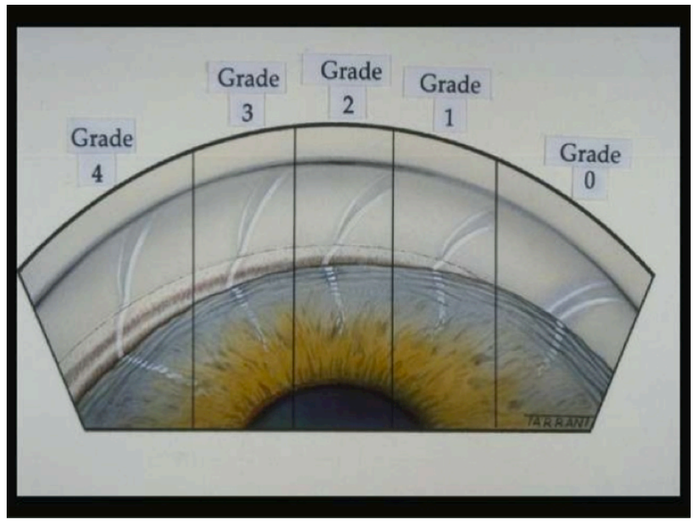


Fig 5: Gonioscopyhttps://www.slideshare.net/vivekparmar5/gonioscopy-34482405

Grade 4 (35-45°) Widest Angle open upto ciliary body band
Grade 3 (25-35°) Angle open upto sclera spur
Grade 2 (20°) Angle moderately narrow : trabecular meshwork identified
Grade 1(10°) Angle very narrow: Schwalbe line identified, top of trabeculum
Grade 0 (0°) Angle closed due to iridocorneal contact

Recommendation : Gonioscopy

Gonioscopy should be done at least once in each glaucoma patient, preferably at the time of the initial workup.

2.2.4 Evaluation of the optic nerve head

Careful examination of the optic disc is important in diagnosis and staging of glaucoma. Early changes can be detected on examination before visual field loss occurs. Table 15 and 16 summarize the key points when examining an optic nerve head.[26, 31]

Table 15: Examining the optic nerve head

EXAMINATION OF THE OPTIC NERVE HEAD		
Optic nerve head feature	**Technique**	**Comment**
Optic disc size	• Measurement of vertical optic disc size using a thin slit beam and a 60D (x1.0), 78D (x1.1) or 90D (x1.3) lens.	• Average discs are 1.8mm • Small Discs: < 1.5 mm and have small cups, large Discs: > 2.2 mm and have large cups. • Document the vertical Cup:disc ratio (CDR). Normal between 0.3 to 0.6 assuming a normal disc size. Asymmetry of >0.2 is suspicious for glaucoma.
Identify the size of the neuroretinal rim	• Distance between border of disc and edge of the cup • **ISNT** guideline:Inferior rim thickness>Superior >Nasal >Temporal	• Identify presence of a notch commonly in the inferotemporal and superotemporal regions.
Examine the Retinal Nerve Fibre Layer (RNFL)	• Best performed using red-free light (green light)	• Look at the loss of striations, and increased visibility of peripapillary retinal vessels • Look for diffuse and localized RNFL loss (slit or wedge defects)
Examine the region of peripapillary atrophy	• **Alpha zone:** Hypo- and hyper-pigmented area, present in normal as well as in glaucomatous eyes • **Beta zone:** Atrophy of the retinal pigment epithelium (RPE) and choriocapillaris. Large choroidal vessels become visible. More common in glaucomatous eyes	• **Beta zone:** Width of beta zone inversely correlates with rim width at same area. • Larger beta zone associated with thinner rim. • Progression of beta zone associated with progressive glaucoma
Look for optic disc haemorrhage	• Flame-shapedhaemorrhage crossing the disc margin.	• Indicative of glaucoma progression, and normally disappear after 2-6 months • More common in normotensive glaucoma
Other non-specific signs of glaucoma	• Bayonetting of the vessels • Deepening of the cup • Lamina Dot Sign	• Occurs at the edge of rim disc where there is focal thinning of the neuro retinal rim • Occurs in early glaucoma prior to exposure of the lamina cribrosa. • Exposure of the underlying lamina cribrosa by the deepening cup reveals a slit-like or oval configuration.

Table 16: Documentation of optic disc changes

DOCUMENTATION OF OPTIC DISC FINDINGS	
Documentation	**Comments**
Disc Diagrams	• Easy to do, should be done in each visit, documenting any glaucomatous abnormalities of the disc. • DDLS (Disk Damage Likelihood System) see appendices
Two-dimensional disc photography	• Relatively simple and cheap to do • Good for follow-up in order to detect progression.
Stereoscopic disc photography	• More reliable for recording disc features in glaucoma.
Optical Coherence Tomography (OCT), Heidelberg Retinal Tomography (HRT), Scanning Laser Polarimetry (GDx)	• Useful in diagnosing early disease before detection on visual field (pre-perimetric disease) None of the instruments provides absolute sensitivity and specificity to be used as a screening tool for early glaucoma

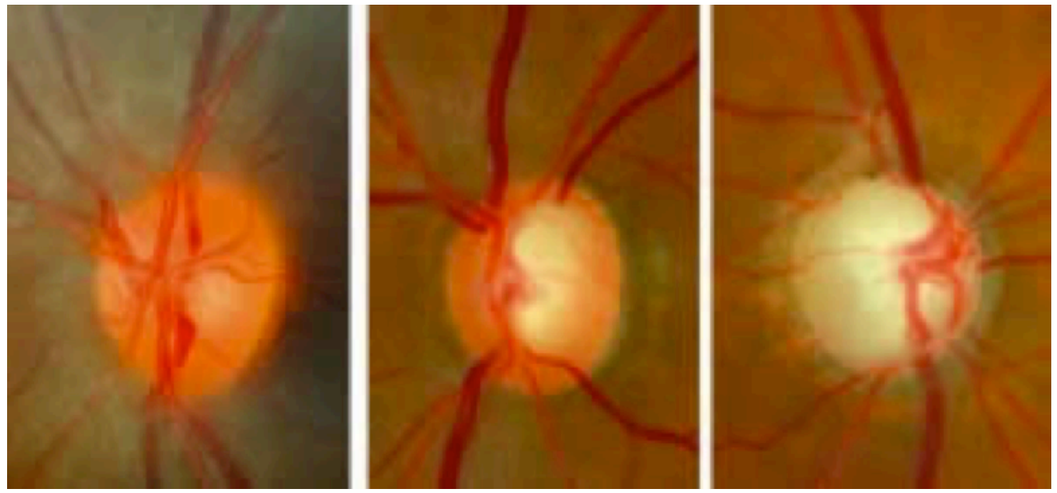


Figure 5: The optic disc in glaucoma: Normal disc with CDR 0.2 (left), moderate glaucoma left eye with vertical CDR 0.7 and a notch at 1 o'clock (middle), advanced glaucoma right eye with vertical CDR 0.99. *©Bourne RRA,* https://www.cehjournal.org/article/the-optic-nerve-head-in-glaucoma/

Recommendation: Documentation of optic disc changes

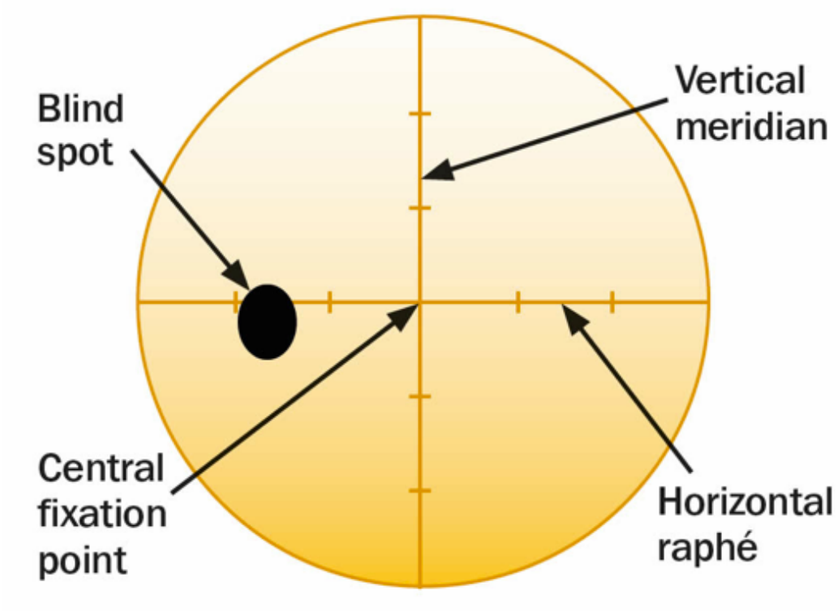
Documenting the optic disc using a detailed drawing or disc photography if available is key to diagnosis and follow-up of glaucoma.

2.2.5 Perimetry

Perimetry is used to quantify a patient's visual field, both for diagnosis and follow-up to determine progression.[26, 32, 33] In patients with glaucoma, central vision is spared until very late in the disease but there is early marked loss of peripheral vision. There are a variety of visual field tests that are available for detecting glaucomatous changes. Table 17 gives a summary of these tests and comments on their use.

Table 17: Visual Field Tests

SUMMARY OF VISUAL FIELD TESTS	
Visual Field Test	**Comment**
Confrontational	• Useful when no other visual field test is available • Can only pick out grossly reduced visual field defects, not early changes
Goldmann Visual Field	• Manual kinetic perimetry • Tests the full extent of the patient's visual field • Useful in the elderly, very young and patients with reduced vision and/or a small field of vision
Standard Automated Perimetry (SAP) • Humphrey Field Analyzer (HFA) • Octopus Perimeter	• Automated static threshold perimetry • Standardized, reproducible and more sensitive for subtle defects • Availability of numeric data for statistical interpretation and comparison • Has a learning curve and it is best not to rely on the first two fields. • Generally recommended for glaucoma diagnosis and monitoring.
Frequency Doubling Perimetry	• Is a good screening method for glaucoma • More sensitive in picking up early defects (pre-perimetric glaucoma) • It is quick to administer and more patient friendly
Amsler grid	• May be able to assess the extent of damage of the central 10 in advanced glaucoma



Recommendation : Interpreting Visual Field

Visual fields should always be interpreted in correlation with the optic disc and nerve fibre layer findings. If the visual field is abnormal, yet there is no obvious structural defect, the visual field examination needs to be repeated after 2-3 weeks and the optic disc thoroughly examined, if possible with disc stereo photography. If the optic disc appears abnormal and the Humphrey visual field is normal, consider FDT to rule out pre-perimetric scotomas.

2.2.6 Optical Coherence Tomography

Optical Coherence Tomography (OCT) is a computerized imaging technology for the nerve fibre layer (RNFL), optic nerve head (ONH) and macular retinal ganglion cell layer (RGCL). OCT measurements are used in diagnosis and detection of progression of glaucoma. There are different OCT units that are available for detecting glaucomatous changes. Table 18 gives examples of these units and comments regarding the manufacturer.

Table 18: Optical Coherence Tomography

Manufacturer	RTVue	Cirrus	Spectralis
Significance limits include	RNFL Thickness Ganglion Cell Complex Macular retinal thickness	Peripapillary RNFL thickness RNFL thickness for the optic nerve head scan cube Optic nerve parameters Macular ganglion cell thickness + Inner Plexiform Layer (IPL) thickness Macular retinal thickness	RNFL thickness

Recommendation : Interpreting Optical Coherence Tomography

Interpretation of test results of optical coherence tomography should be done in combination with clinical information and visual field test results.

2.3 Staging of Glaucoma

Once the evaluation of the patient is complete, it is important to stage each eye according to the damage done by the disease.8 This supports management decisions and the detection of progression. The following summary will assist in staging.

Table 18: Staging of Glaucoma

STAGING FOR GLAUCOMATOUS DAMAGE			
STAGE	**CDR**	**IOP**	**HVF**
Suspect (One of these in at least one eye)	A suspicious disc OR CDR asymmetry of >0.2	An elevated IOP greater than 21 mm Hg. (NTG suspects have normal IOP)	A mild visual field abnormality consistent with glaucoma
Early	Early glaucomatous damage CDR <0.65		and (or) mild VF defect not within 10° of fixation (MD better than –6 dB on HVF 24-2)
Moderate	*Vertical CDR 0.7–0.85		and (or) moderate VF defect not within 10° of fixation (MD -6 to –12 dB on HVF 24-2)
Advanced	*Advanced glaucomatous disc features CDR >0.9		and (or) VF defect within 10° of fixation (e.g. MD worse than –12 dB on HVF 24-2†)

MD, mean deviation; HVF, Humphrey Visual Field Analyzer
**Refers to vertical C/D ratio in an average size nerve. If the nerve is small, then a smaller C/D ratio may still be significant; conversely, a large nerve may have a large vertical C/D ratio and still be within normal limits.*

Also consider baseline 10-2 VF (or similar)
Disc Damage Likelihood Scale (DDLS) for staging can be used where visual field is not available

Recommendation: Staging of glaucoma

Each eye should be staged independently as suspect, early, moderate or advanced glaucoma based on optic nerve and / or visual field exam upon availability.

2.4 Follow-Up Assessment of Patients

Follow-up is essential, and is often required on a life-long basis. As progression may be difficult for patients to recognise, every effort should be made to encourage the patient to come for follow-up regularly. Counselling about the importance of follow-up and addressing the potential barriers to follow-up is an especially important intervention.[8, 34-36]

2.4.1 Glaucoma Suspects

Follow up every 6 months to 1 year depending on risk of progression.

