·Clinical Research·

The East London glaucoma prediction score: web - based validation of glaucoma risk screening tool

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Abstract

• **AIM: It is difficult for Optometrists and General Practitioners to know which patients are at risk. The East London glaucoma prediction score (ELGPS) is a web based risk calculator that has been developed to determine Glaucoma risk at the time of screening. Multiple risk factors that are available in a low tech environment are assessed to provide a risk assessment. This is extremely useful in settings where access to specialist care is difficult. Use of the calculator is educational. It is a free web based service. Data capture is user specific.**

• **METHODS: The scoring system is a web based questionnaire that captures and subsequently calculates the relative risk for the presence of Glaucoma at the time of screening. Three categories of patient are described: Unlikely to have Glaucoma; Glaucoma Suspect and Glaucoma. A case review methodology of patients with known diagnosis is employed to validate the calculator risk assessment.**

• **RESULTS: Data from the patient records of 400 patients with an established diagnosis has been captured and used to validate the screening tool. The website reports that the calculated diagnosis correlates with the actual diagnosis 82% of the time. Biostatistics analysis showed: Sensitivity = 88%; Positive predictive value = 97%; Specificity = 75%.**

• **CONCLUSION: Analysis of the first 400 patients validates the web based screening tool as being a good method of screening for the at risk population. The validation is ongoing. The web based format will allow a more widespread recruitment for different geographic, population and personnel variables.**

• **KEYWORDS:** glaucoma; score; diagnosis; tomography; management; South Africa

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INTRODUCTION

Glaucoma is characterized by chronic degenerative lesions of the optic nerve. This is a chronic and progressive neurodegenerative disease where loss of retinal ganglion cells results in specific alterations in the optic nerve head (ONH) and retinal nerve fiber layer (RNFL). The burden of glaucoma disease and complications pose an important challenge to health care structures worldwide [1-4]. Glaucoma is among the 3 top causes of low vision and blindness in developed countries and developing settings of sub Saharan Africa. The magnitude (prevalence and incidence) of glaucoma increases with aging. An estimated 67 million people are affected by glaucoma in industrialized countries [1,5,6]. Prevalence has been reported as 1%, 2.9% and 5.3% for the age ranges 50 to 64, 65 to 79 and >80 years, respectively. The exact causes of glaucoma are not known. Elevated intraocular pressure (IOP) is proven to be among the major reported risk factors. Others are: ethnicity/race (black Africans, Celtic, Scandinavian, Russian ancestry), age>40 years, family history of glaucoma, diabetes mellitus, previous eye injury (trauma), myopia, and regular use of topical steroids. Treatment and quality of life of glaucoma are reported [7-9]. It is important to note that 25% to 50% of glaucomatous patients with atrophy of the optic nerve have normal IOP[10-12].

Some 50% of people with advanced functional impairment do not know that they suffer from glaucoma [10-12]. Ophthalmologists can detect and treat glaucoma before most patients experience any symptoms. Early detection and treatment of glaucoma is highly desirable to attempt to stabilize progression of optic neuropathy and prevent visual field loss. The early detection of glaucoma is valuable for establishing the diagnosis prior to functional loss which may only be detected when as much as 50% of the optic nerve has been lost [13]. Treatment in early phase may retard ongoing damage and delay sight loss and associated morbidity [12]. Early detection of glaucoma is hampered by many factors, including subjectivity of doctors and inter-expert observer

variability in the interpretation of clinical examination and special investigations. The difficulty of establishing the diagnosis has led to recent proliferation of objective, high Tech investigations and computer software programs that supplement clinical judgment and assist in making decisions concerning diagnosis and management of glaucoma. These techniques include heildelberg retinal tomography (HRT) utilizing confocal scanning laser tomography with moorfields regression analysis (MRA), optical coherence tomography (OCT), short-wavelength automation perimetry (SWAP), frequency-doubling technology (FDT) perimetry, GDX, GCC, RNFL, all of which are now used as valid diagnosis tools for glaucoma detection and management [13-18].

