

Systeme Vestibulaire

Nils Guinand

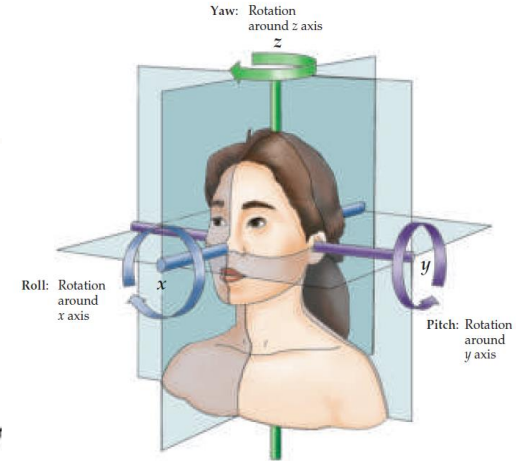
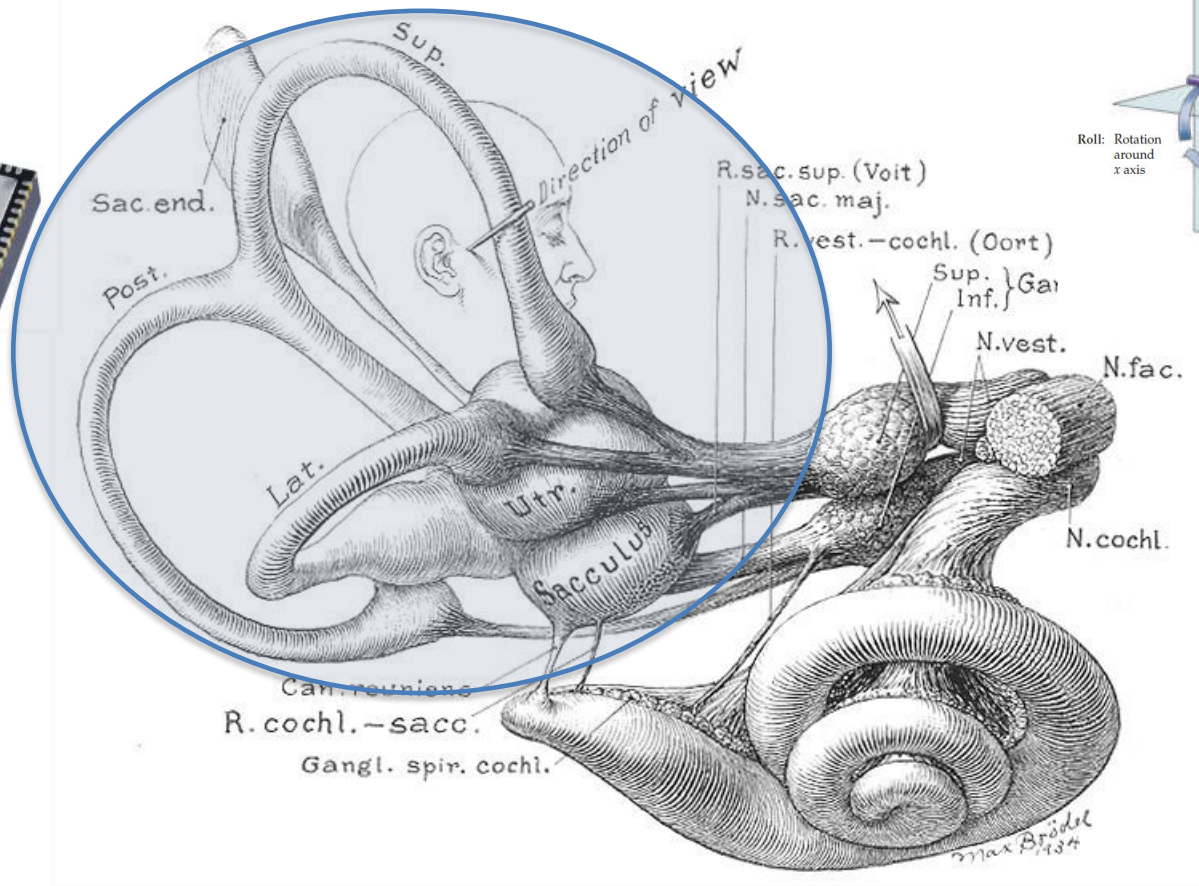
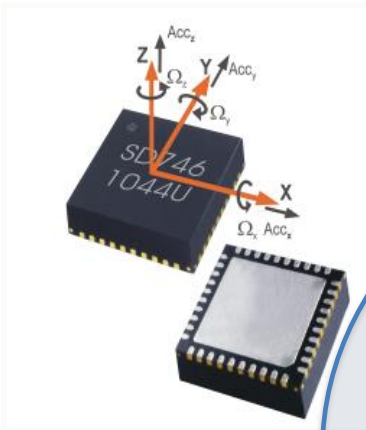
Avril 2023

Contenu

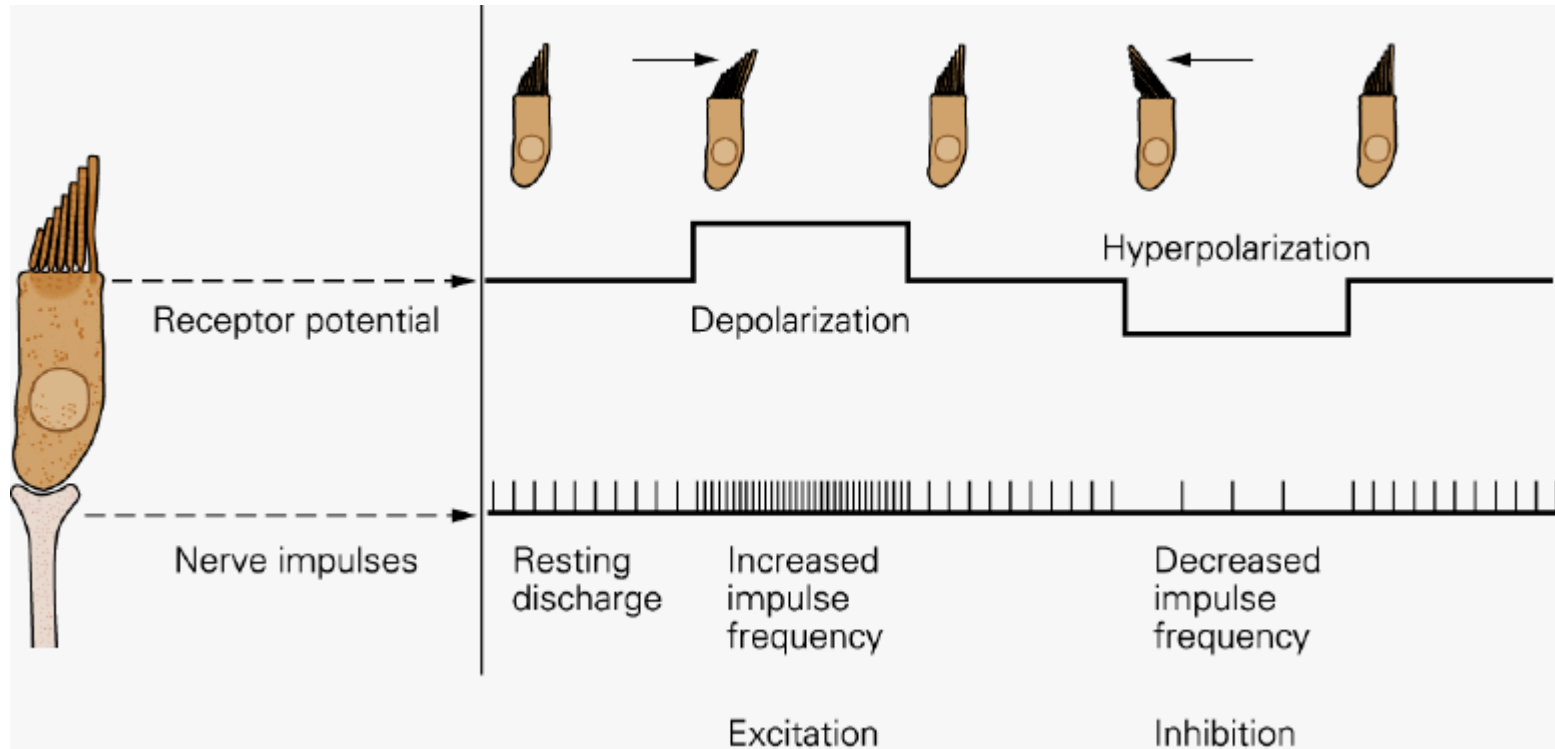
- Anatomie-Physiologie
- Pathophysiologie
- Head Impulse Test
- Urgences: atteinte centrale? HINTS
- Vignettes cliniques: Anamnèse!
- Manœuvres thérapeutiques VPPB
- Questions

Physiologie

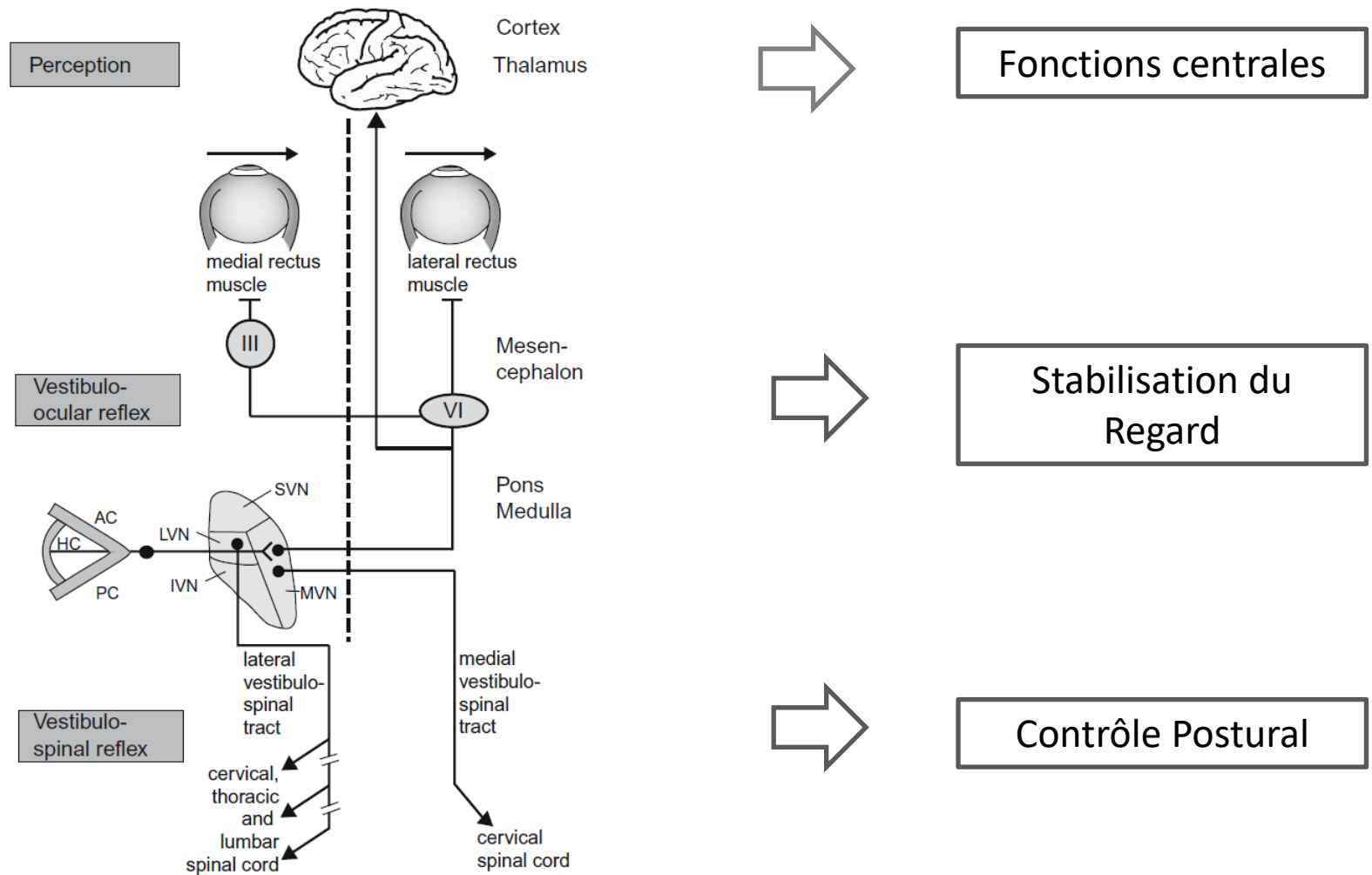
SYSTÈME VESTIBULAIRE: ANATOMIE--PHYSIOLOGIE



SYSTÈME VESTIBULAIRE: ANATOMIE--PHYSIOLOGIE



SYSTÈME VESTIBULAIRE: FONCTIONS CLÉS

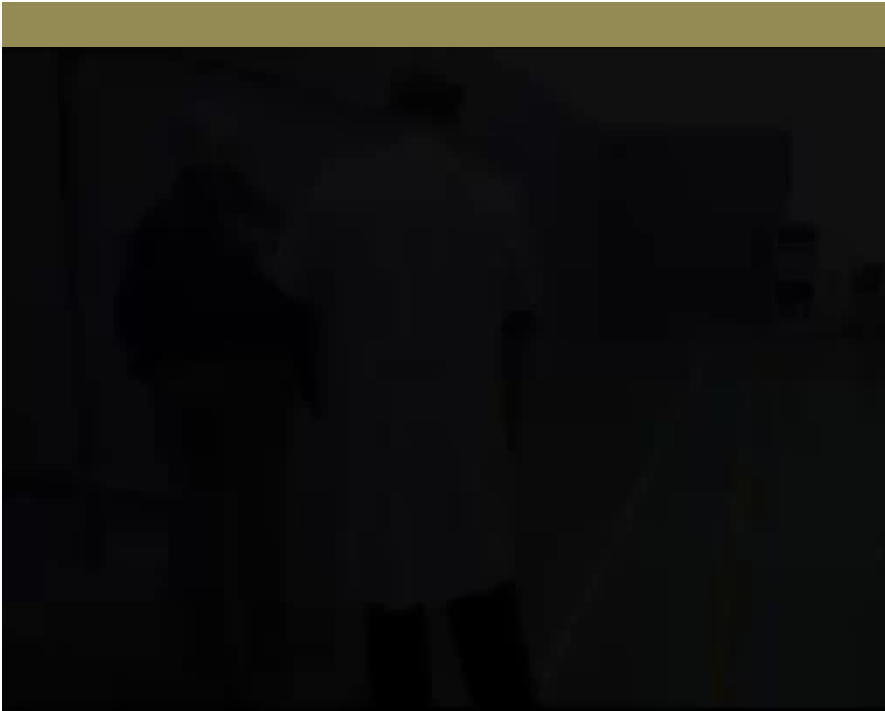


Vertigo and Dizziness, Brandt, 2005

PERTE BILATÉRALE DE LA FONCTION VESTIBULAIRE: CONSÉQUENCES CLINIQUES

Déséquilibre

Oscillopsie



PERTE BILATÉRALE DE LA FONCTION VESTIBULAIRE: CONSÉQUENCES CLINIQUES

«J'ai l'impression d'être ivre en
permanence et pourtant je ne bois
pas!»

