

PROSPERO International prospective register of systematic reviews

Measurement of fusional vergence: protocol for a systematic review

Carla Lanca, Fiona Rowe

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Review question(s)

Objectives

The purpose of this review is to assess and compare the accuracy of tests for measurement of fusional vergence.

Secondary objectives are to investigate sources of heterogeneity of diagnostic accuracy including:

Age

Variation in method of assessment

Study design

Study size

Type of strabismus (convergent, divergent, vertical, cyclo)

Severity of strabismus (constant/intermittent/latent)

Searches

We will use systematic strategies to search key electronic databases, including Cochrane registers and electronic bibliographic databases. In an effort to identify further published data, we will search electronic registers in PubMed and Google Scholar. Additionally, hand search journals and conference transactions, perform citation tracking using Web of Science Cited Reference Search for all included studies and search the reference lists of review articles about fusional amplitudes up to 2016. In addition we will use the orthoptic search facility weblink (http://pcwww.liv.ac.uk/~rowef/index_files/page646.htm) to search in Orthoptic journals and Conference Transactions which are not electronically listed: British and Irish Orthoptic Journal, American Orthoptic Journal, Australian Orthoptic Journal, European Strabismus Association, International Strabismus Association and the International Orthoptic Association.

The following types of studies will be included in the review: randomised controlled trials, controlled trials, prospective and retrospective cohort studies, observational studies and case controlled studies. Case reports and letters will be excluded. All languages will be included and translations will be obtained when necessary. We will include studies of children and adult participants reporting on how fusional vergence ranges were measured, including the measurement technique, order, and stimuli (size and distance) used. Studies reporting fusional vergences in the presence of eso versus exo deviations will also be included.

Types of study to be included

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Condition or domain being studied

Fusional amplitudes are the result of a reflex (motor response) to a sensory stimulus caused by the images of the object of regard drifting off one fovea, causing disparity and involving a subsequent corrective movement of both eyes to maintain fusion and avoid diplopia. The stability of binocular vision depends on good fusional amplitudes and in the presence of vergence system anomalies a great variety of symptoms are elicited interfering with visual comfort and academic performance. The fusion reflex is responsible for maintaining heterophoria compensation, so knowing what proportion of the total vergence amplitude is needed to compensate a deviation, is important to the clinician.

Through the years, clinical measurements of fusional amplitudes have been used to provide information about binocular vision and patient's ability to cope with a deviation. Although this relationship empirically may seem to be very strong, weak correlations between fusional amplitudes and angle of deviation have been reported in the literature. This could mean that other factors in combination with fusional amplitudes may also contribute to this relationship.

Published studies agree in finding a lack of relationship between heterophoria measurements, age and gender in the infant years. These results support the idea that there is little change in heterophoria from ages 6 to 14 year old children. After 6 years of age there is a greater incidence of heterophoria, which can be related with an increase in near work activities. One study reported that near heterophoria in children with myopia became more exophoric over 10 years of follow-up whereas near base out fusional ranges decreased.

Differences have been reported between fusional vergence for eso versus exo deviations and ways of calculating the fusional reserve ratio change according to Sheard's criterion, which appears mostly applicable in exodeviations. The criteria state that fusional reserve opposing the heterophoria should be at least twice the magnitude of the angle of deviation corresponding to a fusion reserve ratio of 2.0. Percival criterion have been described for esodeviations stating that the patient should operate in the middle third of the vergence range.

Positive fusional vergence is reported to be lower in the presence of an exophoria with asthenopic symptoms.¹⁷ In an intermittent exotropia, binocular alignment is achieved by convergence mechanisms, but if diminished horizontal fusional vergences are present the control of the deviation may be poor.^{17–19} However, the role of convergence in the control of intermittent exodeviations is currently unclear and this topic warrants further investigation. One of the factors significantly related to fusional vergence ranges in children with myopia was the extent of heterophoria, with an observed trend in the same direction as would be clinically expected (i.e., greater esophoria is associated with greater base-out (BO) ranges at both distance and near, but smaller base-in (BI) ranges at near).

There are no uniform normative values of fusional amplitudes, especially in children, even though standards for vergence have been established since 1940s. Children have different fusional reserve from adults, but this may relate to methodological differences reported in the literature on fusional vergence when measured with the prism bar method. The major concern with some of the published norms is that they are based on cross-sectional studies that were performed independently of each other by different examiners and have yet to be confirmed by a longitudinal study.

