ESA2015 37th Meeting Venice Italy

37th Meeting of the
European Strabismological Association

Scuola Grande di San Rocco, Venice, Italy
October 1 - 4, 2015

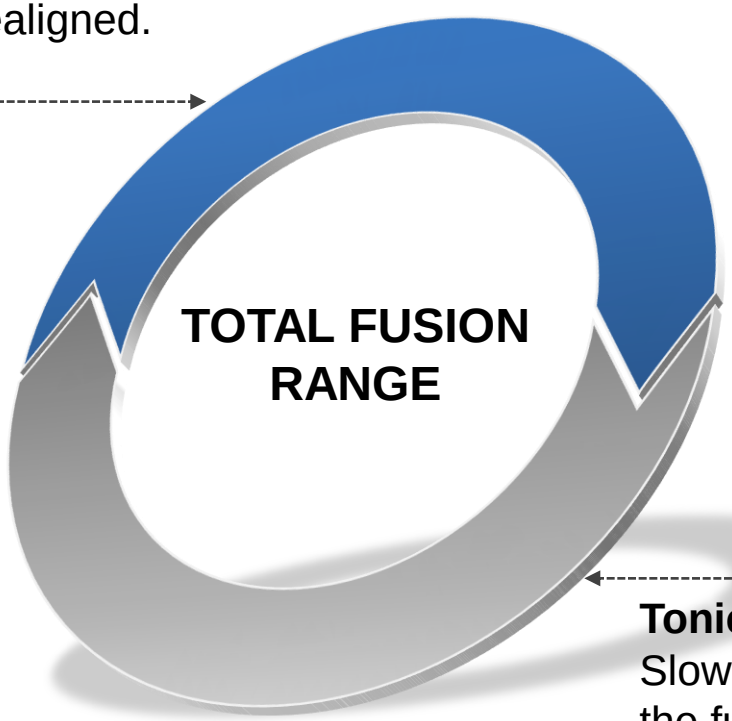
Type of strabismus and changes to fusion measures

Carla Costa Lança, PhD
Lisbon School of Health Technology
carla.costa@estesl.ipl.pt

There is no actual or potential conflict of interest in relation to this presentation.

Vergence system

Phasic
Fast response to a prism in front of one eye (reflex fusion system driven by retinal disparity) - Eyes are realigned.



Tonic
Slow response which adapts to the fusional demand (vergence adaptation) reducing the load placed on the vergence system by the heterophoria.

Cooper J. *Optom Vis Sci*. 1992; Narbheram J, Firth A. *Br Orthopt J*. 1997; Schor CM. *Vis Res*. 1979.

1

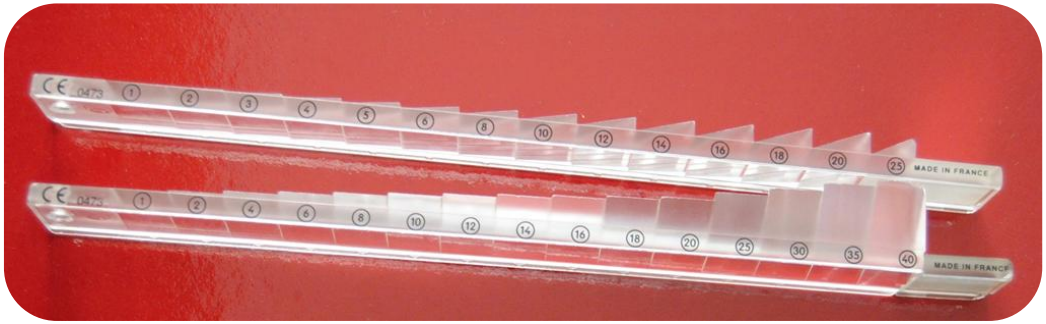
Vergence testing

- Assessing the range of vergence provides information about the patient's ability to maintain the binocular vision.
- Disparity vergence measurements should be used to quantify control of an underlying eye misalignment.
- In the presence of a **manifest deviation** the testing is performed by first compensating the angle of deviation to determine prognosis.