PERTE BILATÉRALE DE LA FONCTION VESTIBULAIRE: CONSÉQUENCES CLINIQUES

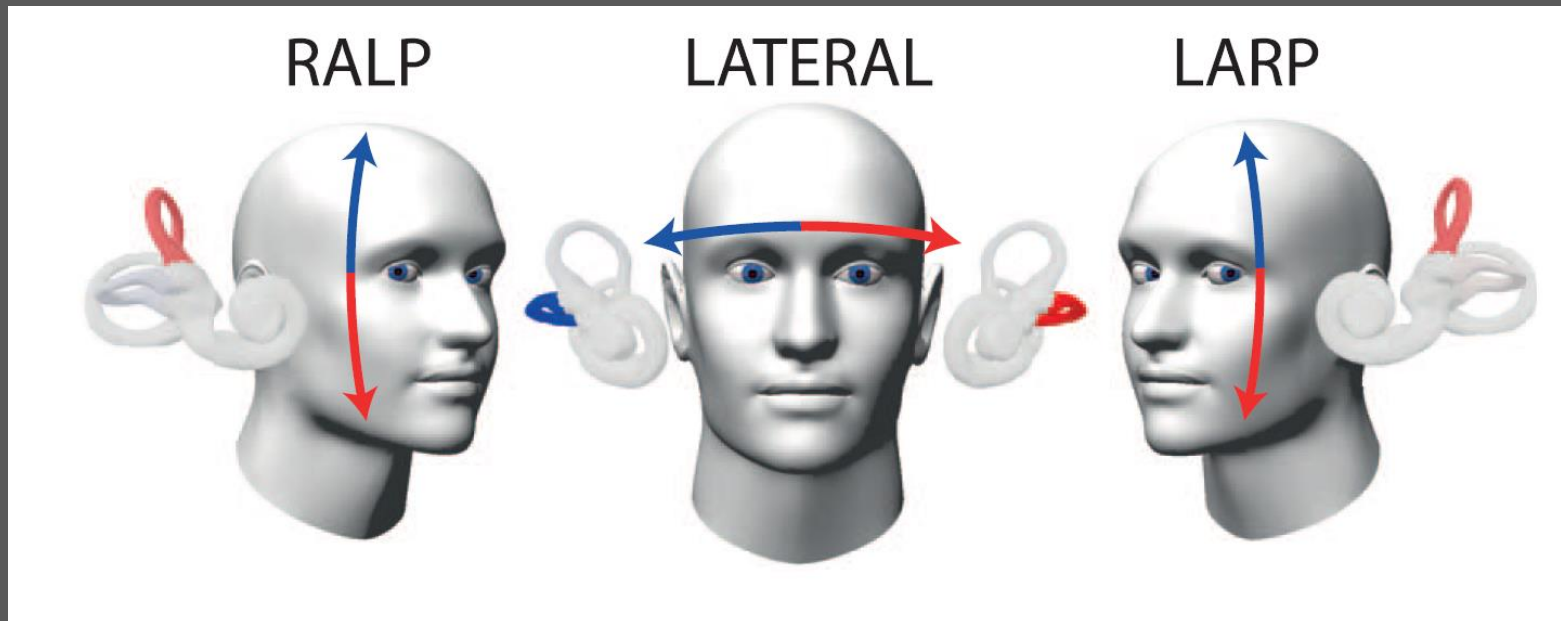
- Déséquilibre
- Oscillopsie

Pas seulement: fonction cognitive, orientation spatiale, personnalité, sommeil, métabolisme osseux, tension artérielle, émotions, mémoire spatiale, perception du mouvement... et probablement bien d'autres...

Evaluation de la fonction vestibulaire
(Réflexe vestibulo-oculaire):

Head Impulse Test (HIT)

HIT: Evaluation des 6 CSC



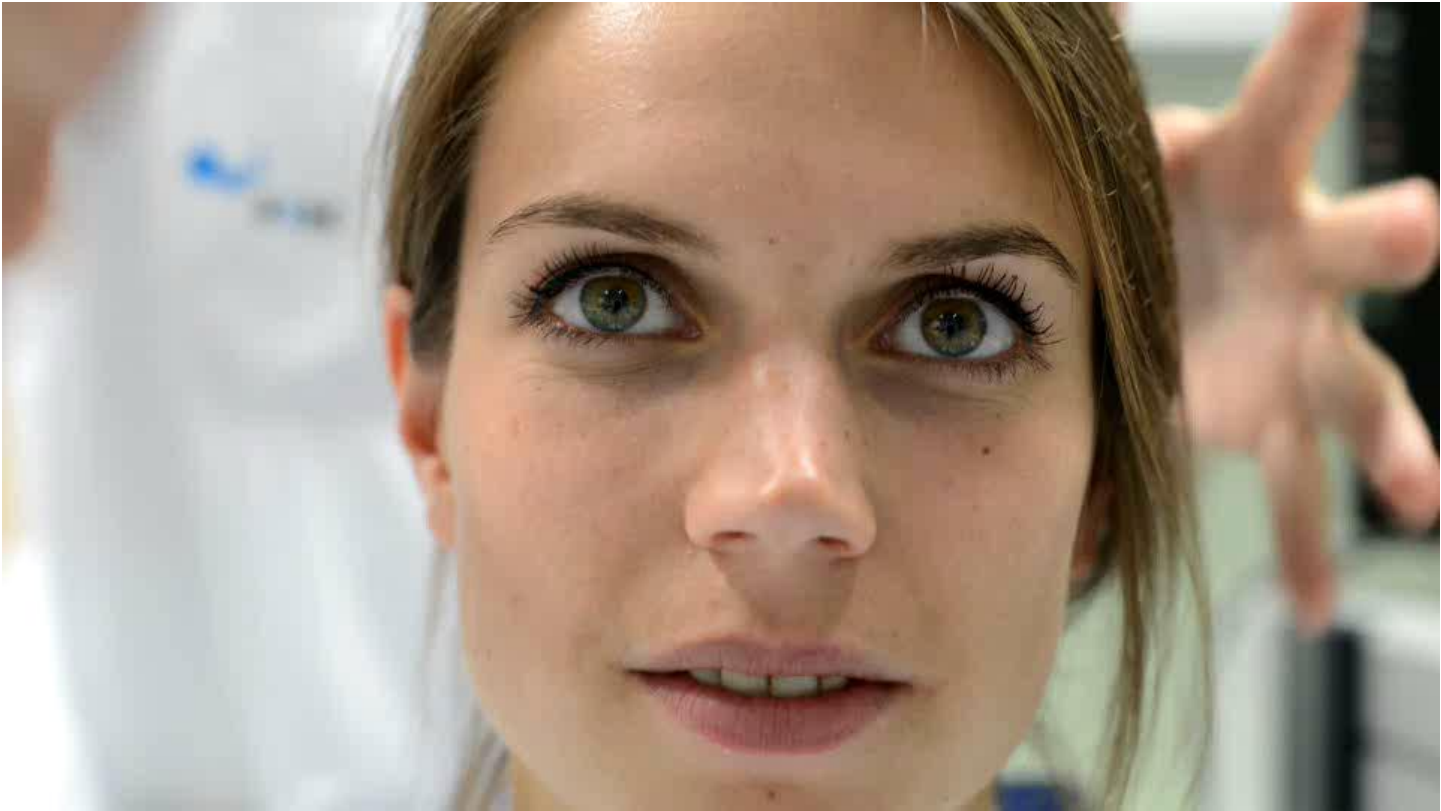
MacDougall 2009

Mouvement de tête passif, rapide, imprédictible
dans le plan de la paire de CSC testée

Sensibilité limitée

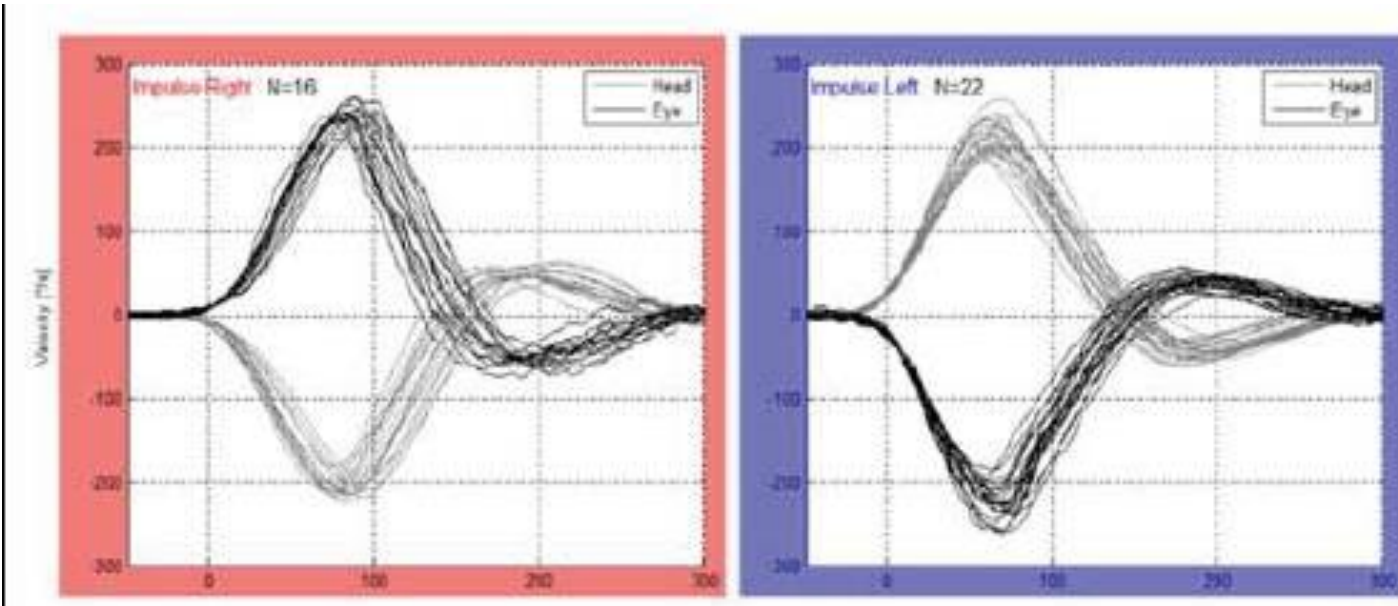
HIT: SUJET SAIN

Le Reflète vestibulaire est présent!



VIDÉO-HIT: SUJET SAIN

Le Reflète vestibulo-oculaire est présent!



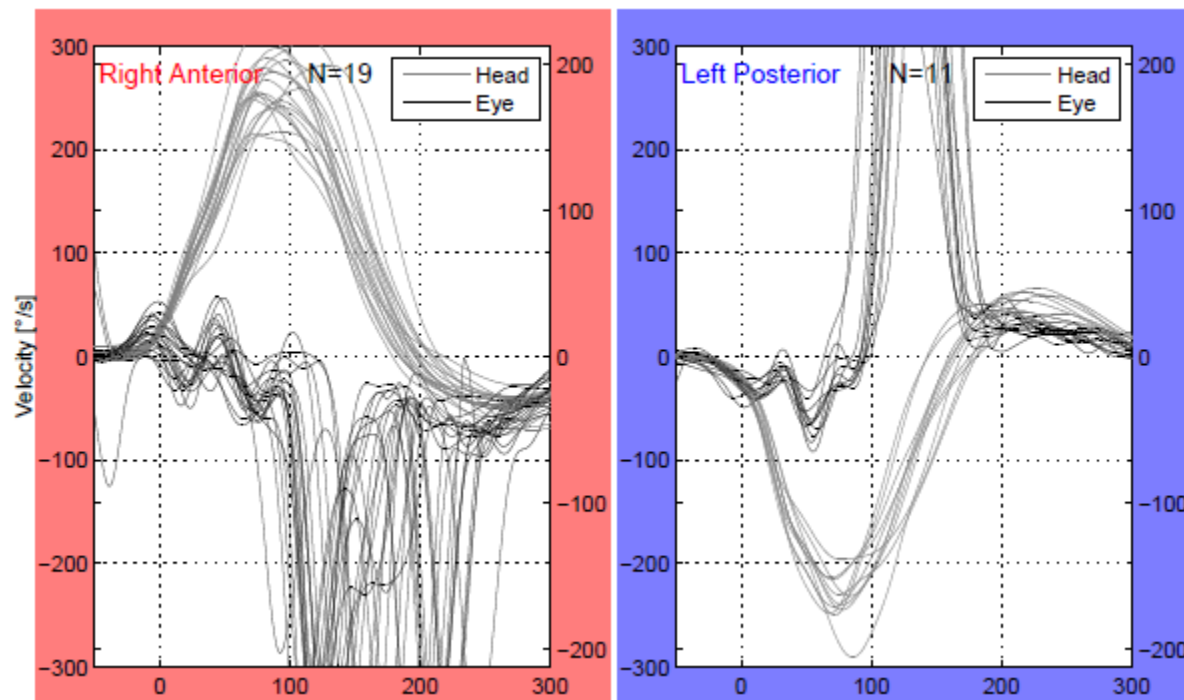
HIT: DÉFICIT VESTIBULAIRE BILATERAL

Le Reflète vestibulaire est absent!

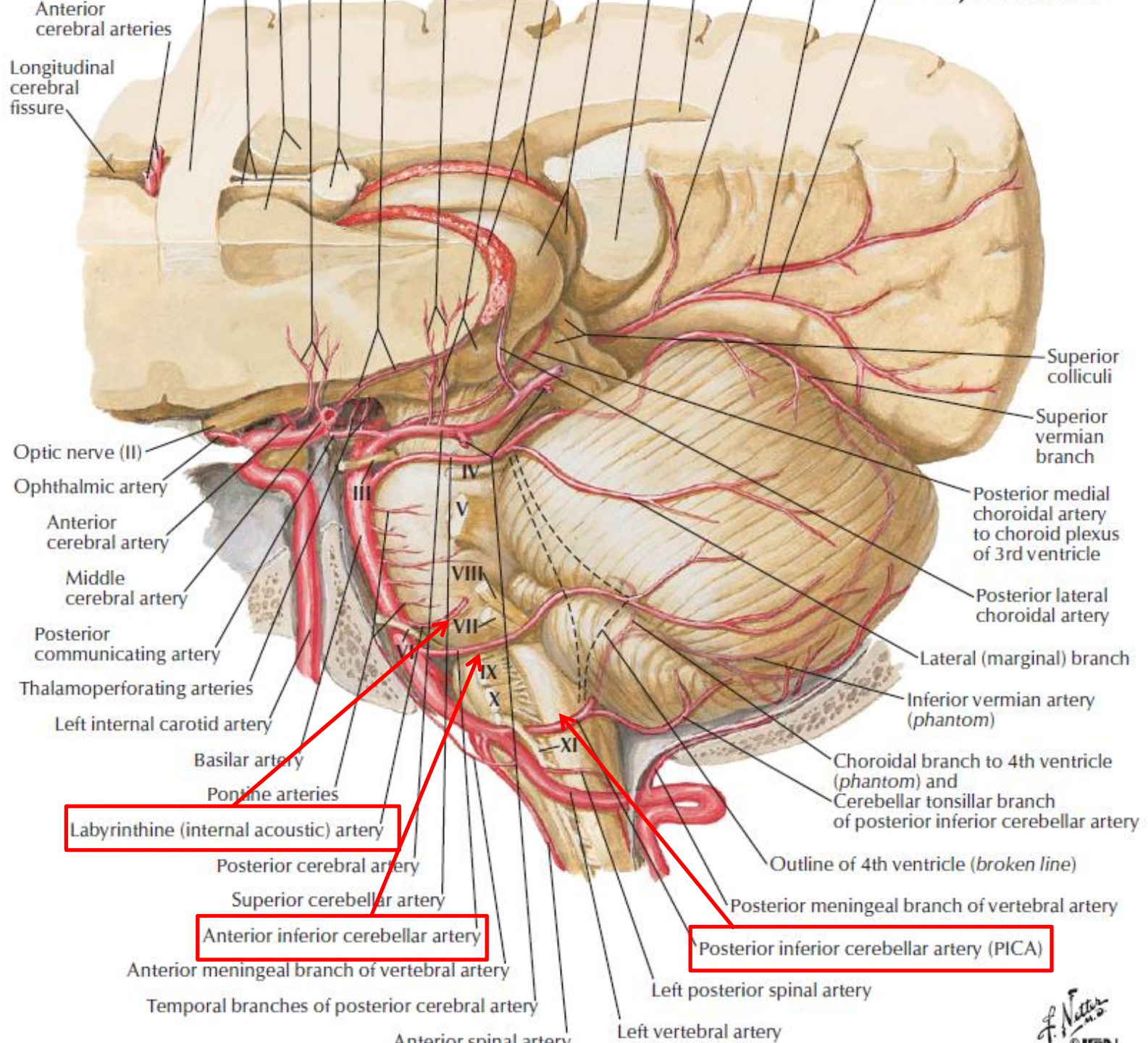


VIDÉO-HIT: Déficit vestibulaire bilatéral

Le Reflète vestibulo-oculaire est absent!



