

**OUTCOME OF GLAUCOMA SURGERY AT MOMBASA LIGHT
HOUSE FOR CHRIST EYE CENTRE.**

RESEARCH PROJECT

PRESENTED BY:

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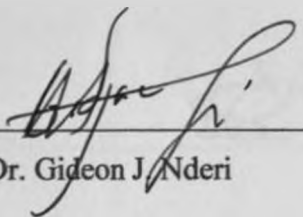


**A RESEARCH PROJECT PRESENTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE AWARD OF A MASTERS DEGREE IN
OPHTHALMOLOGY, DEPARTMENT OF MEDICINE, COLLEGE OF
HEALTH SCIENCIES, UNVERSITY OF NAIROBI.**

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

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DEDICATION

This work is dedicated to my two babies Miki and Mike,
the very spices with which my life is eaten.

'For your righteousness o God reaches to the heavens, you who have done great things; o God, who is like you'.....Psalms 71:19

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ABBREVIATIONS

- AC.....Anterior chamber
- AGIS...Advanced glaucoma intervention study
- ALT.....Argon Laser Trabeculoplasty
- AJO....American journal of ophthalmology
- BJO.....British journal of ophthalmology
- HRT....Heidelberg Retina Tomography
- IOP..... Intraocular pressure
- MLEC...Mombasa Light House For Christ Eye Centre.
- MD.....Mean deviation
- OCT.....Optical Coherence Tomography
- PC.....Posterior chamber
- PD.....Pattern Deviation
- PI.....Peripheral iridectomy
- Post-op...Post operation
- Pre-op...Pre operation
- POAG...Primary open angle glaucoma
- SPSS...Statistical package for social sciences
- TET.....Trabcculectomy
- VF.....Visual fields
- WHO. ..World Health Organisation.

ACKNOWLEDGEMENTS

Special gratitude goes to the darling of my heart Gyneth for bearing with me as I worked long hours and for her support all through.

Secondly my employer and sponsor the Kenyatta National Hospital for their financial support and moral backing especially from the entire Kenyatta fraternity.

May I also express special thanks to my family especially Mr and Mrs Jacob M'nthangi who led me to school even when this was not in my plan, and worked tirelessly to maintain me there.

The ophthalmology department deserves a special mention for their teamwork and support and guidance to the work that was translated into this book.

My supervisors occupy a special place in my heart for their guidance and tireless support in the writing of this dissertation.

Finally glory is to God our father, through Him and for Him I live.

ABSTRACT

OBJECTIVES:

The main objective was to evaluate the outcome of glaucoma surgeries in a centre for eye care in Kenya. The main outcomes were intraocular pressure control, changes of the cup: disc ratio, visual field (VF) changes and short term postoperative complications.

DESIGN:

Retrospective case series.

SETTING:

The study was conducted at Mombasa Light House for Christ Eye Centre, a referral centre serving the Coastal region of Kenya, and parts of Eastern and Northern Provinces of Kenya. Mombasa is the second largest town in Kenya.

SUBJECTS:

All patients diagnosed to have glaucoma and managed by surgery between 2004-2007.

MATERIALS AND METHODS:

Records from 2004 to 2007 were retrieved and data collected on the surgeries done using a structured questionnaire. 2008 was left for follow up to avail a one year minimum follow up time.

Analysis was done using SPSS version 13.

RESULTS:

265 operations were recorded in this period. 213 were retrieved and the outcomes analysed. Males were 65%. The mean age was 56.1, while the range was 1-90 years.

Six cases had congenital glaucoma. 90.6% of the eyes were diagnosed using cup to disc ratio and intra-ocular pressure assessment. 7% had gonioscopy. Baseline VF were available for only three cases hence VFs were not analysed.

Trabeculectomy was performed in 96% of the patients (n=213). Argon Laser Trabeculoplasty, peripheral iridectomy and an Ahmed valve were done for the others. (4%). 7% percent of the surgeries had antimetabolites used, mainly 5-FU and mitomycin-C. 35% had combined trabeculectomy and cataract surgery.

In 166 (77.9%) of cases, there were no complications. 47 (22.1%) had early postoperative complications. Of these, hypotony was the commonest (68%). Others included bleb failure (19%) and hyphema (9%), while infection and severe inflammation were 4%. 7 patients (15%) needed to be taken back to surgery for management of the complications.

The average intra-ocular pressure at two year follow up was 15.0mmHg against a baseline of 28.7mmHg ($p < 0.001$). 29 eyes (13.6%) required medication for intra-ocular pressure control. One type of medication was able to control the pressures post operatively. Surgery reduced topical antiglaucoma medication use by 72%.

Cup to disc ratios were stabilised after surgery with no significant decay during the follow up time ($p=0.449$ at 6months and 0.114 at 2yrs). There was an apparent improvement post surgery.

Most patients were operated late with 68% presenting with cup to disc ratios of ≥ 0.8 .

Post-op follow up was poor with a drop to 58% by the third visit.

CONCLUSION:

Intra-ocular pressure was well controlled for the two year follow up.

Cup to disc ratio was well controlled with even an apparent improvement post surgery in some cases. Complications though present could mostly be managed conservatively with a low re-operation rate.

RECOMENDATIONS:

Surgical intervention can be taken as a first option for glaucoma control in our set up.

Further studies should be done to ascertain whether or not there is an improvement in cup to disc ratio following glaucoma surgery in our set up

1. INTRODUCTION AND LITERATURE REVIEW

1.1 THE MOMBASA LIGHT HOUSE FOR CHRIST EYE CENTER.

Mombasa Light house for Christ Eye Centre is a Christian based non governmental eye centre serving as a referral centre for the coastal area of Kenya. It is located in the heart of Mombasa the second largest town in Kenya. Their main emphasis is prevention of blindness and restoration sight. In this context, glaucoma management is a key area in the prevention of blindness. Having had different surgeons over the years removes bias due to particular expertise. This enabled assessment of the real surgical situation for this study.

1.2 GLAUCOMA OVERVIEW

1.2.1 *Glaucoma Definition.*

Glaucoma refers to a group of diseases with a characteristic optic neuropathy and associated visual field loss.^{1 2 3} Although raised intraocular pressure (IOP) is one of the primary risk factors, its absence or presence does not preclude glaucoma.⁴

Glaucoma can be classified as either:

- Congenital (developmental) or
- Acquired.

It can further be classified, based on the mechanism of aqueous flow impediment. This can be either:

- Open angle or

- Angle-closure glaucoma.

Depending on presence or absence of causative factors it can also be classified as:

- Primary, or
- Secondary glaucoma

The IOP is generated by flow of aqueous from the ciliary body, which flows to the posterior chamber, then the AC, and out via the trabecular meshwork mainly. This is called the conventional flow and is the most important. Flows out via the scleral route and the uveal route play a lesser role, but have been recognised.

Disruption of these mechanisms leads to a deranged IOP. Treatment options for glaucoma target restoration of 'normal' IOPs via direct or indirect effect on these mechanisms.

Some forms of medical treatment have been shown to have a neuroprotective role⁵, though this may be out of the scope of this study.

1.2.2 *Epidemiology*

Glaucoma is the second cause of blindness after cataracts world wide⁶, affecting about 67 million people⁷ globally for primary glaucoma and an additional 6 million with secondary glaucoma. Blindness burden is estimated at 6.7 million people globally.⁸ The glaucoma burden in Kenya is estimated at about 240,000 an estimated burden of about 240,000 in Kenya, estimated using American statistics.⁹ This may be an underestimate as no surveys on glaucoma have been done in Kenya. Since Africans as a race are predisposed to POAG, the actual burden could be higher.^{10 11}

Glaucoma leads to irreversible blindness, thus presenting a major cause of concern in the prevention of blindness. As age is a major risk factor, glaucoma is one of the emerging causes of blindness.¹²

1.2.3 Management of glaucoma

In the 19th century, raised IOPs were thought to be synonymous to glaucoma¹³.

With development in ophthalmology, that has since changed and is now considered a major risk factor.

However, with this valuable association various treatment modalities aiming at lowering IOP were developed, including both medical and surgical. For this study emphasis shall be on the surgical management.