In sub-Saharan Africa including developing countries such as South Africa, the diagnosis of glaucoma is still made on a clinical basis by means of a weighting of risk factors established from history and clinical examination. The cost of diagnosis of glaucoma is not insignificant in general, and in particular this increases when the goal is early detection. Detection of progression demands significant clinical skills and special technology which are available in few countries and cities. In this African environment, treatment options are limited and costly, while compliance is poor and the outcome of the diagnosis may only be confirmed by progression that may take years to manifest. In this context it is no wonder that glaucoma screening is difficult because of the uncertainty of which patients need referral as Glaucoma suspect. The high prevalence of glaucoma in sub Saharan Africa [3-5] contrasts with limited resources. Very few people have regular eye examination by Optometrists or Ophthalmologists. The lack of clarity as to which patients should be referred and the general level of unawareness regarding glaucoma have led to apathy regarding screening efforts. It is difficult for optometrists and general practitioners to know which patients are at higher risk of glaucoma. When we consider the lack of access to health services, the relative shortage of Healthcare professionals, the high cost of investigation and the high incidence of glaucoma we can understand the difficulty of trying to decide who needs referral. Thus an aid to referral to Optometrists, General Practitioners and Ophthalmic nurses was urgently needed. This aid should take ethnic-specificity classification into account and include a larger number of individuals as included in the East London Glaucoma Prediction Score (ELGPS) algorithm. The ELGPS is based on the system described by Swindals and collaborators for discriminating between normal and glaucomatous ONH using a mathematical model of ONH Shape [14,19]. The ELGPS provides a score based on weighting of risk factors established from history and clinical examination of each eye that adds up to predict the likelihood of a whole patient having glaucoma. The present study was initiated because of the importance of establishing the overall risk that an individual patient carries at any one point of screening for developing glaucoma in either eye.

The aim of this study was to investigate the diagnostic performance of the ELGPS to classify patients into those unlikely to have Glaucoma, Glaucoma suspect (with possible mild to moderate morphological and functional damage of optic nerve), and definitive Glaucoma with advanced and severe morphological and functional damage of optic nerve.

SUBJECTS AND METHODS

Study Design This clinical epidemiological research was designed as a retrospective case-reference series. It was conducted between April 2009 and December 2009 according to the recommendations of the Helsinki II Declaration. Its protocol was approved by the local Ethics committee from East London, South Africa. Consent for participation was obtained from the patients to commencement of the survey and informed, written consent was obtained from all willing participants.

Study Setting The Eye Centre, a specialized, private Ophthalmology practice, based in East London, a city in the Eastern Cape Province of South Africa, served as the study setting. The ELGPS is a web-based format with no geographic limitations (www.glaucomascore.co.za). The website is a risk calculator that has been developed to determine glaucoma risk at the time of screening.

Study Population The data set was private patients referred from the Eastern Cape Province for evaluation for Glaucoma who were eligible for analysis. This target population was representative for all ethnic/race groups of South Africa: blacks, mixed-race, Caucasians and Indians.

Inclusion criteria were the presence in the clinical record of an established diagnosis. The analysis was done on a retrospective basis of established clinical records where a diagnosis had already been established. Possible diagnoses were: Unlikely to have Glaucoma, Glaucoma suspect (ICD-10 H40.0) and Glaucoma (H40.1). Exclusion criteria were negative response to participation and incomplete data (not all fields recorded n=25). These were not different from the participants in terms of the rest of the variables.

Data Collection The first evaluation was performed by the study originator (Dr S. Cook) at the primary level to establish the ELGPS according to the risk factors for glaucoma and the total of sum of points of each risk factor (Tables 1 and 2). The points of risk factors were defined by scores produced by logistic regression with Glaucoma as dependent variable versus no Glaucoma within a pilot case control study among 100 participants (screened on World Glaucoma Day). The case notes were reviewed and scores captured on a score sheet which gave a total score for weighted and cumulative risk factors according to the gravity of risk factors with the following classification (new diagnostic test): Unlikely to be glaucoma, Glaucoma suspect, and Glaucoma.