Atteinte centrale?
HINTS



Anterior cerebral arteries
Longitudinal cerebral fissure

Optic nerve (II)
Ophthalmic artery

Anterior cerebral artery
Middle cerebral artery

Posterior communicating artery
Thalamoperforating arteries

Left internal carotid artery
Basilar artery
Pontine arteries

Labyrinthine (internal acoustic) artery

Posterior cerebral artery
Superior cerebellar artery

Anterior inferior cerebellar artery

Anterior meningeal branch of vertebral artery
Temporal branches of posterior cerebral artery

Anterior spinal artery

Left vertebral artery

Superior colliculi

Superior vermicular branch

Posterior medial choroidal artery to choroid plexus of 3rd ventricle

Posterior lateral choroidal artery

Lateral (marginal) branch

Inferior vermicular artery (phantom)

Choroidal branch to 4th ventricle (phantom) and Cerebellar tonsillar branch of posterior inferior cerebellar artery

Outline of 4th ventricle (broken line)

Posterior meningeal branch of vertebral artery

Posterior inferior cerebellar artery (PICA)

Left posterior spinal artery

F. Netter M.D.

Éléments prédicteurs d'un AVC?

Oui	Non
Prodromes: épisodes récidivants de vertige (sec. à min.) dans les semaines/mois précédants	Type de vertige
Installation abrupte	Augmentation lors de mouvement de la tête
Age	Intensité du vertige
Presence de symptômes neurologiques	Absence de symptômes neurologiques
Trouble auditif associé	
Impossibilité de tenir debout sans aide	
Douleurs cranio-cervicales	

Acute Vestibular Syndrome (AVS)

«When dizziness develops acutely, is accompanied by nausea or vomiting, unsteady gait, nystagmus and intolerance to head motion, and persists for ≥ 24 hours.»

Nystagmus spontané



Dans le cas d'un AVS: HINTS

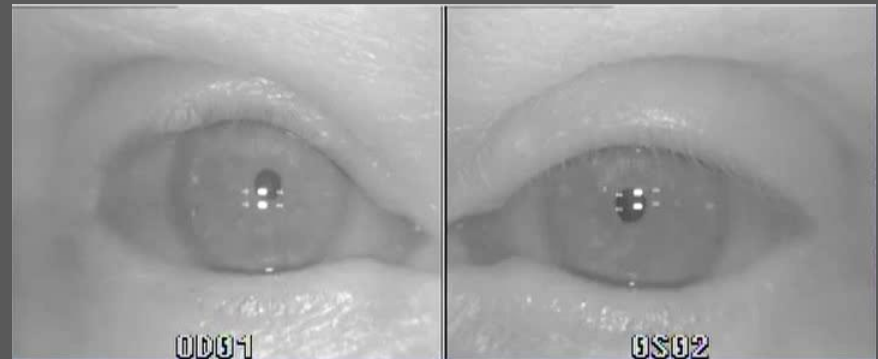
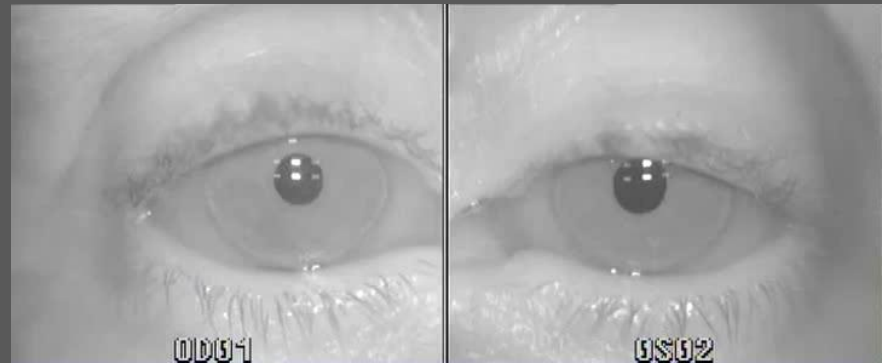
1. Normal Head Impulse
and/or

2. Gaze nystagmus
and/or

3. Skew deviation

→ Stroke

Sensibilité > IRM



HINTS (Head Impulse Test, Gaze Nystagmus, Skew Deviation)






HINTS

Exemples cliniques

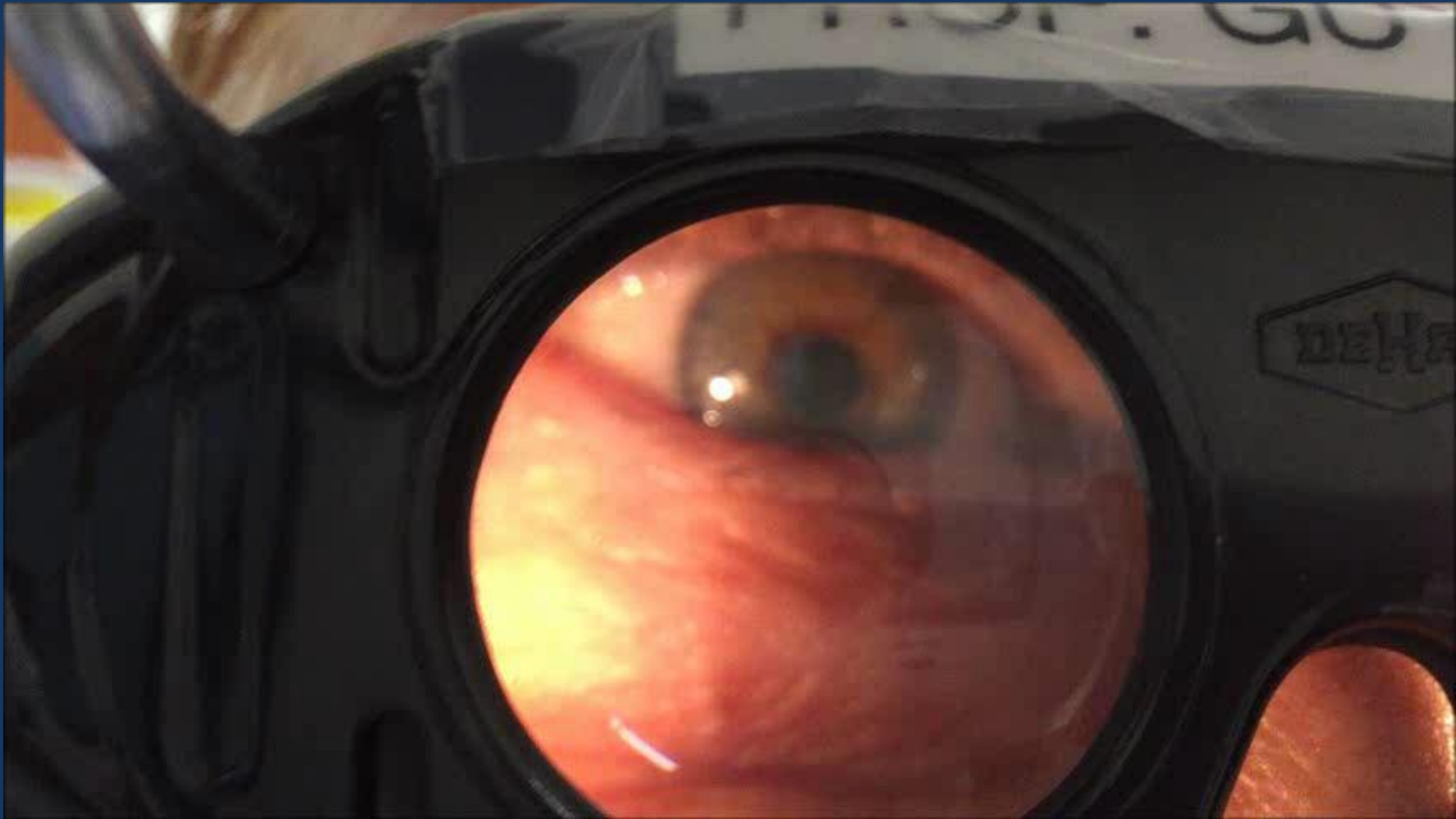
Acute Vestibular Syndrome (AVS)

«When dizziness develops acutely, is accompanied by nausea or vomiting, unsteady gait, nystagmus and intolerance to head motion, and persists for ≥ 24 hours.»

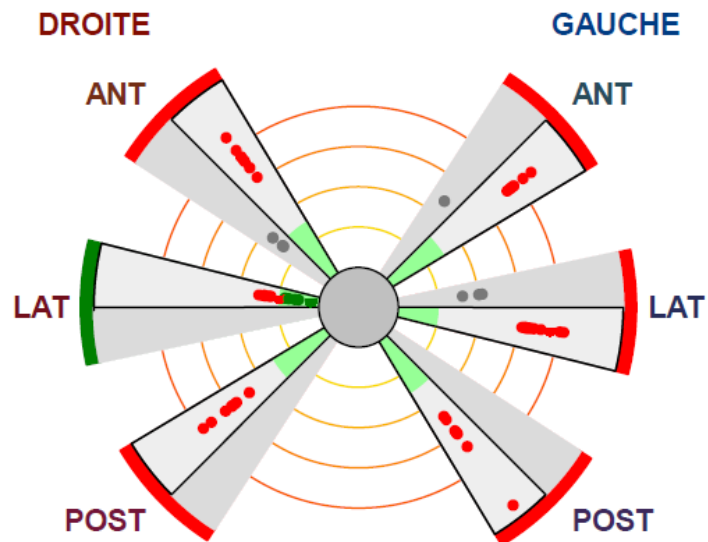
HINTS

- HIT pathologique → 
- Pas de changement de direction du nystagmus → 
- Pas de skew deviation → 

**Déficit vestibulaire brusque
gauche**






vHIT



Impulsions		VOR		Saccades précoces		
Canal	n	Gain moyen	σ	Ratio	Latence moyenne	Gain apparent moyen
Ant D.	7	0.26	0.07	42 %	195 ms	0.70
Ant G.	7	0.21	0.05	14 %	180 ms	0.52
Lat D.	12	0.80	0.08	0 %		
Lat G.	13	0.31	0.07	23 %	187 ms	0.62
Post D.	8	0.38	0.09	0 %		
Post G.	8	0.36	0.17	0 %		

HINTS

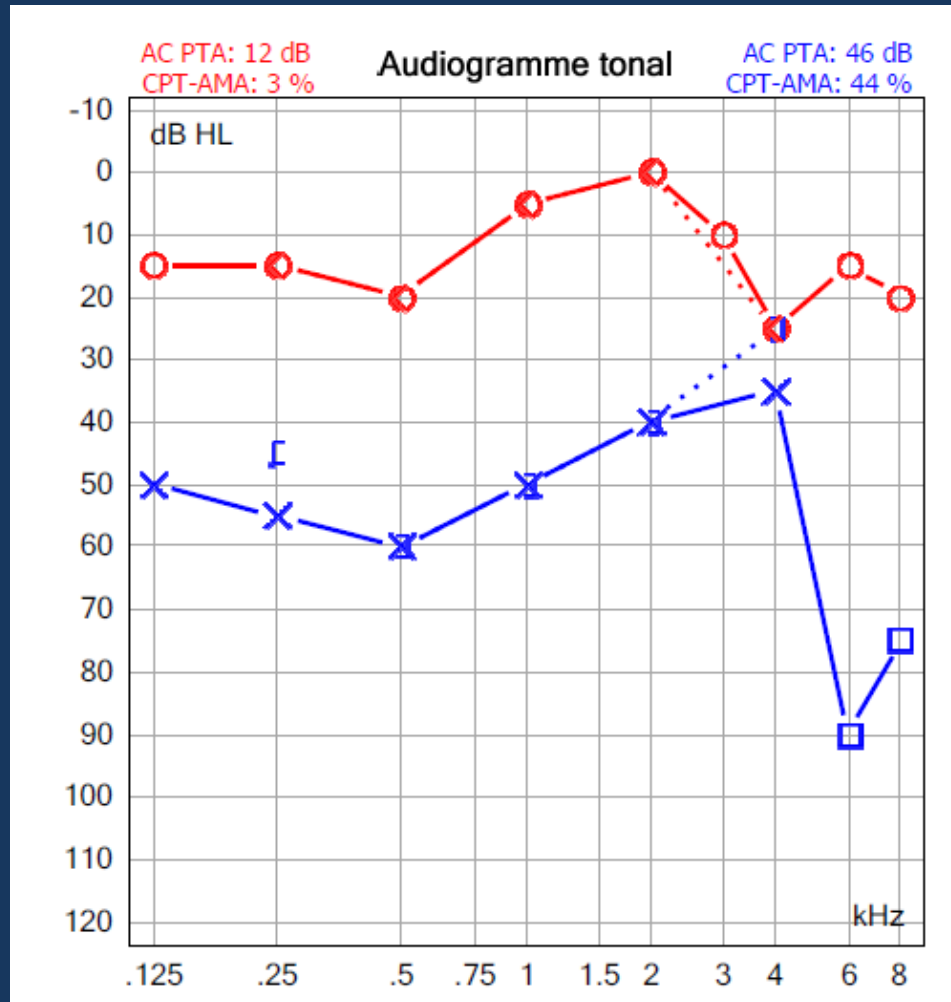
- HIT pathologique → 
- Pas de changement de direction du nystagmus → 
- Pas de skew deviation → 

**Déficit vestibulaire brusque
gauche**

CASE 3—Male 55 years old

- 24 hours ago, while paragliding (rapid turns and altitude changes), vertigo and hypoacusis left
- Transitory horizontal diplopia
- Vomiting