2.4.2 Confirmed POAG

Has target IOP been achieved?	Has there been any progression of ONH or VF damage?	How long has disease control been achieved? (months)	Follow-up Interval
yes	no	≤6	1-6 months
yes	no	>6	3-12 months
yes	yes		1week - 4months
no			1 day – 4 months

2.4.3 What should be done at follow-up assessment?

During the follow up sessions the following interval history and physical exam should be assessed

√ Ocular history	√ Visual Acuity
√ Systemic medical history	√ Slit lamp bio-microscopy
√ Review of use of medication	√ IOP
√ Side effects of ocular medications	√ Optic Nerve Head Examination
	√ Gonioscopy if indicated

2.4.4 Follow up Visual Field Test

Target IOP Achieved	Progression of Damage	Duration of Control (months)	Follow-up Interval (months)
yes	no	≤6	6-18
yes	no	>6	6-24
yes	yes		1-6
no	yes or no		1-6

2.5 Counselling

- It is important to educate and engage patients in the management of their condition.
- Patients should be educated about the disease process, 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) .
- Patients should be encouraged to alert their ophthalmologists to any physical or emotional changes that may occur when taking glaucoma medications.
- Support groups should be formed to help visually impaired patients.

3. MANAGEMENT OF GLAUCOMA

The overall goal of glaucoma treatment is to preserve visual function, and maintain or enhance overall health-related quality of life (QOL).[37, 38]At present, based on the evidence, the only reliable therapy for glaucoma is to lower IOP. Table 19 shows the goals of treatment.

Table 19: Goals of treatment

GOALS OF TREATMENT:
• Setting and achieving individualized target IOP for each eye
• Preserving the structure and function of the optic nerve
• Stabilizing visual fields loss
• Minimizing the side effects of treatment and its impact on the patient's vision, general health, and QOL
• Reversing or preventing angle closure process if applicable
• Vision enhancement/rehabilitation as indicated
• Educate and empower patients so they are active participants in their vision health
• Enabling the patient to access available and affordable treatment for the disease

3.1 Who should be treated?

In general, treatment is indicated for patients with glaucoma or glaucoma suspects when the risks of progressive disease outweigh the risks and potential side effects of treatment.[26] Any identified causal factors for IOP elevation must be treated alongside the pressure lowering therapy (see Table 20). Glaucoma suspects and OHT individuals should be offered treatment based on estimated risk of conversion to POAG using IOP, CCT, age and family history.

Table 20: Treatment of underlying cause of glaucoma

TYPES OF THERAPY DIRECTED AT UNDERLYING CAUSE INCLUDE
• Peripheral iridotomy in types of glaucoma in which pupillary block causes elevation of IOP such as primary angle-closure glaucoma
• Anti-inflammatory treatment in glaucoma with accompanying uveitis
• Retinal photocoagulation and intravitreal antiVEGF in neovascular glaucoma
• Discontinuation of steroid administration in steroid induced glaucoma.

3.2 Glaucoma and Quality of Life

Glaucoma and its treatments frequently affect patients' quality of life.[7, 35, 38]Patients are worried about whether they will go blind. They are also concerned about the adverse effects on employment (e.g., fear of loss of job and insurance from diminished ability to read and drive), social issues (e.g. fear of negative impact on relationships and sexuality caused by long term use of drugs like timolol and acetazolamide), loss of independence and isolation from activities that require good visual acuity (e.g., sports and other hobbies) and a higher risk of falls and depression.

Health care providers should be sensitive to these problems and provide support and encouragement. Some patients may find peer support groups or counselling helpful. Cases that are difficult to diagnosis or manage, or where the condition is refractory to treatment, should be referred to a specialist. Early diagnosis and appropriate treatment helps to preserve vision and maintain quality of life.

Recommendation: Quality of Life

Patients with two or more risk factors for development of glaucoma should be examined further for glaucoma. Patients with glaucoma should have treatment initiated promptly. Difficult cases should be referred to a glaucoma specialist. In advanced cases, consider referral for vision rehabilitation

3.3 Target Intraocular Pressure

Definition

Target IOP is defined as the upper limit of a stable range of measured IOPs deemed likely to retard further optic nerve damage.[20]The lower limit is usually around 5-6 mm Hg (i.e. IOP below which there would be complications related to hypotony). Although there is no universal guideline for establishing the target pressure, important factors to consider when setting the target range include the baseline IOP level before treatment, the stage of glaucoma, the status of the fellow eye, the family history and other risk factors such as low CCT.[12]

It is generally accepted that once the optic nerve has been damaged, a lower IOP is needed to prevent further damage.[37] Based on this philosophy and best evidence from RCT's, the upper limit for target IOP range can initially be set as shown in table below.

Table 21: Stages of glaucoma and target IOP

SETTING OF TARGET IOP ACCORDING TO STAGE OF GLAUCOMA	
Stage	**Pressure range**
Glaucoma suspect	< 24 mmHg with at least 20% lowering from baseline
Early Glaucoma	< 20 mmHg with at least 25% lowering from baseline
Moderate Glaucoma	< 18 mmHg with at least 30% lowering from baseline
Advanced Glaucoma	< 15 mm Hg with at least 30% lowering from baseline
Normal Tension Glaucoma	Lower IOP by at least 30% from baseline

Recommendation: Target pressure

Target pressure range is set per eye and needs to be reviewed and adjusted during each follow up visit depending on stability or change in structure and function of the optic nerve.

3.4 Selecting among Drugs, Laser Treatment and Surgery

Once a decision has been made to treat, the three different methods of lowering IOP in glaucoma, are medication, laser and surgery.[39] Treatment may be initiated using any of these three options depending on the individual patient and circumstances.[13]

By consensus, trabeculectomy was previously considered as the first line therapy for POAG in our setting due to low availability and accessibility of glaucoma medications or trabeculoplasty, and low compliance to treatment. However, it is now considered imperative that an appropriate therapeutic modality is selected based on the individual patient situation and the disease stage and type. Based on this, a comprehensive/holistic ('biopsychosociospiritual') patient assessment with a customized approach is recommended in order to optimize therapeutic (benefit/risk) ratio.[40]The factors to consider in choosing the modality will include

- **Biological –** this considers the extent of IOP lowering required, age, type of glaucoma and systemic health of the patient
- **Psychological –** the personality of the patient and their mental health will have a role in the choice of the treatment
- **Socioeconomic and environmental –** Ability to afford the treatment chosen, adherence to treatment and follow-up is so pertinent in this country.
- **Spiritual/cultural -** Complimentary or alternative approaches that a patient may consider will need to be elicited and appropriate advice given. These may include: Prayer, Traditional healers, Herbal and other 'natural' therapies, Acupuncture and Ayurvedic medicine among other approaches.

3.5 Medical Treatment

In selecting the initiating medication a general rule of thumb is to use the least amount of medication that will accomplish the desired therapeutic effect with fewest adverse reactions.[12, 41]

Table 22 summarizes an overview of currently available glaucoma drugs and a meta-analysis on percentage IOP lowering effects for glaucoma medicines.[42] The mechanism of action and side effects of glaucoma medication are summarized as an appendix to this guideline.

Table 22: Drugs used in glaucoma

IOP-LOWERING EFFECTS OF GLAUCOMA DRUGS[42]			
Group	**Mechanism of action**	**Generic product**	**Peak percentage IOP lowering**
Beta Blockers	Decrease aqueous production	Timolol	26 – 27%
		Betaxolol	20 – 23%
Prostaglandin analogues	Increase of aqueous outflow	Bimatoprost	28 – 33%
		Latanoprost	28 – 31%
		Travoprost	29 – 31%
Alpha Adrenergics	Decrease aqueous production, increase of aqueous outflow	Brimonidine	18 – 25%
		Apraclonidine	20-30%
Carbonic Anhydrase Inhibitors	Decrease aqueous production	Brinzolamide	15-22%
		Dorzolamide	15 – 22%
		Acetazolamide	25% - 35%
Cholinergic agonists	Increase facility of outflow	Pilocarpine	15-25%

3.5.1 General principles of medical therapy

- Anti-glaucoma eye drops can be combined with each other as well as be added to laser and surgical treatment but additional drugs should only be used if needed to obtain the target IOP range.
- Only the IOP lowering effect should be considered to define the comparative efficacy of an ocular hypotensive agent.
- IOP reduction with initial monotherapy should be at least 20% from baseline.
  IOP reduction of less than 10% should be considered as non-response.
- It is best to start medical treatment to lower IOP with a prostaglandin analogue [PGA] or a beta blocker.
- If the first choice treatment has no desired effect or tachyphylaxis occurs, switching the initial treatment is recommended rather than adding a further drug.
- Switching drugs within the PGA class may, upon occasion, provide greater IOP lowering.
- Increasing the recommended dosage will not result in increase of IOP lowering and will only cause wastage and more side effects.
- Drugs which belong to same pharmacological group should not be combined [e.g. do not combine two different prostaglandin analogies]. However, sometimes it is necessary to switch within a group (e.g. from Latanoprost to Travoprost or Bimatoprost).
- When available, combined drug preparations are generally preferable in place of multiple prescriptions.
- For instructions to give to a patient on how to instill eye drops, see appendix

Recommendation : Choice of medication

Beta-Blockers are a cost-effective first-line drug but possible side-effects need to be considered.
Prostaglandins are a more expensive alternative where beta-blockers are contraindicated.

3.5.2 Ocular surface disease and the role of preservatives in glaucoma medications

- Ocular surface should be evaluated and considered in the clinical management of glaucoma patients.
- Symptoms of ocular surface disease include ocular irritation, photophobia, hyperaemia, blurry vision from the chronic use of these medications.
- Common causes of ocular surface disease include anterior blepharitis, meibomian gland dysfunction and chronic use of topical preservatives.
- Chronic use of topical preservatives is associated with corneal epithelial loss & anaesthesia, low-grade inflammation, conjuctival and sub tenon fibrosis. This may lead to reduction in success rate of trabeculectomy.
- Benzalkonium chloride (BAK) is the most commonly used preservative in ophthalmic preparations.
- Ocular surface disease is treated by: using artificial tears (preservative-free if available), reducing the exposure to preservatives by using fixed combinations, treating blepharitis, using medications that contain a lower concentration of BAK, medications prepared with alternative preservatives, preservative-free antiglaucoma medications (if available).

3.6 Laser Treatment

Laser therapy in glaucoma is available in various forms:

Table 23: Types of laser treatment

LASER THERAPY IN GLAUCOMA MANAGEMENT	
Laser therapy	**Laser used**
Laser Trabeculoplasty	• Argon Laser Trabeculoplasty [ALT]
	• Diode Laser Trabeculoplasty [DLT]
	• Selective Laser Trabeculoplasty [SLT]
Peripheral Iridotomy	• Nd-Yag laser
	• Argon laser
Iridoplasty	• Argon laser
Laser Suturelysis	• Argon laser
Cyclophotocoagulation	• Diode laser

3.6.1 Laser Trabeculoplasty

Laser Trabeculoplasty could play a greater role in management of POAG in Africa.[43] Argon laser trabeculoplasty [ALT] and selective laser trabeculoplasty [SLT] are similar in safety and pressure lowering effects. Selective laser trabeculoplasty superseded argon laser trabeculoplasty, with fewer adverse events, greater ease of use, and improved repeatability.[43], [44]They both have a median survival of 2 years. SLT can, however, be repeated. The indications and contraindications of the treatment are highlighted below.[45]

Table 24: Indications for laser trabeculoplasty

INDICATIONS FOR LASER TRABECULOPLASTY
• POAG (including exfoliation syndrome or pigmentary glaucoma) uncontrolled with one or more medications
• Glaucoma suspects or those with POAG who are intolerant to medications, have difficulty with cost or availability of medications, or are poorly compliant
• First line in select patients
• Patients who may benefit from reduction in medication
• Steroid responders

Table 25: Contraindications for laser trabeculoplasty

Contraindications for Laser Trabeculoplasty
• Uveitic glaucoma
• Neovascular glaucoma
• Traumatic glaucoma
• Aphakicglaucoma
• Congenital or juvenile glaucoma
• Primary or secondary angle closure glaucoma
• Inadequate visualization of TM (if secondary to pupillary block then consider peripheral iridotomy or iridoplasty)

Patient Preparation

The patient's informed consent must be sought after a thorough discussion of the goal of therapy and potential complications. At the end of the procedure it is important to document well where treatment was done, settings used (power, duration, and spot size) and the number of spots applied.

Procedure for Laser Trabeculoplasty

A drop of apraclonidine 0.5% or brimonidine 0.2% is instilled in the eye 10-15 minutes preoperatively to minimize IOP elevation after treatment. Pilocarpine 2% can be instilled as well to aid better angle exposure. A topical anaesthetic such as Proparacaine 0.5% is instilled immediately before the procedure to aid the application of the gonioscopy lens. The patient should then be comfortably seated and head positioned on the slit lamp before the goniolens is placed on the eye to be treated.

