Nigerian Journal of Ophthalmology, Vol. 9, No. 1, August, 2001: 40–45.

Visual field measurement with motion sensitivity screening test in an onchoendemic area after ivermectin treatment.

R.E. UMEH

From: Department of Ophthalmology, College of Medicine, University of Nigeria, Enugu Campus, Enugu, Nigeria.

SUMMARY:

Eye disease is a frequent complication of onchocerciasis in countries where the disease is highly endemic. It has been shown that early ocular lesions which manifest as visual field defects or reduction in visual acuity can be reversed following treatment with ivermectin. At the community level, it is important to detect populations with eye disease early and also follow their progress during mass treatment. The Motion Sensitivity Screening Test (MSST) has been suggested as a potential useful method for monitoring visual field in onchocerciasis endemic coummunities. In this study the aim was to determine the usefulness of this test as a quick and simple method for monitoring visual field changes in an onchocerciasis endemic forest - savanna area following mass treatment with ivermectin. The method was evaluated in four villages over a two-year period. A total of 439 individuals had computerized visual field measurements yearly for up to two years after mass treatment with ivermectin and the results was compared with the pre-treatment values. The results showed an overall significant improvement in the motion sensitivity of the sample populaton after treatment with ivermectin. Lower percentages of the sample population than at baseline had abnormal test within a year of treatment with ivermectin. By contrast the visual field tested by confrontation in all the subjects did not show any change over the same period. In conclusion, MSST was found to be a quick and easy-to-understand computer perimetry that could be useful in monitoring visual field changes in onchocerciasis endemic rural community during mass treatment with ivermectin.

KEY WORDS: ***Onchocerciasis, ivermectin, visual field, motion sensitivity screening test, monitoring.***

INTRODUCTION

Onchocerciasis is one of the major causes of blindness in the world. Optic nerve disease and chorioretinitis have been established as two common pathways to blindness from onchocercal infection[1]. Both pathologies can give rise to peripheral visual field loss leaving the individual with only a small island of central vision[2]. Early ocular lesions which manifest as visual field defects or reduction in visual acuity can be reversed following treatment with ivermectin.

In Nigeria as many as 6 million people or more are affected with onchocerciasis. The government has recognized the disease as a public health problem and a priority disease for control. Consequently, it developed a National action plan that aims to control onchocerciasis using mass ivermectin distribution as a strategy[3]. Although the main problem had been how to deliver ivermectin to the affected remote rural communities, recently, Community Directed-Treatment of Onchocerciasis with ivermectin (ComDTI) appears to have addressed this problem. The African Program for Onchocerciasis Control (APOC) has adopted this strategy for ivermectin delivery.

From time to time it will be useful to not only evaluate the distribution program but also to examine a sample of the community to assess the impact of the treatment, utilizing markers such as skin, eye, socio-cultural and entomological examinations.

For the eye assessment one of the necessary examinations is the visual field measurement using

**Author for Correspondence*

a relatively quick and simple method. Wu et al.[4] showed that laptop perimetry with Motion Sensitivity Screening Test (MSST) detected significant improvement in visual field within a period of one year in a group of 44 onchocerciasis patients treated with ivermectin. They further claimed that the changes detected within one year with MSST took three years to detect using conventional perimetry methods. They therefore concluded that laptop perimetry with MSST could play an important role in mass visual function screening from onchocerciasis.

Their study was undertaken in the Guinea Savanna region of Nigeria where onchocercal eye disease was meso-endemic. It is not known whether this method would have the same usefulness in onchoendemic areas where the eye complications are relatively lower in frequency. One such area is the forest-savannah mosaic zone of South-Eastern Nigeria where the present study took place[5].

In this study we used laptop perimetry MSST to measure visual field in a rural area with relatively low onchocercal eye disease with the aim of determining the usefulness as a quick and simple method in monitoring onchocercal eye changes following mass treatment with ivermectin.

