Evaluation and treatment of patients with vestibular disorders: an overview of current approaches used in French physiotherapy clinics.

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Speakers: M. DEBUE, O. DUMAS, T MISERE, J. ORTEGA SOLIS

The role of rehabilitation of the Dynamic Visual Acuity after unilateral or bilateral vestibular loss
Michel DEBUE

High velocity rehabilitation, oscillopsia, saccades.
Olivier DUMAS

The rotatory chair for vestibular rehabilitation
Thierry MISERE

OKN & Virtual Reality current approach in French PT clinics: Survey data about their use for treatment of Visual Vertigo & Motion Sickness
José ORTEGA SOLIS

Dynamic visual acuity (DVA) .

- DVA is the ability to resolve fine spatial detail in dynamic objects during head fixation, or in static objects during head or body rotation.
- DVA can be tested either by asking an observer

  to judge **dynamic objects** while the observer's **head is fixed**,

  or

  to identify **static objects** during **head rotation**
- **These two types of DVA-tests** require different types of oculomotor control mechanisms:
- **Smooth pursuit eye movements** serve to keep small moving targets close to the fovea when the head is relatively stable.
- Whereas the **VOR compensates for fast head rotation**

How to test DVA during fast head movements ?

- We have now lighweight and easy system which provide both test and rehabilitation protocols .

Orange box with accelero-goniometer sensor

Very light Helmet fixed on the patient's head

Movement of the head / fixed target

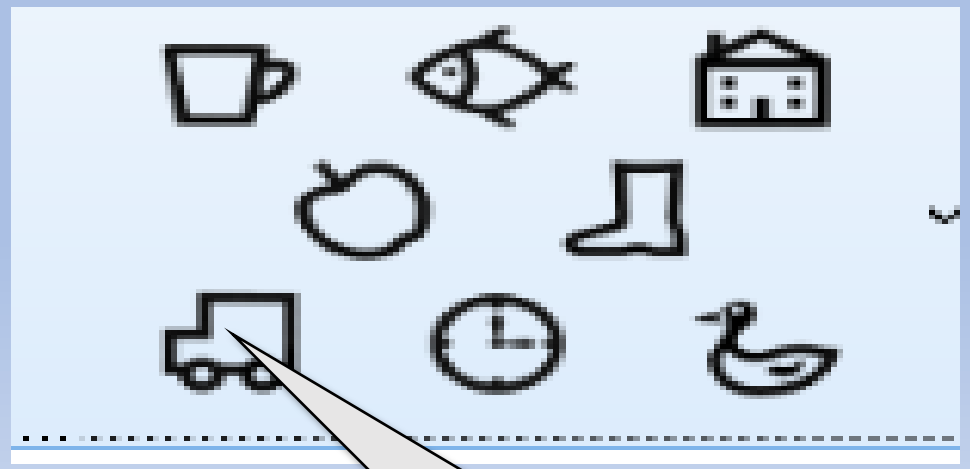
DVA test with fixed target and head in movement.

- There are two ways for testing this kind of DVA
- 1. test with unpredictable head movements (the therapist make a passive unpredictable movement with the patient's head) . In the case of movement faster than 100°/sec , the gaze stability is only dependant of the VOR .
- 2. test with predictible head movements (the patient make a fast saccadic head's movement (more than 100°/Sec) to the target . This kind of movements use a preprogramming movement dependent of the central nervous system .

What the patient is watching on the screen : a flashed optotype during 50 msec

There are several validated optotypes

Before reading's capacity

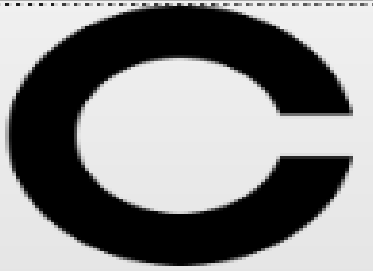


That's a funny test for childrens because it's like a game.