Arnoldi & Reynolds, 2008; Arnoldi, 2009; Ciuffreda, Ciuffreda, & Wang, 2006; Fray, 2013; Narbheram & Firth, 1997.

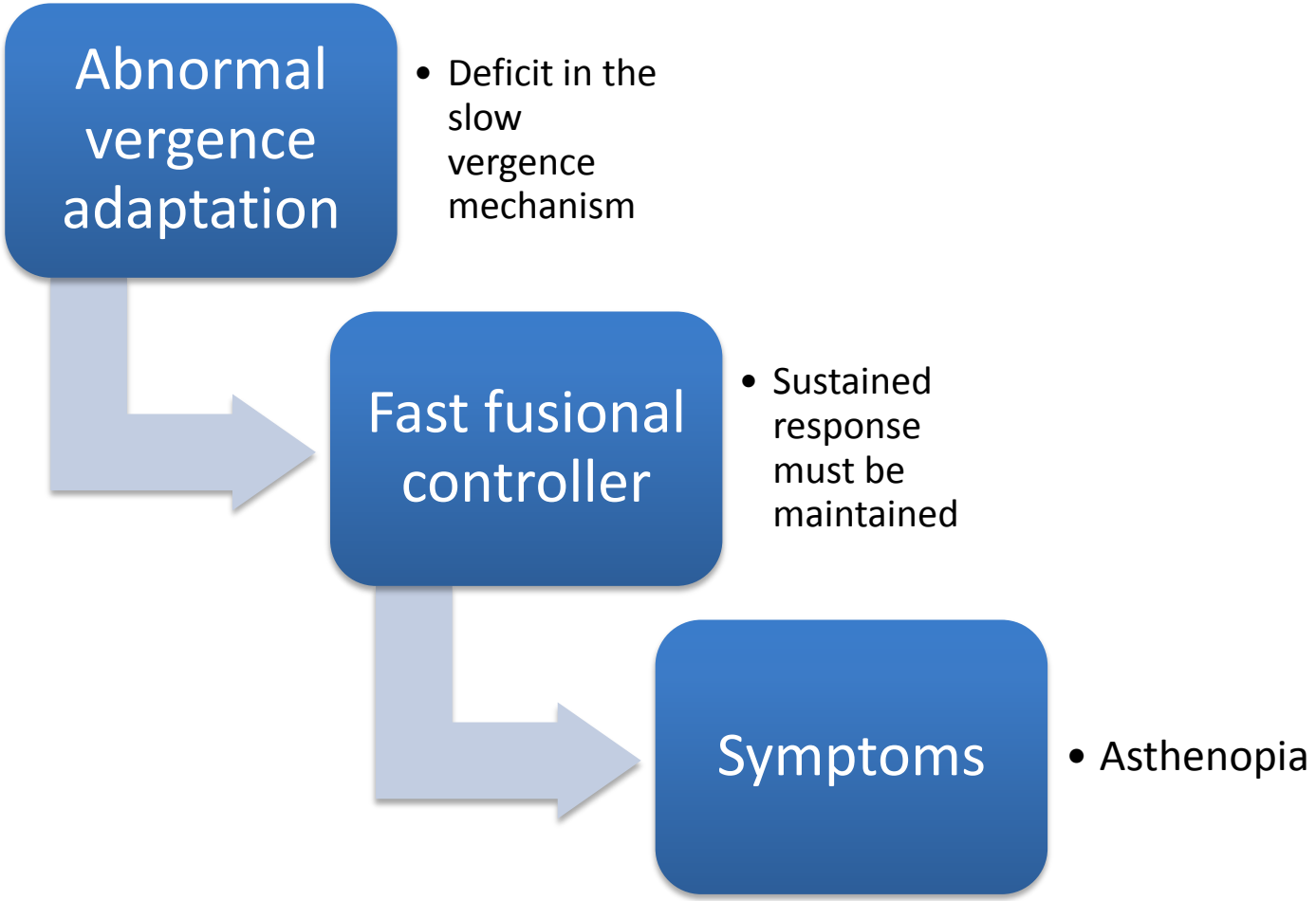
1

Vergence testing



1

Vergence adaptation



Rosenfield M. *Optom Vis Sci*. 1997.