Hearing



HINTS

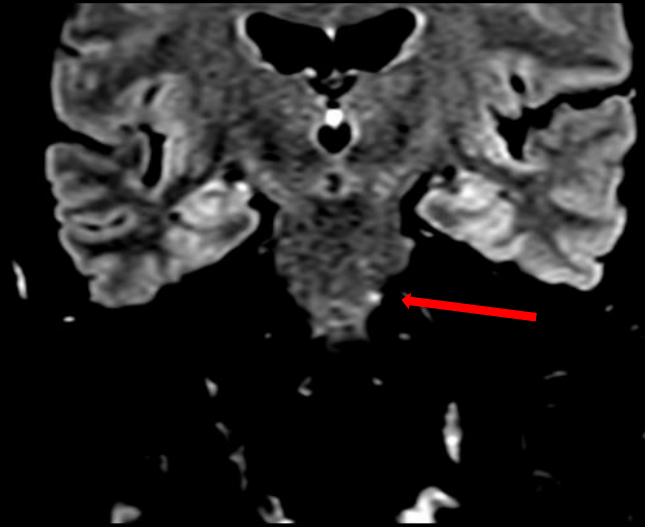
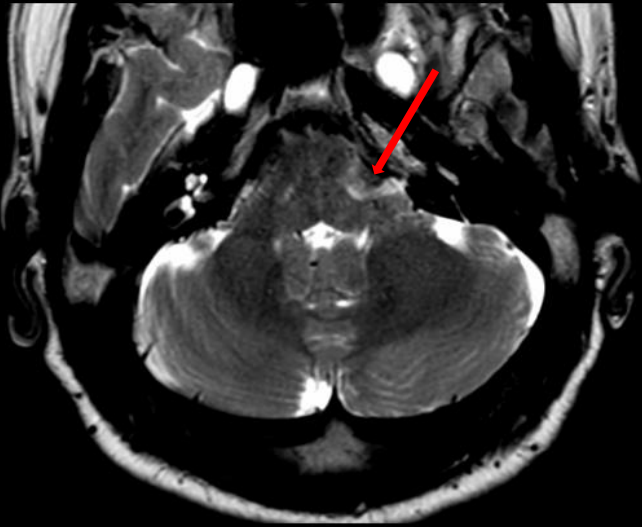
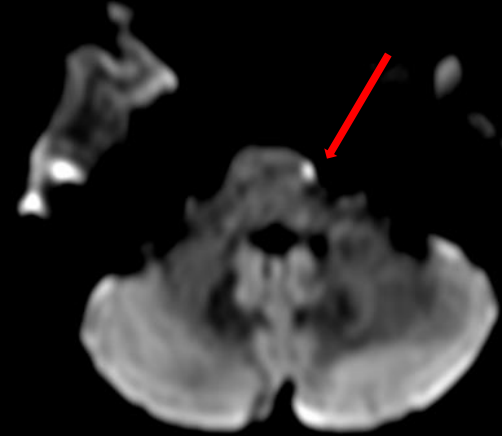
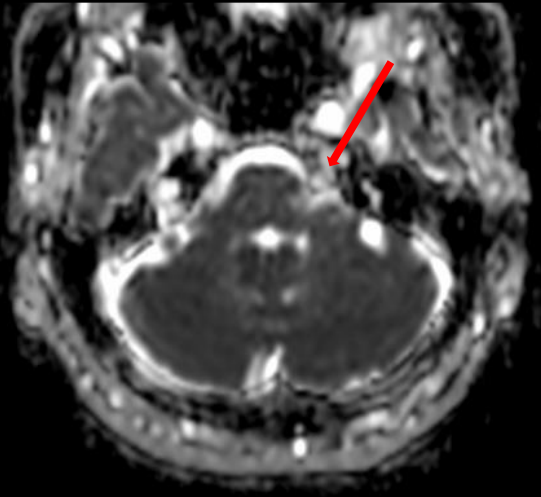
• HIT pathological → 

• No clear Gaze Nystagmus → 

• Skew deviation → 

HINTS +

Cave: SensoriNeural Hearing Loss → 

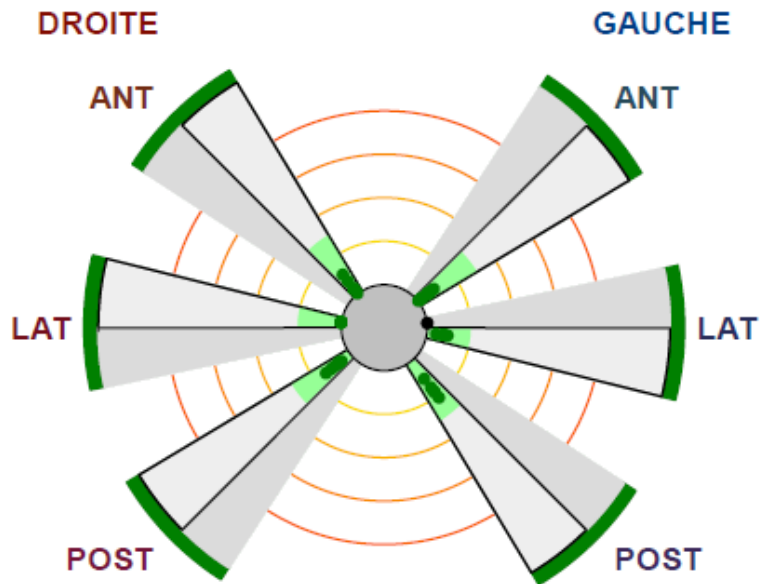


Stroke

PICA left

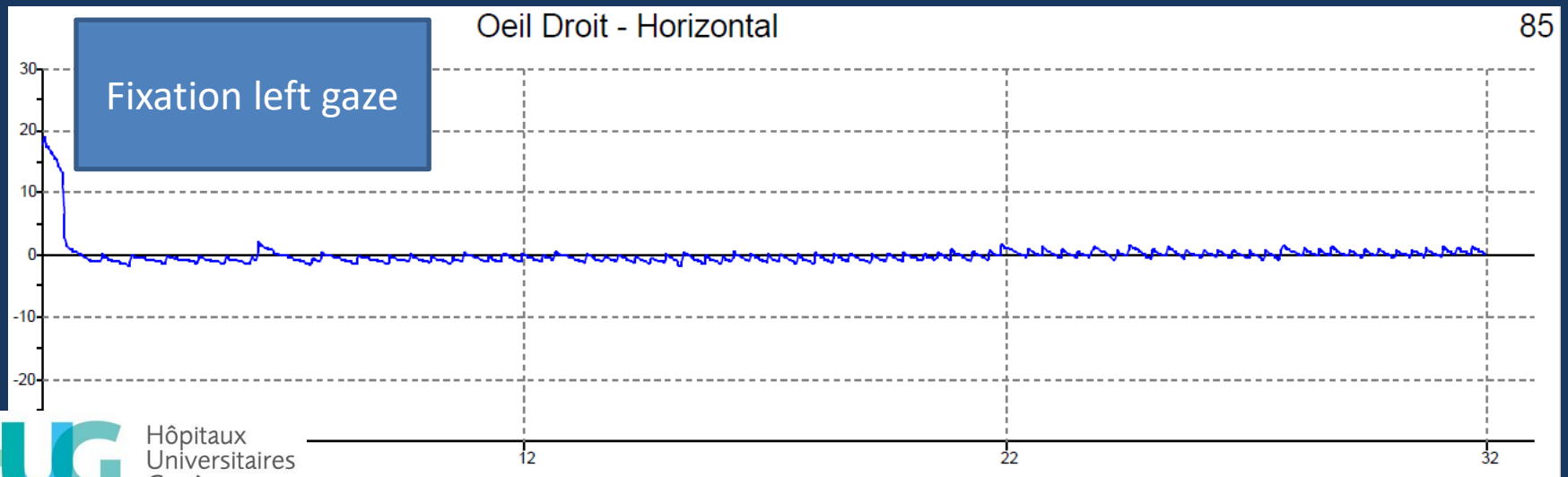
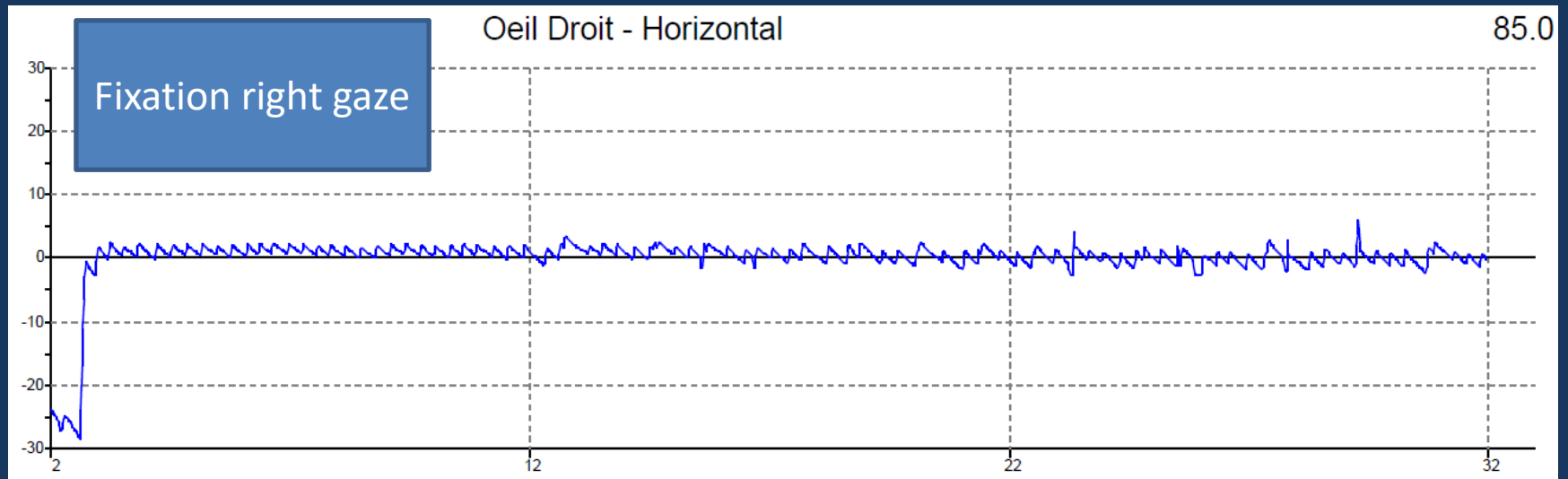


vHIT

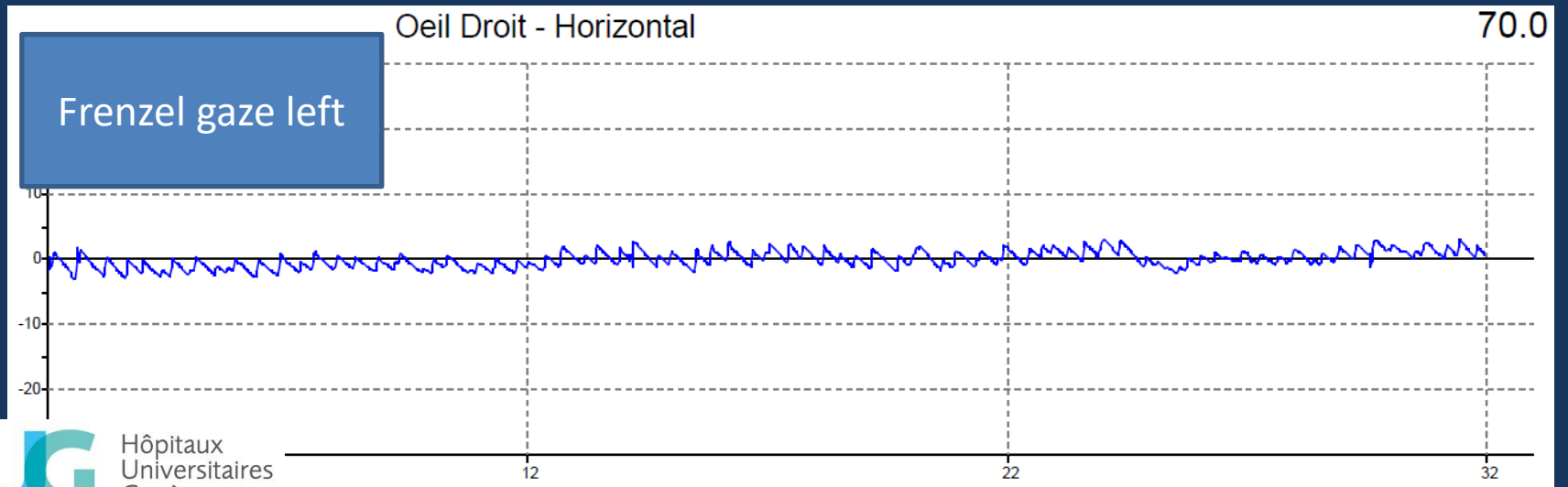
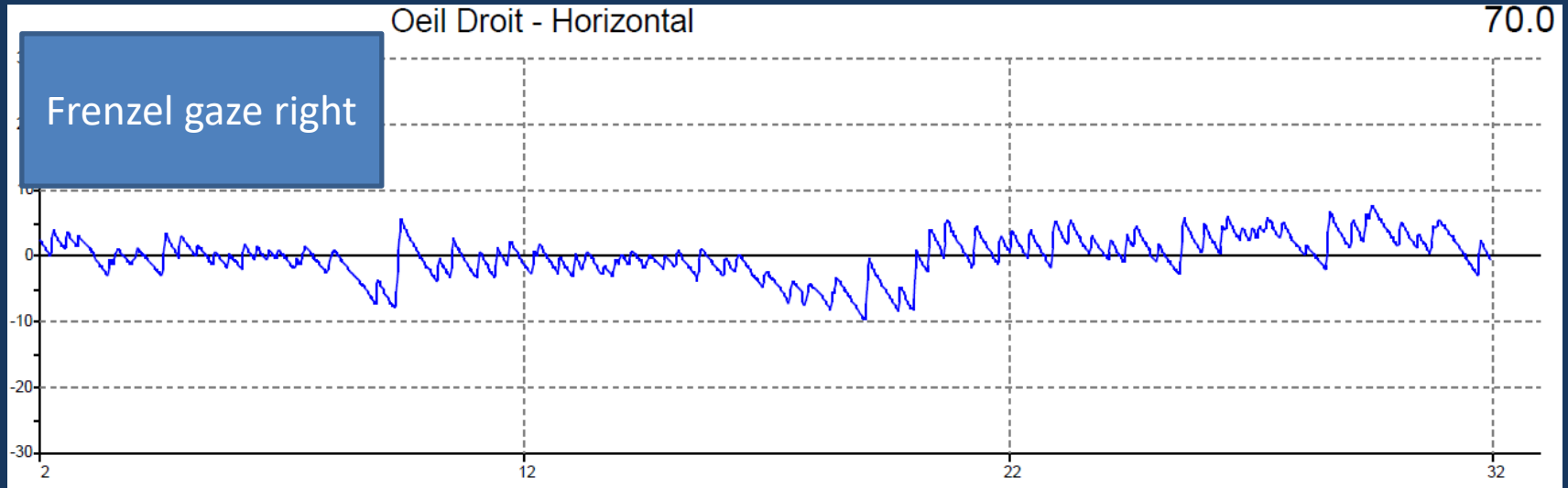


Impulsions		VOR		Saccades précoces		
Canal	n	Gain moyen	σ	Ratio	Latence moyenne	Gain apparent moyen
Ant D.	5	0.95	0.04	0 %		
Ant G.	11	0.96	0.03	0 %		
Lat D.	9	1.13	0.04	0 %		
Lat G.	8	0.93	0.01	25 %	168 ms	1.06
Post D.	8	0.92	0.03	0 %		
Post G.	5	0.84	0.04	0 %		