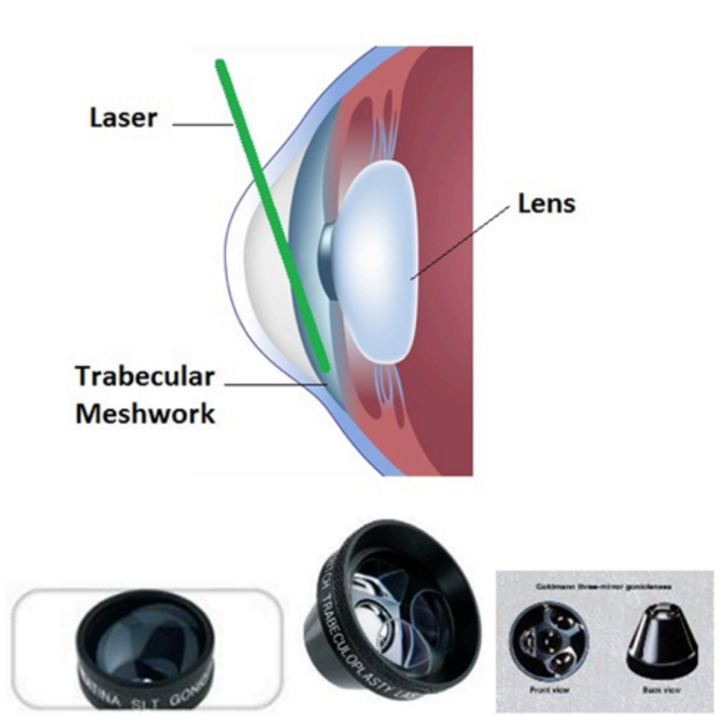


Figure 7: Laser trabeculoplasty

The lenses used in gonioscopy: Latina SLT lens (left), Ritch trabeculoplasty (middle) and Goldman 3 mirror lens (right)

Table 26: Settings for laser trabeculoplasty

SETTINGS FOR LASER TRABECULOPLASTY			
	ALT	**Diode**	**SLT**
Spot size	50μm	75 - 100 μm	400 μm [Fixed]
Duration	0.1s	0.1 – 0.2s	3 nsec [fixed]
Power	300-600mW	750 – 1200mW	0.4-1.4 mJ
Spots	50 [for 180°]	50 [for 180°]	50 [for 180°]
Area	180°-360°	180°-360°	180°-360°
Fluence (mJ/mm2)	40000		6
Laser requirements			Ultrashort pulse duration Low laser energy

Complications of laser trabeculoplasty include IOP spikes (> 6 mm Hg rise in IOP from baseline at 30 mins), failure of the procedure, trabeculitis and peripheral anterior synechiae (mainly ALT).

Follow-up

- The IOP is measured 30 minutes to 1 hour after the procedure or the next day. If it is elevated, an additional anti-glaucoma medication, preferably an aqueous suppressant is used and IOP rechecked within a few days.
- For ALT, topical prednisolone 1% or dexamethasone four times daily is prescribed for 5 to 7 days, and the patient is reviewed after 1 week. For SLT a non-steroidal anti-inflammatory eye drop can be used. If anterior uveitis is present at 1 week, topical corticosteroids are continued.
- If the patient was on anti-glaucoma medication, this should be continued for about one month. A period of at least 4–6 weeks after trabeculoplasty is required before the final result can be evaluated.

Table 27: Predictors of success of trabeculoplasty

POSITIVE AND NEGATIVE PREDICTORS FOR TRABECULOPLASTY SUCCESS		
Factor	**Negative Predictors**	**Positive Predictors**
Age (years)	< 40	> 65
Trabecular Meshwork pigmentation	Little or none	Moderate to marked
Corneal Clarity	Poor	Clear
Disease entities	• Uveitic glaucoma • Angle closure • Juvenile • Angle recession	• Pigmentary Glaucoma • Pseudo-exfoliative glaucoma • POAG • Low tension glaucoma
Lens status	• Aphakia	• Phakic
	• Anterior Chamber IOL	• Posterior Chamber IOL
Contralateral eye	Little effect	Strong effect

Recommendation : Trabeculoplasty

For selected patients SLT and ALT are cost-effective first-line approaches. They might also be used to reduce the number of topical treatments.

3.6.2 Peripheral Iridotomy

Laser iridotomy is the preferred method for managing a variety of angle-closure glaucomas that have at least some component of pupillary block.[45] Although laser iridotomy was first described with the argon laser, iridotomy with the neodymium:yttrium-aluminum-garnet (Nd:YAG) laser has now become the preferred procedure of most surgeons.[45] This is due to the ready availability of these lasers for posterior capsulotomy and a simpler, more rapid iridotomy protocol with less chance of subsequent iridotomy closure. Some surgeons still use argon laser for pre-treatment of the iridotomy site prior to using the Nd:YAG laser especially in patients with very thick irides.

Surgical Iridectomy– This procedure is often required when a YAG laser is not available or the iris is so thick to be penetrated by laser. Both these scenarios are a common occurrence in Kenya.

Table 28: Indications for peripheral iridotomy

INDICATIONS FOR PERIPHERAL IRIDOTOMY	
Indication	**Comment**
Therapeutic	• Angle closure glaucoma
	• Mixed mechanism glaucoma
Prophylactic	• Iridocorneal apposition of >180o (occludable angle) • Silicon oil in the eye (inferior iridotomy) • Early stages of pigmentary glaucoma with elevated IOP and concave iris configuration
Diagnostic	• Aqueous misdirection • Plateau iris

Patient Preparation

- Pilocarpine 2% twice 5 mins apart.
- Iopidine 0.5% or Brimonidine 0.2%, 30 minutes prior to procedure.
- Amethocaine 0.5%.
- The Abraham Iridotomy lens is used.

Table 29: Settings for laser iridotomy

SETTINGS FOR LASER PERIPHERAL IRIDOTOMY		
	Argon Pre-treatment	**YAG iridotomy**
Spot size	50 microns	Standard
Duration	0.02 – 0.05 sec	Standard
Power	500-900 mw (depends on iris pigmentation; lower power for darker irides)	3-8mj
Number Spots	35 – 90	2 – 5

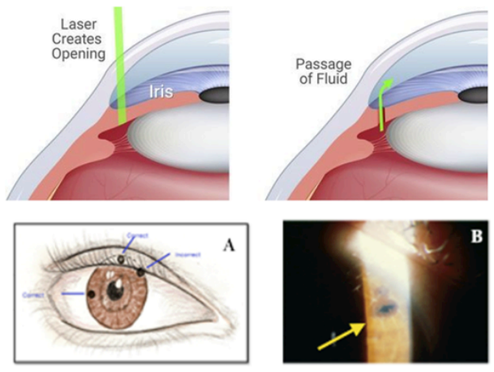


Figure 8: Peripheral iridotomy.
(A) Corrrect positions for iridotomy ***©Dr Danah Al-Breiki***
(B) Patent iridotomy

Complications of Peripheral Iridotomy

- Intraocular pressure spikes
- Iritis
- Iridotomy failure
- Monocular diplopia/glare
- Hyphaema
- Lens opacity
- Corneal injury
- Malignant glaucoma
- Retinal burns

Follow up

- Patient can ambulate 5 – 10 minutes following the laser treatment without restriction as long as no hyphaema is evident and they are not feeling unwell (sometimes a vasovagal episode is triggered during or immediately following the laser)
- Prednisone 1% QID for one week is recommended to reduce anterior chamber reaction and IOP spike
- Patients are seen one hour after the procedure then 4 weeks later
- If the iridotomy remains patent after 4 weeks, the opening usually remains open unless inflammation occurs

Recommendation : Iridectomy

If a YAG laser for iridotomy is not available or the peripheral iris is very thick (a common feature in the region), a surgical peripheral iridectomy is indicated.

3.6.3 Laser Iridoplasty

Laser iridoplasty consists of the placement of a circumferential ring of non-penetrating contraction burns at the far iris periphery, just inside the limbus, to contract the stroma and to widen the angle.45 This can be done without a lens or with the use of an Abraham iridotomy lens or a Goldmann 3 mirror lens.

Indications for laser iridoplasty

- Plateau iris configuration or syndrome
- Pre-trabeculoplasty in a narrow angle to aid visibility, e.g. for SLT
- Narrow angle glaucoma where for some reason peripheral iridotomy cannot be performed.

Figure 9: Laser iridoplasty© *Dr Danah Al-Breiki*

Table 30: Settings for laser iridoplasty

IRIDOPLASTY SETTING	
Spot size	500µm
Duration	0.2-0.5 s
Exposure time	0.5 s
Power	150 – 240 mW
Spots	10 -40 applications over 360°, leaving 1 to 2 spot diameters between spots; 180° treatment may be effective

3.6.4 Laser Suture Lysis

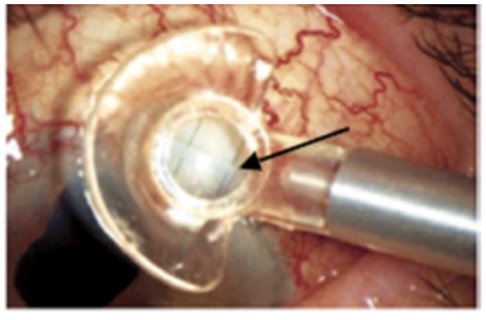
This is used post trabeculectomy when the scleral flap is too tight for the desired filtration. This should be done when the function of the filtering bleb needs to be improved, ideally within the first 2-4 weeks after surgery.45 If done later, fibrosis of the scleral flap may halt any beneficial effect of this procedure. The risk of hypotony should also be considered after suturelysis and one should be ready to treat this complication. Before suturelysis, gonioscopy should be done to confirm the presence of an open sclerostomy with no tissue or clot occluding its entrance.

Table 31: Laser suture lysis

LASER SUTURE LYSIS	
Argon laser parameters:	
• Spot size	50 micron.
• Exposure time	</- 0.1 sec
• Number of spots	1 or more as needed
• Power	300–800 mW

Procedure:

- Topical anaesthesia (proparacaine 0.5%
- Contact lens (Hoskins, Ritch or edge of 4-mirror Sussman lens)
- Focus the beam posterior to the conjunctiva
- Cut one suture per session to fully evaluate the response. If blood present under the conjunctiva, choose different suture to cut or use a longer wavelength laser, or use a short exposure time. Cut suture close to one end or the other
- If IOP still raised and bleb unchanged: gentle ocular massage or focal pressure



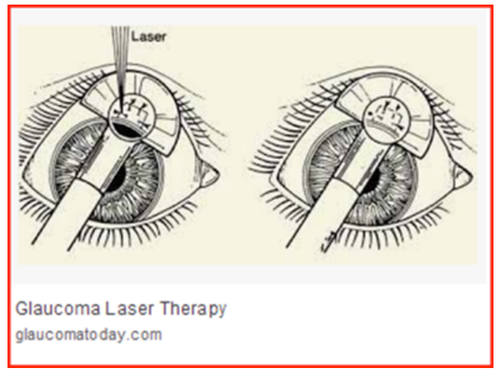


Figure 10: Hoskins lens in place.
Black arrow showing suture cut with argon laser

Recommendation: Releasable sutures

Using releasable sutures is cost-effective, easy to perform and an alternative to laser suturelysis for improving the outcome of trabeculectomy.

3.6.5 Laser Cyclophotocoagulation

Patients with far advanced glaucoma have typically exhausted their potential for aqueous outflow and developed an elevated intraocular pressure (IOP) that cannot be controlled. In such cases, medical therapy has failed and many of these patients have undergone one or more unsuccessful filtration procedures, leading to marked scarring of the conjunctiva and extensive peripheral anterior synechiae (PAS). Some patients also present with painful blind eyes due to secondary causes e.g. neovascular glaucoma.

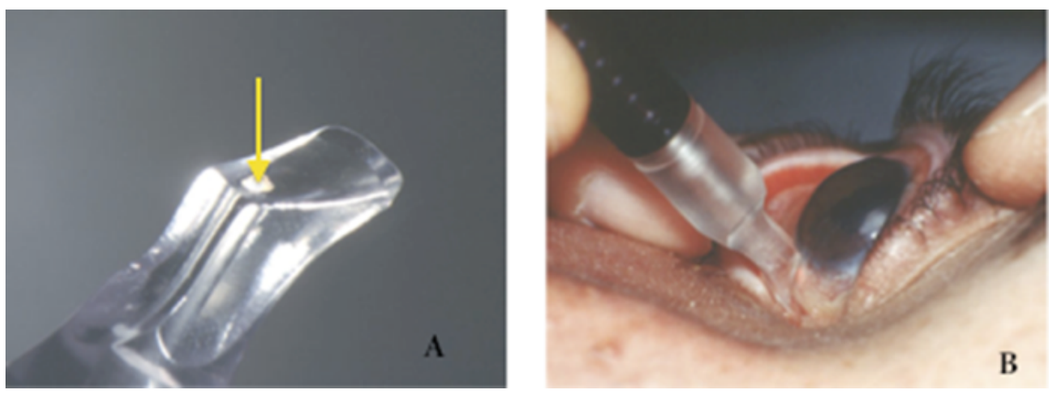
Cyclodestruction, aims to reduce IOP in eyes with refractory glaucoma by reducing the rate of aqueous humour production. The two main procedures for cyclodestruction are cyclocryotherapy and laser cyclophotocoagulation (CPC). Cyclocryotherapy is now being abandoned because of its complications and severe post-operative pain. Controlled CPC can also be used in seeing eyes to reduce IOPs. CPC can be done using trans-scleral, transpupillary or endoscopic approaches. The laser parameters used in trans-scleral CPC, the laser machine used, and the correct positioning of the G-probe are highlighted below.[45]