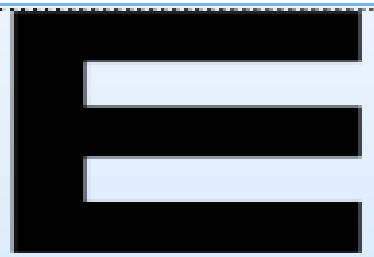
after reading's capacity

Sloan

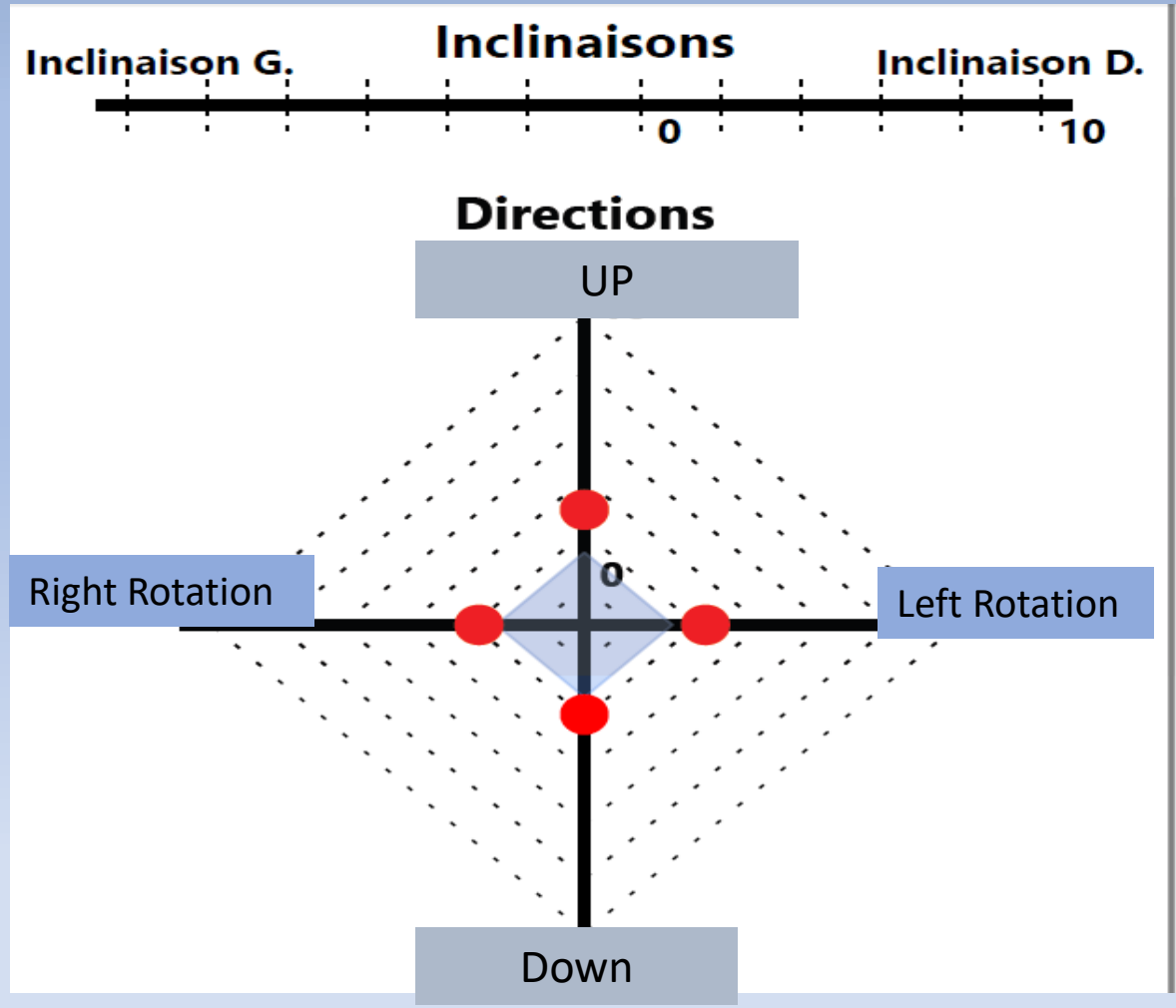
Landolt C



Snellen E



Test of orthogonal directions



Static Acuity : 6,2 /10 Flashed

Dynamic acuity

Type	Acuity	Loss
UP	3,3 /10	2,9 /10
Down	4,3 /10	1,9 /10
Right	3,9 /10	2,3 /10
Left	4,4 /10	1,8 /10

Cet exercice n'a pas été mené à sa fin

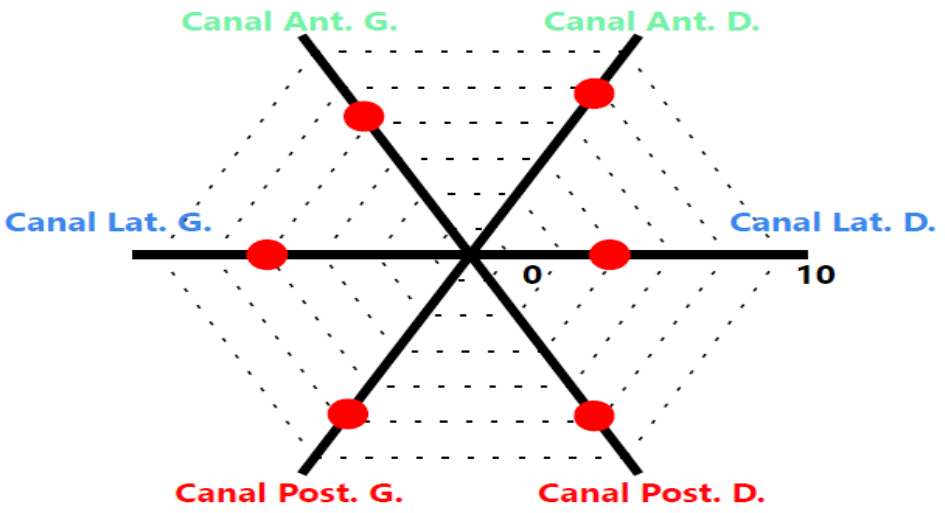
Test of SCC's directions

Static Acuity : 10 /10 Flashed

Dynamic acuity

Type	Acuity	Loss
Canal Ant. D.	2,3 /10	7,7 /10
Canal Ant. G.	3,6 /10	6,4 /10
Canal Post. D.	2,3 /10	7,7 /10
Canal Post. G.	2,5 /10	7,6 /10
Canal Lat. D.	6,3 /10	3,7 /10
Canal Lat. G.	4 /10	6 /10