1.2.4 Surgical evolution¹⁴

From the early nineteenth century a lot of work has been put into surgical management of glaucoma. (See appendix 9.1)

Since then this has been refined to include more successful methods of filtration surgeries to control IOP. Additional laser procedures have been developed for patients not controlled well on medical treatment, or surgical procedures alone.

Other developments in glaucoma treatment include use of implants that assist in drainage e.g. the Ahmed valve. These implants present additional hope for the patient but still remain out of reach for most of our general patients in Kenya.

Trabeculectomy (TET) thus remains a well established surgical option despite recent advances.¹⁵

Traditionally the practice in glaucoma treatment is based on medical treatment with surgery reserved for treatment failure.^{16, 17} This is despite evidence that surgery may give better control for both IOP and VF deterioration^{18, 19}

In our set up where drug availability and affordability are not guaranteed and compliance difficulty to sustain, medical management certainly presents a serious challenge both for the clinician, and the patient.

1.3 FACTORS AFFECTING OUTCOMES OF SURGERY^{20, 21}

Various factors have been identified as playing a role in the outcome of glaucoma surgeries. They include,

- Surgical expertise,
- Use of anti-metabolites,
- Race,
- Age of the patients,
- Type of glaucoma
- Attendant complications

1.3.1 *Surgical expertise.*

This is the single most important factor in determining outcome of any surgery.

Sood et al showed the importance of good expertise especially in congenital glaucoma in an Indian study.²² He demonstrated higher rates of TET failure and subsequently, more repeat surgery in less experienced surgeons.

Roizen et al in a Californian study echo similar sentiments as to the importance of good surgical expertise.²⁰ Anand et al in a Nigerian study underline the importance of experience in achieving a good outcome in glaucoma surgery.²¹

Where as in our local set up not much data is available in emphasizing this, it is clear that appropriate surgical expertise is key in achieving good outcomes.

1.3.2 Use of antimetabolites.

Lots of evidence exists in support of antimetabolite use, especially 5-fluorouracil, and mitomycin-c. Lawan in a study in Nigeria found this to be the surgery of choice in TET²⁵. Anand et al report better IOP reduction with antimetabolite use in another study done in Nigeria.²⁶

Kabiru et al showed no difference in 5-Fu use after two months in a study in Tanzania.²⁷

However Yorston et al in a study in Kikuyu Eye Unit showed remarkably good outcomes with 5-Fu use in TET.²⁸

In Africans where high incidence of failure of convention TET has been shown due higher fibroblast activity antimetabolites have been shown to be of benefit.²⁹ Bleb failure is mainly due to fibroblast activity, thus reduction of bleb failure with use of anti- metabolites.

Mitomycin C has shown good results even in children³⁰.

1.3.3 Race.

Racial differences exist in healing and fibroblast activity. This leads to scar formation and earlier bleb failure in blacks as opposed to whites.³¹ Besides glaucoma starts earlier in blacks as opposed to whites and the disease is more

aggressive and responds poorer to medications.^{12 33} As such conventional TET may fail more in blacks than white.^{34 35}

1.3.4 Age.

As early as the late eighties Skuta et al were able to demonstrate earlier bleb failure among the young as opposed to the older counter parts. This was attributed to higher fibroblast activity³⁶, and conjunctival fibrosis. Congenital glaucoma has been shown to have very good long term IOP control as opposed to adult onset.^{37 38}

1.3.5 Type of glaucoma.

The type of glaucoma will determine the type of intervention surgery undertaken. Primary glaucoma will tend to have fewer complications as opposed to secondary glaucoma. Mermoud et al in a South African study showed poorer bleb outcome in post traumatic angle recession.³⁹ A study done in collaboration between Munich and Nairobi showed higher incidence of secondary glaucoma among the youth due to trauma, implying an already predisposed group to bleb failure. As such antimetabolites would be a top priority in secondary glaucoma as opposed to primary glaucoma.⁴⁰ POAG has been shown to have good outcomes with TET.

1.3.6 Complications.

To a large extent the severity of complications are tied to surgical expertise. Sood et al demonstrated fewer complications especially among children in less experienced surgeons. There was less failure of the surgery as a result.²²

TET has been associated with minimal complications.⁶¹

Primary glaucoma has been shown to have much less complications compared to secondary glaucoma especially post traumatic glaucoma.³⁹

1.4 OUTCOME MEASURES OF GLAUCOMA SURGERY

The European Glaucoma Society and the American Glaucoma Intervention Study Group (AGIS) have done a lot of work on outcomes and the main variables used have been:

- IOP,
- Visual fields(VF),
- Cup disc ratio (CDR),
- Optical coherence tomography.(OCT),
- Nerve fibre layer (NFL).

Different authors have used similar parameters for their outcomes with good results.⁴¹For this study the main emphasis shall be on IOP, CDR and VF.

OCT is not yet available in our set up for patient follow up.

1.4.1 *Intra ocular pressure*

IOP has been shown to play the biggest role in control of VF loss in glaucoma.

Some authors have even shown reversal of deterioration with reduction of IOPs.^{42 43}

Concepts like target IOPs have been used to guide the clinician on the best control for the patient. Jampel suggests a formula for use in computing this (see appendix 9.2) in an attempt at giving the best control to the patient.⁴⁴

Other factors must always be kept in mind to avoid the danger of concentrating on the IOPs and neglecting other parameters like the optic nerve and the VF progression.

In assessment of IOP outcomes various authors have used different approaches. In an interventional review of various authors by Moura et al,⁴⁵ IOP outcome ≤ 21 mmHg or a drop $\geq 20\%$ from pre-operative baseline was accepted as success.

In tandem with this Cochrane review, the same was applied with a follow up of one year minimum.

1.4.2 *Visual fields*

VF has been shown to be affected by IOP changes. Whereas mild losses in nerve fibre may not show significantly in VF loss, this parameter has been used to assess outcomes of glaucoma surgery and treatment. For objective assessment, a baseline VF is mandatory for good follow up and then losses are interpreted from changes in mean deviation (MD) or pattern deviation (PD) mainly⁴⁶.

1.4.3 *Vertical cup disc ratio*

Studies have shown comparable accuracy on clinical evaluation of the vertical CDR, versus a stereo photography and Heidelberg retina tomography (HRT).⁴⁷ Arnalich-Montiel et al demonstrated acceptable accuracy between OCT and slit lamp assessment of CDR especially for large cups.⁴⁸ HRT and OCT have been found to be superior to clinical evaluation especially in terms of reproducibility. Durmus et al clearly demonstrates superiority of HRT over slit lamp CDR.⁴⁹

The challenge experienced here is that where as these two methods may show superiority over the slit lamp CDR, they are not available in our set up.

The study therefore focussed on the slit lamp CDR.

2. RATIONALE

Glaucoma still remains a top cause of blindness both in the developing world and the developed.

With an estimated blindness burden of about 5 million people⁵⁰ world wide, the glaucoma situation in Kenya warrants attention. WHO estimates that 70% of POAG is found in developing countries.⁵¹

Although not quantified, patient follow up in this set up is considered a challenge in the management of glaucoma. This study will describe follow up rates.

Medical treatment remains the mainstay of glaucoma treatment but surgical management might be considered an earlier better choice than medical.^{52 53}

Reviewing the outcomes of surgery provides useful information for this decision.

3. OBJECTIVES

3.1 MAIN OBJECTIVE:

To evaluate outcome of glaucoma surgery in MLEC from 2004-2008.

3.2 SPECIFIC OBJECTIVES.

- a) To identify the methods of diagnosis of glaucoma used in the centre.
- b) To describe complications associated with glaucoma surgery.
- c) To describe the trend of IOP after surgery.
- d) To compare use of antiglaucoma medication before and after surgery
- e) To describe the CDR changes during the follow up.
- f) To describe the VF changes during the follow up.

4. RESEARCH METHODOLOGY

4.1 DESIGN.

The study was a retrospective case series. It involved patients seen and operated for glaucoma from 2004-2007, leaving 2008 for follow up, at the MLEC.

This allowed a one year minimum follow up per operation.

4.2 LOCATION.

The study was carried out at The Mombasa Light House for Christ Eye Centre.

This centre acts as the main referral centre for the Coastal region of Kenya.

4.3 SAMPLE

All available patient data during the study period was collected.

