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Comparative analysis of one year outcomes of selective laser trabeculoplasty versus argon laser trabeculoplasty in Primary Open Angle Glaucoma patients in Nigeria

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Background: ***There are several challenges associated with trabeculectomy and medical management in Nigeria. This makes laser trabeculoplasty a viable option in glaucoma management. This study compares Selective Laser Trabeculoplasty (SLT) with Argon Laser Trabeculoplasty (ALT) in Nigerians with open angle glaucoma.***
Methods: ***This was a retrospective study performed on 26 eyes of 26 patients who had ALT and were recruited consecutively at the glaucoma clinic of the University College Hospital (UCH), and 25 eyes of 25 patients who had SLT recruited from the Guinness Eye Centre, Lagos University Teaching Hospital, Lagos (LUTH). The main outcome measure was intraocular pressure (IOP) at one month, three months, six months and one year. Success was defined as IOP reduction of 3mmHg or more without additional intervention (glaucoma surgery) from the pretreatment IOP.***
Results: ***The mean age of the patients who had ALT was 58.0±7.1 years (range of 40.0-70.0 years) while the mean age of patients who had SLT was 53.52 ± 14.65 years (Range 22 – 74 years). There was no statistically significant difference in IOP between the two groups at the different time periods. Based on our criterion for success, 84.5% of the patients had successful outcome at six months in the ALT group while 70.5% were successful in the SLT group (P=0.6). At one year, there was no statistically significant difference between the two groups on log rank test/Mantel Cox (Chi square 3.36, df=1, P=0.07.)***
Conclusion: ***This study highlights the efficacy and safety of both lasers in Nigerians and adds to knowledge that the adjunctive IOP reducing effect of both lasers is comparable in the short term in this indigenous African population.***

Introduction

Glaucoma is a huge problem in Sub-Saharan Africa (SSA) and in Nigeria. It affects Africans on a scale unparalleled in most of the world. Africa is disproportionately affected by blindness with glaucoma accounting for 15% of blindness compared to 8% in the world.[1] Reported prevalence of glaucoma in population based studies within SSA ranges from 5.3% among South African blacks,[2] to as high as 6.9% in Nigeria[3]

Despite this high prevalence in Nigeria there is limited glaucoma-specific health care resource availability. Medical management of glaucoma is impractical and rarely successful in Nigeria. The high cost of anti-glaucoma medications, the need for regular follow up, and unavailability of the drugs worsens compliance which is an important

factor in delaying progression in glaucoma management [4]. In Nigeria, trabeculectomy is the standard method of surgical treatment and has been recommended as the primary treatment for glaucoma in Africans.[4] Intra-operative anti-fibrotics such as 5 fluorouracil or mitomycin C have been shown to safely increase the rate of success of primary trabeculectomy for open angle glaucoma.[5,6] Despite its success however, it is generally not accepted by many patients and therefore it is not performed in large numbers. Reports from Nigeria have shown acceptability to be as low as 8.2%.[7] One major reason for this is the uncertain results post trabeculectomy with some patients loosing vision at least temporarily and cataracts becoming worse with up to 29% requiring cataract surgery 5 years postoperatively.[8]

The challenges associated with trabeculectomy and medical management in Nigeria makes laser trabeculoplasty a viable option in glaucoma management. Argon laser trabeculoplasty enhances the outflow aqueous humor and has been in use for the management of glaucoma since 1979. Two main theories have been proposed to explain its mechanism of action. The mechanical theory proposes that coagulative damage to the trabecular meshwork (TM) results in collagen shrinkage and subsequent tightening of the meshwork in the area of each burn and reopening of the adjacent untreated inter-trabecular spaces[9] while the cellular theory proposes a cellular activation of the TM with increased cell replication thereby increasing the number of cells involved in maintaining the TM outflow.[10,11]

Selective trabeculoplasty on the other hand was introduced by Latina and Park and gained FDA approval in 2001.[12,13] It uses a Q switched, 3 nanosecond, frequency doubled, neodymium yttrium aluminium garnet laser (Nd:YAG laser); 532nm wavelength green laser to selectively target the pigment granules in the trabecular meshwork cells. This results in the release of cytokines which bind with the Schlemm's canal endothelial cells, compromising the barrier, increasing aqueous outflow and thus causing a reduction in intraocular pressure (IOP). One major advantage of SLT over ALT is the minimal thermal damage and its repeatability. The argon laser machine on the other hand is cheaper and can be used to treat other ocular diseases. This is an important consideration in resource constrained environment such as Nigeria.