Table 1 Algorithm used to establish GPS (Partin 1)

Risk factors of glaucoma	Points for scoring GPS
Age (a)	
<30	0
30-49	1
⩾50	2
Ethnicity/Race	
Black	2
Other	0
History	
Glaucoma in family	4
Personal history of eye trauma	1
Visual acuity (VA)	
6/6	0
6/9-6/12	1
6/18 or worse	2
Myopia: -1 or more myopic	1
Pseudo-exfoliation	2
Intraocular pressure (10P) (mmHg)	
<22	0
22-29	2
⩾30	6
10P difference >2	2

Table 2 Algorithm used to establish GPS (Partin II)

Risk factors of glaucoma	Points for scoring GPS
Cup to disc ratio (CDR)	
<0.4	0
0.4-0.6	2
⩾0.6	2
Asymmetry >0.1	3
Disc features	
Pit	3
Hemorrhage	2
Notch	5
Inferior >Superior >Nasal >Temporal (ISNT rule)	
Obeyed	0
Disobeyed	3
Peri-papillary Atrophy (PPA)	2

The second evaluation of patients was performed by the study originator (Dr S. Cook) who then reviewed the established (historic) diagnosis that the treating Ophthalmologist had established over time. The Ophthalmologists diagnosis was made in all cases prior to the clinical record review to establish the ELGPS. This assessment was performed without knowing the ELGPS results. This reference (gold) standard diagnostic procedure provided clinical diagnosis on all included patients. Both eyes were treated as being contributory to certain clinical diagnosis taking into account history, clinical examination and the presence of abnormality in visual field (VF) and HRT 2. Visual Field data reflecting functional damage in terms of VF loss were used to show the presence and the progression of glaucoma with a Humphrey Visual Field 24.2 strategy or FDT field analysis. The VF defect score was determined by the HFA analysis which is reported as: within normal limits, borderline or outside normal limits. The Heidelberg Retinal Tomograph (HRT 2) uses confocal scanning laser tomography to generate objective, noninvasive, 3-D imaging of the optic nerve. The HRT 2 provides a very accurate map of the optic nerve. HRT 2 assessed structural damage to the optic nerve and nerve fiber layer. These HRT 2 measurements allow the Ophthalmologist to monitor for progression over time by comparing new findings to the original map. The HRT 2 score was determined by the Moorfields analysis outcome which scored the changes as within normal limits, borderline and outside normal limits. The Ophthalmologists diagnosis and actual classification (reference test) of patients was as follows: normal, glaucoma suspect and glaucoma, visual Field defect (None=0, Bordeline=1, Outside normal limits=2) and HRT (Normal=0, Borderline=1, outside normal limits=2).

Statistical Analysis The performance of ELGPS classification was evaluated as to its added value compared to the Ophthalmologists clinical diagnosis performance ("black box"). It was assumed that the clinical diagnosis provides correct and valid classification of unlikely to have glaucoma, glaucoma suspect and glaucoma as the Gold standard test.

Diagnostic performance of ELGPS classification was defined by the biostatistician (LHB) in the sensitivity, specificity, positive predictive value, negative predictive value, KAPPA coefficient statistic, true positive, true negative, false positive, false negative and diagnostic accuracy. The KAPPA coefficient statistic measured the agreement level (concordance) for glaucoma between both diagnostic tests. Diagnostic accuracy of ELGPS was equal to [(true positive + true negative)/all]. Receiver operating characteristic (ROC) curves were plotted when continuous values of ELGPS scores were considered. A measure of performance or discriminatory power of ELGPS score was the area under the curve (AUC) after connecting in a graph the sensitivity-(1-specificity=false positive) hairs obtained for different cut-off values of ELGPS score [20,21]. The threshold of statistical significance was P value <0.05. All analyses were performed using the SPSS software package version 15 for Windows (SPSS Inc, Chicago, IL, USA).

RESULTS

From the sampling process, 400 patients participated (Response Rate = 94.1%, n=425). There were 202 males and 198 females with a sex ratio of males/females of 1:1.

Figure 1 shows the ROC curve for ELGPS test against the clinical decision by practitioners when to refer, by considering the diagnosis made by the specialists as the gold standard. The cut-off point of ELGPS ⩾8 was the optimal value to discriminate normal from glaucomatous: sensitivity = 87%, specificity =91%, AUC=0.947 95% CI 0.913-0.980; P<0.0001.