Spontaneous Nystagmus






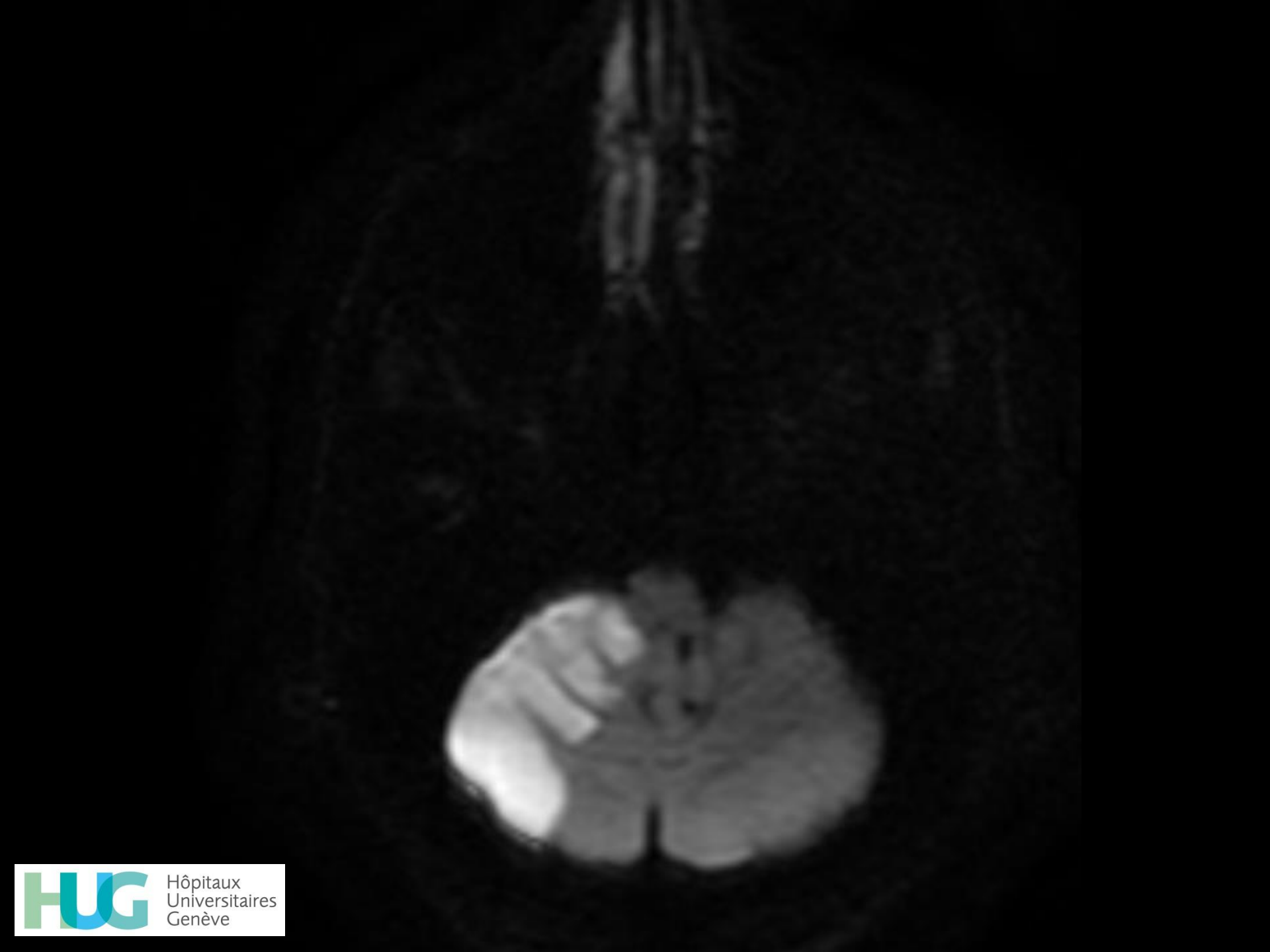
Spontaneous Nystagmus



No Skew Deviation

HINTS

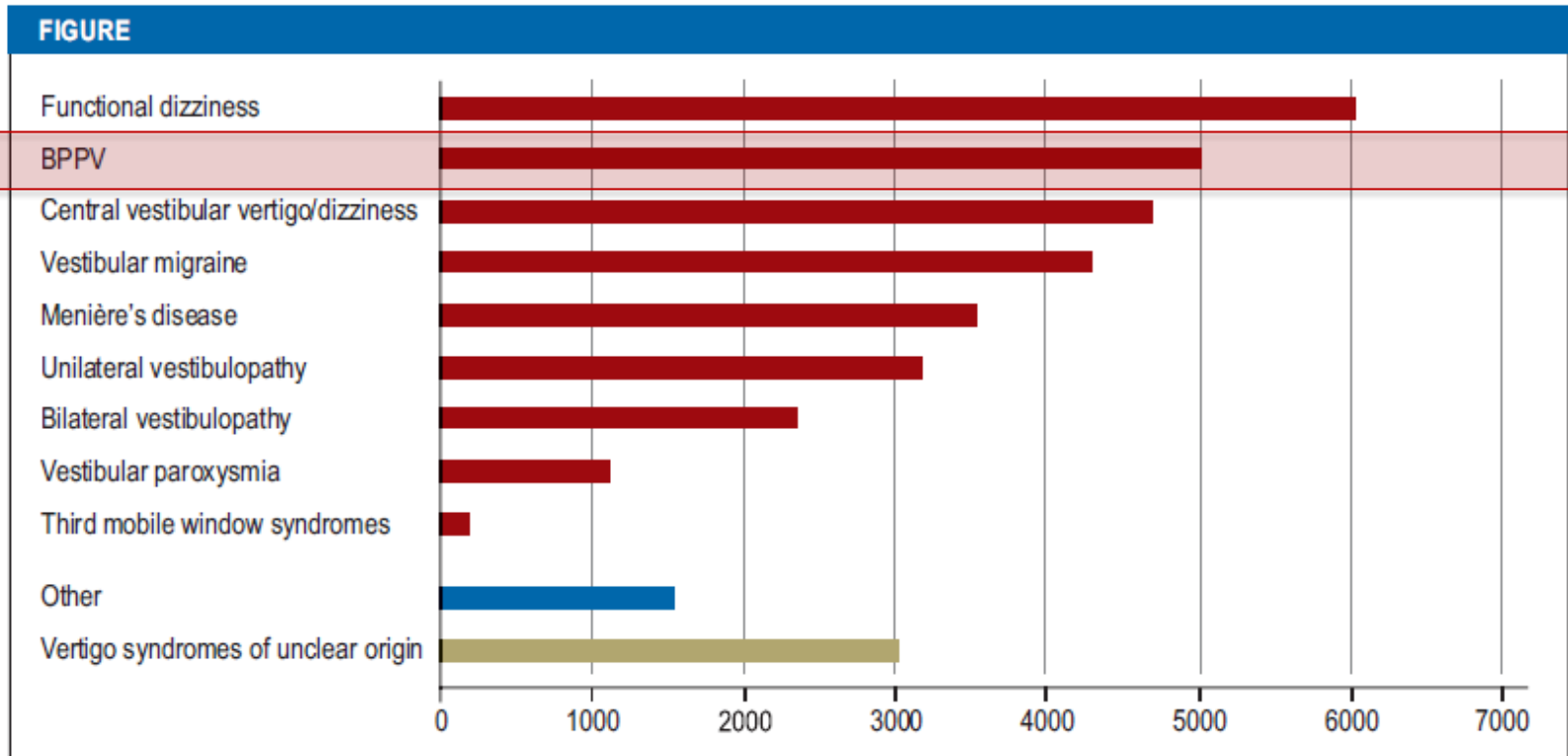
- HIT normal → 
- No gaze nystagmus → 
- No skew deviation → 



Stroke

PICA right

Vertiges: diagnostics principaux



The frequency of various vestibular syndromes among 34 860 patients in a specialized outpatient clinic

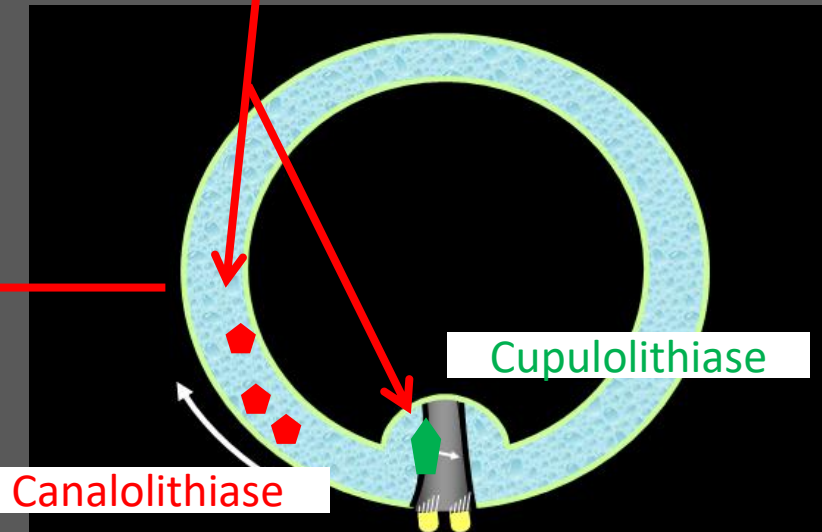
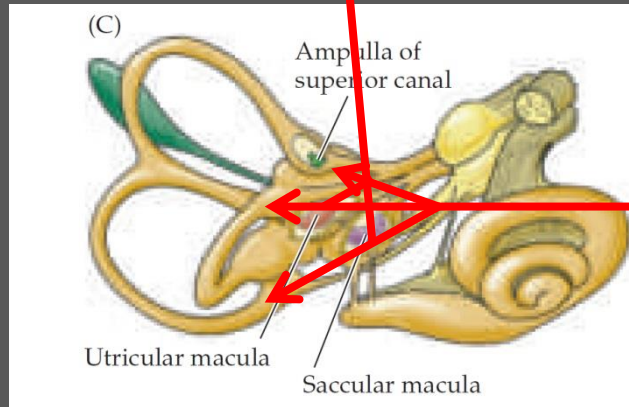
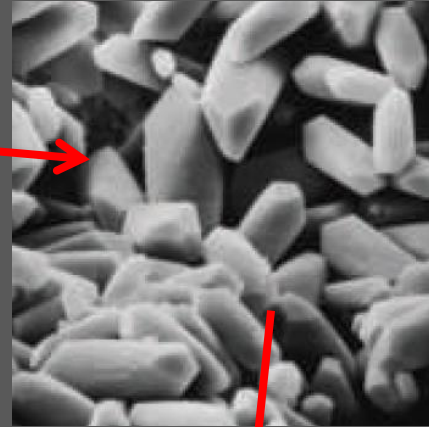
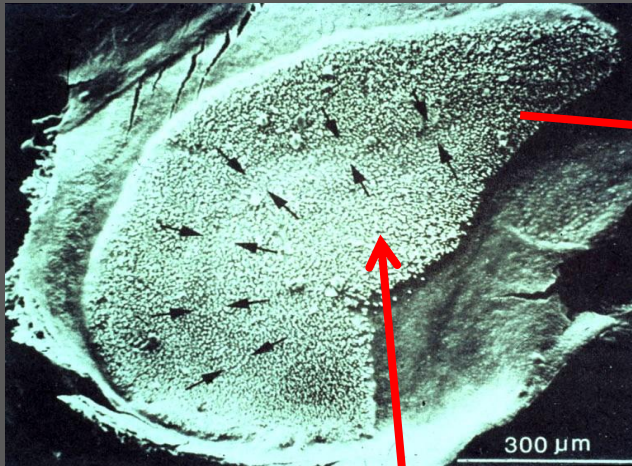
Absolute frequencies of various vertigo/dizziness syndromes in the supraregional specialized outpatient clinic of the German Center for Vertigo and Balance Disorders and the Department of Neurology, LMU, Munich, Germany (1998–2019). BPPV, Benign paroxysmal positional vertigo.

Origine périphérique

Vertige Paroxystique Bénin de Position (VPPB)

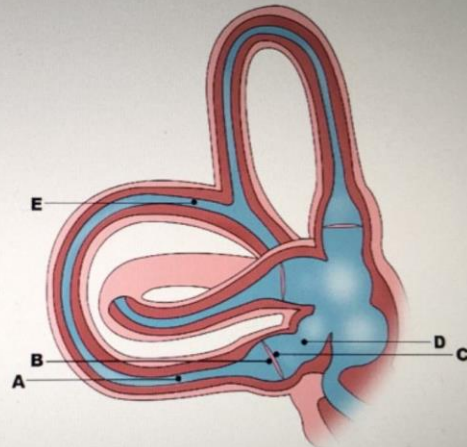
- Revue médicale suisse oct 2022
- <https://doi.org/10.53738/REVMED.2022.18.798.1848>

Vertige Paroxystique Bénin de Position (VPPB)



POSSIBLE LOCALISATIONS OF THE DISPLACED OTOLITHS

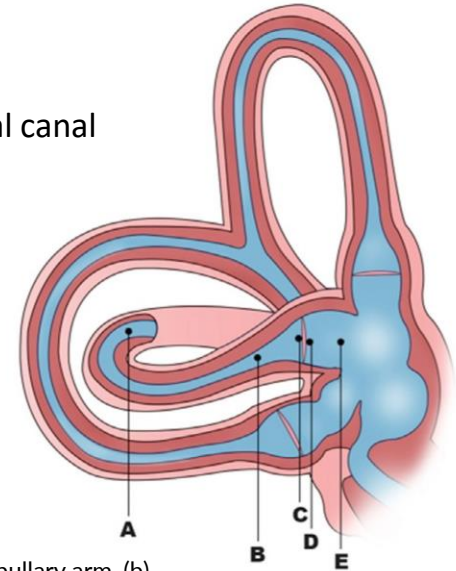
Posterior canal



- (A) Long arm
- (B) Cupula (canal side)
- (C) Cupula (Utricle side)
- (D) Short arm
- (E) Non-ampullary end

© NeuroEquilibrium.in

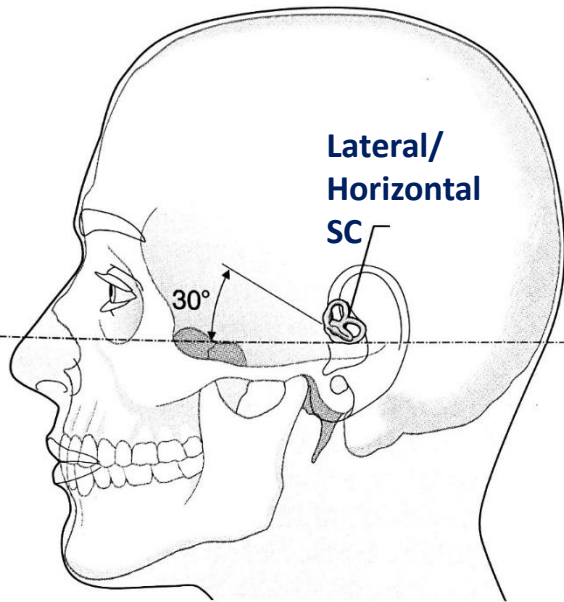
Horizontal canal



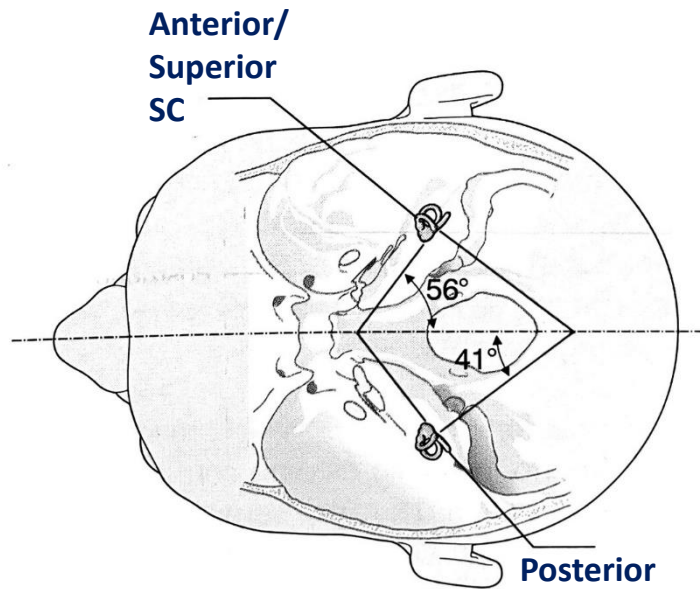
- (a) Canalithiasis nonampullary arm,
- (b) Canalithiasis in the ampullary arm,
- (c) Cupulolithiasis on the canal side,
- (d) Cupulolithiasis on the utricle side,
- (e) Canalithiasis in the short arm

© NeuroEquilibrium.in

HOW TO DIAGNOSE?