Although several studies done among the Caucasians have shown that ALT and SLT have similar efficacy in terms of IOP lowering,[14-17] there is yet no such comparative study done in Nigeria. The objective of this study was to compare SLT and ALT in terms of IOP lowering in Nigerians with open angle glaucoma.

Patients and Methods

This was a retrospective study performed on 26 eyes of 26 patients who had ALT and were recruited consecutively at the glaucoma clinic of the University College Hospital, and 25 eyes of 25 patients who had SLT recruited from the Guinness Eye Centre, Lagos University Teaching Hospital, Lagos The inclusion criteria for the procedure were patients with primary open angle glaucoma who had uncontrolled or suboptimal IOP control and/or had progressive visual field defects on automated standard Humphreys visual field machine. All patients were on at least one anti-glaucoma medication (prostaglandin analogue) and were followed up for a minimum of one year. The study complied with the declaration of Helsinki.

Information recorded included the age, sex, number of pre-operative medications, class of preoperative medications and preoperative (baseline) intraocular pressure. Each patient had either selective laser trabeculoplasty (SLT) or argon laser trabeculoplasty (ALT) done as an adjunctive treatment.

The SLT protocol consisted of 100 applications in 360^{o} of the anterior chamber angle with 25 spots per quadrant and energy level of 0.8 – 1.2 mj delivered to the junction between the non pigmented and pigmented part of the trabecular meshwork with the use of a Latina SLT Gonio Laser lens. Patients were pre treated with a drop of Gutt Brimonidine (Alphagan®) 0.2%. One hour after pretreatment with 0.2% brimonidine, a drop of topical anaesthetic agent (tetracaine) was applied to the eye to be treated before the application of the laser.

All patients were treated by the same Ophthalmologist (O.A). Intraocular pressure measurement was done 1 hour postoperatively in all patients, any spike in IOP was treated with a drop of Gutt Brimonidine 0.2%. Patients were placed on Gutt Diclofenac (Voltaren ophtha®) 8 hourly for 3 days post SLT.

The ALT protocol consisted of 50 applications of 50 micrometer spot sized burns of 0.1s delivered to the junction between the non pigmented and pigmented part of the trabecular meshwork with the use of a laser antireflective coated Goldmann two mirror lens (Ocular Instruments, Bellevue, WA, USA). Only 180 degrees of the anterior chamber angle was treated at a sitting with approximately 25 burn applications delivered to each quadrant. Laser power was adjusted between 400 and 1,200mw to produce tiny champagne bubbles. Patients were thereafter placed on gutt diclofenac (Voltaren Ophtha) 6 hourly for one week. All patients were treated by the same surgeon (O.O). All patients were pretreated with one drop of Gutt Brimonidine 0.2% (Alphagan). One hour after pretreatment with 0.2% brimonidine, a drop of topical anaesthetic agent (tetracaine) was applied to the eye to be treated before the application of the laser. All patients were directed to continue with the antiglaucoma medications they were pre laser treatment.

Patients were evaluated at one month, three months, six months and one year. At each visit, anterior segment examination, visual acuity and IOP measurements were performed. IOP was measured with the Goldmann applanation tonometer between 9.00am and 12 noon to minimize the effect of diurnal variations. The mean of 2 readings at each visit was recorded. Our criterion for defining successful outcome was based on an earlier study.[16] This was defined as IOP reduction of 3mmhg or more without additional intervention (glaucoma surgery) from the pretreatment IOP. All statistical analysis was performed using SPSS software 18.0 (SPSS, Inc, Chicago, Illinois, USA). Statistical significance was set at $P < 0.05$.

Results

A total of 26 eyes of 26 patients were treated during this period with ALT while 25 eyes of 25 patients had SLT. The mean age of the patients who had ALT was 58.0±7.1 years (range of 40.0-70.0 years) while the mean age of patients who had SLT was 53.52 ± 14.65 years (Range 22 – 74 years). Table 1 show the demographic and

baseline characteristics of the patients. There was no statistically significant difference in the demographic characteristics of the patients. There were 10 males (38.5%) and 16 females (61.5%) in the ALT group while there were 16 males (64.0%) and 9 females (36.0%) in the SLT group.

Twenty three patients had a minimum follow up of one year (88.5%) in the ALT group and three patients were lost to follow up. In the SLT group however, about half of the patients (50%) were lost to follow up at one year.