4.4 CASE DEFINITION:

A case of glaucoma was defined as any patient seen at MLEC in period 2004-2008 and a diagnosis of glaucoma made.

A surgical case of glaucoma was defined as a case above who has undergone a surgical procedure.

The surgical procedures included:

- trabeculectomy and trabeculotomies,
- peripheral iridectomy,
- goniotomies for congenital glaucoma,
- glaucoma filtering implants.

Early post-operative complications for this study refer to complications occurring within the first two weeks post-operation. Late complications were not sought for as the researcher felt were more a consequence of the operation.

4.5 INCLUSION CRITERIA:

All available glaucoma case files, within the study period were included.

4.6 DATA COLLECTION AND ANALYSIS

Data was collected using structured questionnaires. (Appendix 9.3)

The researcher filled in the questionnaires from the patients' files, in person.

The relevant data was entered into the questionnaires on perusal of the medical records and into the SPSS 13 computer software. It was validated and analysed using appropriate statistical tests with assistance from a statistician. The results were presented by way of tables, graphs, and pie charts where applicable.

4.7 ETHICAL APPROVAL

Ethical approval was sought from Mombasa Light House for Christ Eye Centre (MLEC) and the Kenyatta National Hospital Ethics committee.

4.8 DEFINITION OF TERMS

Successful glaucoma surgery was defined as one where the IOP has been controlled to 21mmhg and below, in keeping with various reviews⁵⁴.

Changes in IOP during follow up was analysed and data presented.

VF and CDR changes were accepted as true to what is recorded. except where the visual acuity recorded was not correlating.

Follow up period was one year minimum. As such the last year, 2008, data was recorded from patients operated before that year to avail a one year minimum follow up.

Complications were any events post operatively that adversely affected the expected outcome like hypotony, bleb leakage, AC hyphema, bleb failure etc.

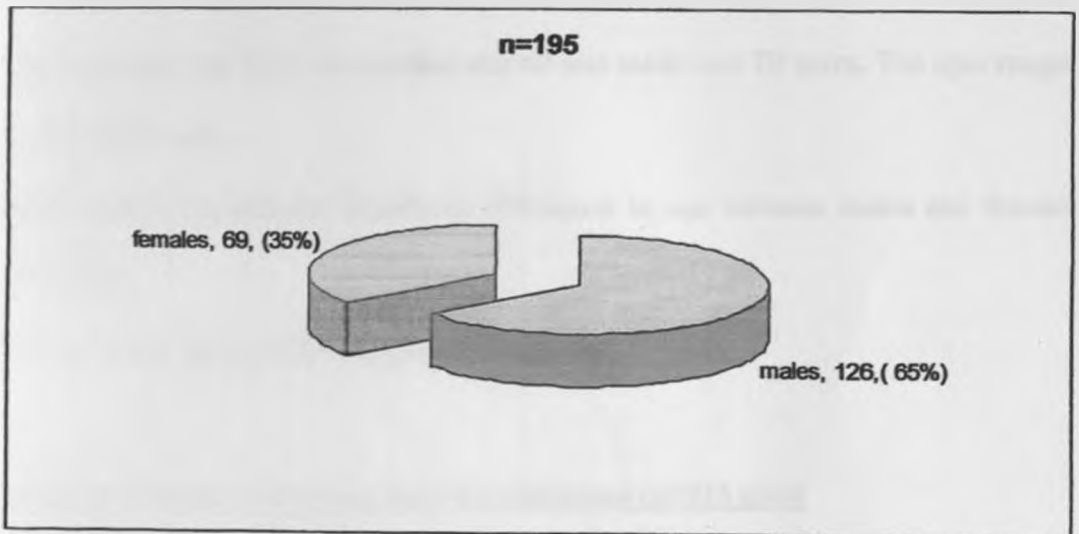
5. PROJECT RESULTS.

A total of 265 surgeries (eyes) were recorded in the surgery register.

Of these, 213 files were traced and analysed. The other files could not be traced or the surgeries were done in the field and the data not available.

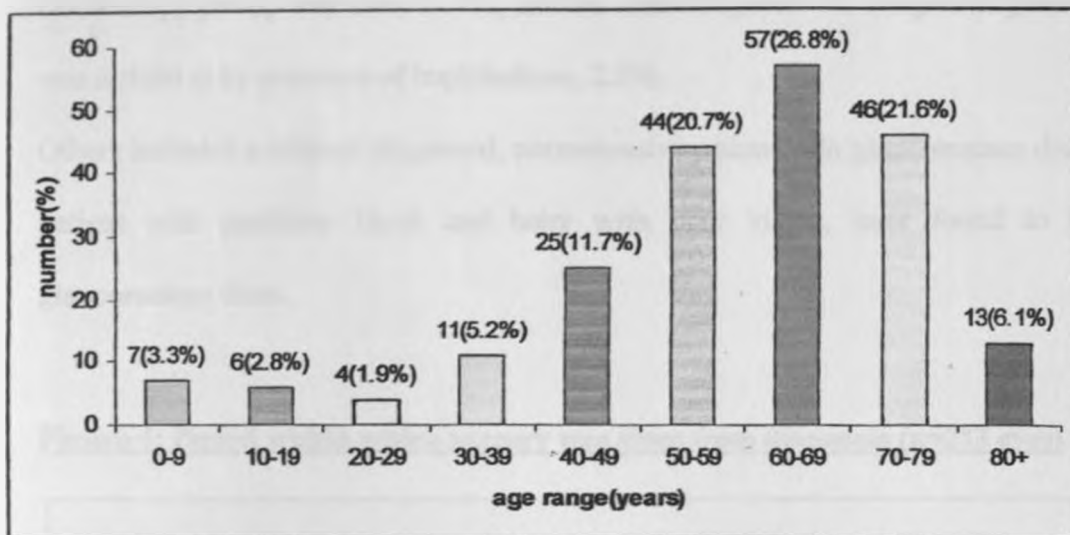
Only three eyes had pre-op baseline VFs hence the visual field progression could not be analysed.

Figure 1: Distribution by sex (n=195 patients)



Males contributed 65% of the patients, while females contributed 35% ($p < 0.01$).

Figure 2: Distribution by age at operation (n=213 eyes)

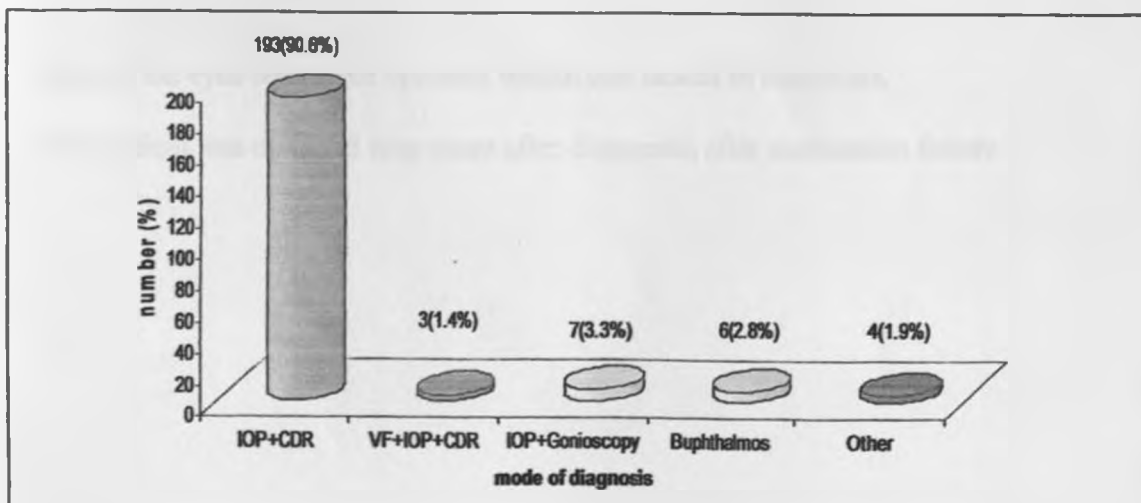


The mean age was 56.1. The median was 60 and mode was 70 years. The ages ranged from 1 to 90 years.

There was no statistically significant difference in age between males and females ($p=0.514$).

Six eyes were operated for congenital glaucoma.