Semi circular canals



Effects of the loss of aVOR on DVA

- The aVOR keeps images stable on the fovea during head motion. When viewing targets at distances greater than 1m, the VOR generates eye movements that are opposite in direction but equal in magnitude to the head rotation. This is necessary to maintain stability of the eyes with respect to space (termed *gaze stability*) and ensure clear vision during head motion. The fovea occupies a small region of the visual field, and image movement off the fovea by as little as 2° to 3° can cause substantial reduction of gaze stability. In the case of vestibular hypofunction, eye rotational velocity is less than head rotational velocity, and gaze stability is reduced

Unilateral or bilateral vestibular loss .

- There is a decrease of DVA in the case of BVL more than UVL (Herdmann 2003, 2007)

- In the case of UVL , the DVA decrease for the head's horizontal rotatory movements to the ipsilateral side of the lesion but equally for the contralateral side. (Vittal 2010)

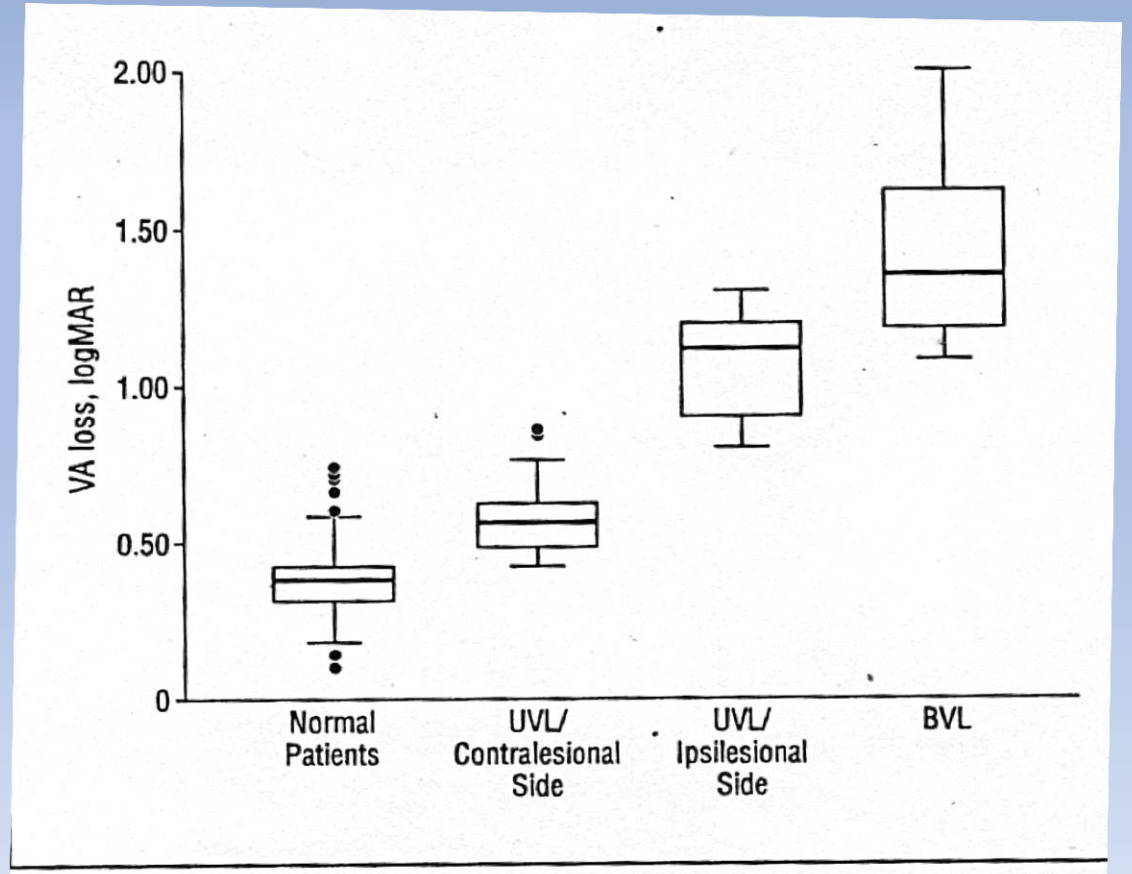


Figure 3. Boxplots of visual acuity (VA) loss for the normal individuals, of the contralesional and ipsilesional side of patients with unilateral vestibular loss (UVL), and of patients with bilateral vestibular loss (BVL). MAR indicates minimum angle of resolution. T-bars indicate 1.5 interquartile distances; dots, outliers. VITAL 2010

Mecanisms of compensation of DVA's loss .