MATERIALS AND METHODS

Study Area

Four villages, Enugu Inyi, Umome, Umuagu and Obune in Oji River Local Government Area in Enugu State constituted the study area. They are located in the transitional forest-savanna mosaic zone of South-Eastern Nigeria.

Sampling Method

Skin snipping was done on a random sample of 2,540 individuals aged 5 years and above. The number positive for onchocercal microfilariae (mf) was 1,160 giving an overall onchocerciasis prevalence rate of 45%. The parasite density was 5mf/ skin snip. A computer generated random sample of 261 persons aged 15 years and above, who were neither pregnant nor lactating, were raised from the 1160 O volvulus - infected subjects in three villages, namely Enugu Inyi, Umuome and Umuagu. In the fourth village, Obune, 178 subject were also randomly computer-generated out of 295 skin snip positive individuals.

Procedure

The randomly selected subjects were examined clinically for skin manifestations of onchocerciasis after which the following eye examinations were carried out - visual acuity using Snellen's Test Type for distance, Slit Lamp biomicroscope for the anterior segment, funduscopy with the direct ophthalmoscope and visual field assessment by confrontation with finger counting in the four quadrants peripherally and paracentrally. Laptop perimetry using MSST was then undertaken. After these examinations, each subject was treated with oral ivermectin, 150ug/kg body weight as a single dose.

Clinical examination and eye tests were repeated one year later on a similar sample from the sample from the same community after which a second dose of ivermectin was given. Two years after baseline studies, the eye tests were again repeated.

In the fourth village, Obune, a different procedure was adopted. One hundred and seventy-eight persons were randomly computer-generated from the same population that had been censused, registered and skin snipped using the same exclusion and inclusion criteria. In this group however, two sessions of eye examinations were carried out with an interval of six months between them before administrating ivermectin. One post treatment eye examination was done a year later. This village therefore afforded an opportunity to study the trend in the absence of treatment and compare it with the situation in the other three villages only one pre-treatment examination was done.

Procedure for MSST

MSST was performed according to the method described by Wu et al[6]. The test was carried out in a section of the village hall darkened with black plastic drapes to cut off sources of daylight flooding the room. A lighted fluorescent bulb was placed at a short distance from the test area. This provided a low illumination in the hall not only to enable safe movement of the subjects but also to facilitate observation of the subjects and the computer screen. It also provided light for the operator to record the results of the tests on the form. This test was carried out by four trained computer operators whose basic education with the equivalent of ordinary level General Certificate of Education. They were supervised by a computer literate member of the team who was also trained to do the test.

When the subject was seated comfortably, the computer operator first explained the test procedure to him. A test run was conducted to familiarise the subject with the instrument, and with both eyes open. He was then told to place his chin on the chin-rest positioned at a distance of 40cm from the screen and one eye was occluded with a patch.

The subject was handed a buzzer and asked to fix his gaze on a central spot on the computer screen. He was to press the buzzer as soon as he perceived motion of any of the lines displayed on the screen. on prompting the computer, a series of vertical oscillating illuminated white lines appeared on the screen arranged in a 6 by 8 pattern. Six of these points coincide with critical points in the central field of vision and these were tested by movement of the corresponding lines. Flashing of each line lasted 2.2 seconds after which it stopped and was followed immediately by flashing in another line. Each of the test locations flashed six times, the order of presentation for each location was randomised. Each sequence was repeated for about 15 minutes after which the test ended. Each test lasted between 15–20 minutes. A subject scored a point if he responded correctly by pressing the buzzer. This response was automatically recorded in the computer system. The computer calculated his total score and displayed it on the screen at the end of the test. The test runs were performed until the subject became conversant with the test and could perform them reproducibly. The definitive test was then performed and the results recorded accordingly, for each eye in turn.