Figure 3: Diagnostic method used for glaucoma (n=213 eyes)



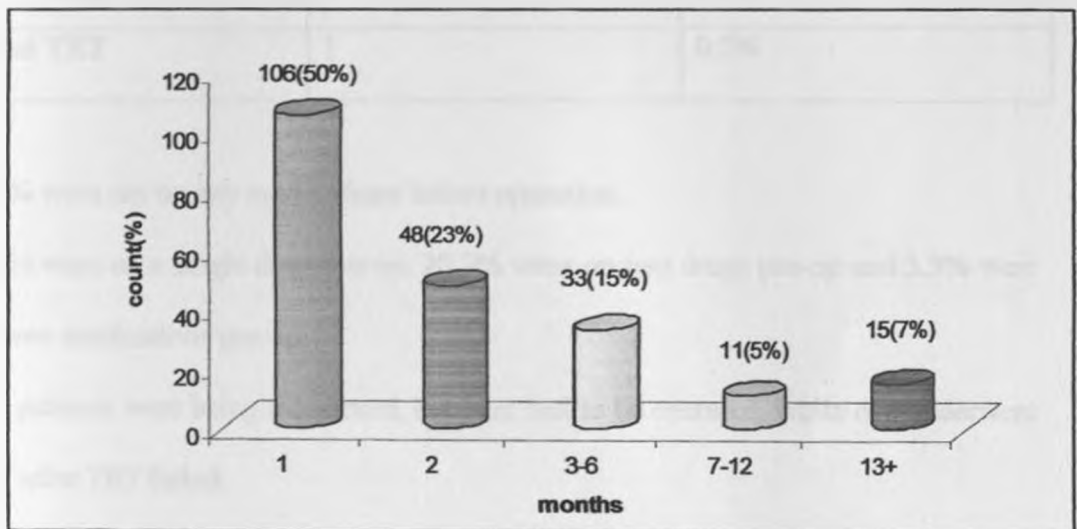
The main mode of diagnosis for glaucoma at this centre is via CDR and IOP (90.6%) assessment.

1.4% had baseline visual fields pre-operatively.

Gonioscopy pre-op was done in 7%, and the main diagnosis for congenital glaucoma was arrived at by presence of buphthalmos, 2.8%.

Others included a referral diagnosed, normotensive patient with glaucomatous discs, a patient with pupillary block and baby with poor vision, later found to have glaucomatous discs.

Figure 4: Period within which surgery was done from diagnosis (n=213 eyes)



50% of the eyes seen were operated within one month of diagnosis.

One patient was operated nine years after diagnosis, after medication failure

Table 1: Pre-op management (n=213 eyes).

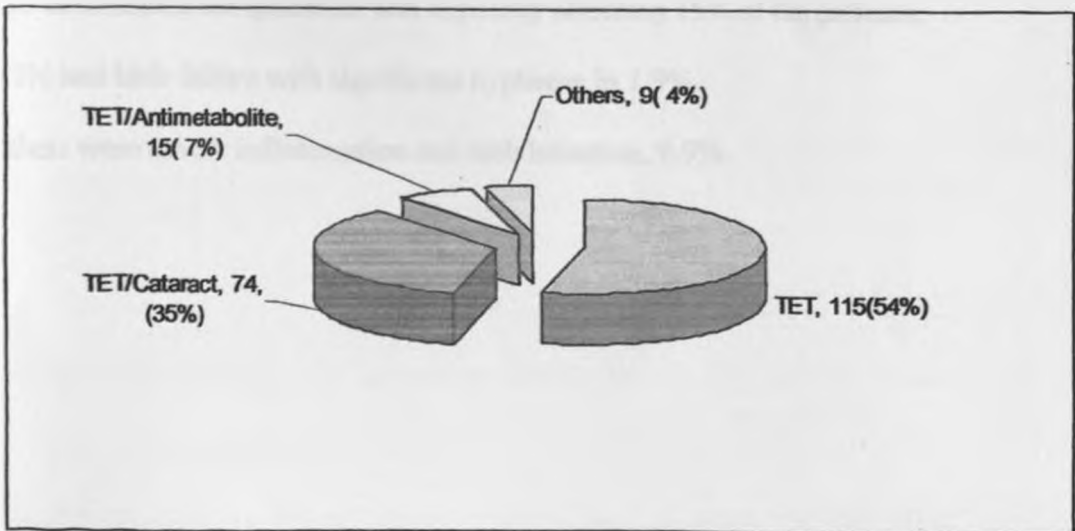
Treatment	Number	Percentage
None (first visit)	105	49.3%
Medication	105	
<i>(Single drug)</i>	<i>(55)</i>	25.8%
<i>(2 drugs)</i>	<i>(43)</i>	20.2%
<i>(3+ drugs)</i>	<i>(7)</i>	3.3%
Monitoring	2	0.9%
Failed TET	1	0.5%

49.3% were not on any medications before operation.

25.8% were on a single drug pre-op, 20.2% were on two drugs pre-op and 3.3% were on three medications pre-op.

Two patients were being monitored, but later had to be operated, while one underwent ALT after TET failed.

Figure 5: Mode of surgery (n=213 eyes).



TET was the main type of surgery contributing 96% of the total surgeries done.

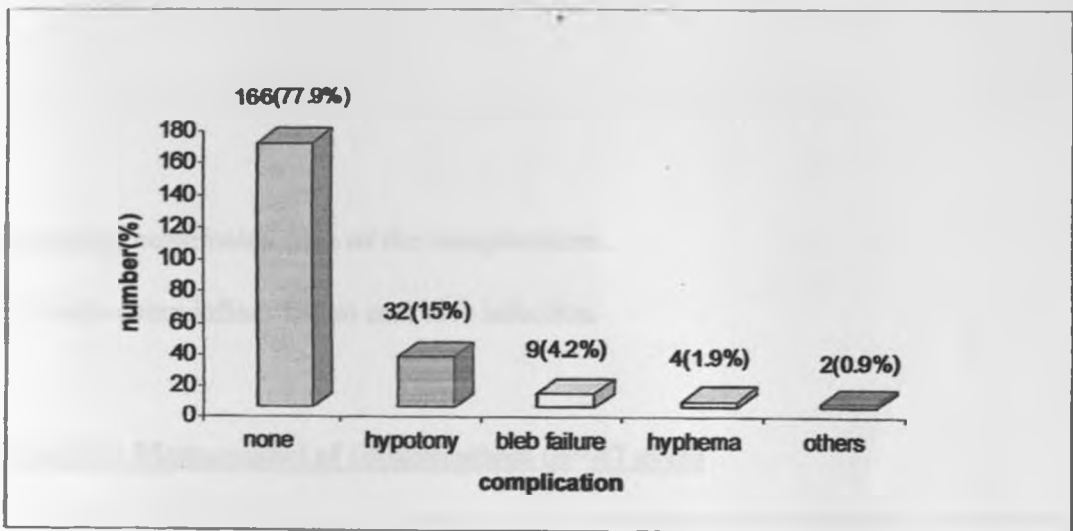
35% of the total surgeries were combined TET with cataract surgery.

Use of antimetabolite in TET surgery was 7% of the total surgeries done.

5-FU was used in 9 eyes and mitomycin-C in 6 eyes.

Others (4%) included Argon laser trabeculoplasty (2), Ahmed valve implant (2), and peripheral iridectomy (5).