- In an attempt to stabilize gaze, people with vestibular hypofunction use different compensatory strategies to improve the ability to see clearly during head motion. Compensatory mechanisms include substitution or modification of a saccadic eye rotation that occurs in the direction of the deficient aVOR, increased gain of the cervico-ocular reflex,and perhaps enhancement of the smooth pursuit system. For voluntary movements of the head, there is a central compensation which provides a pretreatment of the saccades of the eye which correct the hypofunction of the aVOR. (Guinand 2012). The aVOR is modifiable with vestibular rehabilitation and therefore a compensatory strategy of gaze stability.

IS it a correlation between DVA loss and oscillopsia?

- There is no clear correlation between the DVA and oscillopsia severity score

(Guinand et al .,2012 ; Sun et al ., 2014)

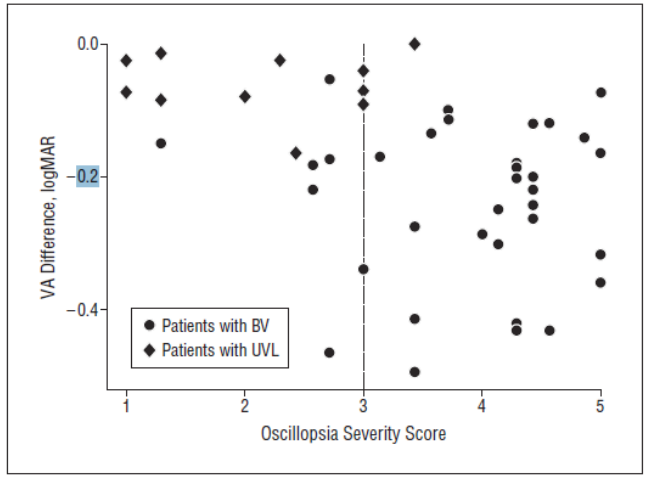
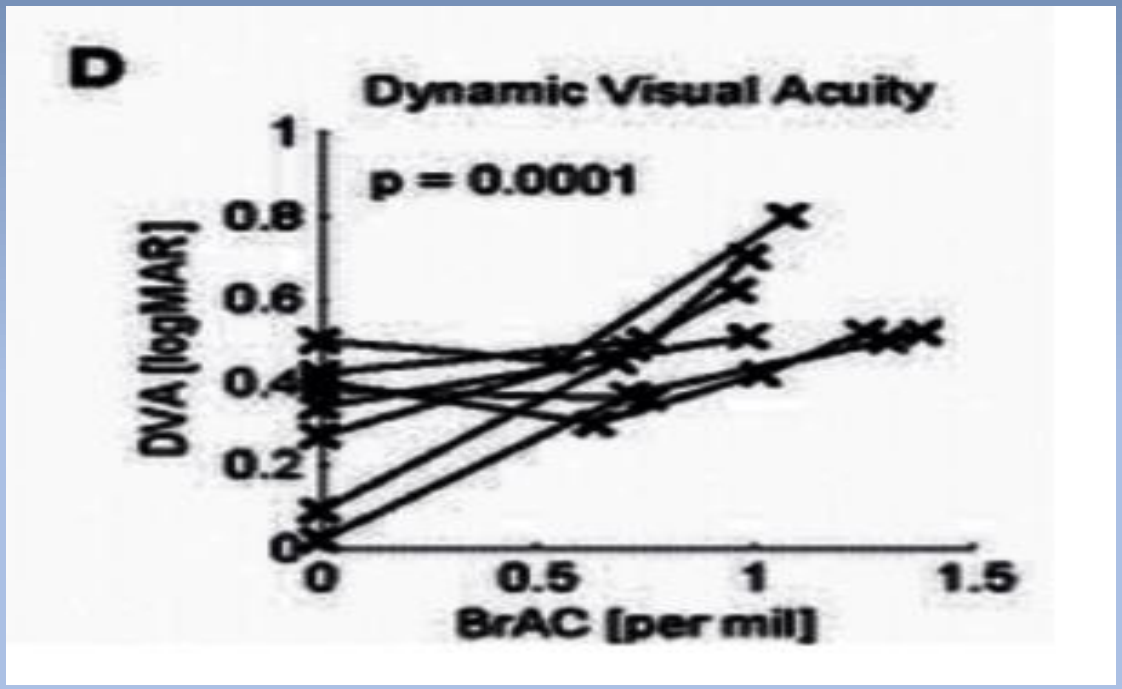


Figure 4. Visual acuity (VA) differences measured while subjects were walking at 4 km/h vs oscillopsia severity scores. Illustrated are data from patients with bilateral vestibulopathy (BV) and patients with unilateral vestibular loss (UVL). No correlation was found (r_{BV}=0.04 [P=.83]; r_{UVL}=0.02 [P=.96]). Similar results were obtained at 2 and 6 km/h. The dotted vertical line indicates an oscillopsia severity score of 3; a score higher than 3 indicated moderate to extreme oscillopsia severity.