Table 32: Transcleralcyclophotocoagulation

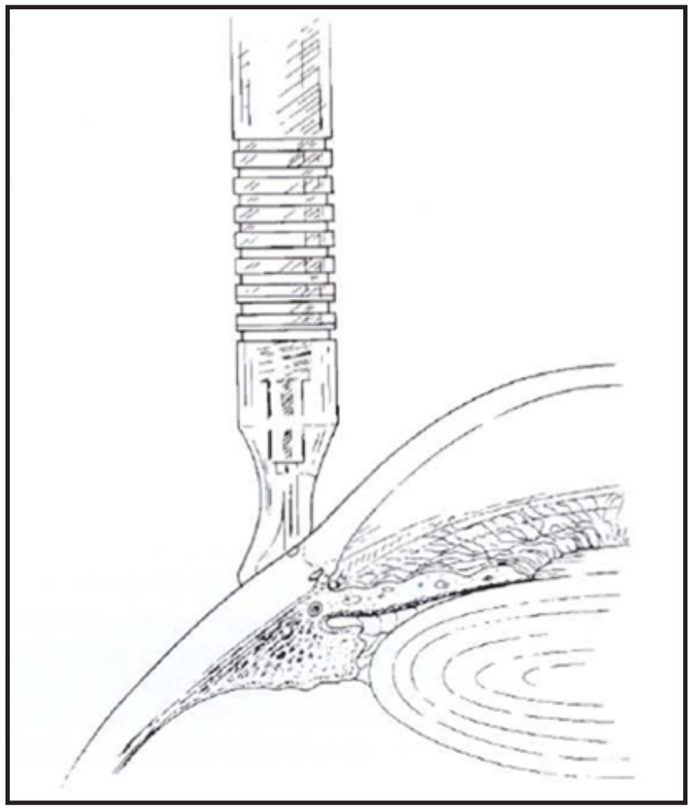
TRANS-SCLERAL CYCLOPHOTOCOAGULATION	
Diode laser parameters:	
• Power:	1000 – 2500 mW
• Duration:	0.5-2.0 sec
• Number of burns:	20 - 40
• Area -	180°-360°
• Location –	1.0 to 2.0 mm from limbus

Procedure:

- Give retrobulbar or peribulbar anaesthesia (5-7 ml of 2% lignocaine)
- Test the G-Probe with a dark object
- Apply the G-probe with its edge against the limbus.
- Applications spots 20 – 25 (approximately 6 per quadrant) over a 2700-3600 area. The sound of a "pop" at the treatment site indicates tissue disruption within the ciliary body. Titrate downwards in 25-50mW to decrease this. Align the edge of the foot-plate with the indentation made by the foot-plate during the previous delivery for an even application.
- Give steroids and cycloplegics together with strong oral analgesics.



Laser photocoagulation:
(A) the fibreoptic tip (arrow) protrudes beyond the curved footplate and indents the conjunctiva and sclera during laser application.
(B) The probe is placed on the sclera so that its leading edge lines up with the limbus.*©Iridex Corporation, Mountainview, CA.*



Edge of the laser probe aligned to the limbus *©Weinreb RN, Mills RP, eds.*[46]
Figure 11: Laser photocoagulation

Table 33: Complications of trans-scleral cyclophotocoagulation

COMPLICATIONS OF TRANS-SCLERAL CYCLOPHOTOCOAGULATION
• Pain
• Persistent inflammation
• Reduced visual acuity (wipe-out)
• Sympathetic ophthalmia
• Irreversible hypotony with subsequent phthisis bulbi
• Hyperaemia
• Perforation of a thinned sclera

Post-operatively, oral anti-inflammatory analgesics and topical steroids are administered for control of pain and inflammation respectively.

Recommendation: Trans-Scleral Cyclophotocoagulation

The risks of irreversible hypotony, severe inflammatory reaction and visual loss due to wipe-out following retrobulbar anaesthesia need to be critically weighed against a possible benefit of the procedure.

3.7 Surgical Treatment

3.7.1 Trabeculectomy

Trabeculectomy is the most widely accepted method for surgical treatment for glaucoma.[47, 48]It can be used either as a first line approach or when laser and medication do not achieve the desired IOP lowering. Trabeculectomy can achieve an IOP lowering of about 50%.[47] Failure rate in Africans has been estimated to be about 30% in 10 years as compared to 20% for Caucasians in the same period.[49]While long-term control is often achieved, many patients will require further therapy or a re-operation, which carries a higher failure rate.[48, 50]

Table 34: Effective trabeculectomy surgery

TIPS FOR EFFECTIVE TRABECULECTOMY SURGERY
• Trabeculectomy is the most preferred surgical method
• Newer methods are more expensive and lower in efficacy
• Surgical technique should be mastered
• Use sub-tenon anaesthesia instead of retrobulbar anaesthesia especially in advanced cases
• Position of filtration area – superior half of the globe
• Use corneal traction suture
• Conjuctiva incised at limbus, gentle handling of conjunctiva
• Dissection wide to make a pocket of 10-15 mm posteriorly
• Scleral flap rectangular or triangle – pre place sclera flap sutures
• Use anti-metabolites (preferably Mitomycin C), including treatment under the flap, but before eye is entered. Wash out antimetabolite with 20ml of balanced salt solution
• Use an oblique paracentesis
• Use anterior segment infusion in high risk eyes eg high myopes, buphthalmics
• Sclerostomy more anteriorly in cornea than sclera with a blade and scissors or a punch instrument.
• Peripheral iridectomy broad at base, short in length
• Apply releasable suture technique
• Meticulous conjuctival closure. Closure at ends of incision and interrupted mattress sutures at limbus
• Remember possibility of bleb revision (needling) with MMC or 5FU

Table 35: Use of Mitomycin C

MITOMYCIN C USAGE PROTOCOL
• Dosage0.3mg/ml (0.2-0.5mg/ml)
• Duration protocol 2-4 min applied with several small soaked sponges (depending on risk factors such as) o Age below 40 years o Repeat trabeculectomy or post SICS o Thick tenon o African origin
• Storage possible up to 6 months (refrigerated, as per preparation and storage protocol)

3.7.2 Glaucoma Drainage Devices

Glaucoma Drainage Devices [GDD] are indicated when filtration surgery has failed or is likely to fail.[51]Tube implants provide an alternative outflow path that bypasses the Schlemm's Canal, and implants also provide a bleb well posterior to the limbus. The procedure is easy to learn and is very effective at providing rapid and substantial lowering of IOP.[52]

There are generally two types of tube implant: valved and non-valved. The valved form (e.g. Ahmed valve) offers immediate IOP reduction but obstructs free outflow from the device into the surrounding tissues thus maintaining physiological levels of IOP until the healing of tissues offers its own resistance to flow. If no valve were present, the IOP would be zero and hypotonous changes would inevitably occur in the eye. The non-valved devices (e.g. Molteno valve, Baerveldt valve) offer no resistance and therefore the tubes must be temporarily occluded usually by sutures, removed after a time, or until the suture dissolves.[51]

INDICATIONS FOR GLAUCOMA DRAINAGE DEVICES
• Younger patients
• Neovascular Glaucoma
• Glaucoma Associated with Uveitis
• Conjunctival Scarring
• Previous ocular surgery – like Trabeculectomy or VR surgery
• Refractory Paediatric Glaucoma
• Glaucoma in Aphakia or Pseudophakia

3.8 Treatment of Glaucoma under Special Conditions

3.8.1 Treatment of glaucoma in pregnancy

Maternal use of anti-glaucoma medication carries risks of
- Teratogenicity
- Interference with establishment or maintenance of pregnancy
- Side effects in the neonate.

Table 36: Treatment of glaucoma in pregnancy

TREATMENT OF GLAUCOMA IN PREGNANCY
• Prostaglandins may be associated with uterine contraction.
• Beta-blockers and alpha agonists can cause serious toxicity (respiratory and central nervous system depression). When possible, these agents should be withdrawn during the last few weeks of pregnancy. Timolol may be used during lactation as long as the baby does not have cardiac or respiratory symptoms. Punctal occlusion is recommended following drop instillation to reduce systemic absorption, as timolol in particular may appear in breast milk
• Systemic carbonic anhydrase inhibitors (CAI) have been reported to have teratogenic effects but topical CAIs are generally well tolerated in pregnancy and breastfeeding.
• Trabeculoplasty is considered safe in pregnancy
• Trabeculectomy can be done without MMC

3.8.2 Treatment of Childhood Glaucoma

3.8.2.1 Medical Treatment of Paediatric Glaucoma

Generally, surgery is the preferred treatment of choice for primary infantile glaucoma.[24] Medical therapy is also indicated, at least in part, in the treatment in many cases of paediatric glaucoma.[23] Medical treatment may be necessary when:
- Child is too sick to withstand a surgical procedure.
- As initial treatment between diagnosis and convenient day for surgery.
- After a surgical procedure has been done, if appropriate IOP lowering not achieved medical management should be tried as preparation are made to proceed to the next surgery.

The main concern with medical therapy is toxicity from various agents.[53] Fortunately most anti-glaucoma medications are tolerated quite well in children. The one exception is the alpha-2 agonists (brimonidine and apraclonidine), which may cause hypotension, bradycardia, and apnoea. These agents cross the blood-brain barrier and should never be used in the first year of life and should be avoided in most other paediatric cases.[54] They may cause sleepiness even in older children or those with small-body-mass.

Adverse drug reactions in children are mainly related to drug dose-to-weight ratios. In the first year of life and for the same reason in older children, it is best to use 0.25% beta-blockers rather than 0.5%. Where practical, parents of particularly small or young children should be instructed in the technique of punctal occlusion when using these drugs to minimise systemic absorption. Other drugs including topical carbonic anhydrase agents and prostaglandins are well tolerated by children. Pilocarpine is not a very effective drug for paediatric glaucoma and headaches and myopic shift may be greater in children. Oral carbonic anhydrase inhibitors are well tolerated and effective in children.

Table 37: Medical management of glaucoma in children

TIPS ON MEDICAL MANAGEMENT OF GLAUCOMA IN CHILDREN
• Outflow medications (pilocarpine and Prostaglandins) are variably effective in paediatric glaucomas, whereas aqueous suppressants lower IOP more consistently.
• Systemic (Diamox, 20mg/kg per day divided into 3 doses every 8 hours) and topical CAI can be safe and effective
• Topical beta-blockers are effective but systemic safety is a concern.
• Betaxolol is safer than timolol.
• Brimonidine is absolutely contraindicated in children

3.8.2.2 Surgical Treatment of the Paediatric Glaucomas

General Considerations

The following are the surgical options available for treatment of pediatricglaucomas:[24]

Goniotomy, Trabeculotomy, Trabeculectomy, Trabeculectomy- trabeculotomy, Glaucoma drainage tube implants and Cyclodestructive procedures.

The least destructive and minimally distorting surgical procedures should be done initially. This will minimize the potential for complications while making available other needed surgical procedures to be performed later for the child suffering from this "lifelong disease". Just because a surgeon is able to perform a given procedure should not be the main criterion for choosing it over one that could be more beneficial in a given situation. In such a case, it would be beneficial for the most effective procedure to be done by another surgeon.

Goniotomy

Goniotomy is relatively simple to do under good training and good conditions. It is the least invasive, most effective procedure for most infantile glaucomas. It has a relatively high degree of success and few complications. The few complications that do occur include: cyclodialysis, iridodialysis, synechiae, and in rare cases when the blade disrupts the lens capsule, cataract.

Goniotomy is comparable to trabeculotomy in success rate, although trabeculotomy has the disadvantage of causing much more tissue distortion and scarring. Unfortunately, some cases of paediatric glaucoma, especially those that present in an advanced state, are not amenable to goniotomy because this technique requires a relatively clear cornea for safe and effective application.

Trabeculotomy

This procedure is the equivalent of goniotomy in success rate, but it differs from goniotomy in that it destroys or alters more tissue than a goniotomy. However, trabeculotomy does offer an alternative to goniotomy in the case of a cloudy cornea.

Trabeculectomy

As briefly mentioned above, the likelihood of success over the long-term with trabeculectomy is lower in aphakia and in infants / children due to scarring at the episcleral level leading to a non-functioning bleb. Antimetabolites have been used with some success, but the fear of thin-walled blebs is always present. As a large portion of the children live in agricultural setting, the chance of contamination/infection is high, and this is the main concern.

As with most developing countries, follow-up is unpredictable at best, and even when successful; most support staff in remote locations may not be able to assess post-operative eyes effectively. This may result in post-operative failure after uneventful and successful surgery due to unrecognized problems such as endophthalmitis, cataracts, corneal decompensation or flat anterior chamber.

Every effort should be made to apply the antimetabolite drug exclusively to the sclera posterior to the scleral flap in the hope of establishing aqueous flow away from the limbus. This will further decrease the chances of a thin-walled bleb. Parents must understand that observation of the eye is very important even years later, and peripheral support staff (doctors and nurses) must be consulted at any time if doubts exist about the eye status.

Tube Implant Procedures

If angle surgery is unsuccessful or if the child has a form of glaucoma that is not typically amenable to angle surgery (aphakic/pseudophakic glaucoma without goniodysgenesis, Axenfeld-Rieger with prominent iridocorneal strands); tube implant procedures may be necessary. Like trabeculectomy, tube implants provide an alternative outflow path that bypasses the Schlemm's canal, and implants also provide a bleb well posterior to the limbus. The procedure is easy to learn and is very effective at providing rapid and substantial lowering of IOP in children of all ages. Additionally, tube implantation does not require the application of antimetabolite compounds although excessive postoperative inflammation can lead to failure of bleb permeability and a rise in IOP unless the inflammation is specifically and aggressively suppressed.