Figure 6: Early complications (n=213 eyes)



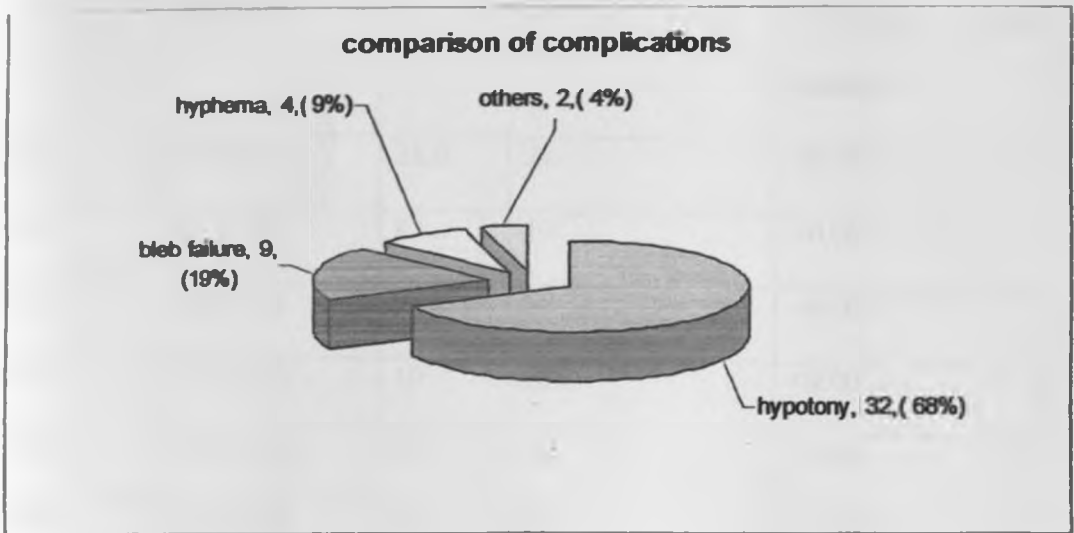
No complications were encountered in 77.9% of the patients.

The commonest complication was hypotony affecting 15% of the patients.

4.2% had bleb failure with significant hyphema in 1.9%.

Others were severe inflammation and bleb infection, 0.9%.

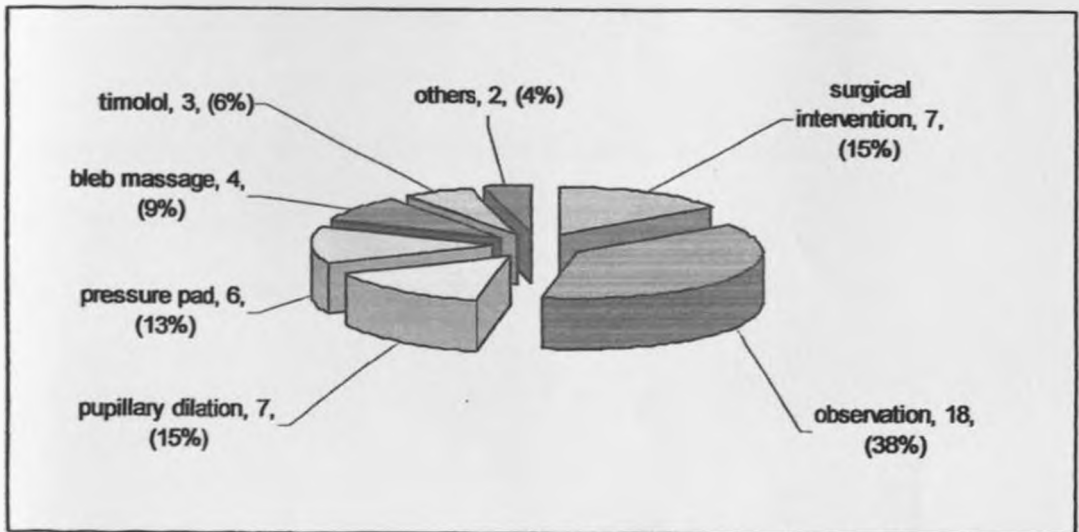
Figure 7: Complications (n= 47 eyes)



Hypotony contributed 68% of the complications.

4% had severe inflammation and bleb infection.

Figure 8: Management of complications (n= 47 eyes)



Others included an eye that needed par bulbar steroids and one that required topical antibiotics and antifungal.

Timolol was given in bleb failure non responsive to massage with high IOP.

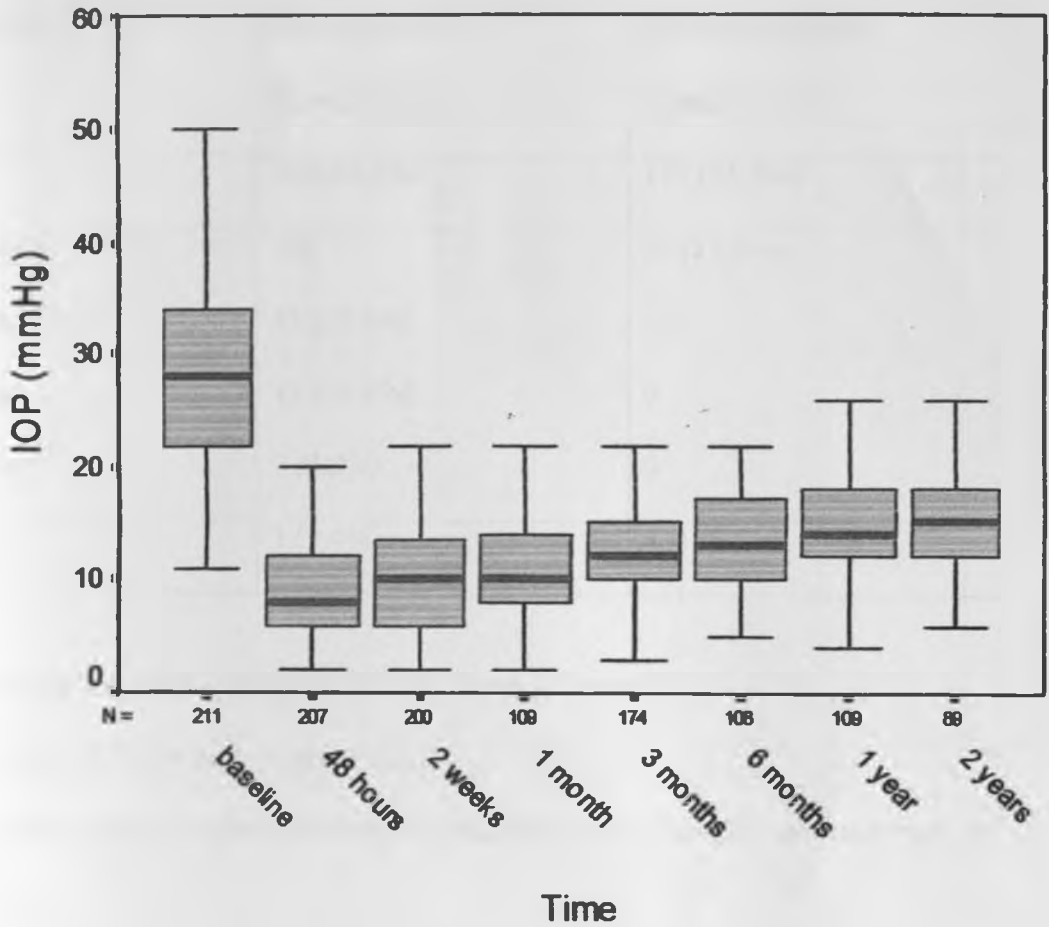
Table 2: Average IOP (mmHg) change over time from pre-op (n=213 eyes).

Time	Mean IOP(SD)	Median	Mode	p- Value of difference from baseline
Baseline	28.7(8.9)	28.0	28	<0.001
48 hours	9.5 (5.5)	8	10	<0.001
2 weeks	10.1(5.1)	10	10	<0.001
1 month	11.5 (4.7)	10	10	<0.001
3 months	12.2 (3.8)	12	10	<0.001
6 months	13.6 (5.1)	13	10	<0.001
1 year	14.5 (4.8)	14	12	<0.001
2 year	15.0 (4.5)	15	16	<0.001

There was significant change in IOP following surgery.

The IOP is significantly controlled ($p < 0.001$) for the period of follow up.

Figure 9: IOP trend post surgery



Although over time the number of eyes followed up goes down, IOP on average remains within normal.

There is noted a gradual increase with time.