- The oscillopsia severity scores showed that despite central adaptive mechanisms, most patients with BVL experience moderate to extreme oscillopsia severity. There is no clear correlation between the DVA and oscillopsia severity

DVA and other pathologia



- **Ethanol cunsumption** provoques loss of DVA

  (Roth et al ., 2014)

- The lowering of DVA is a **marker of the risk of fall** for the **elderly**. The loss of DVA is a comorbidity factor that increases the risk factor for falls

  - by **four** in the case of falls history

  - by **five** in case of abnormal equilibrium score (Dynamic gate index <19)

  (Honaker et al ., 2011)

- **Traumatic brain injury** : a treatment period of **12 weeks or longer** may be required for gaze stabilization scores to return to normative values. (Gottshal et al ., 2010)

Pathological DVA and visual training

Pathological DVA and results of the visual training.

- DVA improvement for UVL more than for BVL (few or any improvement)

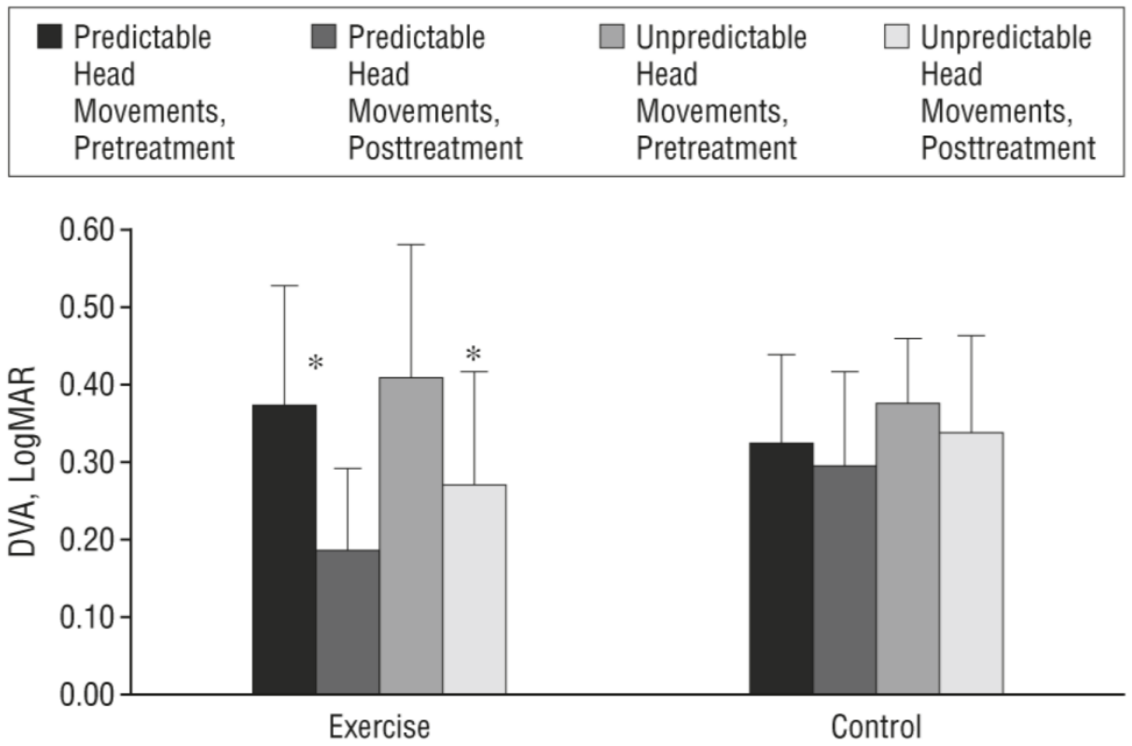
  (Herdmann et al .,2003 ,2007 ; Schubert et al ., 2008)

- DVA improvement for active movements more than passive movements

  (Herdmann et al .,2013)

From: **Recovery of Dynamic Visual Acuity in Unilateral Vestibular Hypofunction**

Arch Otolaryngol Head Neck Surg. 2003;129(8):819-824. doi:10.1001/archotol.129.8.819



Herdman 2003

Figure Legend:

Effect of exercise on recovery of dynamic visual acuity (DVA) during head movement. Note the significant improvement in DVA with predictable and unpredictable head movements in the vestibular exercise group but not in the control group. Data are given as mean ± 1 SD. Asterisk indicates P<.001.

Study UCL –Cliniques Universitaires Saint-Luc - Brussel

- Aim :

Can specific visual training enhance DVA of a population of subjects with UVL , **loss of DVA** ∗and complaining of poor visual stabilisation during fast head movements (blurred view or abnormal perception of the relative velocities between the head and the eyes?