Participants/ population

Subjects of all ages will be included as measurements of fusional vergence can be made from as young as 3 months of age.

Intervention(s), exposure(s)

We will conduct a review aiming to collect all evidence related to fusional vergence measurements and adaptation in the presence of eso versus exo deviations.

Comparator(s)/ control

Target conditions: the target condition is constant or intermittent manifest strabismus or latent strabismus of any type and severity (esotropia, exotropia, vertical deviation, cyclo deviation, exophoria, esophoria).

Context

No validated protocol exists for the measurement of the prism fusion ranges. Many studies report on how fusional vergence ranges can be measured using different techniques (rotary prism, prism bar, loose prisms and synoptophore) and stimuli, leading to different ranges being reported in the literature. Repeatability of the different methods available and the equivalence between them it is also important.

In addition, some studies available do not agree in what order fusional vergence should be measured to provide the essential information on which to base clinical judgements on compensation of deviations. When performing fusional vergence testing the most commonly accepted clinical technique is to first measure negative fusional vergence followed by a measurement of positive fusional vergence to avoid affecting the value of vergence recovery because of excessive stimulation of convergence. Von Noorden recommend using vertical fusion amplitudes in between horizontal amplitudes (base-out, base-up, base-in, and base down) to prevent vergence adaptation. Others place the base of the prism in the direction opposite to that used to measure the deviation to increase the vergence demand.

Outcome(s)

Primary outcomes

No validated protocol exists for the measurement of the prism fusion ranges. To treat and diagnose binocular vision disorders, it is necessary to have a valid protocol of measurement and to know normal mean results in order to classify an individual as normal or abnormal.

Pre-designed data extraction forms will be used to gather information on sample size, study design, type of deviation, vergence order of assessment and population type.

Secondary outcomes

None

Data extraction, (selection and coding)

The titles and abstracts identified from the search will be independently screened by the two authors through each phase of the review (screening, eligibility and inclusion) using the pre-stated inclusion criteria. The full papers of any studies considered potentially relevant will be considered and the selection criteria applied independently by two reviewers. We will resolve disagreements at each step by discussion between the two review authors. If a disagreement remains, we will seek the opinion of a third reviewer.

Pre-designed data extraction forms will be used to gather information on sample size, study design, type of deviation, vergence order of assessment and population type. Data will be extracted and documented by one researcher (CL) and verified by another (FR). Data about country of study, quality appraisal, risk of bias, participants and target condition will also be extracted.

Risk of bias (quality) assessment

Due to the theme of the review it is expected that most of studies designs will be observational. To analyse the relevance of the study designs in our inclusion criteria the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist for cohort, case-control, and cross-sectional studies will be used. Plus CONSORT for randomised controlled trials and QUADAS for diagnostic accuracy studies.

Strategy for data synthesis

Variables will include: prism fusion ranges, age, type of deviation, fusional amplitudes measurement technique, order of fusional amplitudes measurement, and other factors that have impact on measurements (e.g.: size of the stimulus, distance, dominant eye, or other). Prism fusion ranges will be quantitatively synthesised and compared according to the population, measurement technique used and type of deviation. For the other variables, due to the heterogeneous nature of the studies, a narrative analysis will be undertaken

Analysis of subgroups or subsets

None planned.

Dissemination plans

Journal publication

Oral presentations

Contact details for further information

Dr Lanca

Av. D. Joao II, Lote 4.69.01, 1990 - 096 Lisboa, Portugal

carla.costa@estesl.ipl.pt

Organisational affiliation of the review

Lisbon School of Health Technology, Lisbon, Portugal and Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa

<https://www.estesl.ipl.pt/en>

Review team

Dr Carla Lanca, Lisbon School of Health Technology, Lisbon, Portugal and Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade NOVA de Lisboa

Dr Fiona Rowe, Department of Health Services Research, University of Liverpool, Liverpool L69 3GB, UK

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Conflicts of interest

None known

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Country

Portugal

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Subject indexing assigned by CRD

Subject index terms

Convergence, Ocular; Humans; Vision, Binocular

Stage of review

Ongoing

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Date of publication of this revision

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Stage of review at time of this submission	Started	Completed
Preliminary searches	No	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

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