41° from the sagittal plane



Anterior/ Superior SC
56° from the sagittal plane



Lateral/Horizontal SC
30° from the horizontal plane

VPPB CSC postérieur (80%)

Anamnèse: Episodes brefs (<60 sec) de vertiges rotatoires, déclenchés par un mouvement

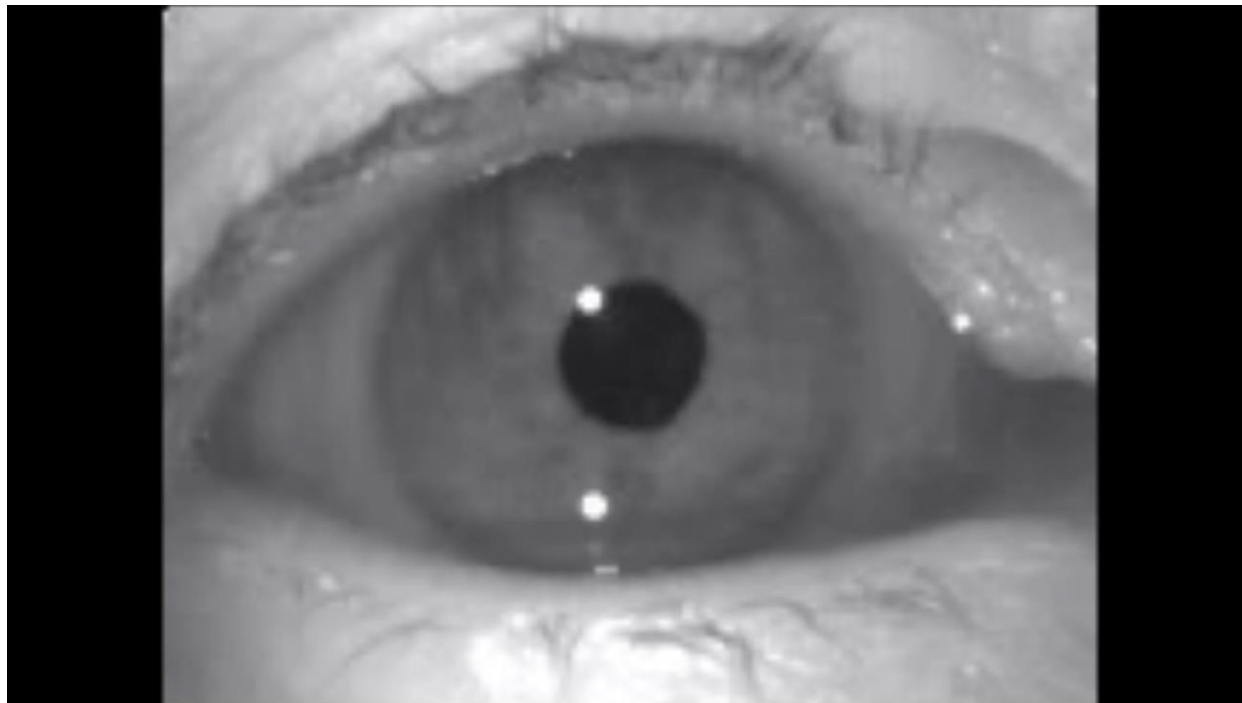
Causes: post traumatique, post neuronite?, osteoporose?
Idiopathique.

Diagnostic: Manœuvre de Dix-Hallpike →

1. Nystagmus ( + )
2. < 60 secondes
3. Latence
4. Epuisable
5. Réversible



HP BPPV POSTERIOR RIGHT

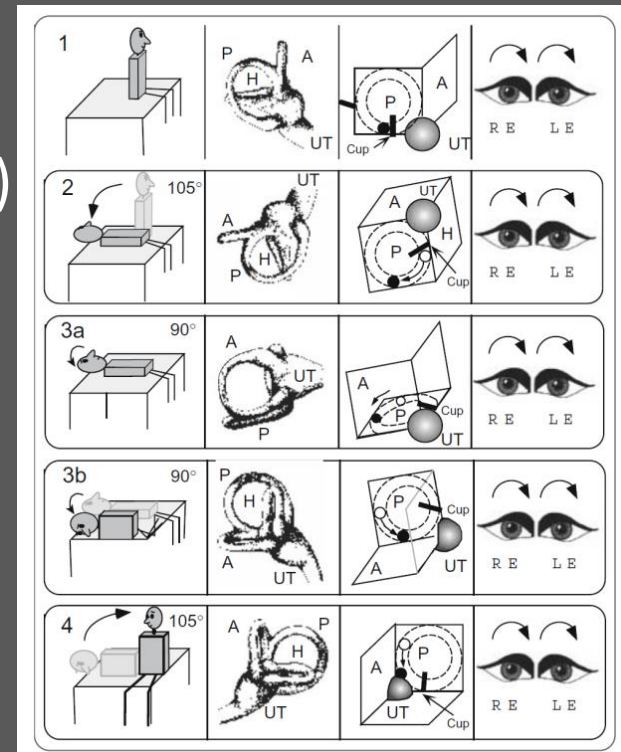


VPPB CSC postérieur (80%)

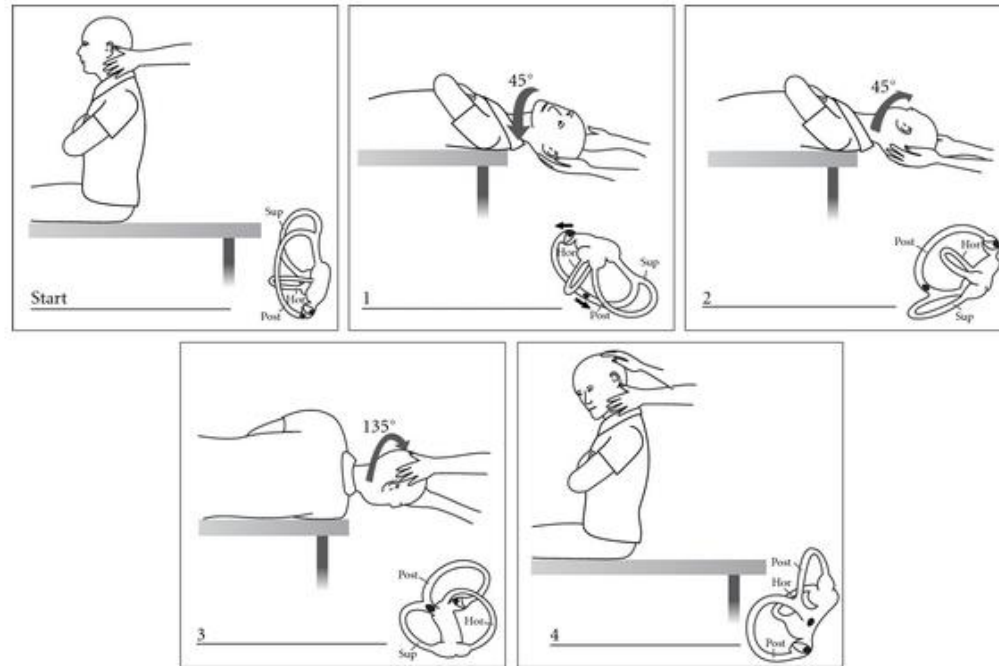
Traitement: Epley, Semont (95% de succès),
spontanée (>75%)

Récidives: 50% (80% dans le 1^{ère} année)

Incontrôlable: Section du
nerf ampullaire postérieur,
plugging du CSC postérieur

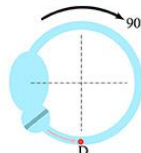
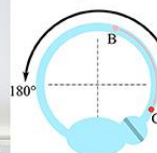
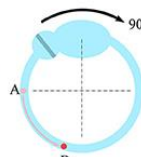


EPLEY

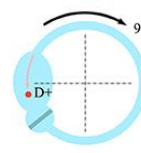
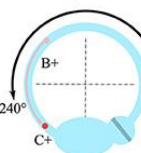
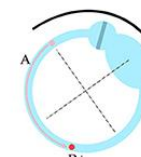
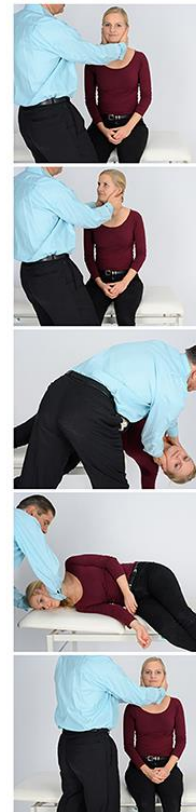


SEMONT/SEMONT PLUS

Sémont



SémontPLUS



SEMONT PLUS MANEUVER



Right Ear



[Bhandari 2021](#)
[Frontiers | BPPV Simulation: A Powerful Tool to Understand and Optimize the Diagnostics and Treatment of all Possible Variants of BPPV \(frontiersin.org\)](#)

VPPB CSC latéral (15%)

Anamnèse: Episodes brefs (<60 sec) de vertiges rotatoires, déclenchés par une rotation de la tête en position couchée

Causes: post traumatique, post neuronite?, osteoporose? idiopathique

Diagnostic: « Test du CSC latéral » →

1. nystagmus →

Canalolithiase antérieure:

géotrope

(ipsilatéral > contralatéral)

Canalolithiase postérieure:

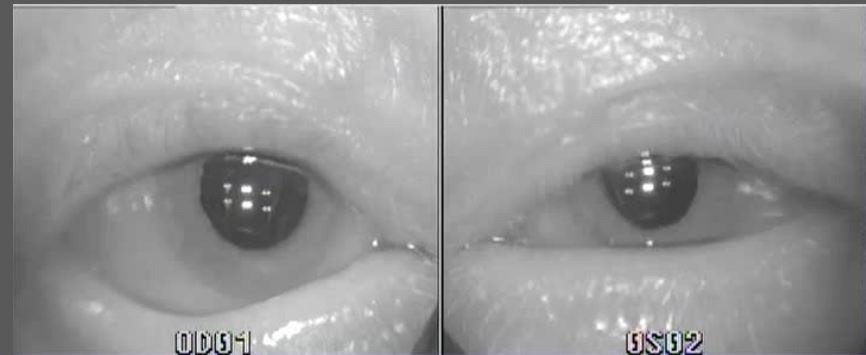
agéotrope

(contralatéral > ipsilatéral)

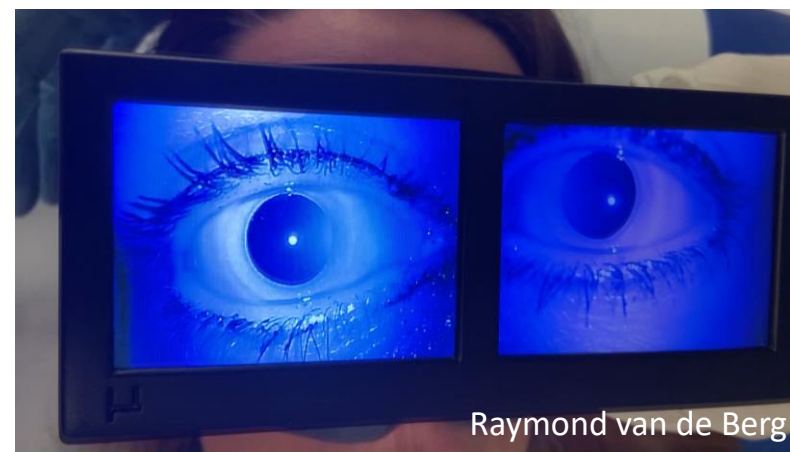
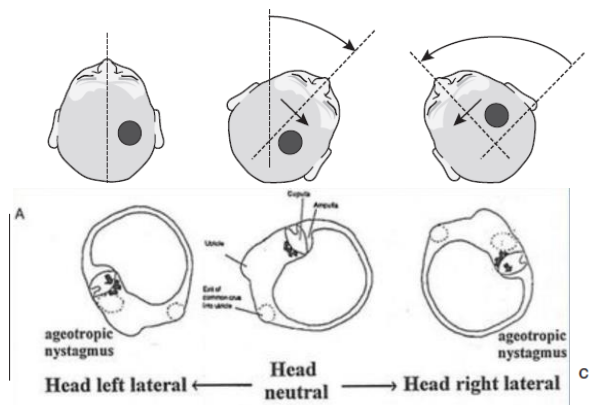
2. latence plus courte que VPPB post.

3. durée secondes à minutes

4. pas de franche fatiguabilité



SUPINE HEAD ROLL TEST: HORIZONTAL BPPV



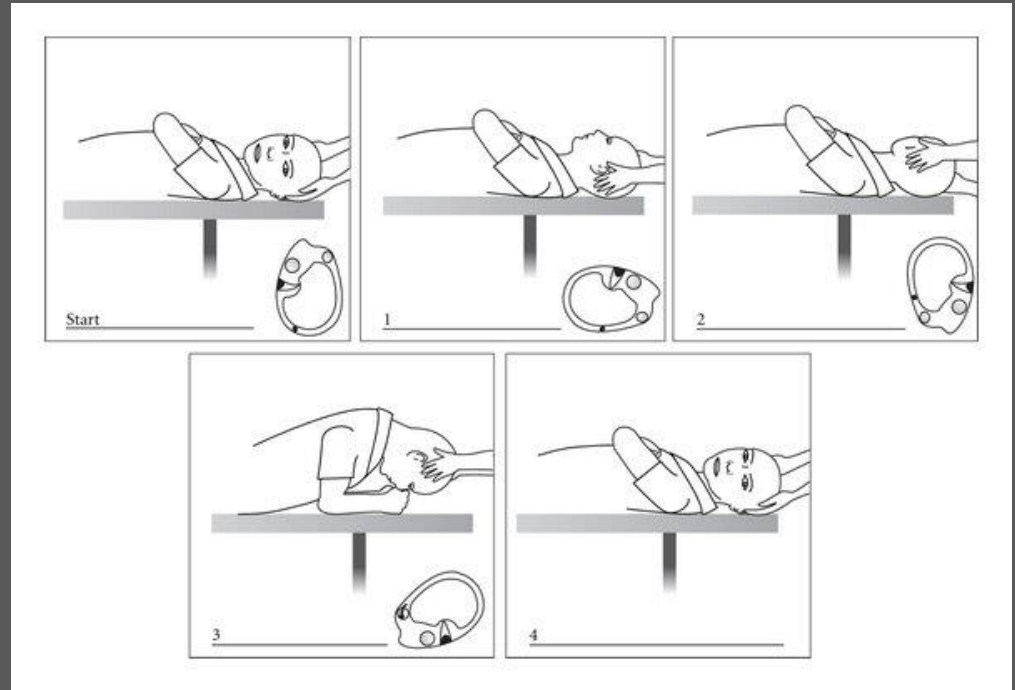
Apogeotropic Nystagmus

Both sides
Weaker towards the affected side
(Inhibitory)

VPPB CSC latéral (15%)

Traitement: Gufoni (86% de succès), barbecue (log roll),
position latérale > 12 heures,
spontanée (qq semaines)

Récidives: rare



VPPB CSC antérieur (<5%)