∗Many patients with compensated UVL , present DVA values in the normal range (schwannoma post chirurgical or post vestibular neuritis. (Peeters 2013)

Study UCL –Cliniques Universitaires Saint-Luc – Brussel DVA Framiral®

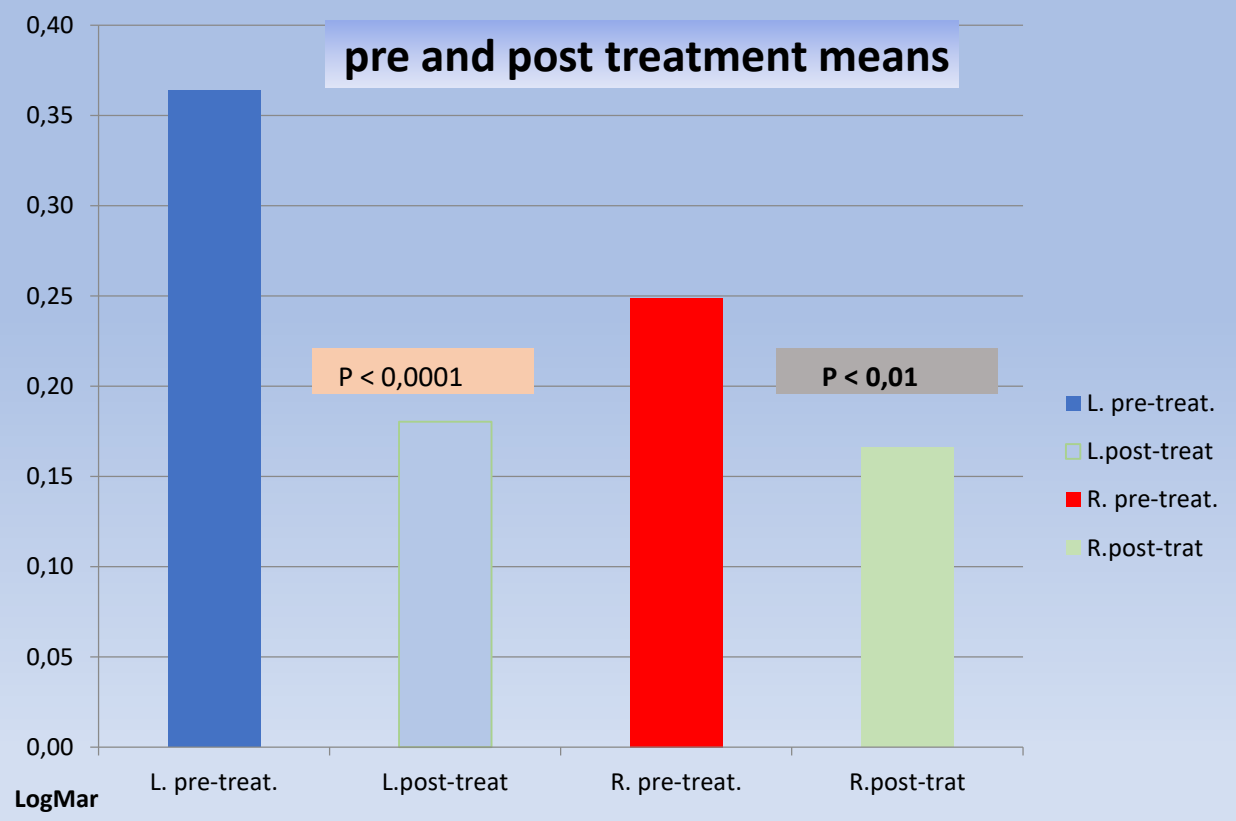
- **Retrospective study**,
- Tertiary academic center

  Saint Luc Academic hospital –UCL - Brussel
- population:

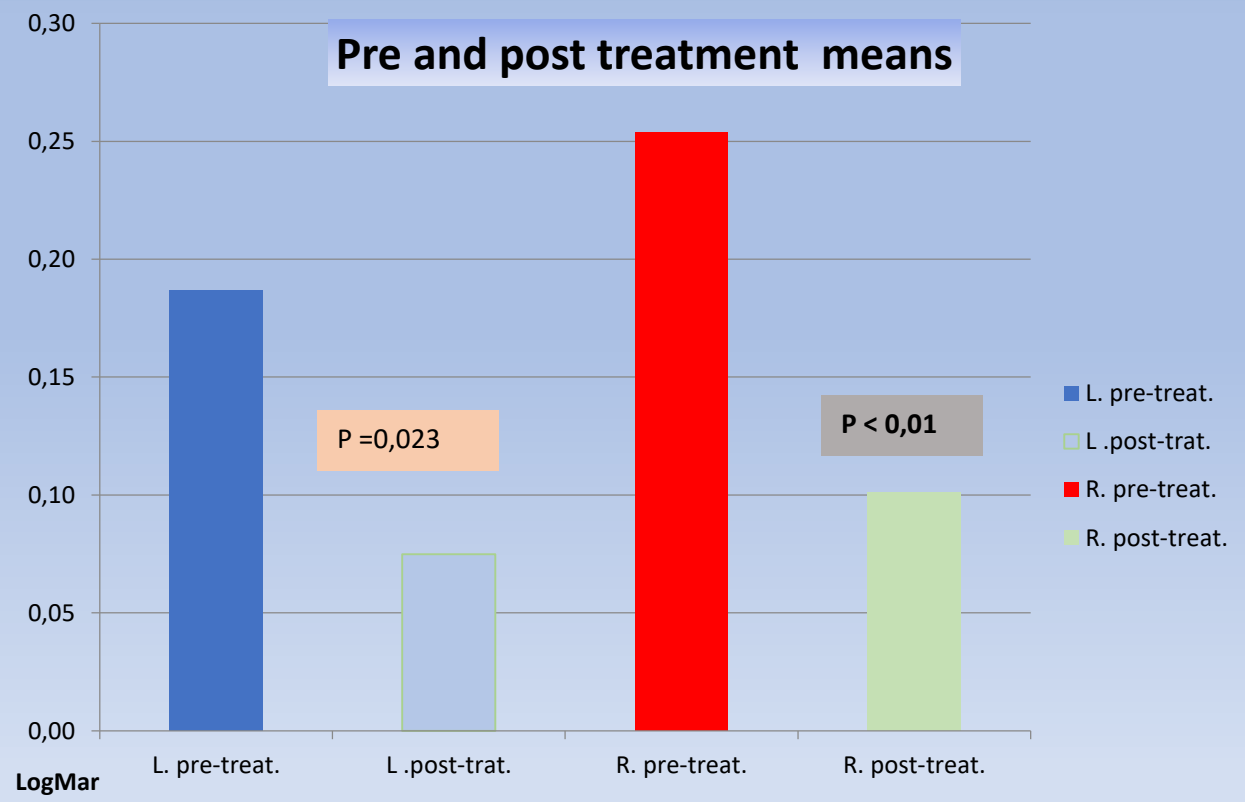
- **35 subjects** : 17 F - 18 M, mean age : 46,5 years (SD: 13,5 years)
- **UVL** (VNG and /or vHIT, and/or PEVM) laps time before treatment(min 7 weeks)
- **With symptoms of poor visual stabilization**
- 23 left / 12 right UVL.