Cycloablation Procedures

Whether using cryo or diode laser modes this is a choice of last resort. Success is quoted as being 30-45% per application but along with hypotony or poor control, long term complications may be band keratopathy, corneal decompensation, cataract formation, and phthisis. Diode laser cycloablation seems to offer fewer complications than cryo. Peribulbar anaesthesia is used here for postoperative pain. In some cases retrobulbar absolute alcohol or Chlorpromazine may be used to provide longer acting pain relief.

3.8.2.3 Follow up of children with paediatric glaucoma

Following successful surgery, children with glaucoma need meticulous follow up to prevent vision loss. Amblyopia may develop despite successful IOP control. The ophthalmologist needs to be familiar with taking visual acuity in children, performing cycloplegic refraction, prescribing glasses or contact lenses, and patching to improve vision. These techniques are particularly important in pre-verbal children. If there are any challenges doing these, the child should be referred to a pediatric ophthalmologist immediately.

Despite treatment, a small percentage of children may not recover vision. These should be referred to the low vision specialist for assessment, reading aids and school placement. Parents should be counseled that the child with glaucoma is a life-long patient, requiring follow up into adulthood.

Recommendation :Treatment of childhood glaucoma

Childhood glaucoma is a surgical disease. Detection, starting immediately with topical and systemic treatment and referral as soon as possible are the first steps. A maximal effort should then be made to ensure that the child arrives as fast as possible at a referral eye care centre.

3.8.3 Cataract and glaucoma

When cataract and glaucoma coexist and a surgical decision for both has been made, combining the surgery offers several advantages[55] including:

- Opportunity to give the patient a better vision while reducing the intraocular pressure
- Allowing for only one surgical procedure rather than two separate operations.
- Avoiding acceleration of cataract that would usually occur if trabeculectomy alone is performed.
- Control of immediate post-operative IOP spikes which can be detrimental to the already compromised optic nerve head.

The surgical approach to a patient with both cataract and glaucoma should be guided by the following considerations:

- How visually significant cataract is/quality of life
- Mechanism of glaucoma (open vs closed angle)
- Stage of glaucoma (early, moderate, advanced)
- IOP target and current control, number of medications
- Ocular & systemic factors (e.g. conjunctiva, sclera, cornea, anticoagulants). Young myopic males are at the highest risk of hypotony
- Surgeon's experience
- Patient and care partner preference(s)

Randomized controlled trails have suggested that SICS is comparable to phacoemulsification in terms of visual recovery as well as intraoperative complications, depending on the surgical expertise. With SICS, almost any type of cataract can be tackled with relative ease and the time of surgery is not altered by the density of cataract in contrast to phacoemulsification. Care should be taken with cataract surgery in the glaucoma patient as this may involve challenges including small pupils, posterior synechiae, abnormally shallow or deep anterior chambers, and weakened zonules (especially in patients with PXF syndrome/glaucoma).

Studies have indicated that the best method for doing the double procedure is two-site phacoemulsification and trabeculectomy with MMC. However Small Incision Cataract Surgery [SICS] which is the more common procedure in this country can be effectively and safely used in this combined procedure.49, 56 When doing combined surgery, it is important to position the IOL horizontally so the haptic is away from any iridectomy site. Consideration should also be given to closing the cataract wound with a suture in order to avoid hypotony/flat chamber, and choroidal effusion. Cataract surgery alone lowers IOP by 2-4 mmHg. Combined SICS/Trabeculectomy may not lower IOP to the same degree as Trabeculectomy alone.

As a rule of thumb, if cataract more advanced than Glaucoma, cataract surgery can be done and continue medical management of glaucoma for surgery at a later date. Trabeculoplasty can also be performed if available. If glaucoma more advanced than cataract, trabeculectomy can be performed and follow up for cataract done.

3.8.4 Treatment of the Painful Blind Eye with Glaucoma

For many years, management of the painful blind eye remains a challenge to ophthalmologists. It is imperative to evaluate these patients carefully to determine the cause of the pain so that an appropriate treatment can be instituted.[57]

Patients who have a high IOP describe a dull ache in or around the eye, often accompanied by pain in the frontal or temporal area. Pain associated with microcystic oedema or bullae is sharper and more “irritating”, which is worse in the morning (because of increased swelling overnight) and improves as the day progresses.

3.8.4.1 Medical therapy

For those patients who have pain associated with microcystic oedema and bullae, hypertonic saline (5% or 10%) with ocular hypotensives as well as bandage contact lenses help to relieve it. Patients who have pain related to high IOPs IOPs may respond to IV Mannitol or Oral CAI.
Topical hypotensive medication may also play a role. If there is additional inflammation, steroids and cycloplegics are helpful. These help to reduce any inflammation and ciliary spasm.

3.8.4.2 Surgical therapy

For those eyes that do not respond to medication, several options are available:

- Cyclodestructive procedures
- Retrobulbar injection of alcohol or chlorpromazine
- Evisceration or Enucleation

Cyclodestructive procedures

(i) Trans-scleral diode cyclophotocoagulation

The overall success rate for this procedure has been reported to be 68% to 74%. Retreatment is often necessary, as the ciliary body’s function can recover over time.

(ii) Endoscopic cyclophotocoagulation

Endoscopic cyclophotocoagulation (ECP) allows for accurate anatomical localization, and photocoagulation of the ciliary processes. ECP has been shown to be effective in refractory glaucomas.

(iii) Cyclocryotherapy

Cyclocryotherapy is a procedure that employs temperatures as low as -112°F (-80°C) to destroy the ciliary body. It is an effective method of reducing IOP in painful blind eyes.

Retrobulbar injection of alcohol or chlorpromazine

These are simple and effective methods of pain relief, which are immediate and usually long lasting. Procedure for retrobulbar injection: Inject 2ml of lignocaine into the retrobulbar space (use a 25-guage retrobulbar needle, or 21-guage needle) without removing the needle, inject 1ml of 100% alcohol or 25 mg Chlorpromazine, flush the needle with a further 1ml lignocaine.

Although these injections are uncomfortable, the alcohol much more so than the chlorpromazine, the effects are quick, with a high success rate for complete relief. Side effects include anaesthesia or dysesthesia of the cheek, lid, or brow; injection or marked chemosis of the conjunctiva and lids and face; ptosis; eye movement abnormalities; and potentially a perforated globe.

Enucleation and evisceration

These are very effective methods of pain relief. Patients have improved cosmesis especially with the use of orbital implants and prosthetic eyes. However, one has to consider the emotional and psychological wellbeing of the patients, most of who feel it is a drastic step to take.

3.9 Rehabilitation and Low Vision

Patients with significant visual impairment should be referred for low vision assessment. This includes psychosocial support, strategies in the use of residual vision, training for good mobility/safety/independence/employability. The blind should be referred for and encouraged to use appropriate vision rehabilitation centres.

3.10 Case detection strategies

Case finding is an extension of the usual clinical routine.[58] Every patient over 35 years of age can be considered a glaucoma suspect and should undergo a comprehensive eye examination for glaucoma.

Thus any contact with such a patient, e.g. during a consultation with the eye care worker for presbyopia, should be evaluated for glaucoma. As no single test is sufficient for screening for glaucoma, the risk factors, ocular history, medical history, visual function, IOP and the optic nerve head should all be evaluated.[58]

Recommendations for case-finding

Opportunistic screening is recommended for every patient over 35 years of age who visits an ophthalmologist or eye care worker for any reason such as for presbyopia. All will need to undergo a comprehensive eye examination which should include the following:

- Best corrected distance visual acuity with refraction
- External Assessment of ocular motility, strabismus examination
- Pupillary reaction (relative afferent pupillary defect)
- Slit lamp bio-microscopy
- IOP, time of measurement, method of measurement
- Assessment of anterior chamber depth using Van Herrick method.
- Examination of Lens
- Stereoscopic examination of the optic disc and RNFL
- Fundus examination

Any person found to have an elevated IOP (>21mmHg) or a suspicious disc (enlarged cup- disc ratio, asymmetric cup-disc ratio of >0.2, notching or narrowing of the neuroretinal rim, a disc haemorrhage, or suspicious alteration in the nerve fibre layer), should undergo further tests including the following:

- Gonioscopy
- Central corneal thickness
- Documentation of optic disc findings (diagrams, photography)
- Visual fields
- Appropriate referral, treatment and management should be instituted thereafter.

4 IMPLEMENTATION OF THE GUIDELINES

4.1.1 Overall responsibility for the guidelines
The Ophthalmic Services Unit will be responsible for all aspects of engagement, execution and evaluation of the guidelines

4.1.2 Dissemination of the guidelines
The guidelines will be disseminated to the end-users using the following methods: Print copies, Electronic copies, Ministry of Health website, Training Institutions websites, Social media and Training workshops.

4.1.3 Training of eye care workers on the guidelines
The Ophthalmic Services Unit and Glaucoma Working Group will organise for initial training workshops for county eye care coordinators and other stakeholders. The latter will then cascade the training at the county level.

4.1.4 Advocacy and public engagement
The World Glaucoma Week and the World Sight Day each year will be important avenues for advocacy and public engagement programs. Advocacy will be useful to raise awareness on glaucoma to the public, to increase adherence to treatment and follow-up, as well as to mobilise resources for glaucoma services. In particular, equipment for glaucoma diagnosis and treatment is a priority.

4.1.5 Stakeholder engagement
The patients, families, support groups, eye care workers, glaucoma specialists, professional bodies, training institutions, government and non-governmental actors (NGOs, pharmaceutical companies, media) are important actors who will be involved in glaucoma care.4.1.6 Referral mechanisms
Referral for glaucoma care will utilise the existing referral mechanisms in eye care.

4.1.7 Indicators for monitoring
The main indicators for monitoring the implementation of the guidelines at each eye care facility are:
(i) The number of glaucoma suspects who receive a comprehensive evaluation, disaggregated by age and gender
(ii) The number of people who are on regular follow-up and treatment for glaucoma, disaggregated by age and gender
(Iii) The number of eye care workers who receive training on the guidelines

This information will be collected through routine data as well as additional facility reports. The county eye health coordinator will collect this information at county level.

4.1.8 Research priorities
The glaucoma research priorities include:
a. Epidemiology of glaucoma
b. Situation analysis of glaucoma eye services in the country
c. Barriers and enablers to adherence to treatment and follow-up
a. Outcomes of glaucoma treatment
b. Cost-effectiveness analysis of glaucoma interventions
c. Predictors of sight loss from glaucoma
d. Visual and health related quality of life in glaucoma patients
e. Mapping of low vision and rehabilitation services in Kenya
f. Factors affecting effective implementation of the guidelines

4.1.9 Revision of the guidelines
The guidelines will be reviewed within 5 years of the official launch

Figure 12: The World Glaucoma Week is an important opportunity for advocacy and public engagement

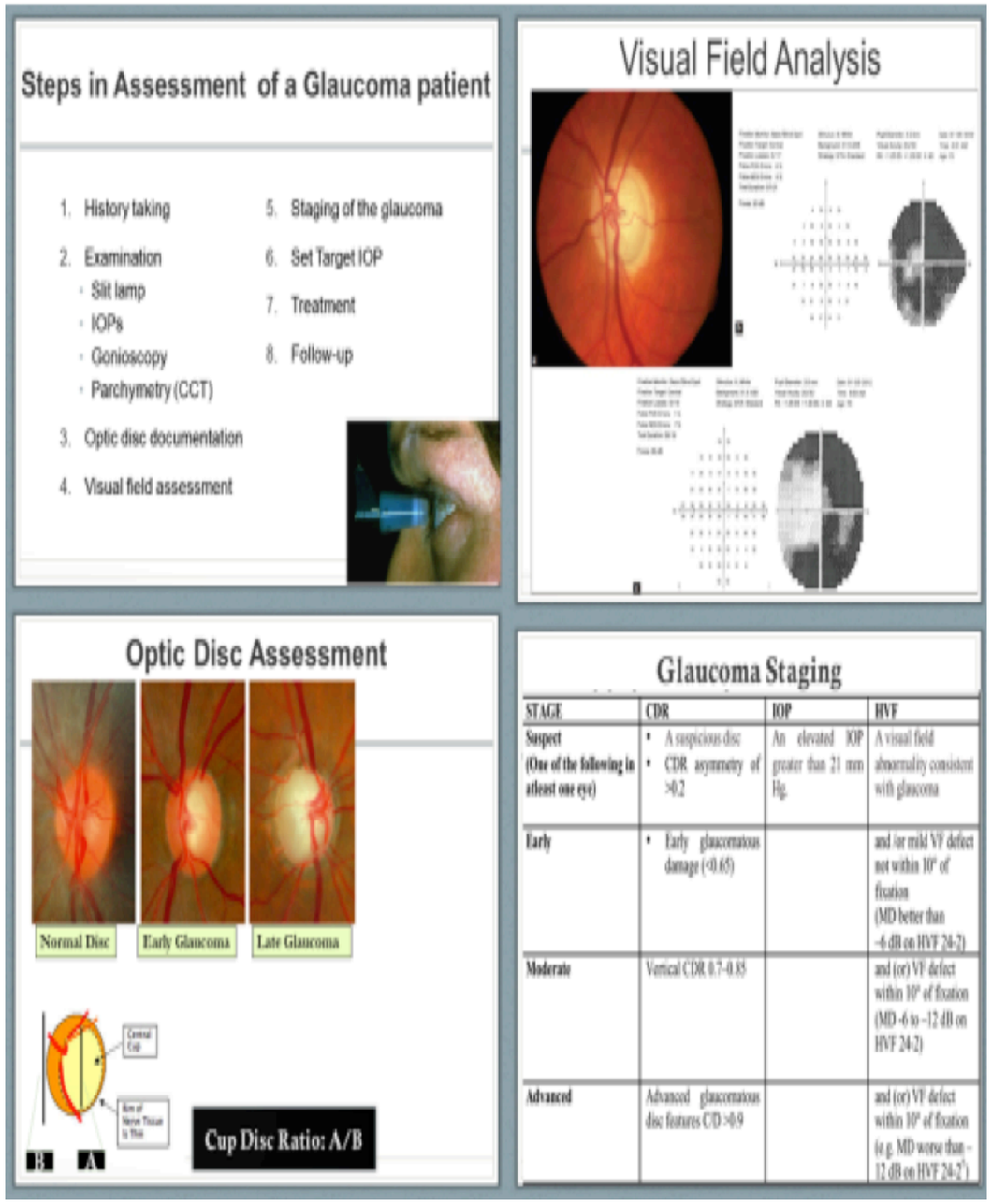
5 Appendix A: GLAUCOMA RISK FACTORS ASSESMENT [Once patient diagnosed to have Glaucoma]