Table 1. Demographic characteristics of patients

Demographic characterisitics	Patients who had ALT	Patients who had SLT	P value
Age (SD) (years)	58.0(7.1)	53.5 (14.65)	P=0.28
Sex: Male (%) Female (%)	 10(38.6) 16(61.5)	 16(64.0) 9(36.0)	 P=0.20
Diagnosis POAG (%) Aphakic glaucoma (%)	 25 (96.1) 1 (3.9)	 25(100.0)	
Number of glaucoma medications 1 2 3 4	2 (7.6) 8 (30.8) 8 (30.8) 8 (30.8)	 6(24.0) 12(48.0) 7(28.0) 0(0.0)	

All the patients in both groups were on medical therapy for glaucoma and all the patients had open angle glaucoma with Shaffers grade ≥3 on gonioscopy. Most of the patients (61.6%) were on ≥2 different anti-glaucoma medications. The mean eye drop use was 2.8± 0.9 in the ALT group and 2.04±0.73 in the SLT group and this was statistically significant (P<0.01) with the patients on ALT being on more eye-drops than patients in the SLT group.

Changes in Intraocular Pressure

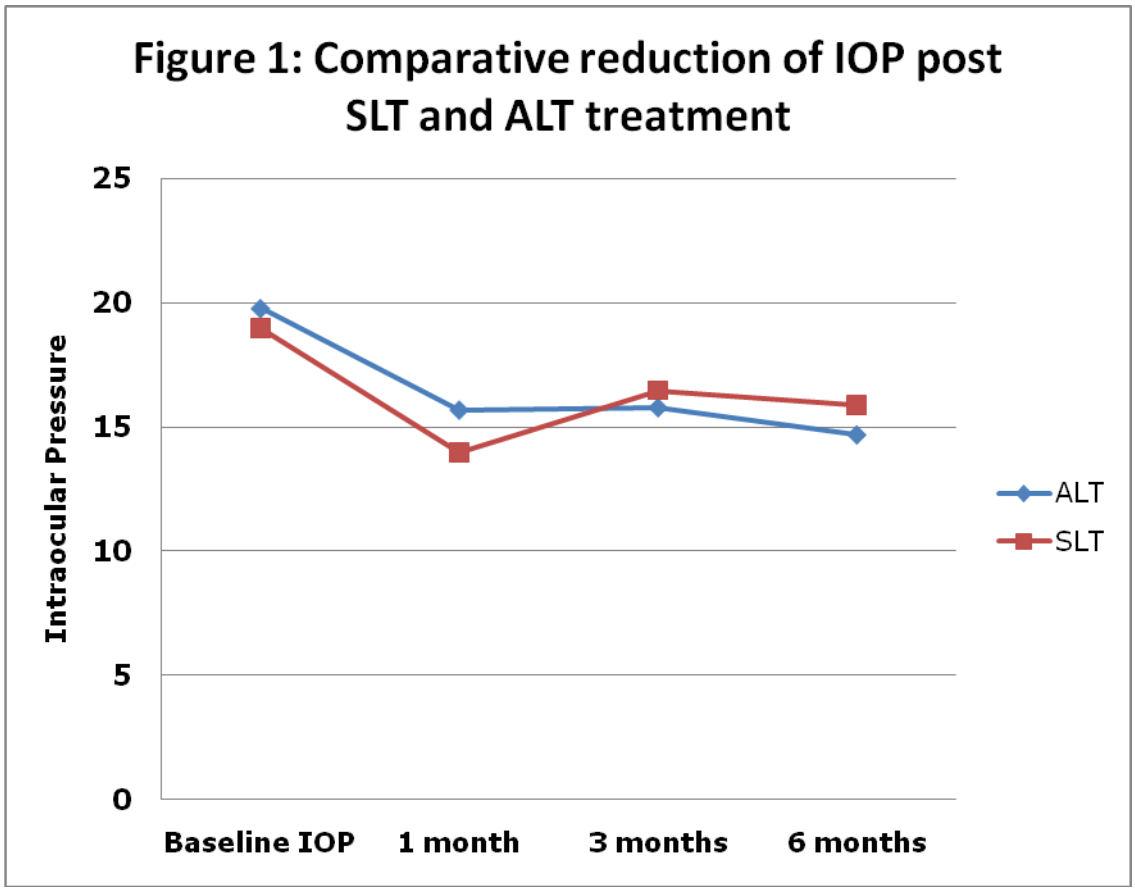
The mean IOP at baseline (prior to treatment) was 19.8±3.1mmhg (range of 16.0-26.0mmhg) in the group that had ALT and 19.0±6.7mmhg (range of 10-32mmhg) in the SLT group. The mean IOP was higher in the ALT group compared with the SLT group. In the ALT group there was no patient with a baseline IOP of ≤15mmhg while in the SLT group 9 patients (36%) had IOP ≤ 15mmhg. The mean IOP in these nine patients was 11.8mmhg. The mean IOP one month after ALT was 15.7±3.2mmhg and 14.0±2.9 in the SLT group. Table 2 compares the mean IOP in both groups with time. There was no statistically significant difference between the two groups at the different time periods.