DVA of umpredictable movements pre and post treatment of DVA rehabilitation

Left UVL



Right UVL



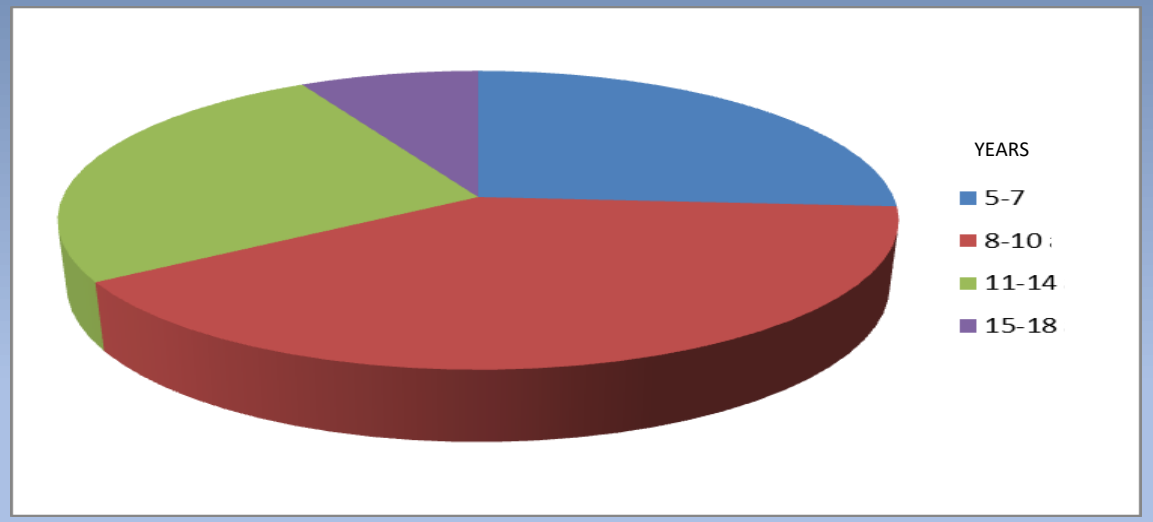
Evolution of the dynamic visual acuity evaluated by the Framiral DVA test in a population of healthy children from 5 to 18 years