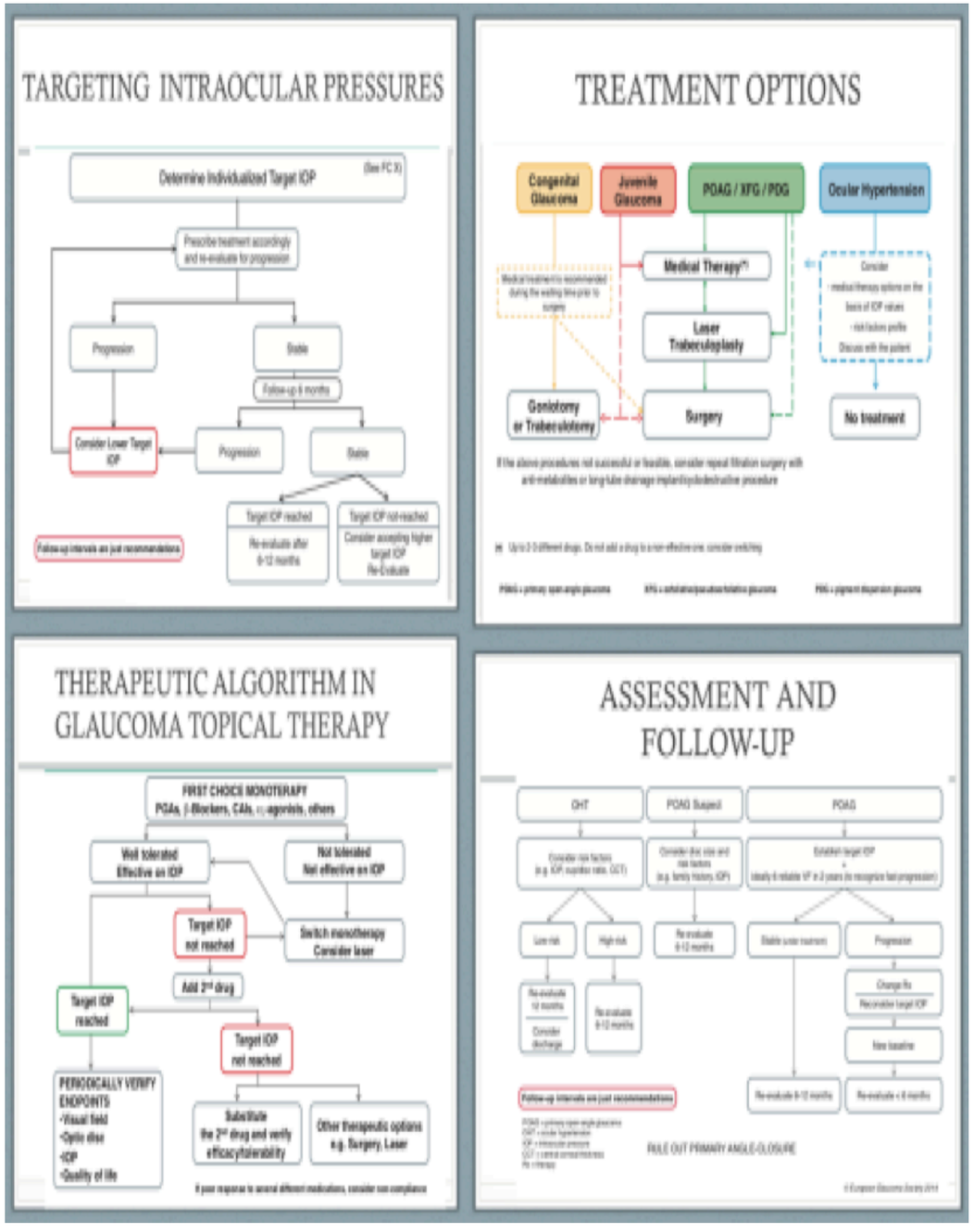
A-BASELINE

	Yes	No	If Yes duration in years	
Does the patient have any Chronic Disease				
Cardiovascular				
Respiratory, eg Asthma				
Diabetes Mellitus				
Other				
Is the patient on Any Medication				
Oral				
Topical				
Is the Patient on Steroids				
Oral				
Topical				
Does the patient have any history of Allergy to medications			Name of drug	
Has the patient had any History of Trauma			When	
Has the patient had Refractive Surgery in the past			When	

B-FOLLOW UP

	Yes	No	Remarks
Does the patient look fine			
According to the patient does he/she feel fine			
Does the patient know his condition, name and details (probe)			
Does the patient think he is improving			
Is the patient worried about his eyes			
Has the patient been using the drugs as prescribed? • Ask pati ent-How frequent have you been instilling the eye drops			
Does the patient know how to administer medications? • Let him demonstrate. [self] • If usually administered by someone else and is also accompanying, let them demonstrate[Others]			





8 HOW TO MEASURE INTRAOCULAR PRESSURE: APPLANATION TONOMETRY

Ensure the tonometer is calibrated regularly in order to obtain accurate readings

5.1 Equipment

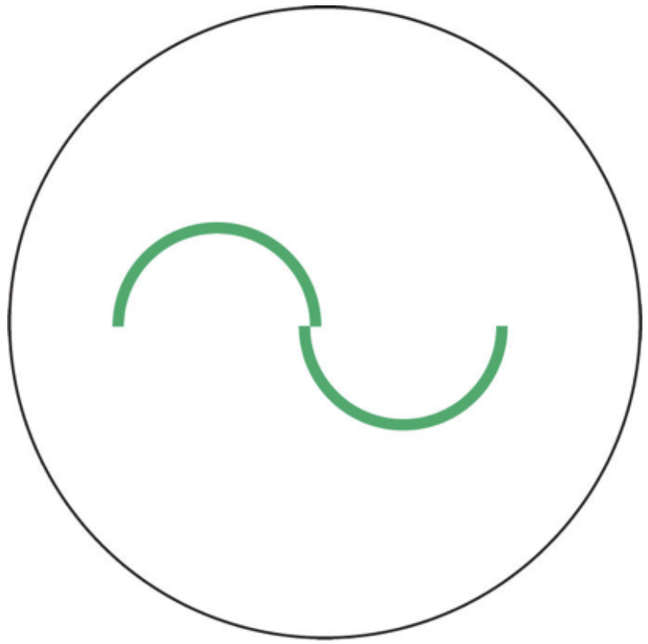
- Tonometer, e.g.Goldmann (used on slit lamps)
- Applanation prism
- Local anaesthetic drops
- Fluorescein strips
- Clean cotton wool or gauze swabs.

5.2 Preparation

- Ensure the prism has been disinfected with isopropyl alcohol 70% (methylated spirit) or sodium hypochlorite 1%. The prism must be rinsed in sterile water and wiped dry with a clean swab (residue of the disinfectant may cause a caustic burn on the cornea).
- Check that the graduation marked '0' on the measuring prism is aligned with the white marker point on the tonometer head
- Check the calibrated dial of the tonometer is set at 10 mmHg
- Ensure that the patient is sitting comfortably at the slit lamp: at the right height, with their chin on the rest and their forehead against the headband
- Set the magnification of the slit lamp at ×10.

5.3 Method

- Instil the local anaesthetic drops and then the fluorescein. Only a very small amount of fluorescein is needed
- For measuring the IOP in the right eye, make sure the slit beam is shining onto the tonometer head from the patient's right side; for the left eye, the beam should come from the patient's left side
- Move the filters so that the blue filter is used to produce a blue beam
- Make sure the beam of light is as wide as possible, and that the light is as bright as possible. This makes visualising the fluorescein rings easier (with the slit diaphragm fully open)
- Ask the patient to look straight ahead, open both eyes wide, fix his or her gaze and keep perfectly still
- With the thumb, gently hold up the patient's top eyelid, taking care not to put any pressure on the eye
- Direct the blue light from the slit lamp onto the prism head
- Make sure that the tonometer head is perpendicular to the eye
- Move the tonometer forward slowly until the prism rests gently on the centre of the patient's cornea
- With the other hand, turn the calibrated dial on the tonometer clockwise until the two fluorescein semi-circles in the prism head are seen to meet and form a horizontal 'S' shape. (Note: the correct end point is when the inner edges of the two fluorescein semi-circle images just touch)
- Note the reading on the dial and record it in the notes
- Withdraw the prism from the corneal surface and wipe its tip
- Repeat the procedure for the other eye
- Wipe the prism with a clean, dry swab and replace it in the receptacle containing the disinfectant.



Correct end point for tonometry

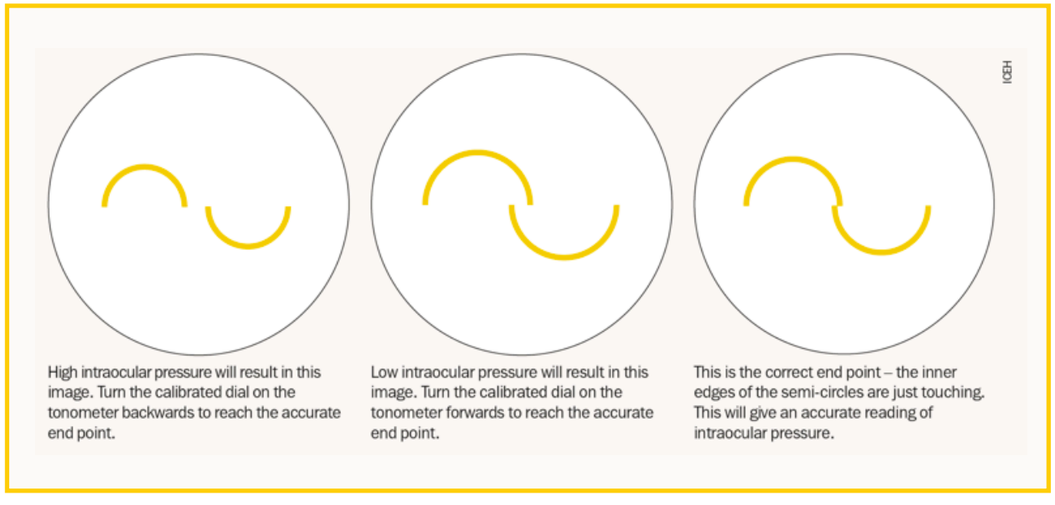


Figure 13: Applanation tonometry:
Applanation tonometry semi-circles viewed through the Goldmann prism*© Stevens et al29*

9 APPENDIX B: EXAMINATION OF THE OPTIC NERVE HEAD FOR GLAUCOMA

Methods

Use the equipment that you have:

Direct ophthalmoscopy
Indirect ophthalmoscopy
Slit lamp examination with a posterior pole lens

How to examine the optic nerve head

1. Dilate pupils, if possible and safe to do so.
2. Identify the disc edge and cup edge, and identify the rim.
3. Does the rim thickness obey the ISNT rule?
4. Is there a haemorrhage?
5. Measure the vertical height of the optic nerve head*
6. Estimate the vertical cup disc ratio (CDR).
7. Examine the retinal nerve fibre layer (using green light).*
8. Draw an annotated diagram of the optic nerve head.

* This may only be possible with a slit lamp and posterior pole lens.

Interpreting the findings:

- The hallmark of glaucomatous optic neuropathy is excavation of the neuroretinal rim
- Advanced glaucomatous ONH can result in a pale optic disc, but disc pallor should also raise suspicion of another cause such as optic atrophy
- A colour difference should not be used to distinguish the cup edge; change in direction of the blood vessels is a more reliable indicator
- The optic disc abnormality should correlate with the visual field defect. Where this is not the case, further investigations (e.g. CT/MRI scan) may be indicated
- The size of the cup always appears smaller when viewed monoscopically rather than steroscopically.

© Bourne RA31

10 APPENDIX C: GLAUCOMA TREATMENT MONITORING CARD

This record card can be attached to the patient records for quick reference.

NAME:
DATE OF DIAGNOSIS OF GLAUCOMA:
DATE OF SURGERY FOR GLAUCOMA:
OTHER IMPORTANT HISTORY:

IOP RECORD

DATE	TIME	IOP RE mmHg	IOP LE mmHg	TREATMENT RECOMMENDED	REMARKS

PROCEDURE AND FINDINGS:

RECOMMENDATION:

11 APPENDIX D: ASSESSING THE VISUAL FIELDS

8.1 Testing each eye to confrontation

1. The patient sits directly in front of you, so that you are one meter apart and your eyes are on the same level.

2. To assess visual field in the right eye, ask the patient to cover the left eye with the palm of their left hand (not their fingers, as it is easy to peep between fingers) taking care not to apply pressure to the eye.