Data analysis

Data analysis was done using Epi Info software version 6.0 (Epi Info Public Domain, USA). Inter-observer variation was measured during the training of the operators by comparing the responses of the subject when tested by the four computer operators. For the inter-observer variation investigation, ten subjects went through the test separately with each tested by all the four operators who recorded their results independently. Level of agreement between the operators were analysed using the simple percent agreement. One hundred percent agreement was assigned if the difference between the results (using a scale 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0 where each number represents a tested point) was 0.0; 90% if it was 1.0 and 50% for a difference of 3.0. In the study, the distribution of simple percent agreement was similar for the four operators. The coefficient of variation was less than 10%.

Intra-observer agreement for each operator was also measured by taking a sample of eight subjects - two for each operator. Each subject went through the test six different times at intervals of 30 minutes to allow him to rest in - between the tests. The results were analysed by determining the coefficient of variation of six determinations in the same subject by the same observer. The coefficient of variation was also found to be less than 10%.

Descriptive data analysis

For each MSST result, the percentage of responses to 36 presentations from six locations for motion observed over the six locations for six flashes varied from 0% to 100%. Perception of motion 5 to 6 times out of six was categorized as normal visual field; 3 to 4 times as moderate field defect and 0 to 2 as severe field defect. These scores for motion sensitivity were then added up for each eye to give an impression of the visual field. They were calculated as a percentage of the maximum score of 36, which represented 100%. The scores, fifty and seventy percents used as cut-off points, allow discrimination between groups with different levels of visual field defect[4]. These arbitrary scores were used in this study as cut-off points for the purpose of analyzing the results and determining the effect of treatment. The recordings from the two eyes were almost similar and it was decided that the analysis be based on right eye readings only.

Statistical analysis

Differences between pre-treatment and post-treatment motion sensitivity were compared using X^2 test and p value less than 0.05 was regarded as statistically significant.

Ethical clearance

Ethical clearance was obtained from the Ethical Committee of the University of Nigeria Teaching Hospital, Enugu. Everybody who participated in the study voluntarily gave their consent after the study had been explained to them.

RESULTS

For ease of analysis, only individuals who had undergone at least one pre-treatment and one post-treatment examination were included in the analysis. A total of two hundred and sixty-one subjects were examined at baseline, that is, before treatment with

ivermectin in three villages namely, Enugu Inyi, Umuome and Umuagu. Of the 261 subjects, 220 (440 eyes) completed the test satisfactorily. Analysis was based on 220 eyes. When 50% was taken as cut-off point of normal motion sensitivity, 45.2% of the patients had reduced motion which implied severe visual field defect. If the cut-off point was taken at 70%, 58.6% recorded-reduced motion (Fig. 1) which implies moderate to severe field defects. Forty-one subjects were not analyzed for various reasons, which included lack of understanding of the procedure and non-cooperation.

One year later when the test was repeated post-ivermectin treatment; a total of 180 out of 191 subjects (360 eyes) underwent the test. At cut-off point for normal motion sensitivity of 50%, 54 (28.3%) had abnormal MSST. This was significantly better than the pre-treatment figure ($P < 0.0002$, RR = 1.6 at 1.23–2.08, 95% CI). If the cut-off for normal was set at 70%, 66 (34.5%) had reduced motion sensitivity, a result which was again significantly better than the pre-treatment value ($P < 0.00004$, RR = 1.7 at 1.36–2.11 95% CI). This indicated an improvement in the population post-treatment at both cut-off points (Fig. 1).

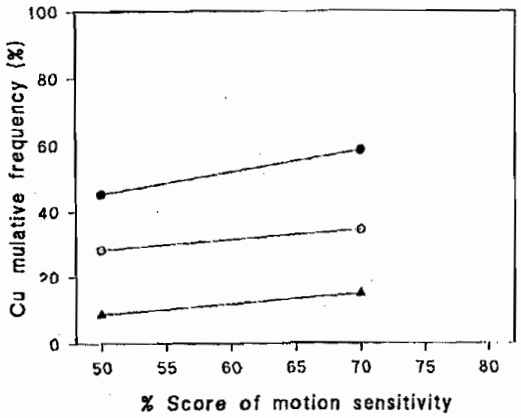

Figure 1: **Pre-treatment; ○: 1st year post treatment; △: 2nd year post-treatment in 3 villages.**