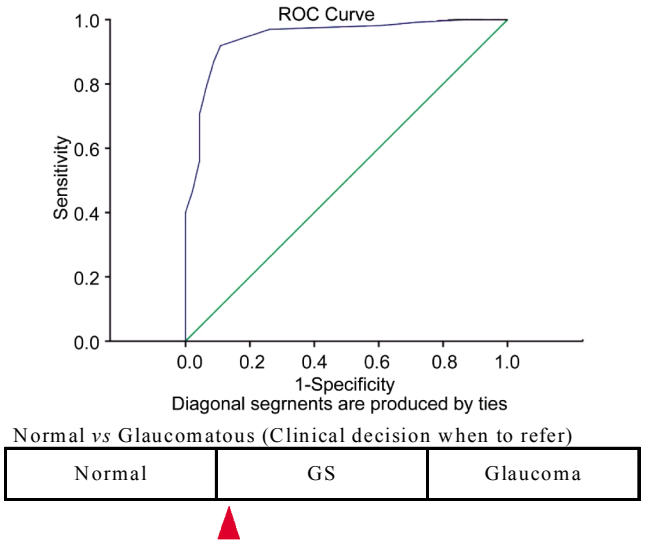

Figure 1 ELGPS *vs* Gold standard to separate normal from glaucomatous.

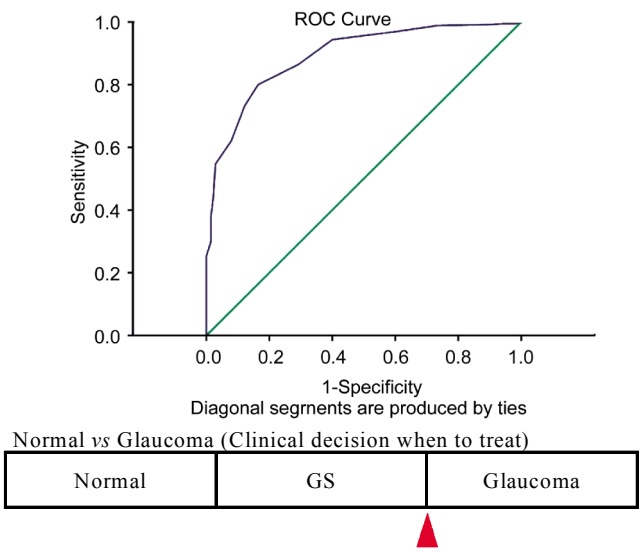

Figure 2 ELGPS *vs* Gold standard to manage glaucoma (glaucoma for treatment).

Figure 2 shows the ROC curve for ELGPS test against the clinical decision from the specialist when to treat (gold standard) patients with the highest power to discriminate normal and suspect for glaucoma from definite glaucoma.

The cut-off point ELGPS ⩾11 was the optimal value to discriminate normal and suspect glaucoma from definite glaucoma: sensitivity=80% , specificity=84% , AUC=0.891 95%CI 0.862-0.921; P<0.0001.

Figure 3 shows the ROC curve of ELGPS test against the morphology damage defining glaucoma Hemifield Analysis (GHT=presence of functional test) as Outside Normal (Gold standard) or GHT3 with the highest power to discriminate normal and borderline n=69 from GHT3 (n=296) at ELGPS ⩾11: sensitivity=80%, specificity=84%, AUC=0.830 95%CI 0.780-0.881, standard Error=0.026; P <0.0001. Figure 4 shows the range of scores for guidance in determining risk for management. Figure 5 presents the suggested algorithms for management of screened patients at primary, secondary and tertiary levels.

The diagnostic accuracy and agreement level (concordance) was characterized by KAPPA coefficient statistic =0.958, standard error=0.042 and P<0.0001 in comparison with clinical decision (diagnosis). However, in considering LR+ for glaucoma with IOP=14.3mmHg and pretest probability of definite glaucoma=0.52, but the post ELGPS probabilities were 92% and 85% in presence of glaucoma and absence of glaucoma, respectively.