Table 3: Comparison between pre-op medication and post-op intervention for

IOP control. (n=213 eyes)

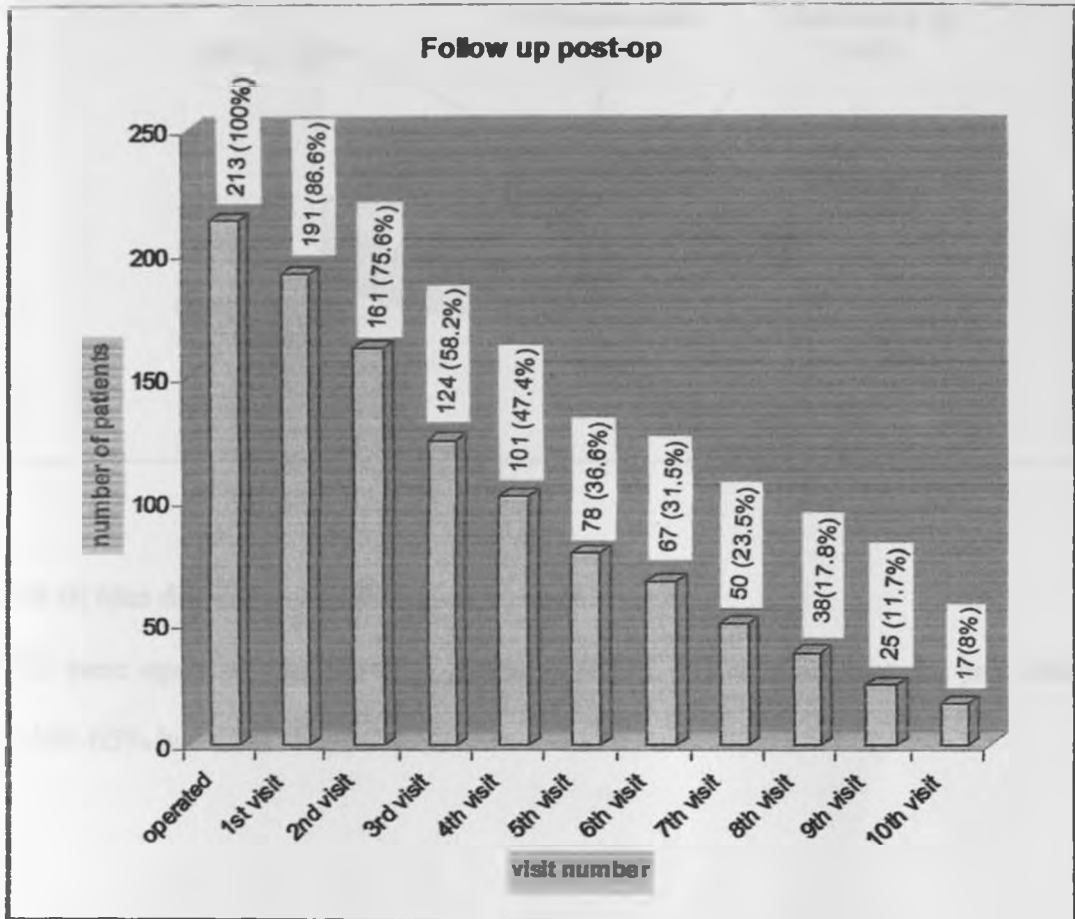
Treatment	Pre-op (n=213)	Post-op (n=213)
	Number (%)	Number (%)
None	105(49.3%)	178 (83.5%)
Medication	105	29 (13.6%)
<i>Single drug</i>	55 (25.8%)	29
<i>2 drugs</i>	43 (20.2%)	0
<i>3+ drugs</i>	7 (3.3%)	0
Other	3 (1.4%)	4 (1.9%)

Others pre-op included one failed TET and 2 eyes on monitoring.

Four patients (1.9%) required repeat surgery.

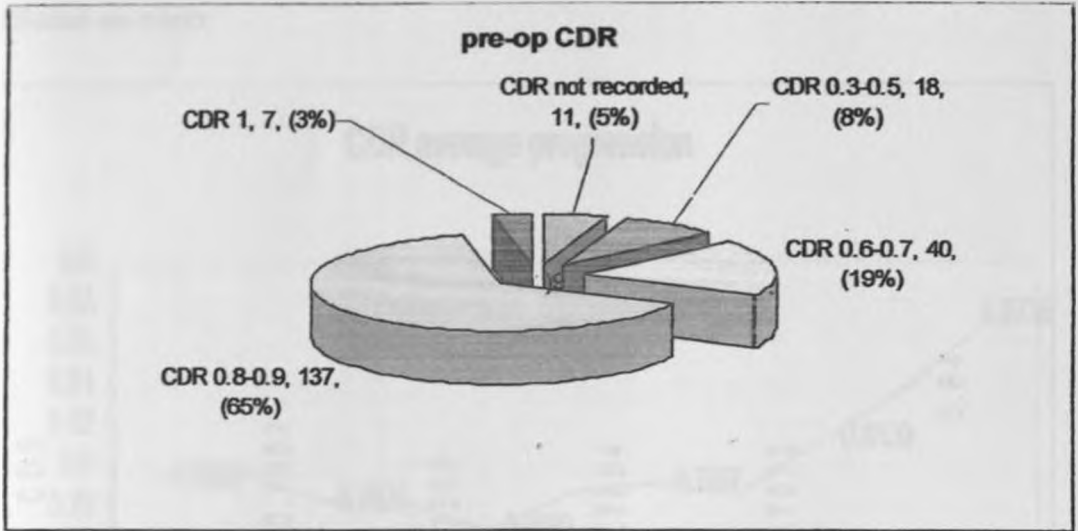
Most patients were controlled where medications were necessary on one type of medication.

Figure 10: Post-op follow up (n=213eyes).



Of the 213 eyes operated, post op follow up was 86.6% for the first visit dropping to 58.2% by the 3rd visit. Only 17 patients were seen for more than ten visits during the follow up time.

Figure 11: CDR pre-op (n=213)



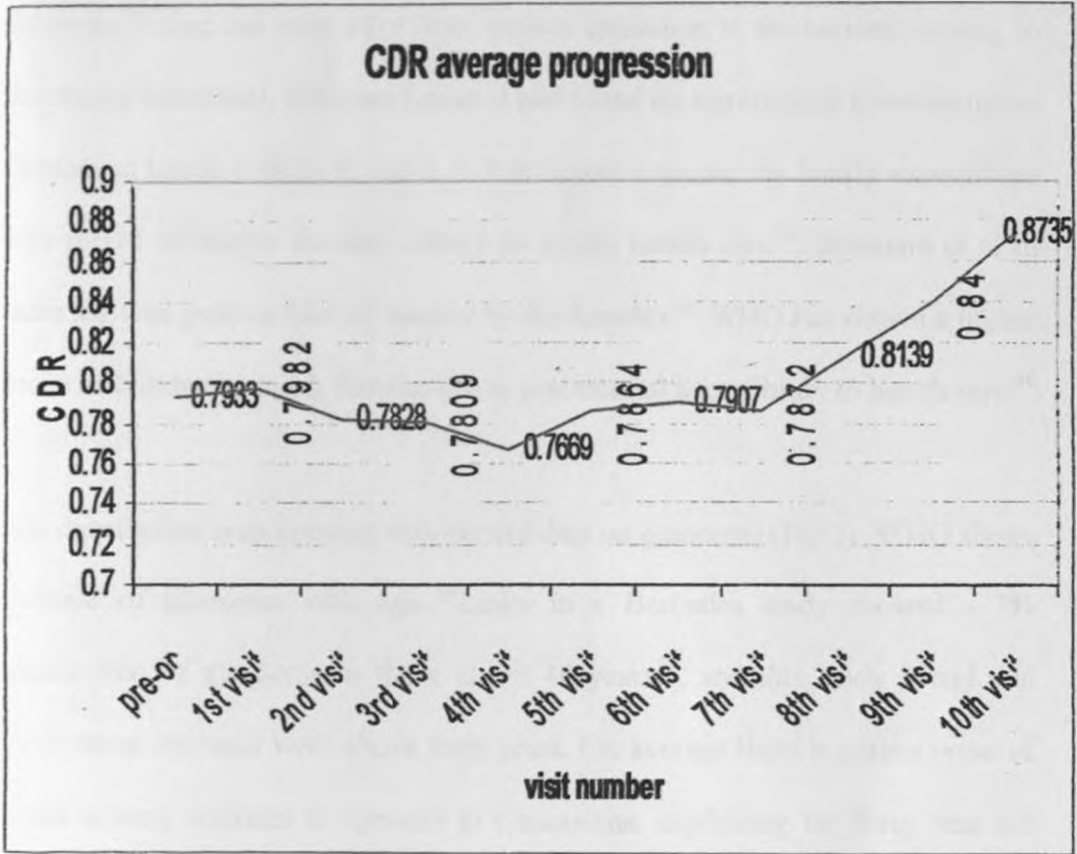
5% of files did not have CDR recorded pre-op.