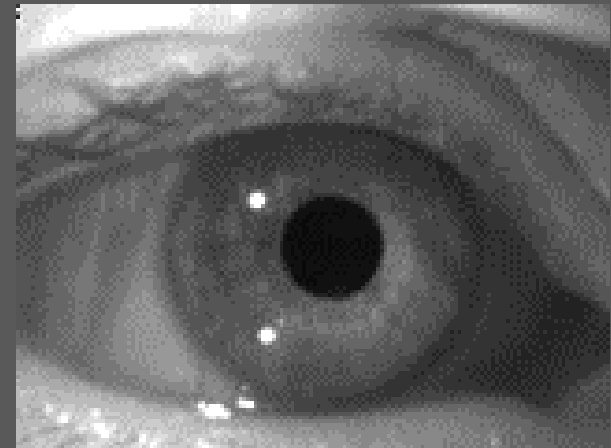
Anamnèse: Episodes brefs (<60 sec) de vertiges rotatoires, déclenchés par un mouvement

Causes: post traumatique, post neuronite?, osteoporose? idiopathique

Diagnostic: Hallpike →

1. Nystagmus (↻ + ↓)
2. < 60 secondes
3. Latence
4. Epuisable
5. Réversible

Traitement: Yacovino (85%)



MODIFIED YACOVINO MANEUVER



Right Ear



**Neuro
Equilibrium**
www.neuroequilibrium.in

[Bhandari 2021](#)

[Frontiers | Diagnostic and Therapeutic Maneuvers for Anterior Canal BPPV Canalithiasis: Three-Dimensional Simulations \(frontiersin.org\)](#)

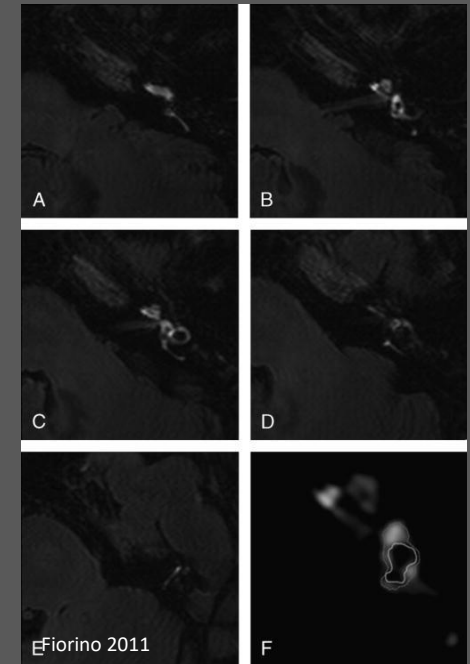
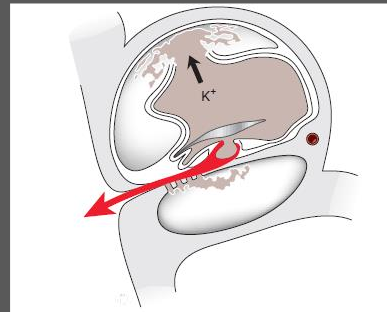
Maladie de Menière

Maladie de Menière

Anamnèse: -Episodes récidivants de vertige (minutes à heures)
-Hypoacousie (év. fluctuante)
-Acouphène (év. fluctuant)
-sensation de plénitude dans l'oreille

Cause: -inconnue

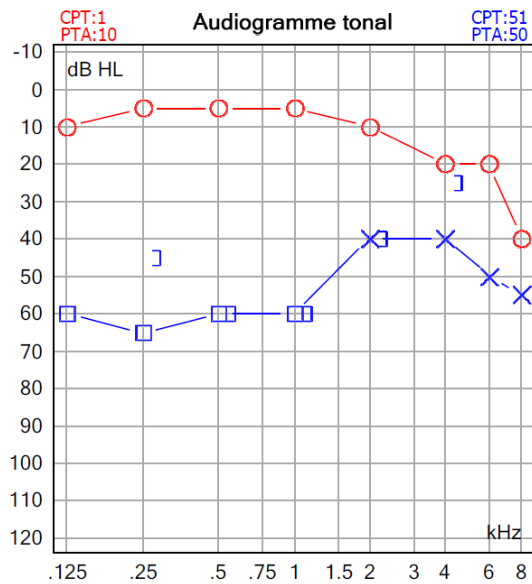
Diagnostic: -anamnèse, audiogramme, év. déficit vestibulaire pendant la crise
-év IRM après injection transtympanique de gadolinium,
-év DDPOEA



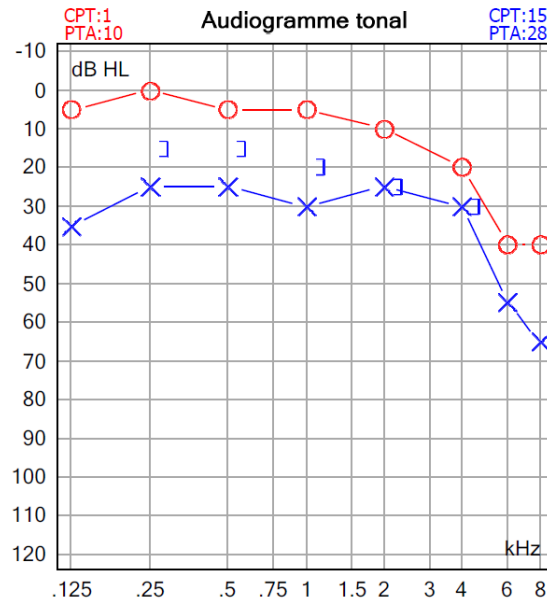
Maladie de Menière

Diagnostic: déficit de perception (classiquement les fréquences basses), fluctuant

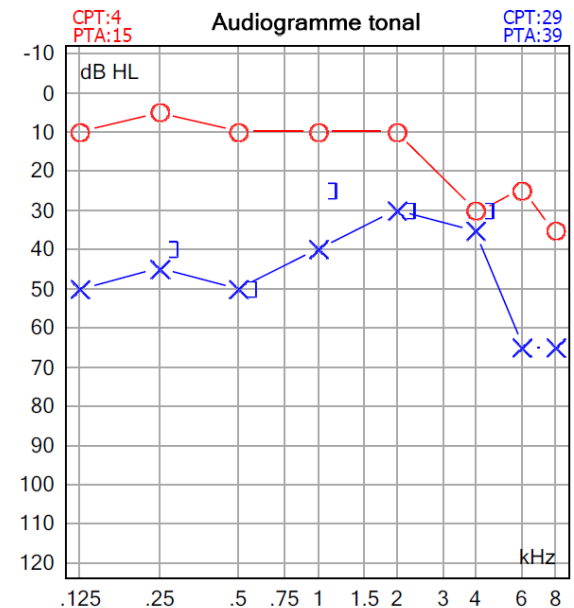
AUD 07.01.2014



AUD 14.03.2014



AUD 06.05.2014



Maladie de Menière

Diagnostic:

Definite MD

- A. Two or more spontaneous episodes of vertigo^(1,2), each lasting 20 minutes to 12 hours⁽³⁾.
- B. Audiometrically documented low- to medium-frequency sensorineural hearing loss^(4,5) in one ear, defining the affected ear on at least one occasion before, during or after one of the episodes of vertigo^(6,7).
- C. Fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear⁽⁸⁾.
- D. Not better accounted for by another vestibular diagnosis⁽⁹⁾.

Probable MD

- A. Two or more episodes of vertigo or dizziness, each lasting 20 minutes to 24 hours.
- B. Fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear⁽¹⁾.
- D. Not better accounted for by another vestibular diagnosis⁽²⁾.

Maladie de Menière

- Traitement:
- Coaching!**
 - Gentamicin transtympanique**
 - Drain transtympanique?
 - Bétahistine haute dose?
 - Glucocorticoïdes transtympaniques?
 - Labyrinthectomie/Cochléo-sacculotomie
 - Neurectomie vestibulaire

Déficit vestibulaire Brusque

Déficit vestibulaire brusque

Anamnèse: Vertige de plusieurs heures à jours

Cause: -inconnue (virale? vasculaire? ...)

Diagnostic: -Nystagmus spontané



Déficit vestibulaire brusque

- Head Impulse Test pathologique,
- Test calorique (hypo-arefléxie)

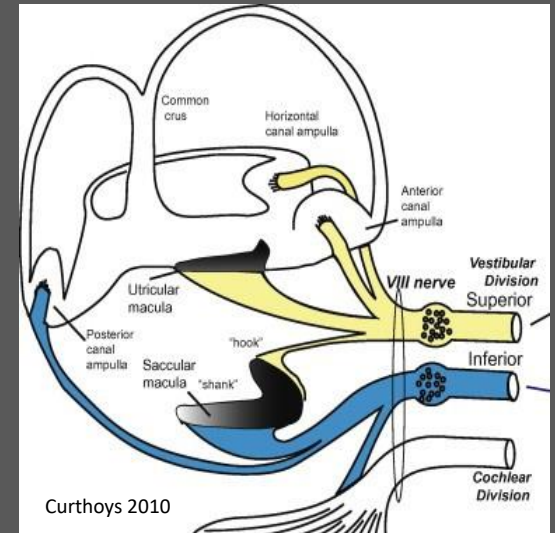
branche supérieure:

oVEMPs, HIT CSC lat/sup

branche inférieure:

cVEMPs, HIT CSC post

- Headshaking (après disparition du nystagmus spontané)



Déficit vestibulaire brusque

Traitement: -év Corticoïdes (dosage?, iv? p.os?)
 -év physiothérapie vestibulaire

Pronostic: -récupération de la fonction dans env. 50% des cas
 -compensation centrale
 -récidive rare (1-2%)

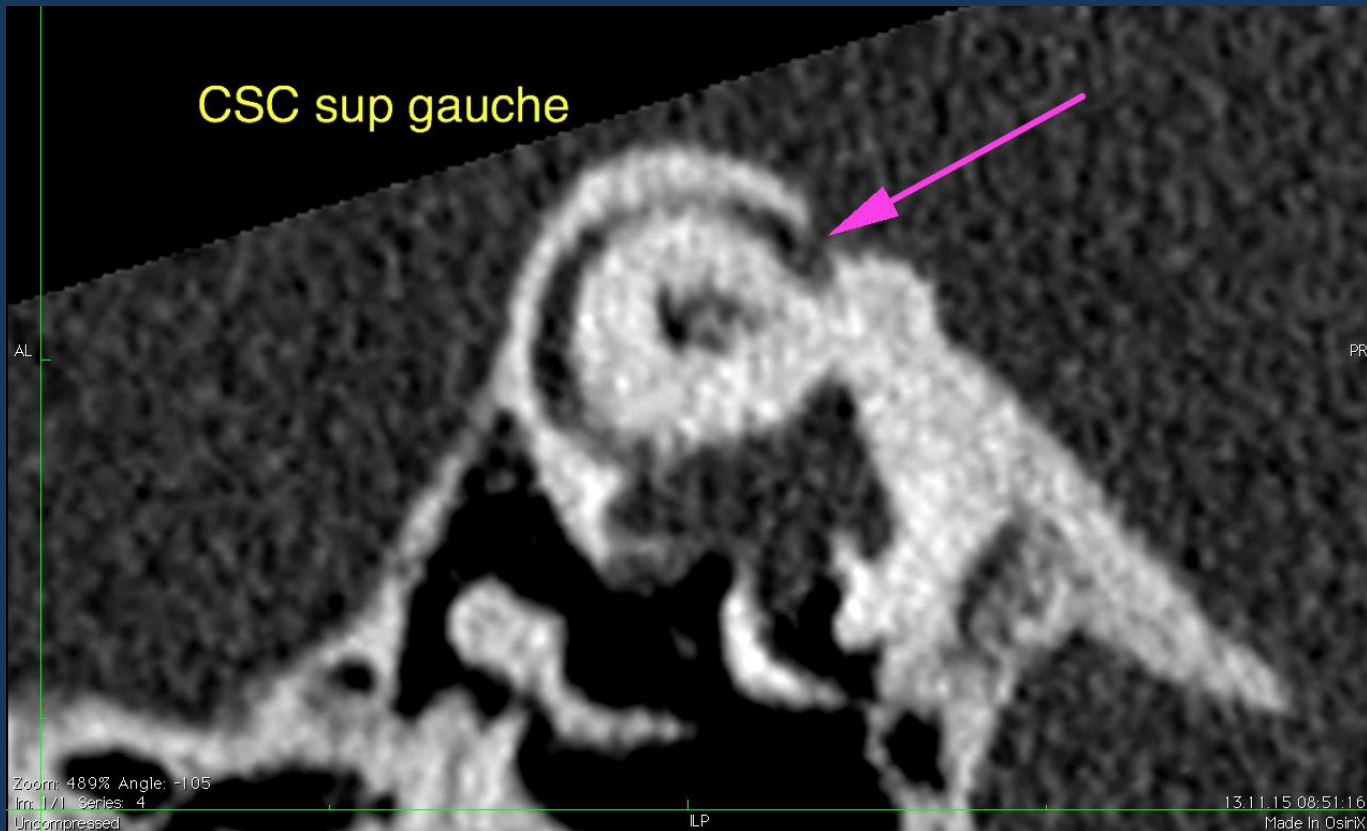
En résumé

	Vertige positionnel paroxystique bénin	Déficit vestibulaire brusque	Maladie de Menière
Temporalité du vertige	Intermittent	Constant	Crise
Début/facteur déclenchant	Changement de position de la tête	Début brusque	
Durée	20-30 secondes	Quelques jours à semaines	Quelques minutes à heures
Nystagmus	Positionnel, rotatoire géotrope	Spontané, bat du côté sain	Spontané, bat du côté sain ou atteint

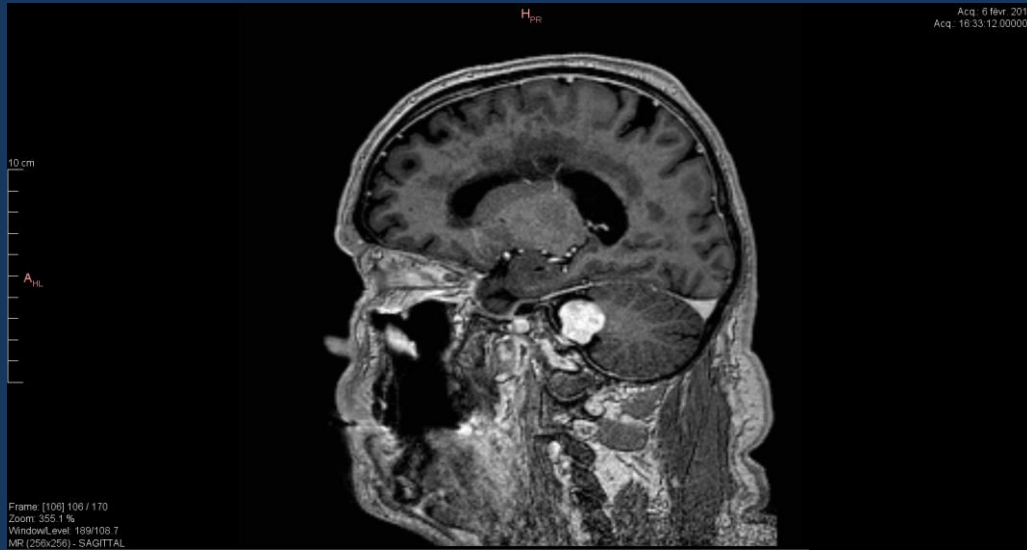
Autres

- Vertige des hauteur/mal des transports/mal de l'espace
- Labyrinthite
- Neurinome du VIII
- Déhiscence du CSC supérieur
- Traumatisme (fracture du rocher/contusion labyrinthique/enfoncement de la platine de l'étrier)
- Ototoxicité (Gentamicin/Cisplatine)

