BIPOSA Research Award Report

Binocular vision disorders experienced by people with cognitive impairment: Prevalence, nature and relationship to pupillary dynamics

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Abstract of preliminary results

Purpose: Poor visual acuity is related to rate of cognitive decline in people with dementia[1-4] and other forms of cognitive impairment [5-7]. Such studies have not considered prevalence of binocular vision problems, which can contribute to falls in older people[8, 9], impact upon fine motor task performance[10, 11] and affect psychosocial wellbeing[12]. Binocular vision problems increase in prevalence with age[13], but studies exploring binocular vision in older people with cognitive impairment are limited to stereoacuity[1-3], with conflicting findings due to differing stereotests used. An indepth exploration of BV for this patient group, using multiple assessment methods, could account for these issues and inform selection of appropriate tests, along with test approach.

Separately, recent results suggest pupillometry measures (quick, non-invasive and straightforward to perform) may have valuable diagnostic potential, by indicating risk level for further cognitive decline in older people with mild cognitive impairment[14] and Alzheimer's disease[15]. The proposed study aims to gather prevalence data on the nature of BV disorders experienced by people with cognitive impairment, evaluate pupil size and pupil dynamics during a short cognitive task (digit span), and relate pupillometry findings to binocular and refractive status.

Methods: Service users in a social care setting (community day centre) were invited to complete a battery of vision tests – monocular near/distance visual acuity (logMAR), cover test, ocular motility, convergence nearpoint, Bagolini glasses, horizontal prism fusion range (near/distance), prism cover test (near/distance), and the Frisby, TNO, Preschool Randot and ASTEROID (simple mode) stereotests. Inclusion criteria were capacity to give informed consent, mini-Addenbrookes Cognitive Examination-III (M-ACE-III) score ≤ 21 (a score highly suggestive of dementia regardless of clinical setting[16]), no pathology or current medications affecting pupil function, and no history of childhood amblyopia/strabismus. Obtaining consent and testing took approximately 60 minutes.

Results: At present, 8 eligible participants have been tested (mean age 82.5 ± 5.86 years, 5F, 3M, mean M-ACE-III score range 11, range 2-21). 1 participant (M-ACE-III score = 2) was unable to participate in binocular vision testing due to poor fixation and difficulty understanding the tests. All other participants (n = 7) had at least one abnormal binocular vision test result (intermittent heterotropia on CT n = 1; horizontal heterophoria on PCT > 10Δ n = 3; convergence nearpoint >10cm n = 2; horizontal prism fusion reserves violating Sheard's criterion n = 3; deficient stereoacuity on at least one test n = 6). This reduced to n = 4 participants when discounting deficient TNO and Preschool Randot scores, as the majority of participants scored poorly on these tests despite demonstrating understanding of how to complete them, e.g. identifying control stimulus in TNO or identifying certain shapes within Preschool Randot.

Conclusions: Due to sample size constraints, it was not possible to establish prevalence of binocular vision disorders amongst individuals with cognitive impairment, or ascertain relationship between binocular function and pupillometry measures. However, this pilot study demonstrates comprehensive binocular vision testing can be performed in many individuals with low cognitive test scores highly suggestive of dementia, who can engage and participate effectively in these tests. Participants struggled with TNO and Preschool Randot stereotests despite scoring better on other stereotests e.g. Frisby, ASTEROID. Possible explanations include increased difficulties with static random-dot contour detection, or dissociative effects associated with polarising/anaglyphic glasses wear, in contrast to the free-space testing offered by the Frisby and ASTEROID stereotests. Lack of a control stimulus within the Preschool Randot test also made it more difficult to confirm understanding of the test. Data from this pilot study will inform test battery choice in a larger study with people who have dementia within NHS memory clinic settings.

Project Status

Recruitment of eligible participants for this study proved difficult for a number of reasons not anticipated within the original proposal. Changes required to the study inclusion criteria to obtain ethical approval precluded access to the day centre's dementia lounge, as individuals without capacity were excluded from participating. This had a significant impact on ability to recruit eligible participants to the study, as recruitment was instead conducted in the day centre's main lounge, attended by a mix of service users with and without cognitive impairment. As a number of popular activities are conducted in the main lounge, this also restricted times when potential participants were available to approach for recruitment. Over 10 weeks, 15 participants volunteered, of which 8 were found to be eligible to take part. Other volunteers were not eligible due to previous history of amblyopia, medication affecting pupil size, or M-ACE-III score >21.

Planned outputs

Pilot data from this study will be presented to rationalise choice of stereotests within the protocol for a larger study involving people with dementia in NHS memory clinic settings. This protocol will be submitted for publication to JMIR Research Protocols or BMC Research Methodology.

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