3% were operated with absolute glaucoma (CDR =1) in blind eyes for pain relief,

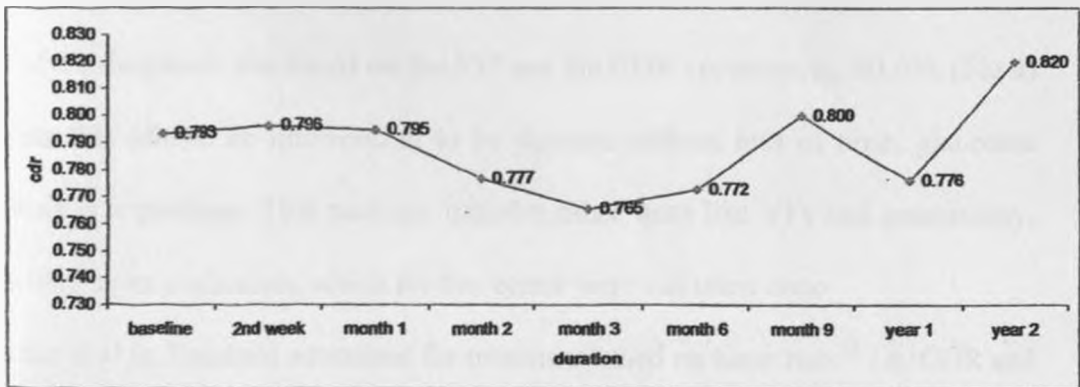
while 65% had CDR above 0.8

Figure 12. Average CDR Progression over time and number of visits.

a) Based on visits



b) Real time.



The average CDR change from baseline pre-op does not statistically change through out the follow up time ($P > 0.05$).

There is an apparent improvement on the CDR after the operation although not statistically significant ($P = 0.545$).

6. DISCUSSION:

More males were operated during this period than females (Fig 1). This may however not reflect the glaucoma burden on the ground, as female sex is a known risk factor for glaucoma.⁵⁸ One can only infer from various studies as to the barriers leading to health seeking behaviour. Whereas Lee et al had found no significance between males and females in health seeking in India, in Africa males control the family expenditure and this might affect the females' ability to access health care⁵⁵. Bowman et al in Tanzania showed poor up take of surgery by the females.⁵⁸ WHO has shown a higher incidence of blindness among females due to preferential accessibility to health care.⁵⁶

The age distribution is in keeping with current data on glaucoma (Fig 2). WHO shows an increase of glaucoma with age¹⁰. Leske in a Barbados study showed a 7% prevalence rate of glaucoma in those above 40 years⁵⁷, and this study found that 86.9% of those operated were above forty years. On average there is earlier onset of glaucoma among Africans as opposed to Caucasians, explaining the forty year old spurt.^{30, 31} There was no statistical difference between the males and female ages at presentation ($p=0.514$). Six operations were done for congenital glaucoma.

Most of the diagnosis was based on the IOP and the CDR appearances, 90.6%. (Fig 3) Whereas this allows an intervention to be decided without loss of time, glaucoma diagnosis is a package. This package includes other tests like VFs and gonioscopy, nerve fibre layer evaluation, which for this centre were not often done.

Bowman et al in Tanzania advocates for treatment based on these two,⁵⁸ i.e. CDR and IOP. He states that VF may delay treatment and are not essential to intervention for glaucoma in our set up. Coupled with late presentation and few resources, this study concurs with Bowman's findings that interventions can be safely put in place with an

evaluation of CDR and IOPs only as most of the surgeries were done based on these two.

VFs are not available in most cases.

Besides other factors could play a role, like the likelihood of patients not being able to afford these tests and the danger of subsequently getting lost to follow up.

In a situation where patient capture is a recognised challenge,⁵⁸ an attempt at intervention ought to be earlier rather than later.

Majority of the eyes were operated within one month of diagnosis, 50 % (Fig 4).

One patient was operated nine years after diagnosis after medical therapy failed.

This is in keeping with Bowman et al where they advocate for primary treatment for glaucoma in Africa as surgical.⁵⁸

Whereas previous medical treatment has been shown to affect outcome of glaucoma surgery, the period of treatment in this series does not allow significant analysis for this, as majority were operated by one year of diagnosis (93%).

On diagnosis most of the patients were planned for surgery (49.3%, see table 1).

A further 49.3% were put on some medication before surgery was done.

Two patients were on monitoring before eventual surgery was done as they were later found to have normotensive glaucoma. One patient had a failed TET that was later controlled after ALT. Of those on medication, 25.8% were on a single drug, 20.2% needed two drugs, while 3.3% were on more than three medications. The main medication used was timolol, alone or in combination. Oral Acetazolamide (Diamox) was used to control IOPs to an operable level. Timolol has been shown to give good IOP control as early as 1977.⁵⁹ In this series it was used as patients waited for surgery and to bring down IOPs to operable levels.

Trabeculectomy accounted for 96% of the surgeries done for the control of glaucoma in this centre (Fig 5). As earlier seen in a Tanzanian centre Bowman et al advocate for standard TET.³⁶ Use of anti metabolites was in 7% of the surgeries. Where as several authors demonstrate the superiority of antimetabolite use in TET surgery for long term control in Africans,^{23, 24} Kabiru in another study demonstrated no difference in outcomes.²⁵ Yorston et al in a study done in Kikuyu eye unit in Kenya, demonstrated good outcomes with anti metabolite use.²⁶ Anti metabolite use in this centre was on surgeon's preference. The data available was not sufficient to do a comparison between use and non-use of Antimetabolite. 5-FU and mitomycin-c were the preferred anti metabolites, and were used in 9 and 5 eyes respectively. The methods of application of the anti metabolites and their concentrations are outside the scope of this study.

Combined cataract and TET surgeries contributed 35% of the operations (see fig 5). In view of the ages of the patients this gave the best care to these patients. Besides cataract surgery falls under avoidable causes of blindness and MLEC is a vision 2020 centre.

4% of the patients had other forms of surgeries apart from TET.

Five patients had PI two of which were due to glaucoma secondary to pupillary block. The others were due to narrow angles. Two patients had ALT and two had Ahmed valve implants.

ALT is an emerging alternative to TET and an alternative to failed TET. Due to its non invasiveness its gaining popularity in the industrialised world though TET is still superior in terms on long term control of IOPs.⁶⁰ Implant use in filtration surgery is a relatively new field in Africa. Implant use is largely limited by the cost.

Majority (77.9%) of the operations had no attendant complications (Fig 6). 22.1% had some form of complication and of these; the commonest was hypotony accounting for 68% of all complications (Fig 7). Bleb failure accounted for 19% of the complications (4.2% of the operations). Significant hyphema was seen in four patients.

Two eyes had severe inflammation and bleb infection. This eye with bleb infection actually progressed to no perception of light despite vigorous treatment.

Even so majority did not require surgical intervention. Only 15% needed some form of surgery. The rest were managed on observation (38%), topical drugs and pressure padding. Four patients benefited from bleb massage (Fig 9). This is in keeping with other studies on TET outcomes. Stallman et al found an infrequent rate of complications, with flat AC and hypotony topping the list. Similarly, minimal interventions were necessary for control.⁶¹ The surgical interventions used were bleb manipulation, tightening of the flat stitch, needling of the bleb etc although this is outside the scope of this study. Where a good bleb was not formed after TET and pressure was elevated, timolol was used awaiting a surgical intervention. Low pressures without an over active bleb or a positive Seidel's test were monitored and in most cases improved without surgery.

IOP is the single most important target in TET and other glaucoma surgeries.^{40, 41}

In this series, the follow up reveals good post-op control over the entire follow up period.

There was significant change post – operatively ($p < 0.001$) as shown in Table 2.

Over the various follow up periods, the drop is maintained and remains significant.

Even for those that were on medication, the number of medications they were using dropped, for those that would later require medications (see table 3).