3. Close your right eye with your right hand and ask the patient to look only at your open eye at all times during the test. This ensures that the patient's field of vision of the right eye corresponds to your (normal) field of vision of left eye and forms the basis for comparison. It is advisable for the eye health workers to have a visual field test themselves.
If the patient cannot maintain fixation on your eye, they may have a central blind spot. In this case, ask the patient to look steadily at your face.

4. Present one to four fingers in each quadrant of the visual field, midway between the patient and yourself so that both of you see the target equally well. Do not move the fingers (static testing). Ask the patient to report the number of fingers without looking at the fingers directly.

5. Repeat the procedure for the other eye. The static test can detect differences in the visual field from side to side (hemianopia) and from above or below.

6. Next, move your target fingers from the far periphery in towards the centre in each quadrant (kinetic testing). Ask the patient to say when they first see the target. Perform kinetic testing at a speed appropriate for the patient's responses. If the visual field is normal the target will come to view at the same time for both patient and examiner.
Repeat from several different directions, ensuring that the full 360° for each eye is tested.

7. Next, test the peripheral field with a white-headed neurological pin (beyond a central 30° radius) and the central field with a red-headed neurological pin (within a 30° radius).
Testing with neurological pin targets gives much more accurate results than testing with fingers, and can detect earlier visual field loss.

Red-headed neurological pins are also useful for assessing the size of the blind spot (e.g., with papilloedema), again by comparing the size of your blind spot with that of the patient's. In addition, red-headed neurological pins can be used to test for red-desaturation in early optic nerve disease.

Figure 14: Confrontational visual field test© *Dr Faith Masila*

11.2 Testing each eye on standard automated perimetry

Humphrey's Visual Field Analyser (Fig 15) is mainly available in referral eye clinics in the country. Conduct the visual field testing using the standard procedure.

If the patient wears spectacles for reading, the test should be done with their reading glasses on.

The strategy used for testing glaucoma patients is 24-2 and 10-2 when there is involvement of the central fixation.

The right eye is by convention, tested first, and the following details are recorded.[33]

1. Patient data
2. Reliability indices
3. Grey scale (must be read with the other eye's grey scale at the same time)
4. The total deviation
5. Pattern deviation
6. Global indices

When examining the test results, you MUST hold the two printouts, Fig 16 and 17 (right eye print out in your right hand facing your right eye, and left eye printout in your left hand facing your left eye), and examine them together.[33]

The print out should be read in the sequence of the points 1-6 above.

11.3 Points to note

- The VF reflects changes in the visual pathway. It does not diagnose glaucoma.
- One should always look carefully at the fundus, to see if the VF defects match the appearance of the disc and retina or not.
- Visual fields are the most important disease progression parameter for physicians, but visual acuity is the single most important disease progression parameter for patients.
- The two tests cannot be separated: one looks at the visual function and the other at functional reserve of the eye.

Figure 15: Humphrey Visual Field Testing
© Dr Faith Masila

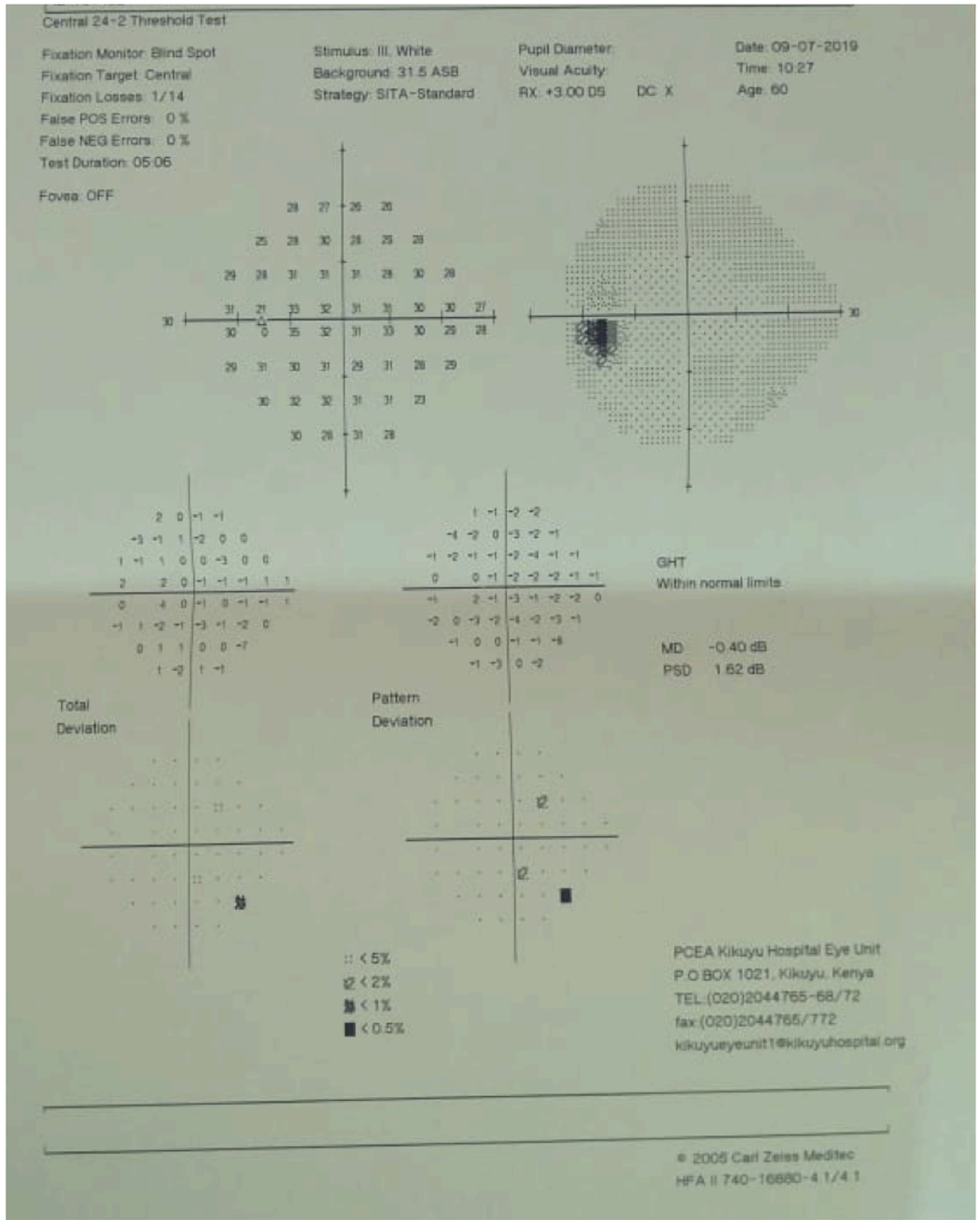


Figure 16- Normal Visual field (A) ***© Dr Faith Masila***

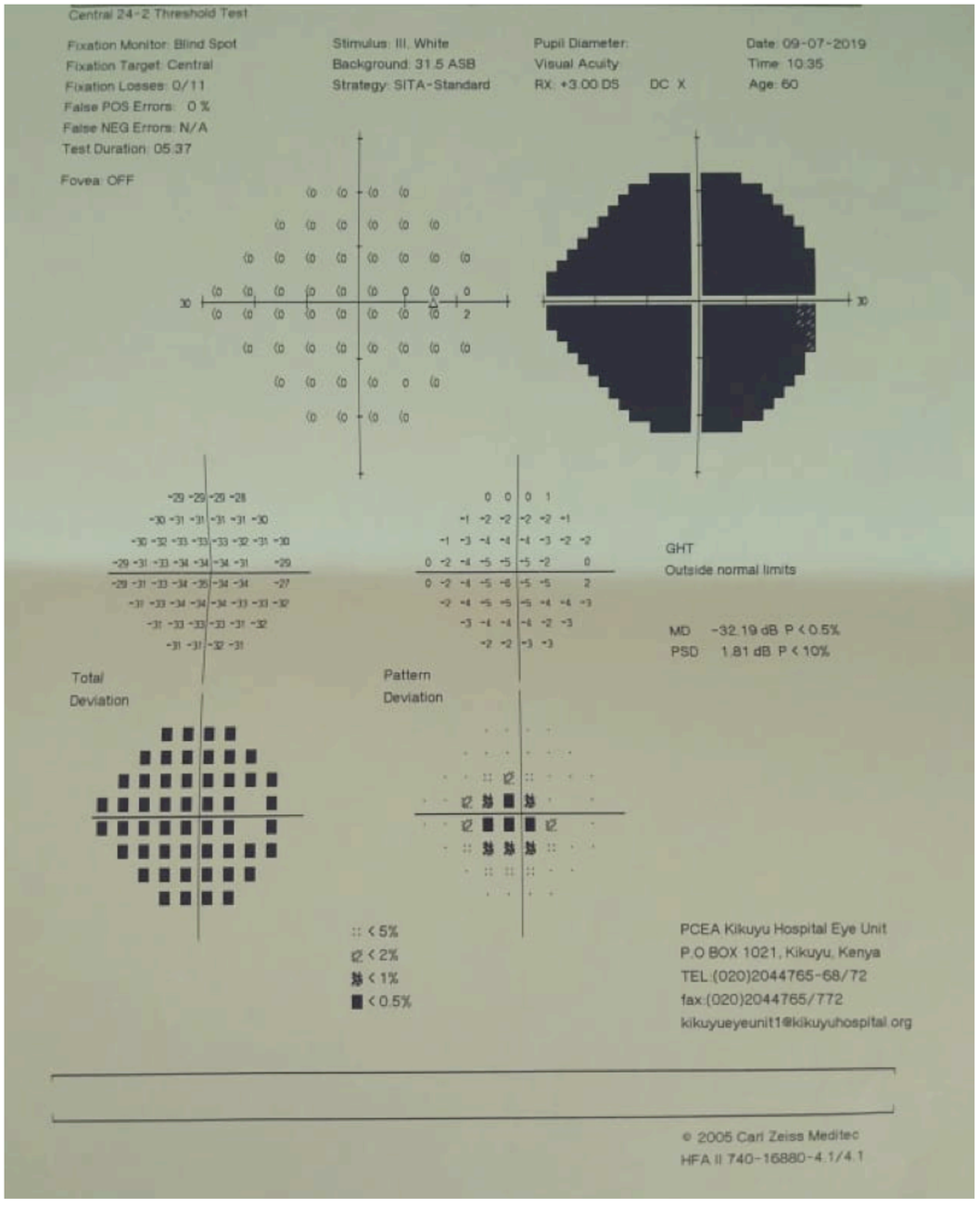


Figure 17: Advanced Visual field loss (B) ***© Dr Faith Masila***

12 APPENDIX E: INFORMATION FOR PATIENTS AND THEIR FAMILIES

What is Glaucoma?
Glaucoma is an eye disease that causes progressive irreversible damage of the optic nerve and loss of field of vision. There is usually no warning, or obvious symptoms to detect it until marked irreversible loss of vision has occurred and this has led to glaucoma being described as the “sneak thief of sight”. It is often associated with high pressure in the eye.
Glaucoma is the leading cause of irreversible blindness worldwide. It afflicts more than 67 million people globally of whom about 5.0 million are blind. In Kenya, over 200,000 people are affected of whom about 25 000 people are blind from the disease.
Unfortunately most people with glaucoma are unaware of it. It is the estimated that over 90% of Kenyans who suffer from glaucoma are not aware of it! Glaucoma is asymptomatic in its early stages.
Once sight is lost it cannot be recovered, but if treated most patients will not become blind.
Glaucoma runs in families and family members are encouraged to get tested.

What are the different types of glaucoma?
Primary Open Angle Glaucoma (POAG) is the most common type
The normal eye is filled with fluid, which slowly flows inside the eye and keeps it healthy. As new fluid is made the old fluid flows out. If the fluid does not leave the eye as it should, or if too much fluid is formed, the fluid will build up. As this happens, the pressure inside the eye rises to a level that damages the optic nerve and loss of vision may result. That is why controlling the pressure inside the eye is very important.
Congenital/Childhood glaucoma
Children may be born with a defect in the angle of the eye that slows the normal drainage of fluid. Symptoms are obvious, such as: Cloudy eyes, Sensitivity to light and Excessive tearing. The treatment is usually surgery, and it is safe and effective. If done promptly, there is usually an excellent chance of the child having good vision.
Secondary glaucoma:
This is glaucoma that develops as a complication of other eye conditions such as eye surgery or advanced cataracts, eye injuries, certain eye tumours, or eye inflammation. Treatment includes medicines, laser or surgery.

Who is at risk?
Every person is at risk of getting glaucoma. However there are groups of people who are at a higher risk of getting the disease. These include people with

- History of glaucoma in the family
- Aged over 35 years old
- African race
- High Intraocular Pressure (above 21 mmHg)
- Myopia (short-sightedness)
- Diabetes mellitus

For this group of people a yearly eye check-up is very important

How do I know I have glaucoma?
At first there are no symptoms. Vision stays normal, and there is no pain. However, as the disease progresses, you may slowly lose side vision. Objects in front may still be seen clearly, but objects to the side may be missed. If untreated, you will slowly lose your peripheral (side) vision. You will seem to be looking through a tunnel. Glaucoma can develop in one or both eyes.