UCL Study with DVA Framiral

Cliniques Universitaire Saint Luc - Brussel

- Population

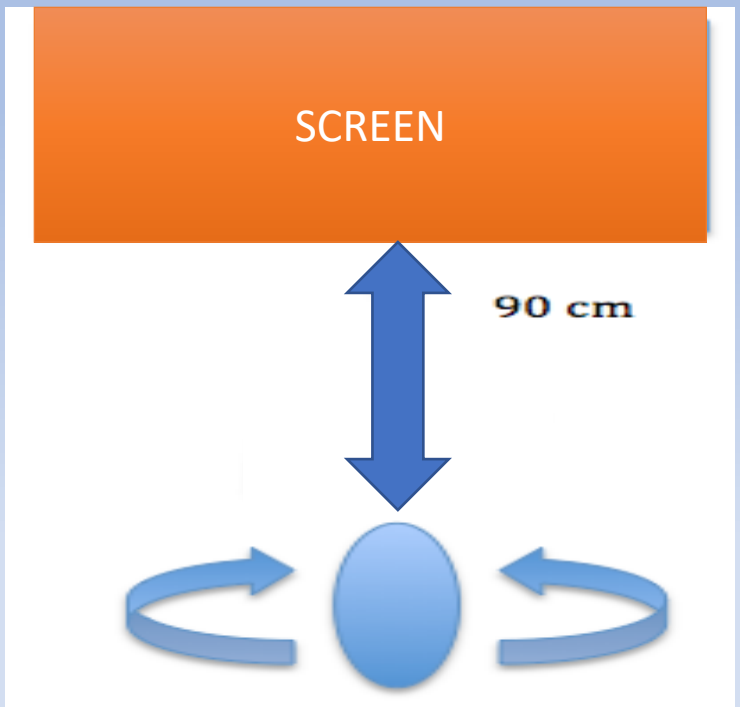
  87 healthy children



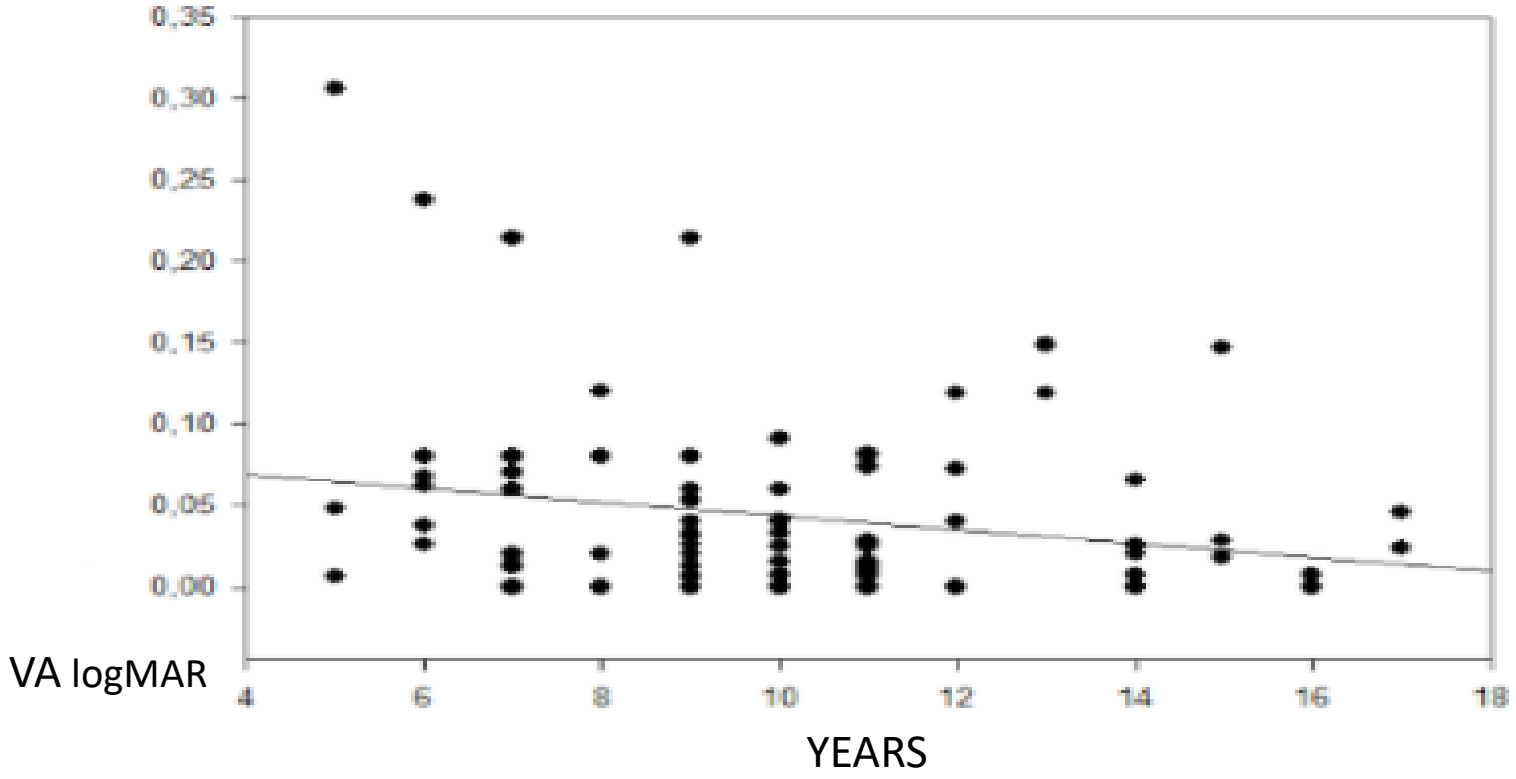
- Method

  DVA and SVA tested

  Difference SVA-DVA



Difference between DVA and SVA



Take home message

Test device

- The DVA test device permits a quickly highligting of the lack of vision stability often complained by patients after unilateral vestibular involvement . They give fine tuning of the DVA rehabilitation process.
- DVA test is well tolerated by the child .

Rehabilitation device

- The DVA rehabilitation device permits calibrated and targetted exercices of adaptative saccads that compensate the loss of VOR gain . The final aim of this rehabilitation is to give to the patient the possibility to obtain the more normal possible DVA during the movements of the head and the body.