Abstract

Purpose: To compare the visual characteristics of subjects who had survived a cerebrovascular accident (CVA) and returned to independent living against an age matched normal population.

Method: Seven stroke survivors (mean age±sem: 67.1±8.49yrs) who were at least six months post stroke were recruited via a rehabilitation consultant. All subjects had returned to community living. The subjects underwent clinical tests of visual acuity using Logmar charts, cover test, ocular motility, fusional vergence and stereopsis using TNO stereotest. Subjective opinions of patient’s vision were estimated using an activities of daily living tasks dependant on vision (ADLDV) questionnaire. Visual field analysis using 30-2 Fastpac program on a Humphrey Field Analyzer (HFA) series VI was undertaken. Subjects without major visual field defects completed further attentional visual field analysis using a modified HFA in which they detected and responded to a second target at fixation. This second assessment gave an indication of behavioural effect on visual performance. The 76 locations tested within the 30 degrees where averaged to give a mean sensitivity value in dB. Response times for the central targets were compared with and without the field task. Results were compared against a control group (70.4±6.45yrs) using ANOVA.

Results: No statistical significance was found between groups for orthoptic tests although stroke subjects displayed reduced levels of vision (control: 0.03±0.07 vs. subject: 0.12±0.17), motor fusion range (near: 44.28±12.45∆ vs. 30.71±10.1∆; distance: 24±8.34∆ vs. 14±4.89∆) and stereopsis (171.43±100.2secs of arc vs. 217.86±172.19secs of arc). In both the control and subject group no subjects presented with a manifest deviation. Three stroke survivors presented with abnormal ocular motility. Three subjects presented with previously unidentified complete homonymous hemianopia. The four subjects without gross visual field abnormality underwent attentional visual field analysis and showed reduced sensitivity (26.82±1.44dB vs. 22.22±1.91db; p<0.01) but similar response times to the additional target at fixation (546.66±49.12msec vs. 562.44±21.29msec; p=0.542) compared to the control group. The ADLDV questionnaire showed no significant difference between groups.

Conclusion: Subjects considered to have recovered from a CVA presented with visual problems, exacerbated when attention was divided. This highlights the importance for further investigation or visual monitoring for all brain injured patients.

Keywords: Cerebrovascular accident, visual fields, attention
Introduction
The incidence of stroke is predicted to rise because of the rapidly ageing population. (Rothwell et al., 2004) Stroke survivors though are more likely to return to the community after attending a rehabilitation centre. (Kramer et al., 1997) We wished to investigate vision required for everyday tasks amongst patients who had survived a stroke and returned to independent community living.

Material and Methods
With ethical approval and informed consent, seven stroke survivors (mean age±sem: 67.1±8.49yrs) who were at least six months post stroke were recruited via a rehabilitation Consultant. All subjects had returned to community living. The subjects underwent clinical tests of visual acuity using Logmar charts, cover test, ocular motility and fusional vergence. Stereopsis was measured using the TNO stereotest. We used the Activities of Daily Living Tasks Dependant on Vision (ADLDV) questionnaire to assess the subjects’ daily visual experience. Standard visual fields were measured using 30-2 Fastpac program on a Humphrey Field Analyzer (HFA) series VI.

Subjects without major visual field defects completed further attentional visual field analysis using a modified HFA. Two small lasers were mounted on the left side of the HFA and aligned to project high intensity spots of light (approximately 0.35° in diameter) for 100ms, 0.35° to the left or right of the HFA fixation target. A self-contained microprocessor-based module provided control of presentation rates and collected manual response times to the central targets via an additional handheld button. The timing intervals for the signals driving the lasers were based on a maximum-length pseudo random number series (“m sequence”) generated from a positive feedback shift register algorithm. The test paradigm was implemented on a PC using a graphical user interface communicating with the laser control module across a standard serial connection. The user interface provided the operator with information on the next central target in the sequence and displayed each manual reaction time as it was collected.

The 76 locations analysed within the central 30 degrees by Fastpac algorithm were added and averaged to give a mean sensitivity value in decibels (dB). Response times for the additional targets were compared with and without the field task. Results were compared against a control group (70.4±6.45yrs) using ANOVA.

Results
No statistical significance was found between groups for orthoptic tests although stroke subjects displayed reduced levels of vision (control: 0.03±0.07 vs. subject: 0.12±0.17), motor fusion range (near: 44.28±12.45Δ vs. 30.71±10.1Δ; distance: 24±8.34Δ vs. 14±4.89Δ) and stereopsis (171.43±100.2secs of arc vs. 217.86±172.19secs of arc). No subjects presented with manifest deviations or pathological ocular motility. Three subjects presented with previously unidentified complete homonymous hemianopia on the standard visual field test. These subjects did not undergo attentional visual field tests. The four remaining subjects without gross visual field abnormality underwent attentional visual field analysis. Standard visual field sensitivity was reduced for the subject group compared to the control group (26.75±0.4dB vs. 24.09±1.56db; p<0.05). Attentional visual field sensitivity was unaffected in the control group but decreased by 1.7db in the subject group (26.54±1.56dB vs. 22.21±1.9db; p<0.01) Fig.1.
Fig. 1. Average visual field sensitivity for the 76 locations plotted during a 30-2 threshold program on the HFA. Similar results are found for the control group in both attentional and standard visual fields. The standard visual field sensitivity was reduced for the stroke survivors group which reduced further for the attentional test.

Response times increased by approximately 20msec in the subject group for both conditions but no statistical significance was found (Without Field: 351±22.52msec vs. 370.59±9.79msec; p>0.05) (With Field: 546.66±18.59msec vs. 562.44±10.95msec; p>0.05) Fig. 2. The ADLDV questionnaire showed no significant difference between groups.

Fig. 2. Response Times for the central targets for both groups in a single task (without field) and dual task (with field) paradigm. No statistical significance was found between groups or between tasks.

Discussion
Traditional investigations in vision amongst stroke survivors suggest the presence of visual signs and symptoms including visual field defects, reduced vision, cortical blindness, visual hallucinations, agnosia, ocular motility disorders and visual inattention (neglect). (Macintosh, 2003) Visual disorders have been suggested to affect 34-42% (Beis, Andre, & Sauguez, 1994) of all people who have had a stroke with visual field loss present in 20% of acute strokes. (Beis et al., 1994) Visual field loss was found to be more frequent in this study; three out of seven subjects presented with hemianopia and visual field analysis for the four subjects revealed...
lower thresholds in both the standard and attentional tests. In a visual dual task computer based measure of attention Marshall et al concluded individuals who had suffered a cortical stroke had significantly impaired attention. (Marshall, Grinnell, & Heisel, 1997) The effect of visual training programs have been shown to improve visual attention in patients with brain injury (Calvanio et al., 2004; Mazer, Sofer, Korner-Bitensky, & Gelin, 2001) and it’s effect on returning to driving. (Mazer et al., 2003) However these retraining programs utilise equipment not readily available in the UK. This study adapted a readily available HFA and produced results that have become familiar to clinicians. In comparison to many CVA patients the subjects included in this study had made a sufficient recovery to return to independent living which maybe shown by the comparable manual response times yet their attentional threshold reduced by more than in the control group. Further studies are needed to assess the impact of training on attentional visual field analysis using automated perimeters.

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References