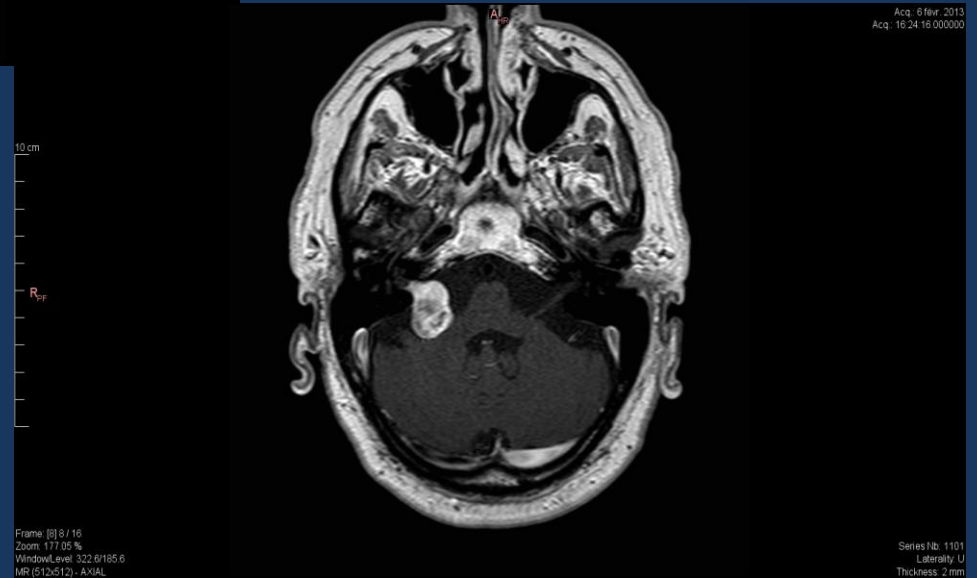
3^{ème} fenêtre (p.ex. Déhiscence du canal semi-circulaire supérieur)



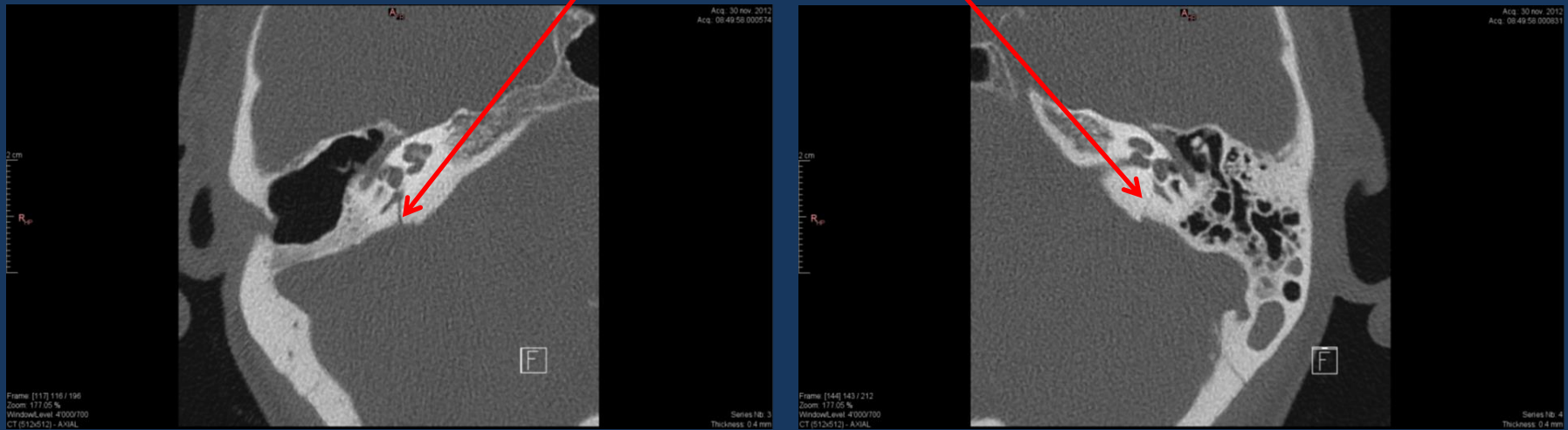
Neurinome NVIII



Progressif,
compensation
centrale



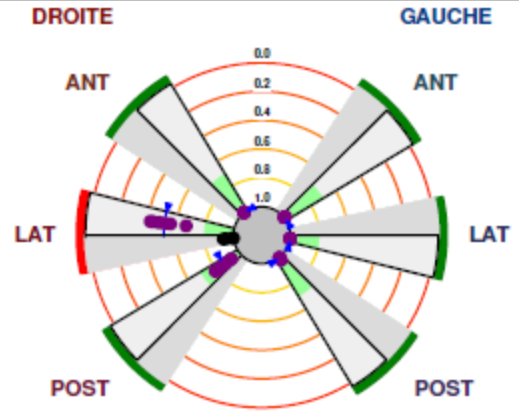
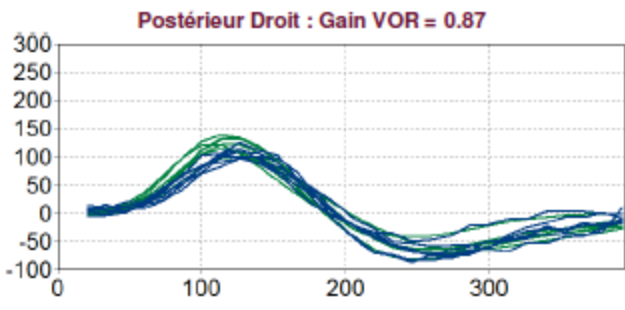
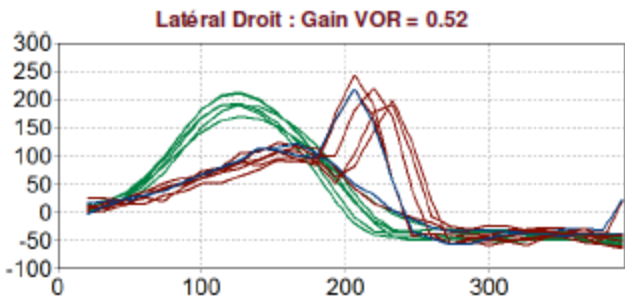
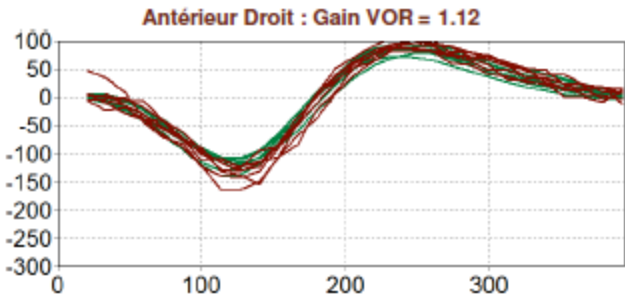
Fracture du rocher bilatérale



Intraotique

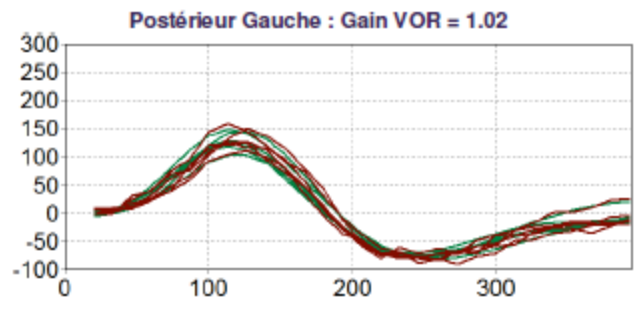
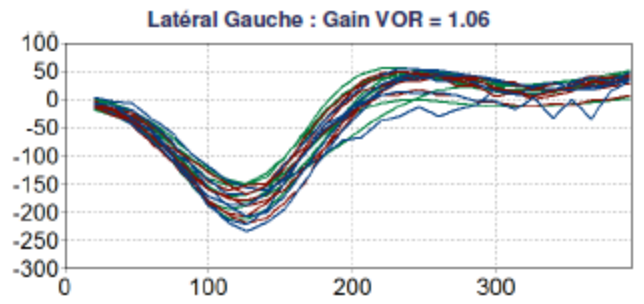
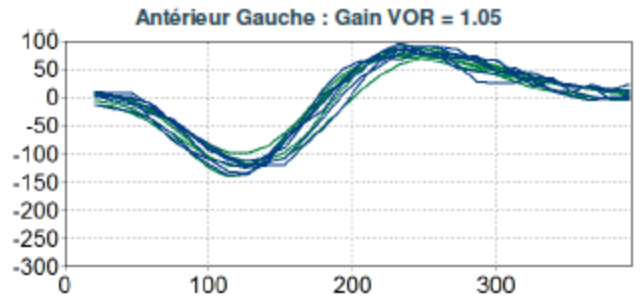
CASE 5—Male 50 years old

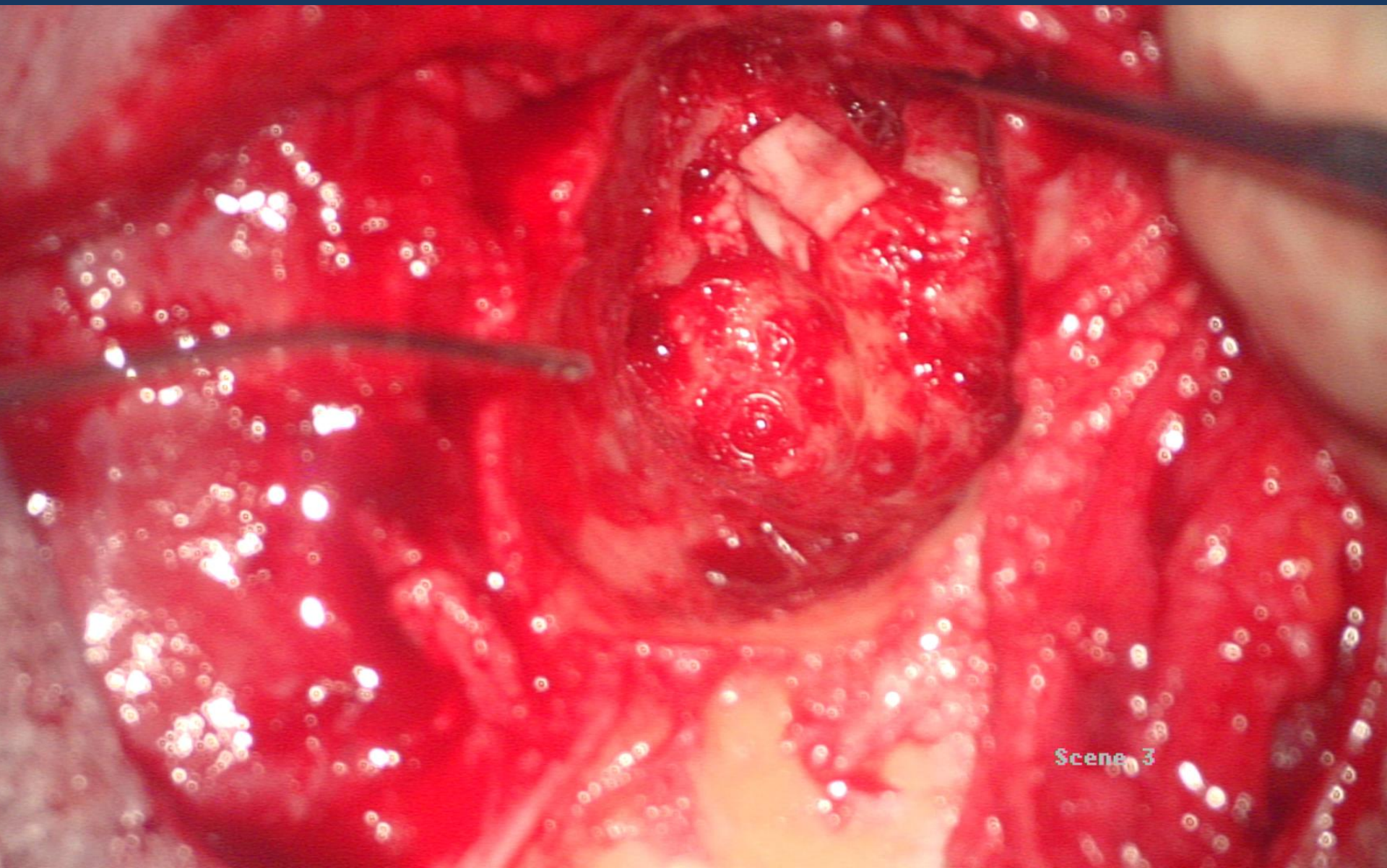
- Vertige lorsqu'il fait un effort ou un valsalva
- Instabilité chronique
- Otorrhée et hypoacousie droite
- Signe de la fistule
- Otite moyenne chronique, cholestéatome
- Chirurgie



Impulsions			VOR		
Canal	n	Gain moyen	σ	Asymétrie	
Ant.	D	7	1.12	0.04	4 %
	G	6	1.05	0.03	
Lat.	D	6	0.52	0.08	35 %
	G	7	1.06	0.02	
Post.	D	7	0.87	0.05	8 %
	G	6	1.02	0.04	

— Vitesse de la tête
— Vitesse de l'oeil droit
— Vitesse de l'oeil gauche





Scene 3

Origine centrale

Migraine Vestibulaire



Anamnèse:

- Vertiges épisodiques (minutes à heures, mais parfois jours...)
- parfois céphalée concomitante

Diagnostic:

1. Vestibular migraine

- At least 5 episodes with vestibular symptoms¹ of moderate or severe intensity², lasting 5 min to 72 hours³
- Current or previous history of migraine with or without aura according to the International Classification of Headache Disorders (ICHD)⁴
- One or more migraine features with at least 50% of the vestibular episodes⁵:
 - headache with at least two of the following characteristics: one sided location, pulsating quality, moderate or severe pain intensity, aggravation by routine physical activity
 - photophobia and phonophobia⁶,
 - visual aura⁷
- Not better accounted for by another vestibular or ICHD diagnosis⁸

2. Probable vestibular migraine

- At least 5 episodes with vestibular symptoms¹ of moderate or severe intensity², lasting 5 min to 72 hours³
- Only one of the criteria B and C for vestibular migraine is fulfilled (migraine history *or* migraine features during the episode)
- Not better accounted for by another vestibular or ICHD diagnosis⁸

Lempert 2012

Traitement:

- Metoprolol 50-200mg/jour, Erenumab? (calcitonin gene related peptide (CGRP))

Autres

- AIT/AVC!!!
- CANVAS
- Ataxie épisodique
- Paroxysme vestibulaire
- Downbeat Nystagmus
- Ataxie Cérébelleuse

timing	trigger	syndrome	diagnosis benign	diagnosis dangerous
episodic	trigger	t-EVS	BPPV orthostasis	CPPV/Tumor internal bleeding vascular stenosis vertebral artery
	spontaneous	s-EVS	Meniere's Migraine SCDS paroxysms vasovagal panic	arrhythmia/MI TIA pulmonary embolus hypoglycemia
acute	postexposure	t-AVS	perilymphatic fistula	skull base fracture vertebral dissection drugs (genta, AED) carbon monoxide, etc.
	spontaneous	s-AVS	neuritis labyrinthitis	CVA/Vertebral Wernicke's/encephalitis other internal / neuro
chronic	context		e.g. Vestibular hypofunction	
	spontaneous		e.g. Cerebellar degeneration	

- <http://www.hermankingma.com/>
- <http://www.jvr-web.org/ICVD.html>