At the second repeat test (one year later still), at which 174 subjects were tested, the results showed that with the cut-off point for normal motion at 50%, 8.6% of the population had reduced motion sensitivity. The deference compared with the pre-treatment value was significant ($P < 0.0001$, RR = 5.2 at 3.17–8.66, 95% CI). When the cut-off for normal was set at 70%, 14.9% had abnormal MSST. This was also significantly better than the pre-treatment value at this score thus indicating further improvement in motion sensitivity in the study population after two rounds of annual ivermectin treatment ($P < 0.0001$, RR = 3.92 at 2.71–5.67, 95% CI).

Fig. 2 illustrates the results from Obune village where two pre-treatment tests were done with a six-month interval between them and one post-treatment test a year later.

At the first pre-treatment test (n = 178), with the cut-off for normal at 50%, 29.2% of the subjects had low motion sensitivity and if the cut-off was 70% the number of subjects with abnormal MSST increased to 44.4%. At the repeat pre-treatment examination, (n=134) six months later, 37.3% had abnormal MSST if the cut-off point for normal was 50% and 53.0% showed low motion sensitivity if the cut-off point was 70%. The differences were not statistically significant at both 50% and 70% cut-off points.

One year after treatment of this group with ivermectin (n=87), the percentage of subjects with abnormal MSST with cut-off point for normal at 50% was 20.7%. The differences was significant when compared with the immediate pre-treatment value ($P < 0.005$, RR = 1.8 at 1.13–2.87, 95% CI). When the cut-off for normal was at 70%, the percentage of

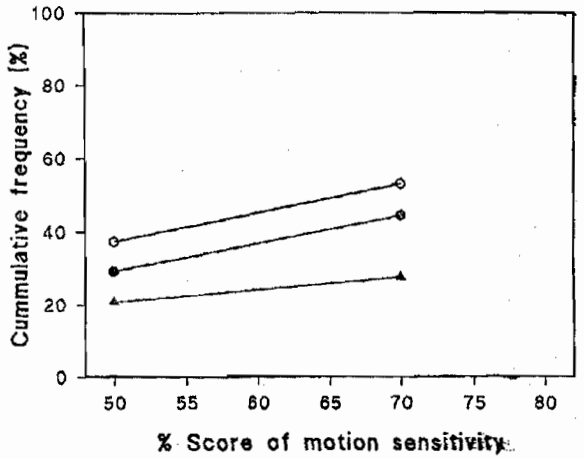

Figure 2: **Patients with abnormal motion sensitivity at 50% and 70% cut-off scores. ○: 1st pre-treatment; ○: 2nd pre-treatment 6 months later; △: 1 year post-treatment.**

subjects with abnormal MSST was 37.9%. This was also significantly better than the corresponding value at the pre-treatment examination ($P < 0.02$, RR = 1.4 at 1.02–1.9, 95% CI).

The result showed an overall improvement in the motion sensitivity of the population after treatment with ivermectin. By contrast, the visual field tested by confrontation in all the subjects did not show any change over the same period of time. This has been reported in a previous paper[3]. The results of visual acuity, anterior segment and fundoscopy examinations are presented in another paper.

DISCUSSION

Optic nerve disease has been shown to be one of the major pathways to blindness form onchocerciasis[7]. Damage to the nerve causes both peripheral and paracentral visual field loss in this condition[1].

In community-based studies, changes in the visual field have been measured using standard methods like confrontation with finger counting in the peripheral and paracentral fields and perimetry with Friedman field analyzer. The latter gives more reliable results but the instrument used is bulky and cumbersome to move about in the field. Besides, it requires constant electric power supply to run. However, this technique fails to detect early visual field defect which is desirable since it is the early lesions that are reversible by treatment[7].