Only 13.6% needed medications for their IOP control post-op as compared to 49.3% that were on topical medications. One type of medication was enough post-

operatively to control the IOPs, for those that were previously on multiple medications, and required treatment after surgery. This is in keeping with what Migdal et al had shown as early as 1994, in support of surgical management of glaucoma.¹⁶

Lay et al in an even earlier comparative study had shown TET to be superior to conventional treatment.¹³ Leske et al in early manifest glaucoma trial showed surgery to be superior to medical management alone, for both IOP and VF control.¹⁷

There is noted a gradual increase in time, mainly as the low post-op pressures stabilise, and this is reflected in a steady rise initially. Even later the rise in IOP as it stabilises, demonstrates a rise. However these pressures remain below 20mmHg. Fig 7 clearly demonstrates within the confidence limits the IOP averages for two year follow up. Moura et al in a Cochrane review found similar successes where IOP was taken as successful if below 21mmHg or dropped by more than 20%.⁴² However, a decline in the number of eyes followed is seen with time.

There was relatively good follow up in this centre in the short term comparative to some African studies (Fig 8). 76% were able to honour the second visit compared to a study in Kano that showed a 7% attendance to follow up,⁵⁶ by the second week. In the industrialised world good follow up is the norm rather than the exception.⁵⁶ However; the long term follow up was poor, as only 11% were available by the 9th visit. Other studies demonstrate similar trends in follow up.^{25,26}

In a situation where long term follow-up is necessary for good control and intervention in case of failure, this presents a dilemma.

Cup to disc ratios are crucial in determination of how much nerve fibre layer is lost to glaucoma. Direct relationships have been elicited in monkey eyes between the IOP

and CDR increments.⁶² An increase in the vertical CDR of 0.1 corresponds to about 10% nerve fibre layer loss.

In this study, 68% presented with CDR greater than 0.8, indicating quite advanced disease (Fig 11).

5% did not have their CDR recorded pre-op.

Only 8% had CDR below 0.5 at presentation (see Fig 11).

The progression over time demonstrates a good control. There is no statistically significant change from the pre-op CDR and the follow-up CDR (Fig 12 b).

There is noted an improvement from the first month to one year, in the CDR. Whereas studies have shown an improvement in CDR post surgery,^{40 41} this did not show any statistical significance.

7. CONCLUSION

More operations were done in males than the females, contrary to the expected population distribution of the disease.

The age distribution is in keeping with the trends for the disease in an Africa population.

Diagnosis of glaucoma in this series is mainly based on the CDR evaluation and IOP measurements. This reduces the time needed for a definitive intervention and hence allows earlier treatment. As other African data on management of glaucoma shows, treatment should be instituted with the simplest tools available since patients present late. Use of other methods to confirm diagnosis and for follow up should still be practised.

Surgery should be instituted within the shortest time possible as good control, with acceptable complication rate have been demonstrated in this series. Primary treatment for glaucoma is surgical from this series.

Glaucoma surgery can be done with minimal complications in the short term.

Hypotony is the commonest, but most of the time can be managed without a surgical intervention. Bleb massage was shown to give good control for most of the early bleb failures.

Intra ocular pressures were well controlled for the follow up period, indicating that glaucoma can be managed surgically with good results. IOP drop was significant through out the follow up period. The few who needed additional care required fewer medications for good control, usually one type of medication. There is a gradual rise in IOP over time.

Of those on previous use of medical treatment for glaucoma, surgery seemed to alleviate, or reduced the medications needed to control their IOP.

One type of drug was enough after surgery even for those who were on more than three drugs.

Patients present when the decay in CDR is advanced, often with ratios above 0.8.

However, there was good control of CDR from deteriorating during the study period.

No significant change after surgery in the CDR was demonstrated during the follow up period.

This series suggests that there could be an improvement in the CDR post surgery.

8. RECOMMENDATIONS

1. Effort should be made to avail all records and follow up even for those operated in the out reach programmes as glaucoma is a chronic condition.
2. A study should be done to establish the actual sex distribution of glaucoma in the population vis a vis the uptake of surgery, to eliminate the possibility that females are not accessing surgery, yet the burden is there.
3. Glaucoma surgery should be considered first line management in our set up as this study has shown good control or/and reduces medication need to the patient, as often patients present late.
4. Visual fields and nerve fibre layer assessment should be used more for completeness of diagnosis if and when available.
5. More reproducible ways of recording the CDR should be employed to enable reproducibility of data. E.g. Fundus photographs, especially to confirm for certain that there was an improvement in CDR post operation.
6. More studies could be done to ascertain whether or not there is CDR improvement after IOP control in our set up.

9 APPENDICES

9.1 SURGICAL DEVELOPMENT OF GLAUCOMA SURGERY

Surgical Treatment of Glaucoma (1830-1920)

- 1830 Mackenzie recommends scleral punctures to release vitreous and to relieve the pressure on the retina.
- 1857 von Graefe's iridectomy almost overnight gains the position of *the* glaucoma operation.
- 1882 de Wecker, in a paper on the "filtering cicatrix" , expresses the concept that in the presence of elevated intraocular pressure, a properly executed corneoscleral incision can heal in a manner allowing intraocular fluid to "filter," i.e., be driven by a pressure gradient through the loose scar tissue into subconjunctival spaces.
- 1891 Bader finds the occurrence of an iris prolapse during or shortly after an iridectomy a favourable sign, auguring success of the operation.
- 1903 Herbert reports on a series of subconjunctival fistula operations in which he purposely leaves the iris in the operative incision. The report includes the first detailed description of the transformation of the epibulbar tissues that become exposed to the steady flow of aqueous.
- 1905 Heine first reports on the operation of cyclodialysis, based on Fuchs' and Axenfeld's observation of the association between postoperative choroidal detachment, a tear or tears in the insertion of the ciliary muscle at the scleral spur, and hypotony.
- 1906 Lagrange first reports on his iridosclerectomy.
- 1909 Freeland and Elliot independently substitute the trephine for Lagrange's scissors.
- 1913 At the first international review of glaucoma surgery the pronouncement is made that chronic glaucoma can only be arrested by establishing a filtering cicatrix in connection with the anterior chamber. The iridectomy loses its status of *the* glaucoma operation but still is first in favour for acute glaucoma.
- 1915 The ab externo incision is introduced by Foroni.
- 1920 Seidel demonstrates the transconjunctival passage of aqueous after trephining procedures.

APPENDIX 9.2

CALCULATION OF TARGET PRESSURES

Target IOP = Maximum IOP - Maximum IOP%-Z.

Where Z is an optic nerve damage severity. (See table below)

Z	OPTIC NERVE DAMAGE
0	Normal disc and normal visual field
1	Abnormal disc and Normal visual field
2	Visual field loss not threatening fixation
3	Visual loss threatening or involving fixation

APPENDIX 9.3: QUESTIONNAIRE

Name/no. of pt:.....

Age at presentation:.....

Sex:.....Date of surgery.....Eye.....

1. How was the diagnosis of glaucoma made?
 - a) Deranged IOPS
 - b) Deranged Visual fields.
 - c) Gonioscopy plus IOPs
 - d) Others (Specify)
2. How long did it take from diagnosis to eventual planning for surgery in months?
3. What was the patient on before surgery?
 - a) Wait and see
 - b) Antiglaucoma medication. (Specify)
 - c) Was the first contact with ophthalmologist
 - d) Others (Specify)
4. What surgery was done?
 - a) TET + PI
 - b) combined cataract sx + TET
 - c) TET + PI + anti metabolites (specify)
 - d) Others (specify)
5. Were there any complications during or within the first one week that may impact on outcome?
 - a) None
 - b) Hypotony
 - d) AC hyphema
 - d) Infection e.g. blebitis, endophthalmitis
 - e) Others. Specify
6. How was the above managed?
 - Repeat surgery
 - Observe and reassure
 - Others (specify)

7. ASSESMENT OF IOP, CDR, AND VF DURING THE FOLLOW UP TIME

	Pre-op	1st 48hrs post-op	1st Visit	2nd visit	3rd visit	4th visit	5th visit	6th visit	7th visit	8th visit	9th visit	10th visit
IOP												
CDR												
VF												
Visual acuity												

Key for VFs...0) No VFs done 1) No deterioration X) Deteriorating. (Using the MDs and the PDs)

8. Were any other intervention necessary to maintain IOP control?

- None
- Taken for repeat surgery
- Added medications (specify type and number of drugs)

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