Table 3 presents the comparisons of rates of variables between normal (no glaucoma) and glaucoma suspect. Other ethnic groups, Myopia, CDR> or =0.6, CDR asymmetry of more than 0.1, ISNT and Peripapillary Atrophy were significantly commoner in Glaucoma suspect than normal (no glaucoma), whereas the rates of the other variables were similar between these groups. However, 90% of Black, aged

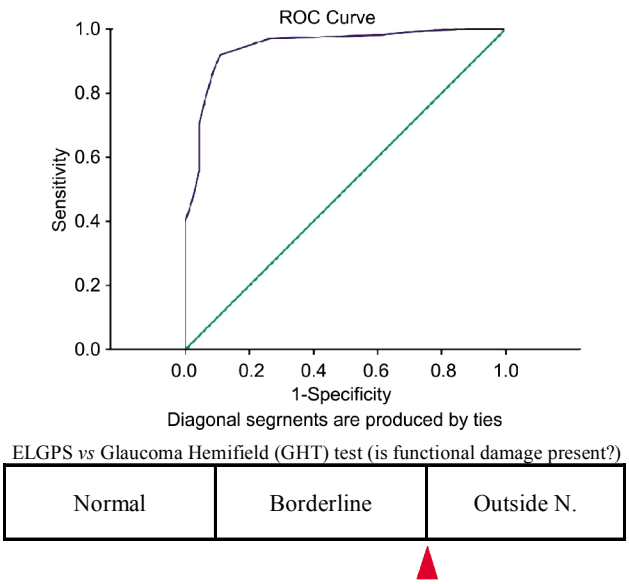

Figure 3 ELGPS *vs* GHT to separate normal from outside normal (GHT3).

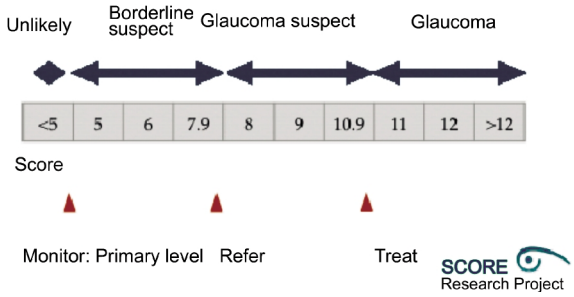

Figure 4 Final ELGPS management recommendations after cut point optimization from ROC curves.

>50 years with a family history were Glaucoma suspects (n= 18/20).

In Table 4, the rates of Black ethnicity, family history, IOP>30mmHg,age more than 50, Visual acuity worse than 6/18, Myopia, IOP difference >2mmHg, CDR >0.6, CDR asymmetry >0.1, disc pit, notch, ISNT and peripapillary atrophy were significantly commoner in Glaucoma than

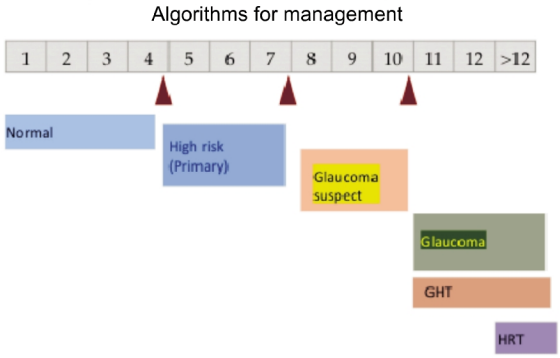

Figure 5 Classifications of ELGPS.

Table 3 Comparing the rates of variables between normal (no glaucoma) and glaucoma suspect [n/total(%), $\bar{x} \pm s$]

Variables of interest	Glaucoma	Glaucoma suspect	P
Ethnicity			<0.0001
Black	10/28(35.7)	18/28(64.3)	
Other	130/157(82.8)	27/157(17.2)	
Family history: Yes	12/14(85.7)	2/14(14.3)	0.363
Trauma: Yes	7/8(87.5)	1/8(12.5)	0.425
Haemorrhage	1/2(50)	1/2(50)	0.395
IOP ⩾30mmHg	0(0)	0(0)	
Age ⩾50 years	89/118(75.4)	29/118(75.4)	0.538
Visual acuity ⩽6/18	13/17(76.5)	4/17(23.5)	0.728
Myopia ⩾-1.00	46/52(88.5)	6/52(11.5)	0.011
Pseudo-exfoliation	1/1(100)	0/1(0)	0.570
IOP difference >2mmHg	15/17(88.2)	2/17(11.8)	0.205
CDR >0.6	42/42(100)	0/42(0)	<0.0001
CDR asymmetry >0.1	20/20(100)	0/20(0)	0.007
Disc pit	0	0(0)	
Disc notch	1/1(100)	0/1(0)	<0.0001
ISNT not obeyed	23/24(95.8)	1/24(4.2)	0.014
Peripapillary atrophy	63/76(82.9)	13/76(17.1)	0.040

Glaucoma suspect. Although pseudo-exfoliation was commoner in Glaucoma than Glaucoma suspect, the difference was statistically weak. However, trauma and haemorrhage were uncommon.