1 Testing and clinical implications

ACCESSING SLOW FUSIONAL VERGENCE

Prescribing prisms

- Estimate the magnitude of the true phoria after dissociation.
- Additionally use temporary stick-on fresnel prims until the real magnitude is properly accessed.

Surgical intervention (avoid angle underestimation)

- **Prism adaptation testing** is important in strabismic patients revealing latent esotropia (total deviation).
- An **alternative method** could be sustained dissociation.

Rosenfield M. *Optom Vis Sci*. 1997.

2

Type of deviation

- In an **exophoria** there is an increase in the fast fusional convergence while in an **esophoric deviation** there is an increase in reflex fusional divergence to attain binocular single vision.

- Convergence fusion amplitudes have been found to correlate with control of the exodeviation.

- There is a greater BO range for esos and greater BI range for exos.

Hatt *et al*., 2011; Kim *et al*., 2010; Rowe, 2010; Sreenivasan, Irving, & Bobier, 2012.

2 Type of deviation: unpublished data

- **Five-hundred and thirty children** with a mean age of 7.66±1.20 (range 6 to 14) years were included in the study.
- There were 280 females (52.8%) and 250 males (47.2%).
- The **median angle of deviation** was:
  - 4PD (2 to 10PD) at near fixation (n=181) and 4PD (2 to 4PD) at distance (n=20) for exophoric children
  - 6PD (2 to 10PD) at near fixation (n=22) and 4PD at distance (n=1) for esophoric children

2 Type of deviation: unpublished data

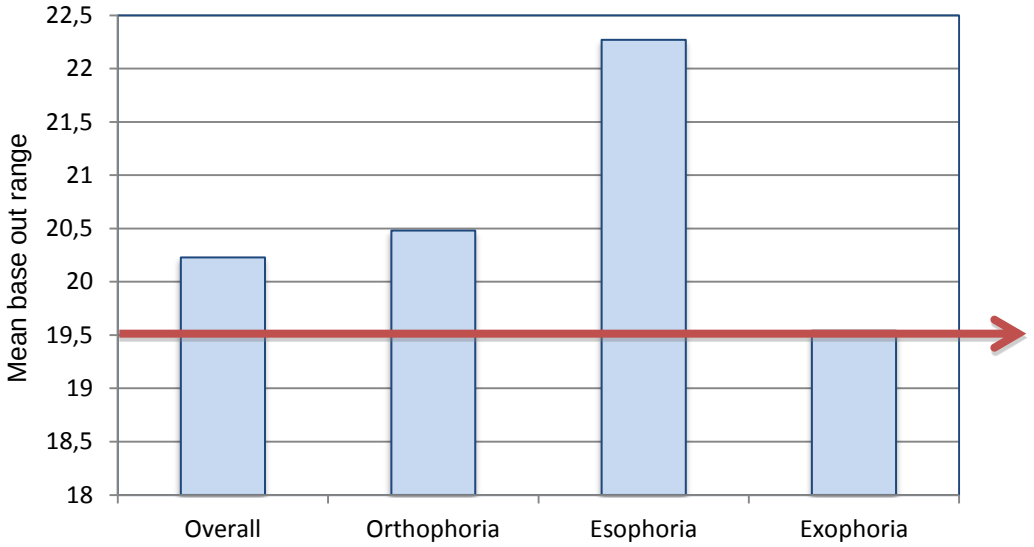
Heterophoria	Fusional amplitudes	Mean	Std. Deviation	Median
Orthophoria	Near PFV	20.48	4.83	20.00
	Distance PFV	13.10	3.22	12.00
	Near NFV	9.57	1.96	10.00
	Distance NFV	6.97	1.83	8.00
Esophoria	Near PFV	22.27	5.60	20.00
	Distance PFV	14.00	0.00	14.00
	Near NFV	9.64	2.11	10.00
	Distance NFV	6.00	0.00	6.00
Exophoria	Near PFV	19.54	5.26	18.00
	Distance PFV	12.60	2.44	12.00
	Near NFV	9.96	2.02	10.00
	Distance NFV	7.20	1.20	8.00

Legend: PFV – positive fusional vergence; NFV – negative fusional vergence;

Statistically significant: exophoria-orthophoria - p=0.003; exophoria-esophoria - p=0.035

2 Type of deviation: unpublished data

A shift towards **base-out range** was seen in esophoric children while a shift towards the base-in range was seen in exophoric children.