How is glaucoma diagnosed?
A comprehensive eye exam is needed by an eye specialist. It will include:

- Visual acuity test. This eye test measures how well you see at various distances
- Eye pressure measurements. An instrument is used to measures the pressure inside the eye
- Visual field test. This measures your side(peripheral) vision
- Dilated eye exam. Drops are placed in your eyes to widen, or dilate, the pupils. A special magnifying lens is used to examine your retina and optic nerve for signs of glaucoma damage and other eye problems. After the exam, your close-up vision may be blurred for several hours.
- Other tests may be done as necessary

Glaucoma and driving
Healthcare providers should ascertain the vision status of any patient in whom they suspect an inability to pass the driving regulations. Individuals who have field defects in both eyes and/or who have acuity suspected of falling below the legal limits for driving should be informed that it is their legal obligation to inform the National Transport and Safety Authority (NTSA) of their ophthalmic diagnoses/status.
Glaucoma patients with advanced visual field defect are at risk for car accidents, and therefore, should not drive for their own safety and public safety even if they have good central vision.

Informing relatives of their risk of glaucoma
There is evidence that first-degree relatives, and in particular siblings, of glaucoma patients have a significantly increased risk of glaucoma within their lifetime. Healthcare providers should inform a patient with glaucoma of this and recommend that the first degree relatives be examined.

How is glaucoma treated?
Early diagnosis is very important. Immediate treatment for early stage open –angle glaucoma can slow down the disease`s process.

Treatments include:

- Pressure lowering eye drops, laser, surgery, or a combination of any of these. While these treatments may save remaining vision ,they do not improve sight already lost from glaucoma
- Pressure lowering medicines work by either increasing outflow of the fluid inside the eye or reducing its production. It is important that the drops are used exactly as instructed by your doctor. Because glaucoma usually has no symptoms, people may be tempted to stop taking medication, or may forget to take their medicines. You need to use the drops or pills for a long time as they help control your eye pressure.
- Laser trabeculoplasty helps fluid drain out of the eye. Your doctor may suggest this step at any time. In many cases, you need to keep taking glaucoma drugs after this procedure. Studies show that laser surgery is very good at reducing the pressure in some patients.However,its effects can wear off over time. You doctor may then suggest further treatment.
- Conventional surgery makes a new opening for the fluid to leave the eye.Your doctor may suggest this treatment at any time.This surgery is carried out in a clinic or hospital .You doctor will make small injections around the eye to numb it.A small piece of tissue is removed to create a new channel for the fluid to drain from the eye

How can I delay or prevent the progression of glaucoma?
Having an eye check for glaucoma, regular check by your eye specialist and adhering to the treatment are very important. This is the most important role that you can play.

Where can I get the examination for glaucoma?
Visit an eye clinic near you and ask for assessment for glaucoma.

Figure 18: Patients and eye care providers sharing information at an eye clinic

13 APPENDIX F: INSTILLING YOUR OWN EYE DROPS

It is important to learn to instil your own eye drops as medication for glaucoma usually has to be used for a long time. Ask your doctor for a demonstration on how to do this and practice under supervision. Instilling your own eye drops is not easy at first, but your skill will develop as you practice.

Eye drops are packaged in various containers: a bottle (plastic or glass) with a removable dropper and combined cap; a plastic bottle with dropper attached and removable cap; or a glass bottle with plastic pipette attachment and removable cap. Whatever type, *do not touch the part from which the drop falls*.

Figure 19: Technique for instilling your own eye drops
© Beatrice Nyaga

How to instil your own eye drops

1. Before instilling eye drops, wash your hands thoroughly
2. Sit or lie down with your head supported. (As your skill develops, you may eventually manage to instil your eye drops while standing).
3. Use your dominant hand to hold the bottle/dropper/pipette
4. With the index finger of your other hand, hold a clean piece of tissue or cotton wool, and gently pull down the lower eyelid to form a 'pocket'.
5. Hold the bottle/dropper/pipette between your thumb and forefinger, and place the 'heel' of your hand (where the wrist meets the hand) on your cheek. This will help to steady shaky hands.
6. Make sure there is a distance of about an inch (2.5 cm) between your eye and the end of the bottle/dropper/pipette. Be careful – *the tip must not touch any part of the eye or eyelids or eye lashes*.
7. Look up or to the side. Do not look directly at the bottle/dropper/pipette.
8. Squeeze the bottle/dropper/pipette – allow one drop to fall into the lid pocket.
9. Slowly let go of the lower lid. Gently close your eyes; try not to shut them tightly as this will squeeze the drop out of your eye.
10. Dab your closed eye with the tissue or cotton wool to remove any excess drops.
11. Put gentle pressure on the inside corner of your eye and count to 60, very slowly. This prevents the medicine from draining out of your eye before it is absorbed.
12. Wash your hands after instilling the drops

If you are using several medications

1. Wait at least 10 minutes between instilling different types of eye drops.
2. Start with eye drops first, then eye ointment (if both prescribed).

If you have difficulties:

1. If you struggle to hold a small bottle/dropper/pipette, wrap something like a folded piece of tissue around it
2. If, after much practice, you are still struggling, ask a family member or carer to instil the eye drops for you.
3. You may think it will help to use a mirror and some people may even advise this. In fact, the use of a mirror only complicates matters and can even create a dangerous technique. Avoid the use of a mirror.

As you are using your eye drops:

1. Instil your drops at regular intervals throughout the day. This is vital in controlling the intraocular pressure.
2. Store eye drops in a cold place, if possible in a refrigerator. It easier to feel a cold drop going in; this will reassure you that your technique is good.

3. Keep this handout safe for future reference.
4. Keep a record of the time you administered the drug
5. Do not miss your medication
6. Carry your medicines to the clinic while attending the follow up visit

Reference:
How to instil eye drops.Comm Eye Health Vol. 25 No. 79 & 80 2012 pp 79. Published online 05 February 2013.
If you are using more than one medication, keeping the record below is very helpful:

YOURNAME:

DATE	NAME OF MEDICATION	EYE (R=right, L=left, B=both)	BREAKFAST	LUNCH	EVENING / SUNSET	BEDTIME

14 APPENDIX G: DRUGS USED IN GLAUCOMA

Adrenergic Agonists

Generic	Mechanism of Action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)	Remarks
Apraclonidine 0.5-1.0%	↓ Aqueous humour production Prevents severe elevation of IOP following anterior Segment laser procedure	-Maximum effect in 4 to 5 hrs. -Duration of effect: 12 hrs.	Contraindicated [C/I] in Children Side Effects: Dry mouth Lid elevation Follicular conjunctivitis Periocular contact dermatitis Allergy [more with Apraclonidine] Sleepiness, Fatigue Hypotension	
Brimonidine 0.2 % (0.15% using Purite as preservative)	↓ Aqueous humour production ↑ Uveal Scleral outflow Elevation of IOP where IOP can be deleterious to visual function	Duration of Effect : 8-12hr TID if monotherapy and BID if adjunctive.		The drug is very costly. There is insufficient proof regarding whether this drug has a neuro-protective effect in humans

Beta Adrenergic Blockers

Generic	Mechanisms of Action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)	Remarks
Betoxolol 0.25 to 0.5% [selective]	↓ Aqueous humour production Peak effect – 2 hours Washout – 2 to 5 weeks	Better tolerated than nonselective but not as effective	Relative side-effects and CI as Non-selective	
Timolol 0.1 –0.5% [non-selective]		Additive effects to most IOP lowering agents Reduces IOP more than Selective	SE: Bradycardia, Arrythmias Heart failure Bronchospasms Airway obstruction, Depression Masks hypoglycaemia in Type 1 diabetes CI: Asthma, COPD Sinus Bradycardia, Heart block	This is the most used topical glaucoma medication in this region owing to its availability, cost and long experience. Coupled by their favourable efficacy, this group of drugs is recommended as first line medical treatment for glaucoma.
Levobunolol 0.25-0.5% [non-selective				

Carbonic Anhydrase Inhibitors (CAIs)

a. Systemic CAIs

Generic	Mechanism of Action	Properties	Major side effects (SE), Precautions and contraindications (C/I)	
Acetazolamide	↓ **Aqueous formation.** Indicated when topical medication is not effective or feasible	Wash- out – 3days May lead to hypokalemia. Dose 125 to 250mg QID or 500 mg BD for slow release	**Major S.E.** – Parasthesia, GIT symptoms, depression, ↓libido, kidney stones, blood dyscrasias, metabolic acidosis, electrolyte imbalance. **CI –** When Sodium and potassium blood levels are depressed, in Kidney and liver disease. In Sicklers - due to its tendency to increase red blood cells destruction leading to fatal anaemia Precautions – Allergy to sulphonamides Pregnancy and Nursing Mothers: Teratogenic effects reported	Patients should be encouraged to take potassium rich food on a daily basis (e.g. bananas) and to have their CBC and electrolytes checked periodically Methazolamide is an oral CAI that is not as powerful as acetazolamide but is generally well tolerated (less fatigue and GI upset). The dose is 50 to 100 mg bid.

b. Topical CAIs

Generic	Mechanism of Action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)	Remarks
Brinzolamide Dorzolamide	CAI - ↓Aqueous formation. Indicated in elevation of IOP where IOP can be deleterious to visual function	As Monotherapy – TID As Adjunctive to topical beta blockers – BID Wash-out 1wk	**Major SE**: Ocular burning and discomfort, Other SE of Sulphonamides. **Precaution:** May increase cornea oedema in low endothelial cell count and/ or corneal endothelia dysfunction (e.g. Fuchs' dystrophy) Oral and systemic CAI not recommended	Due to their lower efficacy of the topical CAI - their main role is in further reduction of IOP in addition to a Beta Blocker or Prostaglandin, separately or as a combined formulation.

Parasympathomimetics

Generic	Mechanism of Action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)	Remarks
Pilocarpine 0.5 to 4% (Isoptocarpine, pilocarpine) Carbachol (Isoptocarbachol) Acetylcholine 1% (for intracameral use during surgery)	Increases facility of outflow of Aqueous. Direct action on longitudinal ciliary muscles Indicated in elevation of IOP where IOP can be deleterious to visual function	Pilocarpine lowers IOP in 1hr and lasts 6-7hrs. Therefore used QID Gel used QHS. Intracameral use during surgery. Drug Interaction: In theory, competitive interaction on uveoscleral outflow with prostaglandins In practice usually not a problem Wash out – 3 days	**Major SE:** Intestinal Cramps, brochospasms, miosis, pseudomyopia [up to 8D], brow ache, retinal detachment, Ciliary spasms, Increases pupillary block (dose dependent). **Major CI:** Age < 40yrs, cataract, uveitis, NVG **Precautions:** Axial myopia, History of RD or Rhegmatogenous retinal lesion	Heavily pigmented eyes have been shown to be relatively resistant to pilocarpine, therefore a higher concentration [4%] is recommended in the black population.

Prostaglandin Derivatives

Generic	Mechanism of Action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)	

Bimatoprost 0.003%, 0.01% Latanoprost 0.005% Travoprost 0.004%	↑ Uveal scleral outflow. Bimatoprost may also increase trabecular outflow.	IOP lowering starts 2-4hrs after administration with peak effect reached within 8-12hrs. Max. IOP lowering often takes 3-5weeks from start of treatment. Once Daily dose. Preferably evening. Washout can take 4-6wks	**Major SE.** Conjunctival hyperaemia. Burning, Stinging, foreign body sensation, Eyelash change [length, thickness, colour] reversible after cessation CME in aphakia and pseudophakia - Co-current use of NSAIDs may reduce this. Reactivation of herpes keratitis Anterior Uveitis **Precautions.** Patients must not administer these drugs while wearing contact lenses. But the contact lenses can be reinserted 15mins following administration	The cost remains a major area of concern for this group of drugs especially in the African context. Where finances allow the prostaglandins can be recommended as first line medication for glaucoma.

Osmotics

Generic	Mechanisms of action and indications	Properties	Major side effects (SE), Precautions and contraindications (C/I)
Glycerol	Hyperosmotic action Most potent pressure lowering agents	Dose: 1-1.5g/kg orally Onset of action is 10 mins, peaks in 30 mins and lasts about 5 hours	The patient must be evaluated for heart and kidney disease because hyperosmotics increase blood volume which increases the load to the heart. They may increase blood sugar levels and should be given to diabetics only with great caution and monitoring
Mannitol	Hyperosmotic action Most potent pressure lowering agents	Dose: 0.5 -1g/kg IV [100mL to 200mL of 20% solution]. Onset of action is 20 to 60 mins and lasts for 2 to 6 hours	

Combinations of Anti-glaucoma medications

Timolol 0.5% + Brinzolamide 1%
Timolol 0.5% + Dorzolamide 2%
Timolol 0.5% + Brimonidine 0.2%
Latanoprost 0.005% + Timolol 0.5%
Bimatoprost 0.03% + Timolol 0.5%
Travoprost 0.004% + Timolol 0.5%
Brimonidine 0.2% + Brinzolamide 1%

15 Appendix H: Basic Equipment in a Glaucoma Clinic

Recording system for notes

Visual acuity assessment

Slit lamp

Tonometer

Indirect slit lamp fundoscopy lens

Dilating and Anaesthetic drops

Fluorescein drops if a Golmann tonometer is used

Gonioscopy lens

Perimeter

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Ministry of Health,
Afya House, Cathedral Road,
P.O. Box:30016–00100, Nairobi, Kenya.