Using the ELGPS, Figure 6 shows that the characteristics of ROC curve discriminated no Glaucoma and Glaucoma suspect with excellent diagnostic performance. ELGPS also discriminated Glaucoma and Glaucoma suspect (Figure 7). Figure 8 shows an inverse relationships of the rates of Glaucoma Suspect and increase in IOP levels without significant difference (P=0.688), whereas a positive and significant (P<0.0001) relationship between the rates of definite Glaucoma and increase IOP levels.

DISCUSSION

The present study demonstrated the evidence base for screening and diagnosis of suspected glaucoma, glaucoma,

Table 4 Comparing the rates of variables between glaucoma and glaucoma suspect [n/total(%) , $\bar{x} \pm s$]

Variables of interest	Glaucoma	Glaucoma suspect	P
Ethnicity			<0.0001
Black	200/210(95.2)	10/210(4.8)	
Other	156/286(54.5)	130/286(45.5)	
Family history: Yes	70/82(85.4)	12/82(14.6)	0.003
Trauma: Yes	22/29(75.9)	7/29(24.1)	0.614
Haemorrhage	5/6(83.3)	1/6(16.7)	0.527
IOP ⩾30mmHg	64/64(100)	0/64(0)	<0.0001
Age ⩾50 years	305/394(77.4)	89/394(22.6)	<0.0001
Visual acuity ⩽6/18	74/87(85.1)	13/87(14.9)	<0.0001
Myopia ⩾-1.00	70/116(60.3)	46/116(39.7)	0.002
Pseudo-exfoliation	12/13(92.3)	1/13(7.7)	0.079
IOP difference >2mmHg	151/166(91)	15/166(9)	<0.0001
CDR >0.6	192/234(82.1)	42/234(17.9)	<0.0001
CDR asymmetry >0.1	111/131(84.7)	20/131(15.3)	<0.0001
Disc pit	44/44(100)	0/44(0)	<0.0001
Disc notch	63/64(98.4)	1/64(1.6)	<0.0001
ISNT not obeyed	278/301(92.4)	23/301(7.6)	<0.0001
Peripapillary atrophy	270/333(81.1)	63/333(18.9)	<0.0001

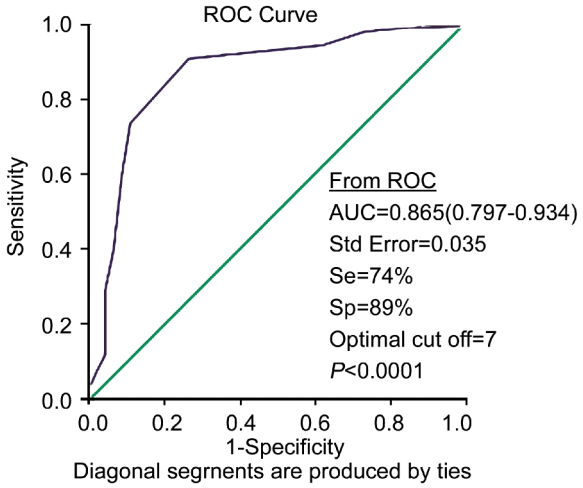

Figure 6 Characteristics of ROC curve discriminates no glaucoma from glaucoma suspect.

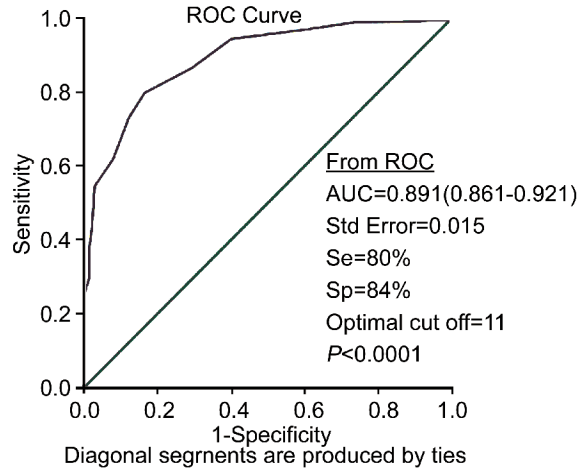

Figure 7 ELGPS discriminates glaucoma and glaucoma suspect.