- This result is in accordance with Rowe's (2010) study reporting a skewed vergence range with exophorias having a bias towards the divergent range and vice versa.

- Exophoric children also had significant **lower positive fusional vergences** for near compared with children with orthophoria and esophoria.

2 Type of deviation: unpublished data

- Exophorics have a significantly reduced base-out prism adaptive response when compared to orthophorics.
- Reduce convergence break points have been suggested as a maker of severity in intermitent exotropia.
- In the present study there was no significant difference in **divergence amplitudes** when comparing exophoric children with children with orthophoria or esophoria.
- Others studies found similar divergence amplitudes between patients with intermittent exotropia and normal subjects.

Dowley, 1990; Fu *et al.*,2015; Hatt et al., 2011; Liebermann *et al.*, 2012.

Order of vergence testing

CONVENTIONAL PROCEDURE

Base-in measurements should be measured first to avoid **vergence adaptation** caused by base-out prism.

OR

Base-out, base-up, Base-in, and basedown to prevent vergence adaptation.

(Cooper, 1992; Fray, 2013; Rosenfield et al., 1995; Von-Noorden & Campos, 2002)

STUDIES ON VERGENCE ADAPTATION

Phorias should be measured before vergence amplitudes to avoid the shift in the lateral phoria towards the direction of the prism duction.

The base of the prism should be placed first in the **direction opposite** to that used to measure the deviation so as to increase the vergence demand.

(K. Arnoldi, 2009; Rosenfield et al., 1997)

4 Angle of deviation: unpublished data

- Smaller convergence fusion amplitudes were associated with larger angles and vice versa at near (r_s=-0.115; p<0.008).

- A similar finding was done by Hatt *et al.* (2011), however as we used children with heterophorias with angle of deviation ≤ 10DP the strength of the correlation was lower.

- Lower fusion reserve ratios were associated with larger angles and vice versa) at distance (r_s=-0.849; p<0.001) and at near (r_s=-0.821; p<0.001).

4 Angle of deviation: unpublished data

- No correlation was found between distance fusional convergence and distance angle.

- This results are in accordance with Hatt *et al.* (2011).

Exophoria and fusional vergence

EXOPHORIA

Smaller fusion reserves are associated with larger angles and vice versa at near.

CONVERGENCE

Exophoric children have significant lower positive fusional vergences for near compared with children with orthophoria and esophoria.

DIVERGENCE

No significant difference in divergence amplitudes when comparing exophoric children with children with orthophoria or esophoria

When convergence is stimulated an inhibition of the natural tendency to diverge as to occur, which results in a reduction of convergence peak velocity (Kim et al, 2010).

Testing and end results

Ocular dominance

- There is a slightly trend for greater base out vergence range fixing with the non-dominant eye, these effects do not constitute clinically significant impact.