Motion sensitivity screening test (MSST) is a form of software video perimetry which utilizes laptop computer. It has been shown to be useful in the measurement of glaucomatous visual field loss and other conditions[1]. This method appears to be a practical way of assessing the effect on the visual field of annual treatment with ivermectin in the community. It has the advantage that the equipment needed is only a laptop computer which is portable and easy to transport and, because the battery can be readily recharged, it is amenable for use in remote villages[8].

This study showed that at baseline, reduced motion sensitivity was detectable at fifty and seventy percent cut-off points in all the villages studied in subjects who has understood and accurately performed the test. This worsened a little within six months in one of the villages where treatment was not instituted immediately, whereas significant improvement was recorded within a year in administering ivermectin treatment and the improvement continued for a second year. Although there was no standard control group, for ethical reasons, the observation of two pre-treatment tests in the 4th village, Obune where ivermectin could not be administered for 6 months due to logistic problems, provided a natural control even though the numbers were small. When results obtained from here were compared with those in the other three villages the test detected significant changes in visual field. This finding is in good agreement with that of Wu et al[1] in the Northern part of the country and lends support to their suggestion that this may be a good method for mass visual function screening for onchocerciasis.

We conclude therefore that MSST is a good method, cheaper in the long run and suitable for mass field screening of visual field. It is easy to perform and skills required for administering the test could be acquired easily by persons with no more than primary school education. Rural people, with little or no education easily understand the test. It is suggested that further evaluation of the method be carried out in other communities with the ultimate aim of adopting it as a method of choice for monitoring changes in eye disease following mass treatment for onchocerciasis.

ACKNOWLEDGMENT

I wish to thank most immensely, Professor Barrie R. Jones for supporting this work not only with some materials but also served as our overseas expert adviser to the project. I am grateful to Dr. John Wu for his kind assistance.

I thank the computer operators, N.U., I.N., E.A. and G.O. for their contribution to the success of the work, the Inyi Community for their cooperation and Mrs. F. O. Baiyewunmi for secretarial assistance.

This study received financial support from the UNDP/World Bank/WHO Special Programme for Research and Training on Tropical Disease (Project ID 930470).

REFERENCES

1. Sandford-Smith J. Eye diseases in hot climates. Bristol, Wright. 1986.

2. Thylefors B and Tonjum AM. Visual field defects in onchocerciasis. *Br J Ophthalmol.* 1978; 62: 462–467.

3. Dadzie KY. Mectizan distribution for control of onchocerciasis in Nigeria. *Nig Ophthalmol,* 1996; 4: 21–22.

4. Wu JX, Jones BR, Cassels-Brown A, Murdoch I, Adeniyi F, Alexander N, Minassian D and Abiose A. Preliminary report on the uses of laptop computer perimetry with a motion sensitivity screening test to detect optic nerve disease in onchocercal communities of rural Nigeria. Perimetry Update 1992/93 pp. 323–329. Proceedings of the Xth International Perimetric Society Meeting. Kyoto, Japan, October 20–23, 1992.

5. Umeh RE, Chijioke CP and Okonkwo PO. Eye disease in an onchocerciasis-endemic area of the forest-savanna mosaic region of Nigeria. *Bulletin of the World Health Organisation*, 1996; 74(1): 95–100.

6. Abiose A, Jones BR, Cousens SN, Murdoch I, Cassel-Brown A, Babalola OE, Alexander NDE, Nuhu I, Evans J, Ibrahim UI, Mahmoud AO. Reduction in incidence of optic nerve disease with annual ivermectin to control onchocerciasis. *Lancet,* 1993; 341; 130–134.

7. Umeh RE. Use of computerized visual function tests in a community-based study of onchocerciasis in Nigeria. *Nig Opthalmol,* 1997; 5: 41–45.

8. Wu X, Wormald R, Fitze F, Poinooswamy S, Subramanian N, Hitchings R. Laptop computer perimetry for glaucoma screening. *Invest Ophthalmol Vis Sci* (Suppl) 33: 757, 1992.