Fig 1 shows the IOP reductions in both groups at one month, three months and six months. Based on our criterion for success 84.5% of the patients had successful outcome at six months in the ALT group while 70.5% were successful in the SLT group (P=0.6). Fig 2 shows the survival curve of the patients based on the criterion for success

at one year. There was no statistically significant difference between the two groups on log rank test/Mantel Cox (Chi square 3.36, df=1, P=0.07.)

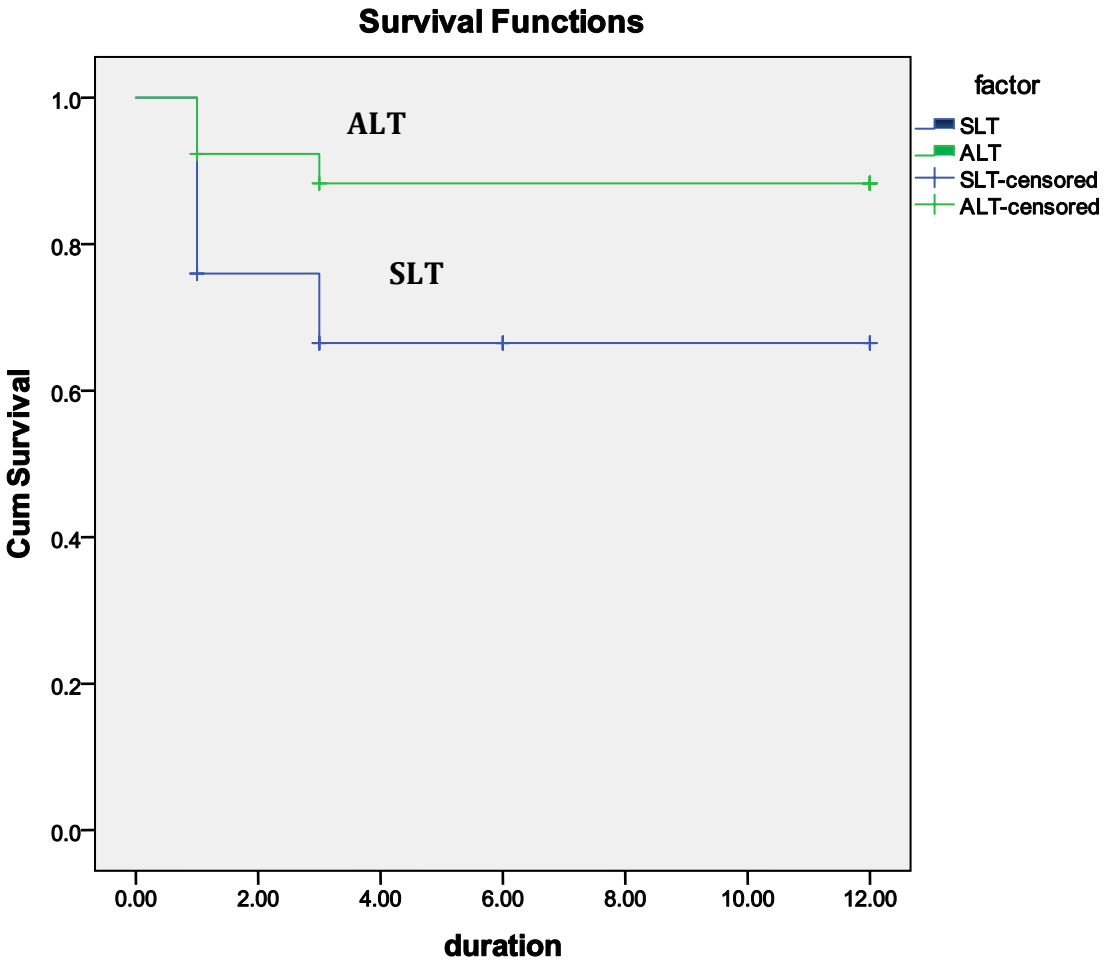
Table 2. Comparison of the mean pretreatment IOP with mean IOP drop based on time