Target size

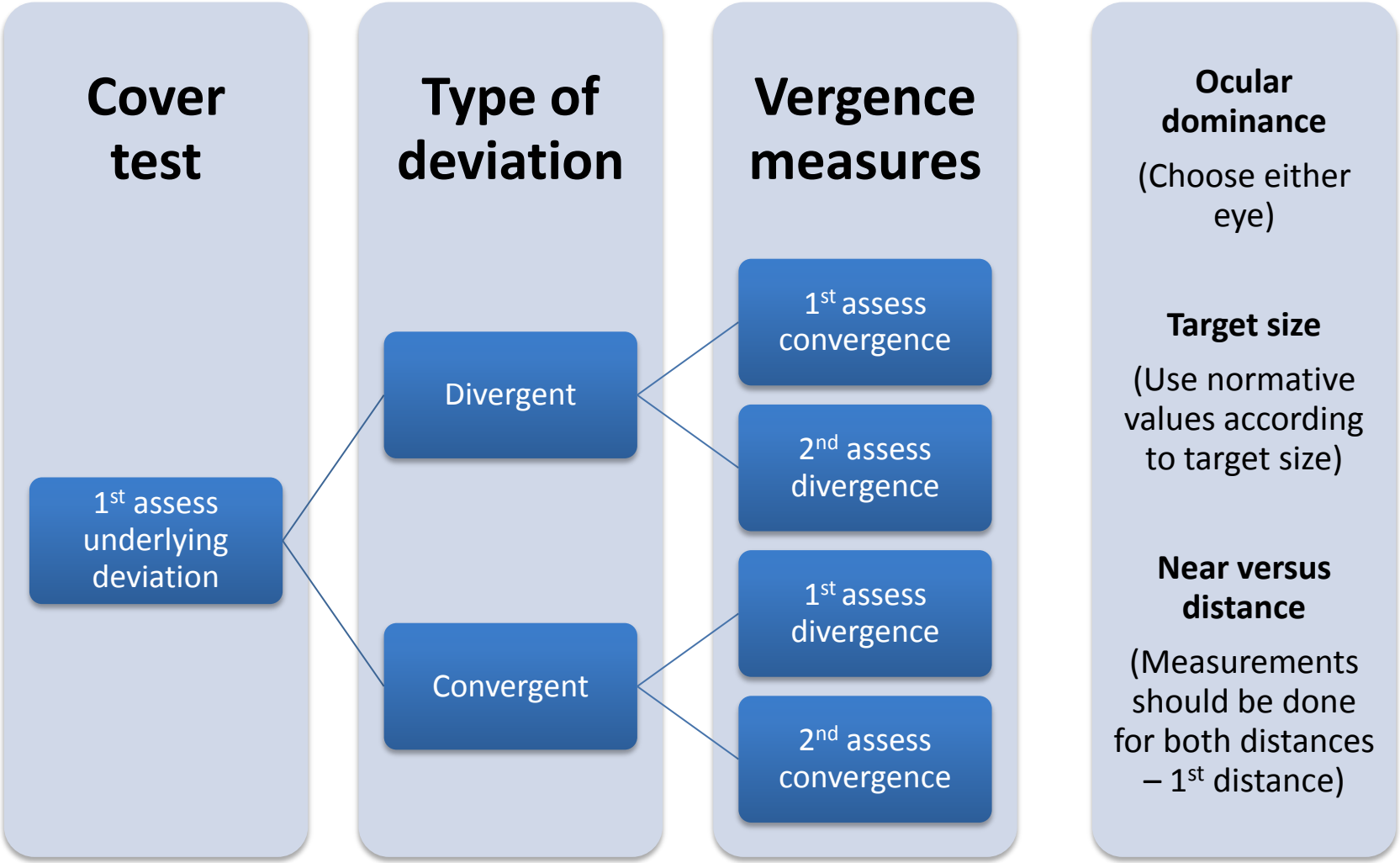
- Vergence range is higher when measured with a peripheral target compared with a central target (particularly for positive fusional range).

Near versus distance

- Measurements at near versus distance fixation also have significant differences, especially in positive fusional vergence.

Fray, 2013; Jillian et al, 1999; Hainey, Cleary, & Bed, 1999; Rowe, 2010

5 Protocol for testing: recommendations



Final considerations

- The present findings suggest that phoria as an important role within the vergence system and fusion measures should take these findings in consideration.
- Binocular vision assessment in symptomatic patients should include an assessment of vergence adaptation.
- There is no protocol for assessment of vergence (prism) adaptation or time line for duration of dissociation.
- Further studies are necessary to fully comprehend the vergence system.

ESA2015 37th Meeting Venice Italy

37th Meeting of the
European Strabismological Association

Scuola Grande di San Rocco, Venice, Italy
October 1 - 4, 2015

Type of strabismus and changes to fusion measures

Carla Costa Lança, PhD
Lisbon School of Health Technology
carla.costa@estesl.ipl.pt

There is no actual or potential conflict of interest in relation to this presentation.