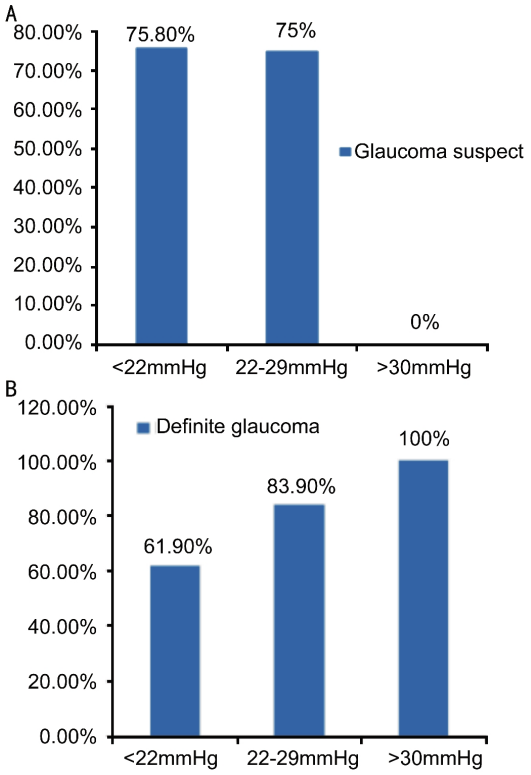

Figure 8 Relationships of Glaucoma Suspect (A) and definite Glaucoma (B) with IOP levels.

and both suspected glaucoma and glaucoma, respectively with sufficiently high specificity of the ELGPS at the primary level.

This clinical epidemiological research has investigated to a case review approach that showed unambiguously that sensitivity, specificity, post-test probability, Kappa coefficient statistic, diagnostic accuracy, and ROC curves of the ELGPS had a very high clinical, diagnostic, prognostic and therapeutic predictive power.

This highly affordable tool can be used to establish by means of careful history and examination the odds (probability) of a patient being unlikely to have Glaucoma, being a glaucoma suspect or having glaucoma. This is extremely useful for referring Health professionals, Doctors and Optometrists in their decision as to who requires referral to the Ophthalmologist for Glaucoma screening, diagnosis and management. The ELGPS can be used with a high level of confidence even when the IOP measurement is left out of the analysis. This is especially important in settings where glaucoma screening is performed where there is a scarcity of resources, sophisticated infrastructure, Ophthalmologists, but plenty of glaucoma disease and low vision [1-12].

The early detection of glaucoma is highly desirable as prevention of early nerve damage prolongs nerve survival. In sub-Saharan Africa and in many disadvantaged settings of developed and developing countries, the diagnosis of glaucoma is still made on a clinical basis by means of a weighting of risk factors, physical examination and loss of function. It is possible to make highly sensitive observations without appreciation of their exact pathophysiological significance. In this environment, treatment options are limited and costly, compliance is poor and the outcome of the diagnosis may only be confirmed by progression that may take years to manifest. The need for accurate validated diagnostic tests is paramount.

The present findings show a strong and significant correlation between the clinical diagnosis, visual field, and HRT 2 outcomes, and the ELGPS. It is interesting to compare our results with those from various tools developed in rich countries to improve early detection and management of glaucoma. The sensitivity and specificity of the ELGPS to discriminate normal from Glaucoma were close to 100 % respectively. The present findings were more capable than some older literature reports [13-15], but similar to more recent literature on technology[22-25] and diagnosis[26-29]. The sensitivity and specificity of the ELGPS were between 80% and 91% even though expensive tomography and computerized fields are not used in its determination. Computerised visual field analysis and tomography were used as external measures. The cut points for these were determined. This is of use in situations where these investigations are not available. The statistical approach in this study calculated ROC curves with AUC and 95% CL intervals, the magnitude of the change from pre-test to post-test probability (predictive values), the likelihood ratio and the diagnostic accuracy.