	Mean +SD (mmhg) (ALT)	Mean +SD (mmhg) (SLT)	P - Value
Mean IOP Pre-treatment	19.8±3.1	19.0±6.7	0.68
Mean IOP at one month	15.7±3.2	14.0±2.9	0.07
Mean IOP at 3 months	15.8±2.5	16.5±7.2	0.59
Mean IOP at six months	14.7±2.8	15.9±0.8	0.73
Mean IOP Drop at one month	5.0±3.5	5.3±5.0	0.94
Mean IOP drop at three months	4.4±3.6	3.3±6.5	0.70
Mean IOP drop at six months	5.2±1.8	5.0±4.61	0.93
Mean % IOP drop at one month	23.7±17.5	21.8±22.8	0.49
Mean %IOP drop at three months	20.4±17.2	15.8±2.5	0.88
Mean % IOP drop at six month	25.5±8.4	21.0±17.2	0.4



*IOP-Intraocular pressure; SLT-selective laser trabeculoplasty; ALT- Argon laser trabeculoplasty

Figure 2. Kaplan Meier survival curve showing survival functions of SLT and ALT at one year



Discussion

Both ALT and SLT have been used successfully in the treatment of POAG. Several studies have documented the efficacy of these 2 laser treatments in reducing IOP [15-17]. In this study we compared the IOP lowering efficacy of ALT with SLT in a retrospective study over 6 months and reported the treatment survival at one year. There was no statistically significant difference in the mean IOP between the two groups. To the best of our knowledge this is the first study from West Africa to compare ALT and SLT treatment outcomes.

Several studies have been done in other populations to compare the 2 laser treatment modalities. A few of these studies have been non randomized studies and they all reported that SLT and ALT were similar in IOP reduction, biological effects, and complication rates among the patients studied.[14,16,18] Other randomized studies have also reported the same finding. Damji et al[17] in a randomized clinical trial compared the effect of SLT and ALT over a period of 18 months and found similar IOP lowering effect in both groups. In another study by Juzych et al[19] in which 195 patients with POAG were treated with SLT or ALT, they reported that the IOP lowering effect of both treatments were similar. In a similar study Popiela et al[20] treated 27 patients with ALT in one eye

and SLT in the other eye and they also reported similar results with no statistically significant difference in the intraocular pressure in both eyes.

Our results show that more patients were successful in the ALT group than in the SLT group based on the criterion for success at six months although this was not statistically significant. One explanation for this may the lower baseline IOP in the SLT group compared to the ALT group. Higher baseline IOP has been shown to have higher IOP reduction. [21, 22, 23]

There was a greater initial IOP reduction in the cohort of patients who had SLT compared with those who had ALT with the SLT group having a lower mean IOP at one month post treatment. In the ALT group however the mean IOP was lowest at 6 months post-treatment. Almeida et al[24] compared the magnitude of IOP reduction at different time points following both SLT and ALT and reported that there was a significantly lower initial IOP drop in the SLT group compared to the ALT group.

An explanation for this difference may be related to the different specific actions of the two lasers on the trabecular meshwork. While SLT stimulates aqueous outflow without structural damage to the TM, ALT causes structural damage and subsequent tissue healing to increase outflow facility. It is possible that this process may take a longer period to occur. SLT may be a better option in patients requiring a faster IOP reduction compared with ALT. Another advantage of SLT is that it uses a lower power setting resulting in less tissue damage to the trabecular meshwork and this allows the procedure to be repeatable unlike ALT.

There was no major complication in the 2 groups post treatment although we could not assess for other secondary outcomes such as pain and inflammation between the 2 groups since this was a retrospective study. Other limitations to this study include the small sample size and the short follow up period. This was not a prospective randomized study therefore there could be selection bias. The procedure was also performed on patients who were already on medications for varying lengths of time. It is possible that the IOP lowering effect may be different in newly diagnosed patients who have never used any medication.

The results of our study however highlights the efficacy and safety of both lasers in Nigerians and adds to knowledge that the adjunctive IOP reducing effect of both lasers is comparable in the short term in this indigenous African population.

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