Clinical Implications and Public Health Perspectives

The present findings agree with the findings of the European Society of Ophthalmology symposium held in Amsterdam, June 13-16, 2009, that constant monitoring and management of glaucoma are associated with many challenges. Part of the problem is to determine which equipment and testing methods to use to address these challenges. The present study developed and utilized an algorithm the ELGPS with risk factors and parameters available at the primary care level. Our website www.glaucomascore.co.za enables widespread access for registered users to the algorithm and seeks to gather bias free data from a world-wide base of different users. The site can be accessed from a smart phone. Users are invited by requesting a link from elgps@eyecentre.co.za .We recommended the ELGPS for use as a screening tool because of its low variability and significantly fewer hositines (1-specificity). The ELGPS is designed as an aid to ophthalmic nurses, optometrists and general practitioners to screen and refer patients at high risk for glaucoma. The assumption that the risk factors can be pooled between eyes assumed that glaucoma is a systemic disorder influenced by environment and endogenous oxidative stress, and that age, ethnicity (race), myopia and that the presence of risk factors in each eye needs to be taken into account. The ELGPS

provides an opportunity for health professionals to establish an early diagnosis and overall score of high reliability and probability.

The most important clinical impact of the present study is to emphasize the importance of history and careful clinical examination with particular attention to disc morphology in determining the presence of glaucoma. IOP measurement and examination of pseudo-exfoliation are the only measurement that requires special equipment. The rest can all be done by means of direct ophthalmoscopy.

From the public health perspective, prevention of the eye trauma, diabetes, education of patients on the interaction of genetics (heredity, age), environmental factors in general and for aging people , and early referral suspected glaucoma are crucial to stabilise or to delay the progression of glaucoma and the onset of blindness.

Lowering of IOP by means of drops is considered the first-line therapy (European Glaucoma Society treatment). The addition of a second drug to achieve the target pressure may be necessary. Regular monitoring of progression may suggest surgical intervention with trabeculectomy, valves and implants.

The study methodology is known to be prone to bias. We are taking steps to attempt to remove the influence of this by utilizing a web based tool where the observer is blinded to the scoring system and by collecting high numbers from different observers. The use of calculators has been cautioned against in Glaucoma management. We advocate the use of the ELGPS as an adjuvant to clinical decision making. It should not be seen to replace clinical judgment. We observe that there is a tremendous potential for the ELGPS to be used as a teaching tool. The data is captured in Excel format. This means that the submitting practitioner builds his/her own data set whilst contributing to the collaborative effort. This will hopefully lead to a Glaucoma register. It will also help profile the disease. This format enables analysis of the relative weight or predictive value of each risk factor. This will hopefully lead to prioritization of risk factors. The website is equipped with a dashboard that scores the overall performance of the ELGPS and also that of the individual. The disciplines that the systematic evaluation of risk factors enforces are useful to all levels of healthcare practitioner in managing this challenging disease process.

In practice, monitoring (Figure 4) and classifications (Figure 5) of ELGPS are still made on a clinical basis by means of a weighting of risk factors (established from history and clinical examination), evidence of morphology damages (HRT, GDx, OCT) and loss function (visual acuity, visual field). Progression of damage confirms the presence glaucoma. Detection of progression of glaucoma demands significant clinical skills and may require specialists in African settings. The ELGPS will continue on the basis of a multi-centre web-based data collection scheme that will allow data collection and refinement of the present scoring system for glaucoma. The early detection of glaucoma is the goal in sub-Saharan Africa.

Strengths of the Study The sensitivity analysis was not influenced by the experience of the staff. Furthermore, the score was easily performed utilizing history and routine clinical examination as suggested by sensitivity. The ELGPS can be used routinely at all levels of care. The validity was assured by the pilot study. ELGPS may be generalized to all Glaucoma patients in the Eastern Cape Province. These results can be duplicated in the rest of South Africa and developing countries. Indeed we are using a shortlist of doctor scored criteria.

In conclusion, the diagnostic performance of ELGPS is excellent for definite glaucoma and good for glaucoma suspect when compared with established clinical diagnosis as the gold standard test. The ELGPS is recommended as a tool for early detection of glaucoma at the primary level and is valid for all ethnic groups. The test performs relatively well even when IOP is excluded as a risk factor.

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